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Legal Ontologies for Public Procurement Management

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Abstract

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The thesis explores ways to formalize the legal knowledge concerning the public procurement domain by means of ontological patterns suitable, on one hand, to support awarding authorities in conducting procurement procedures and, on the other hand, to help citizens and economic operators in accessing procurement's notices and data.

Such an investigation on the making up of conceptual models for the public procurement domain, in turn, inspires and motivates a reflection on the role of legal ontologies nowadays, as in the past, retracing the steps of the "ontological legal thinking" from Roman Law up to now. I try, at the same time, to forecast the impact, in terms of benefits, challenges and critical issues, of the application of computational models of Law in future e-Governance scenarios.

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Finally, I thank my friends and my family.

Contents

Chapter 1

Introduction

1.1 Public procurement: an introduction

Drive along a highway, take a train, sit on a park bench, benefit health care from a public hospital, read a book in a national library, attend a state university, admire the panoramic view from the Constitution Bridge in Venice.

At first glance, these activities seem to have nothing in common, but actually, many common, everyday actions, such as those listed, represent the way in which we enjoy of public goods or public services. Furthermore, public works and many public services, whose we are users, share another join-point: they are realized through the same process. Our satisfaction in enjoying public goods and services, and therefore, quality in our every day life, largely depends from how this process is managed. Much more than we realize.

The term *public procurement* refers precisely to this process whereby public authorities, including entities operating in utilities sectors and those operating on the basis of special and exclusive rights, acquire goods and services or commission works. The main step of this process, is undoubtedly the stipulation of a contract, specifically a *public contract*. However, unlike in private law, this step represents not just a matter of agreements between parties, but also, and above all, the result of a procedure, which is the cornerstone of public procurement's fundamental architecture. This procedure, established by law for procuring public goods, services o works, is therefore no less important.

It worth stressing that such procedure exists because public entities have only limited freedom of contract. In fact, contrary to private agents, which have a wide-range contractual freedom, public bodies have to comply with much more strict rules, because their contractual relationships must always be driven by the pursuit of public interest. Actually, also the "contracts between private persons are not concluded in a preserve

of unrestricted self-interest, and therefore even the ordinary civil law of contract of any country necessarily includes rules which reflect a public interest in the objects and terms of private contracts. The element of the public interest is, however, significantly more prominent in the sphere of public contracting" [149]. This significance of public interest in public contracting is due the fact that any act, which falls under the scope of administrative law, is finalized to pursue the utility of the group, of generality of citizens, in other words, of the State.

> *Publicum ius est quod ad statum rei romanae spectat; privatum, quod ad singolorum utilitatem pertinet.*
>
> (Ulpianus, Dig. 1.1.1.2)

This distinction is probably the most important one for understanding the public contracts. A contract between private parties is, indeed, the mean whereby individuals or an organizations pursue an interest for the benefit of oneself, of another person or organization, or of a limited group of persons; the public contract, instead, is stipulated for ensuring an utility to generality of citizens. Thus, for example, a public contract for the construction of a highway, a library or a bridge, is signed between a public authority and one or more parties, but the public authority is only a bearer of citizens' interests. For example, the interests of those citizens that will be, one day, drivers on that highway, readers in that library, tourists on that bridge.

The realization of citizens' interest inspires public contracts, even when they are signed for the needs of ordinary public machine's function, i.e. to provide the goods and services required for normal function of public entities. Of course, efficiency of public offices is instrumental to efficiency in achieving public interest.

Hence, public procurement procedures exist because each administrative action is driven only by the pursuit of public interest, or more generally, of public function. Moreover, the path to follow for accomplishing public function, is rigidly established by law, even to meet transparency as well as economic and financial audit requirements. These are the reasons why in every attempt to understand public procurement it is necessary to bear in mind that the "why" (the achievement of public interest) and "how" (the compliance with a procedure established by law that guarantees the correct achievement of public interest) is as important as the "what" (the public acquisition of goods, services and works; the public contract in itself). These aspects are so closely related that each of them depends on the other.

The reason why so many interlinked issues affect the public procurement field can be properly understood only by overlapping the legal insight with a general public finance

perspective: after all, public contracts represent one of the most relevant items of public expenses. As shown by figure 1.1 which encloses the results of a survey by Organisation for Economic Co-operation and Development (OECD), general government expenditures account for between 20% and 60% of gross domestic product (GDP) of major world economies, and in particular, during 2009, government expenditures represented 46% of GDP across OECD member countries. In the same year, government expenditures of Denmark, Finland and France were equal to or above 56%, whereas Mexico, Chile, Korea and Switzerland spent between 24% and 34% of GDP. Furthermore, as can be noted, EU countries have generally a higher ratio than emerging national economies with the notable exception of Brazil.

However, as properly observed by OECD, "the large variation in these ratios highlights different approaches to delivering public goods and services and providing social protection, not necessarily differences in resources spent", because, "for instance, if support is given via tax breaks rather than direct expenditures, expenditure/GDP ratios will naturally be lower". "In addition, it is important to note that the size of expenditures does not reflect government efficiency or productivity" [103]. Indeed, public expenses are also extremely sensitive to economic crisis, like the one that in 2009 was just started.

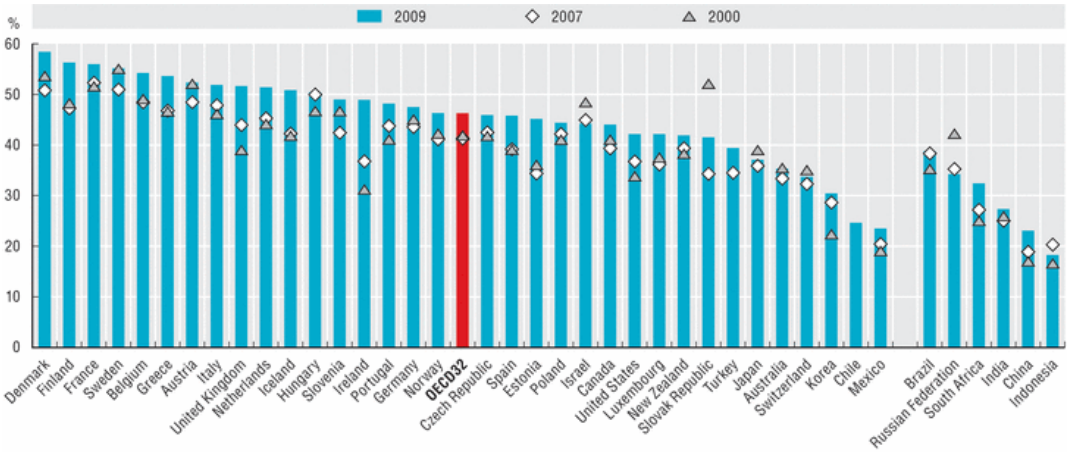


FIGURE 1.1: The figure shows the general government expenditures as a percentage of GDP (2000, 2007 and 2009). Source: OECD publishing.

Anyway, according to economists [116], the government expenditures are of three types: purchases of goods and services; transfers of income to people, businesses, or other governments (for example, in order to pursue a welfare program, the government decides to pay subsidies to farmers for the production of certain commodities); interest payments.

While taking into account this feature, the significance of public procurement as part of public expenses is quite clear. In fact, as shown in figure 1.2 the size of public procurement market (including state-owned utility) is measurable between 5 and 20 percent of

GDP. Then, though some distinctions between diverse economic and legislative frameworks are mandatory, it can reasonable stated that public procurement market accounts for at least one third of major economies' public expenses.

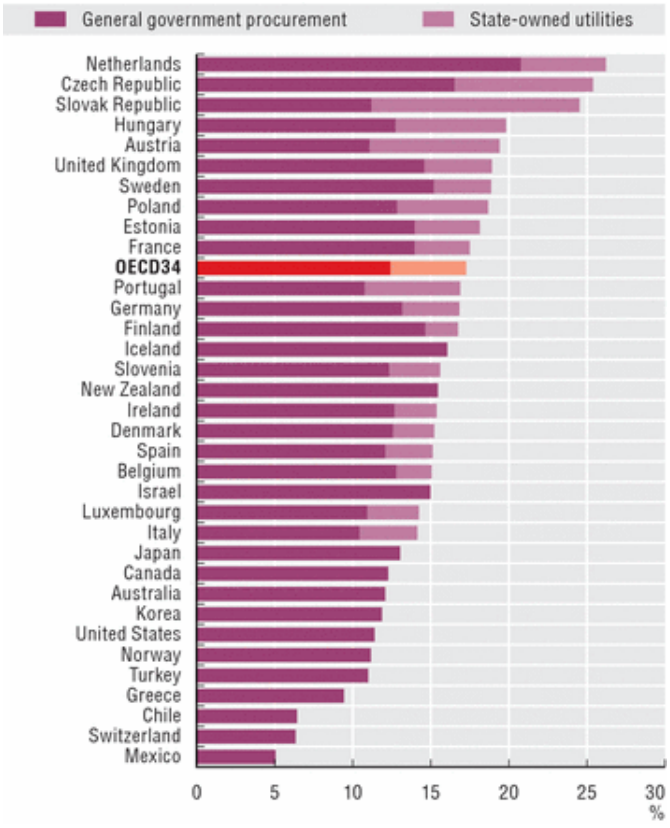


FIGURE 1.2: The figure shows the size of general government procurement as a percentage of GDP (2006 and 2008). Source: OECD publishing.

On the other side, opposite to expenditures, public revenues are derived primarily from taxes. The taxing and spending activities of governments, as well as their influence in resources allocation and redistribution of income is usually recognized as matter of public finance, also known as economics of the public sector [140]. The economists analyze public finance not only for its intrinsic significance, but also and above all, in order to develop guidelines about economic governments' activities. However, the relation between revenues arising from taxes and their use in public expenditures, is not only a matter of economic studies. Allocation choices of public resources reflect the attempts to meet certain objectives, political and then social. In democratic societies, both taxing and spending choices are made in a collective manner: they are made by elected representatives to whom is delegated the power to decide about the use of public resources, on behalf of citizens. Thus, public finance depends from *public choices* and public choices are the substantial result of common values, beliefs, desires and goals shared by majority of citizens. That is why, one of the most influential economist of 20th

century said, "the public finances are one of the best starting point for an investigation of society, especially though not exclusively of its political life" [129].

And that is why, even when we analyze public procurement from the perspective of public finance, again, the resulting picture is an inextricable tangle between the "why" (the public choice among various needs, desires, objectives of the society); the "how" (how to provide economic resources to finance the achievement of public choice) and the "what" (the purchase of goods, the provision of a service or the realization of a public work for materializing public choices).

But, at the same time, superimposing the two paintings (the legal and the economic one), it becomes also strikingly clear what we mean when we talk about public procurement 1.3.

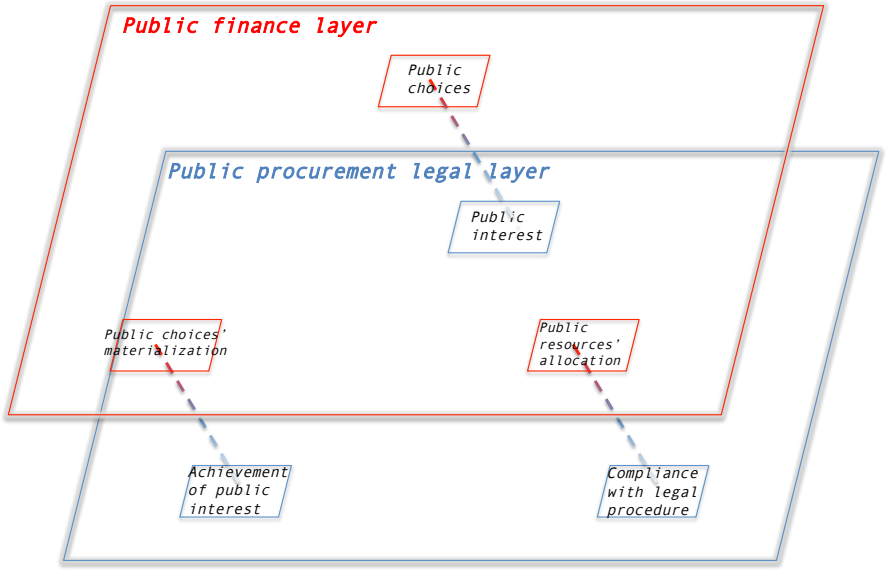


FIGURE 1.3: The figure shows the relationship between public choices, public interest, and their materialization through resources allocation and legal procedures.

First of all: public procurement represents not only one of the most relevant voice of governments expenditures and then, of public finance. Public procurement is also and, above all, one of the most prominent link between public choices and their concrete realization. Therefore, world of public procurement reflects the attempts to meet many social and political objectives [142] but also "the ability of government to transform taxes and other revenues into consumption by government institutions at federal, state and local levels, ostensibly for the public good" [94].

This ability is realized only through the achievement of "value for money" [142] (public money, taxpayers' money), which must be also demonstrated or provable. The public

procurement system in itself is designed by law just for ensuring this distinguishing feature, or for trying to achieve this goal. In this perspective, transparency, accountability, and integrity (i.e. the basic principle of good governance) [30] are not empty words, but the fulfillment of a complex architectural design, whose main aim is the guarantee of citizens' interest.

Such architecture, the public procurement system, is the context, the world where research that I am going to tell you is placed.

1.2 Research scope: legal ontologies for public procurement management

Despite the relevance of the field, public procurement has been recognized by many scholars [145] as a neglected area of study and research. This because of many factors. Callender and Matthews [29] claim that "procurement seems to have a reputation for being *reactive, clerical, unimaginative*" [1], essentially agreeing with Twyford [150], and Stewart, who argues that procurement management is conducted by "*unglamorous individuals*" [2] [139], whose only purpose is to accomplishing a complex accountability process of government. Something tremendously boring, at a first glance.

The reasons of a such academical disregard are probably related to a cultural attitude of the legal scholars, who consider this field as not enough theoretical for the research investigation. It is indeed a very technical and practical domain. However, as emphasized by [28] the public procurement domain is also a field which consists of many bodies of knowledge (law, public finance, accounting, management's issues, etc.)and this feature makes it extremely interesting as subject matter of research investigation.

This thesis focuses on the relationship between the legal aspects of public procurement and a precise area of 'information science', namely formal or computational ontologies.

This thesis work moves from an assumption: the need of legal ontologies for the public procurement domain. As highlighted in the introduction, there are many arguments which support such a claim.

The most evident one is arguably that, over recent years, the management of procedure for the award of public contracts is progressively becoming electronic. The increasing

[1] Our emphasis
[2] Our emphasis

importance of the *electronic procurement* (*e-procurement*) [3] is nowadays largely emphasized by many Governments' plans and strategic actions across the world.

In a recent Communication, the European Commission has stressed the strategic importance of e-procurement for the European Union since it can contribute to addressing "*two of the main challenges the European economy is facing today: the need to maximise the efficiency of public expenditure in a context of fiscal constraints and the need to find new sources of economic growth*". [4] Furthermore, e-procurement "can significantly simplify the way procurement is conducted, reduce waste and deliver better procurement outcomes (lower price, better quality) by stimulating greater competition across the Single Market". [5] On the basis of these considerations, the e-procurement represents a key factor for the sustainable growth objective of the EU 2020 Strategy [6] and for the Digital Agenda for Europe and the e-Government Action Plan 2011 - 2015 [7]. Thus, a series of strategic actions have been planned in order to support the transition *towards full e-procurement market place* in the European Union.

The adoption of electronic communications and transaction processing by the public sector organizations, although not full completed, is nowadays a well-established reality in many phases of the procurement processes. Consider, for example, that the publication of contract notices (and of the others tender's notices) for the European tenders takes mainly place in the internet. The TED (*Tenders Electronic Daily*) website [8], namely the online version of the "Supplement to the Official Journal of the European Union" dedicated to European public procurement, is updated five times a week with approximately 1500 public procurement notices from the European Union, the European Economic Area and beyond, providing free access to business opportunity for economic operators interested in participating to tenders. Moreover, information about every procurement document is published in the 23 official EU languages, in that way guaranteeing the respect of the non-discrimination principle, which is one of the pillars of the procurement domain.

Nevertheless, this huge amount of textual and unstructured data stored in large repositories, as well as on the Web, produced by institutions at all various levels (European, national and local) in awarding public contracts requires ways of bringing order and handle in the right way this unstructured information. The Semantic Web infrastructure

[3] E-procurement means alternatively "the use of online technology to assist with the procurement function" [45] or "the use of electronic communications and transaction processing by public sector organisations when buying supplies and services or tendering public works" (source: COM(2012)179 final.

[4] COM(2012) 179 final

[5] Ivi

[6] COM(2010) 245

[7] COM(2010) 743 of 15 December 2010

[8] http://ted.europa.eu/

and ontologies, legal ontologies, may provide the strategic solution to make effective the major need and challenge of our times.

The public procurements domain is a complex and very technical legal field but also a strategic one, since it concerns a large number of stakeholders. These include: *traders*, for whom it represent interesting opportunities, although sometimes not easy to grasp, especially for small and medium enterprises (SMEs); *public authorities*, for whom it is crucial to choose the best contractor, by maximising information access and then competition; *communities of citizens*, who may be interested in monitoring the management of the *res publica* and of the operating expenses utilized on behalf of the public interest.

Since law, and public procurement as well, impacts and affects the everyday life of all individuals, representing legal knowledge in the Semantic Web scenario is both a timely need and a challenge. Indeed, the e-Government sector is one of the major drivers in the emergence of Open Linked Data and governments are making accessible a large amount of datasets, about a wide range of topics, such as spending reports, administrative staff organizations, public healthcare, etc. Data on public contracts notices are open data by their nature. By law, they must be accessible. However, without the right interpretation, data are only raw data, which by themselves may not provide useful information. Government Open Data are in many cases related to the legal domain and, as a result, legal ontologies may play a key role uncovering the semantics of these data and driving the integration of this information with other datasets. Thus, it would be possible to build semantic e-Government applications, which may provide a significant contribution in bridging the gap between citizens and institutions.

Nevertheless, as recently emphasized by some scholars, this consideration implies to rethink the role and the utility of legal ontologies, "questioning the need for a highly axiomatised and unified knowledge representation" and conceiving instead "a new way of designing legal ontologies and of embedding them into architectures for legal information systems and other web services"[33].

1.3 Objectives of research

Consistently with these needs and challenges, in this thesis I explore a novel path in designing legal ontologies, trying to combine the representation of legal concepts with the usability required for the description of data, while also taking into account the issues arising from the integration of legal ontologies with other vocabularies and ontologies in the Semantic Web world at large.

In addition, I outline the theoretical foundations and an ontological pattern for describing public procurement procedures. Such an ontological framework could be useful to support awarding authorities in conducting procurement procedures.

Such an investigation on the making up of conceptual models for the public procurement domain, in turn, inspires and motivates a reflection on the role of legal ontologies nowadays, as in the past, retracing the steps of the "ontological legal thinking" from Roman Law up to now. I try, at the same time, to forecast the impact, in terms of benefits, challenges and critical issues, of the application of computational models of Law in future e-Governance scenarios.

Part I

ON LEGAL ONTOLOGIES

Chapter 2

On legal ontologies

2.1 On the early history of Legal Ontology: how, when and why Legal Ontology was born

Legal concepts are not necessarily dependent on the existence of normative texts. History teaches us that social groups were able to generate laws, and then to create legal concepts, even before written records.

More than 2.6 million years ago, hominids were certainly able to conceptualize a 'stone tool' (*type*), by building new units (*tokens*) of that type and by replicating the use of them. Indeed, as well emphasized by Lakoff,

> "Categorizing is a fundamental human activity.[...] there is nothing more basic than categorization to our thought, perception, action, and speech. Every time we see something as kind of thing, for example, a tree, we are categorizing. Whenever we reason about kinds of things – chairs, nations, illnesses, emotions, any kind of thing at all – we employ categories.[...] An understanding of how we categorize is central to any understanding of how we think and how we function, and therefore central to an understanding of what makes us human."[81]

There are no reasons to exclude law from the range of what is being categorized by human mind. A primitive man was probably able to categorize also some basic norms that ruled life in archaic societies (social norms). Indeed, as ancient Romans have taught us

Ubi homo, ibi societas. Ubi societas, ibi jus. Ergo ubi homo, ibi jus.

The law is a cornerstone of human societies and categorizing is a fundamental human activity, therefore we can arguably merge the two aspects claiming that also 'legal things' had their place in the system of categories used by the human being, since its origins.

However, even if a primitive man was certainly able to conceptualize a stone, he was probably not really aware of his ability to conceptualize 'things'. Humanity must wait for the birth of philosophy to reach the full consciousness of its ability to conceptualize 'categories', by explicitly wondering *what entities exist* (Ontology) and *what they are* (Metaphysics).[1] After all, as pointed out by Bielfeldt, "ontology is as old as philosophy itself"[19].

A detailed presentation of the history of ontology is outside the scope of this thesis, which concerns *legal* ontologies, instead of ontologies in a broad sense. Thus, what I am interested in, is rather an investigation on the cognitive and conscious processes that led to the rise of legal ontologies. Provided, of course, that there is something worth investigating.

One could argue, indeed, there is nothing special to inquire regarding the emergence of legal ontologies. They may have been simply the result of the human attitude to categorize the business of law, at its various degree of evolving complexity, as any other human business. And then, one may argue that humans have become aware of their ability to categorize law, simply by borrowing from philosophy the methods of questioning about the nature of 'legal entia', just as one of the many entities that exist.

Personally, regarding these conclusions, I want to retain my skepticism.

[1] On the distinction between Ontology and Metaphysics, Varzi states that "ontology is concerned with the question of what entities exist (a task that is often identified with that of drafting a 'complete inventory' of the universe) whereas metaphysics seeks to explain, of those entities, what they are (i.e., to specify the 'ultimate nature' of the items included in the inventory)." [Therefore,] "a thesis to the effect that there are such things as colors or virtues would strictly speaking belong to ontology" [whereas] "it would pertain to metaphysics proper to establish whether such entities are Platonic forms, immanent universals, tropes, moments, or what have you"[161].

As Varzi emphasizes, this is a common way of dividing up the business of philosophy, made popular by Quine[114].

Instead, for Loux, the distinction seems to be less apparent. He, indeed, states that "central to metaphysics understood as a universal science is the delineation of what Aristotle calls categories. These are the highest or most general kinds under which things fall. What the metaphysician is supposed to do is to identify those highest kinds, to specify the features peculiar to each category, and to identify the relations that tie the different categories together; and by doing this, the metaphysician supposedly provides us with a map of the structure of all that there is"[86].

An important issue to be underlined is that Aristotele himself did not know the word 'metaphysics' (nor the word 'ontology'). The first term (metaphysica) was coined by the first century C.E. editor who assembled the fourteen books by Aristotle that we currently think of as making up "Aristotle's Metaphysics". The title 'metaphysics', indeed, means literally, 'after the Physics', to indicate the books after the physical (books), namely, after the treatises dealing with nature (*ta phusika*)[37]. The origins of the word "ontologia", instead, are quite uncertain, however, as far as we know, the term appeared for the first time approximately in 1606, on the frontispiece of Jacob Lorhard's book *Ogdoas scholastica*. The term "ontologia" was used by Lorhard synonymously with "metaphysica"[104].

Just to begin, it may be particularly attractive for a legal scholar to discover that the term 'kategoria' was used by ancient Greek to describe "what could be said against someone *in a court of law*[2], and indeed Aristotle uses what can be said *of* or *in* a subject as a route to distinguishing categories"[146]. This would suggest strong similarities between earlier forms of judicial argumentation and Aristotelian method of investigation on the ontological nature of entities, and, at the same time, this might led to the conclusion that role of law was probably not so marginal in the emergence of the 'ontological thinking'. There must have been something more to categories *in* law than categories *of* law.

Nevertheless, the historical process that turns an unaware attitude into a conscious ability to categorize legal concepts is far from being clear and plain. On my opinion, an interesting and deep attempt in disclosing such a path, is provided by the work of Aldo Schiavone, ius*: L'Invenzione del Diritto in Occidente*[127].[3] Schiavone reassembles various and (only ostensibly) scattered pieces of Roman law's history, from the monarchy to the high-empire and Justinian's codifications, under an unified and evolutionary perspective, and by doing that, he draws a striking genealogical glance on the processes which determined the "*invention of Law*" in the West.

This 'invention' coincided with "the projection, by the jurists, of legal abstractions as a *comprehensive ontological schema*, capable of subsequent rationalization on the basis of internal principles alone (and thus capable of *autopoiesis*); and more importantly, through this ontological projection, capable of claiming independence from other competing realms of human interaction (such as politics). This achievement is, for Schiavone, properly called 'law' (*ius*), and its historical genesis is in Rome"[27].[4]

[2] My emphasis

[3] An English translation of the book is also available:[128].

[4] My emphasis. Bryen (op. cit.), whilst reviews the work of Schiavone, skillfully uses the word *autopoiesis*. In Greek 'poiesis' means 'creation, production', thus etymologically 'autopoiesis' means the capacity to create or produce oneself. The term was introduced in 1972 by two biologysts, Maturana and Varela[95, 159], in order to describe living organisms, such as cells. They coined that word to explain, for example, how an eukaryotic cell, through an external flow of molecules and energy, produces the components which, in turn, enable to maintain the organized bounded structure that gives rise to these components, namely of the cell itself. Both Maturana and Varela provide several definitions of autopoietic systems. The classical definition is:

"An autopoietic system is organized (defined as a unity) as a network of processes of production (transformation and destruction) of components that produces the components that

(*i*) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produce them and

(*ii*) constitute it (the machine) as a concrete unity in the space in which they exist by specifying the topological domain of its realization as such a network"[157].

Maturana provides another more concise definition:

"A molecular autopoietic system is a closed network of molecular productions that recursively produce the same network of molecular productions that produced them and specify its boundary remaining open to the flow of matter through it" (source http://web.matriztica.org/1290/article-28335.html).

Finally, Varela defines the necessary conditions to recognize an autopoietic system:

"A system is autopoietic if: (a) it has a semi-permeable boundary, (b) the boundary is produced from within the system, and (c) it encompasses reactions that regenerate the components of the system"[158].

The title of Schiavone's work, i.e. *the Invention of Law*, should not mislead. Of course, the author is aware that arguments on the origins of law are unavoidably intertwined with arguments about the origins of human beings, society and social institutions, and indeed, exactly the Romans emphasized that *ubi homo, ibi ius*. So, the intention of Schiavone should not be understood in the sense of a statement about the origins of law, as such. Neither it should be understood as a preconception about the excellence or the superiority of the Roman Law against other legal systems. There must have been certainly other equally sophisticated and complex legal systems, prior to the Roman Law, e.g. in ancient Greece, as well as in Egypt, to say nothing of Mesopotamia, but that, exactly, is no longer *the West* and, above all, Schiavone is not interested in investigating which of these legal systems (or *Laws*) was the first to born. Rather, he is interested in analyzing and showing the process by which the Law becomes a 'system', i.e. the evolution of Law, from its being a *fait accompli* of human interactions into its becoming a *systematic discourse*.

Moreover, the Roman Law differs from other legal systems of the past mainly for two reasons, and Schiavone, as a shrewd scholar of Roman law, knows very well. First, no other legal system has withstood so long, over the centuries: to be precise, thirteen centuries from the founding of Rome (753 b.C.) until the end of Justinian's Reign (565 a.d.). Second, no other legal system of the past has been so well chronicled, through the witness and the documents of the past, as the Roman Law. The amount of evidences and arguments for historiographical research is immense and invaluable, in a word, is *unique*. Starting from this background, Schiavone discovers other important arguments for claiming the uniqueness of Roman Law.

The author stands as an observer of this long period of time, traversed by deep institutional changes (from Monarchy to Republic and then to Empire); ascents and declines

Apart from the biological domain, the concepts of 'autopoiesis' and 'autopietic systems' have raised interest in a wide range of disciplines. In particular, the notion of autopoietic system has been applied in cognitive science (also starting from this work:[160], by which derives the so called 'Enactivism' embodied approach) and sociology (the most important work in this direction is arguably that of Luhmann [87]).

Precisely Luhmann[88, 89], but also Teubner[143, 144] (just to cite the most active in the field), have pointed out that also the legal system is an autopoietic system. The idea, as realistic in its approach as suggestive in its theoretical implications, is groundbreaking. Indeed, thinking at the legal system as an autopoietic system helps to understand the essential features that distinguish it.

The legal system, as a 'living' organism, is an *open system*, continually traversed by a flux of energy and matter that comes from society, i.e. from the social environment (social and economic demands, new technologies and scientific progress issues, ethical issues, etc.). The legal system continuously adapts to its environment and by adapting itself continuously changes. The intuition is surprisingly similar to that of Levi, which defines the legal system as a "moving classification system"[83]. Nevertheless, at the same time, the legal system is featured by a sort of *closure*: it recursively produces (and reproduces) itself and, by reproducing itself, it is autonomous.

Bryen emphasizes that precisely the inherent logic of the legal system and of legal reasoning (as it has been structured from the 'invention of law' by the Roman jurists until our days) allows this autonomy. In this sense, the legal system is capable of autopoiesis.

of charismatic political leaders; social and economic revolutions; destruction and reconstruction of social and ethical values, due also the birth of a major monotheistic religion. Nevertheless, such an observation is not only that of the classicist, rather is that of the jurist, who searches for his origins, and while is searching for this, reconstructs what has happened to Law. Therefore, what Schiavone talks about, is not the Law which exists *per se*, but the Law that has been *invented*, invented by the jurists:

> "Roman jurists were not only "sages", "experts", or "scholars" of the law. For a considerable part of their history they were also its most important "constructors" and "producers". [...]
>
> Roman law was unique among ancient systems of law not only because it was elaborated "scientifically" but also because it was the only system in large part produced by a class of experts "professionally" engaged in this task over the centuries."[126]

Precisely this scientific elaboration of law by the jurists, coincides and culminates with the abstraction of the human empirical behaviors, along with laws regulating them, under a series of 'categories', featured by intrinsic rational principles, and then capable to be recognized following a logical path. As well explained by Bryen, this path was carried out

> "translating dung receipts into concepts of 'contract', donkeys and farms into concepts of 'property'; translating, in other words, "what they do" into master concepts of "what their law is" and by so doing, making those master concepts somehow real (that is, claiming that sale is an actual entity which begins in this way and ends in that and activates a series of other concepts in the process [...]).
>
> Within these headings "what they do" could then be evaluated as sophisticated or inconsistent, developed or developing, depending, e.g., on the degree to which the principles reflected in the contract for transporting dung mirrored those in the contract for hire of donkeys, or whether a generalizable reason might be found for why they did not. It was, for Schiavone, the Roman jurists who invented this method whereby scholars define law by reference to such master concepts which subsume practice within a structure capable of rationalization".[27]

In other words, this path matches with the emergence of a *legal ontological thinking*, and the method invented by the Roman jurists is the same we apply still today in recognizing "what we do" and "what is our law".

Schiavone reconstructs that process, by designing sort of fictional axes representing the forces generated by the major social, economic, institutional changes, which were fighting with tradition. At the intersection of the equilibrium points among such forces, there is the invention of Law by the jurists. That is to say that the Law was able to answer to the enormous pressure of all those factors, by inventing itself.

The first little step asking for a 'revolution' in thinking the Law occurred during the transition from the archaic Rome to the Republic. It is represented by the shift of the prerogative to make *ius* from the college of *pontifices* to a group of republican aristocrats, empowered to give *responsa*. The oldest nucleus of the *ius* of Rome has its origins in a inextricable tangle between religion and law. The *pontifices* –literally "road makers", "those who open the way" (id.)– were the keepers of a "magic-sacral-religious knowledge" (id.) expression of a divine or magic investiture. Along with the power to preserve the *mores* (i.e the *gens*' tradition of behaviors), this sacral investiture was the key factor for their ritualistic pronouncements constituting the *ius* until, at least, the third century b.C.

The responses of pontiffs were sort of oracular answers: the *patres* addressed to these archaic priests their *ius*' demands on landownership, patrilinearity, commercial or matrimonial exchanges, etc. and they gave their guidance in such matters through authoritarian, detailed and minute precepts. Nevertheless, the very important aspect to emphasize is that the *iuris dictio* of pontiffs was

> "intrinsically casuistic, 'local', and operating point by point, it offered a different *responsum* for every demand. Cognition of the *ius* did not emerge elsewhere, nor had the *ius* any meaning excerpt to resolve immediate and concrete problems corresponding to the needs of the community" (*ivi*, p. 89)

Hence, the activity of *pontifices* was not susceptible to be checked, nor to being known in advance by all the citizens, especially by the plebeians. Arguably because of the plebeian intolerance against such a management of the *ius*, approximately around 450-451 b.C., occurred the production of the Twelve Tables. The Twelve Tables should not be intended as a sort of Constitution of Rome. The classicists are quite sure that the Tables did not include any norm regulating the institutional setting of the city. Rather, this written source of the *lex* was comparable more to a set of definite rules governing particular aspects of landownership, patrilinearity and commercial or matrimonial exchanges. In other words, the same matters which were covered by the *responsa* of the *pontifices*. And indeed, the aim of the revolutions following the end of the monarchy was precisely that to obtain the certainty of the law for both the patricians and the plebeians.

That is to say that starting from that "unexpected, mysterious, and traumatic episode" (id.), another dimension joins the conflicting space of the Romans' Law history: the emerging novelty of *legislative* written records vs. the oral (unwritten) form of the *responsa* authored by the *pontifices*. Even when the prerogative of *iuris dicere* in form of *responsa* became an aristocratic privilege, expression of the patrician-plebeian hegemony that prevailed since the third century b.C., i.e. by Tiberius Coruncanius onwards, the *resposa* were still "consumed in their pronouncement; their duration was the time it took to put them into effects" (*ivi*, 91). They were not forgotten but their memory was then kept by aristocratic families rather than by the college of pontiffs. And even though the laic *resposa* of the nobles-sages (as opposed to the priest-sages) were more sophisticated in their hermeneutic features, that judicial knowledge was still inadequate to solve the complex cases which were emerging, as side effects of the growth of the city that after a couple of centuries would have become an empire.

The only two texts of Roman *jurisprudence* which appeared before the mid-century b.C. (the *De usurpationibus* of Appius Claudius Caecus and, a hundred years later, the *Tripartita* of Sextus Aelius Paetus Catus) were strongly connected with political issues and, above all, with political strifes.

> "Nonetheless, the presence of writing always betrays an intent to "popularize" juridical knowledge, or at least an interest in moving it toward awareness of it among a more general audience. The written word mitigated an exaggerated dependency on the aristocratic oral tradition. The closed and verifiable space of the text, of the liber, of the tables, opposed the arbitrariness of secret memory: this was what had already taken place with Twelve Tables." (*ivi*, p. 93)

The effects powered by the use of the writing that, up to this point, were still opaque, became more and more clear, from the development of the *ius honorarium* onwards. By virtue of their functions, which included the *ius edicendi* (i.e. the power to issue edicts), the *praetores* (i.e. elected magistrates), started to grant a new type of *actio*, that was no longer based on the archaic rules of *lege agere* and on the rituals of *certa verba*, but on words agreed together (*per concepta verba*) by the *praetor* and the litigants, for the definition of the conflicting claims involved in the dispute. Those definitions were still generated case by case, but now, the *in iure* ritual was not consumed immutably, by mixing the sacred and the magic. The achievement of the new *actio*, instead, was a sort of flexible agreement between the *praetor* and the parties, whose primary aim was the search for a 'formula', a schema that would fit to the specific case. Afterwards, the jurists referred to that new procedure exactly as *per formulas* procedure.

It is not easy for a jurist of our time to understand the nature of that procedure, since it, ultimately, included both procedural and substantive elements. By granting the *actio*, indeed, the *praetor*, indirectly, created also those claims taken into account by the procedure that would have been applied for their satisfaction. Such priority of the procedure over the substance, of the form over the matter, is contrary to what we think of that relationship nowadays. However, the reason why this new procedure was conceived in that way should be understood. In fact, it represented a sort of compromise between the traditional *legis actiones* of pontiffs, that formally still survived, and the need to provide judicial rulings for the new issues arising from a cosmopolitan society that was learning a new "Mediterranean mercantile cunning"(id.).

All things considered, the importance of the *ius honorarium* in the history of Romans law is invaluable. This body of law constituted a gloss or a supplement to the main body of civil law, the *ius civile*, in a manner comparable to the relationship between equity and the English common law. In that way, "the *ius honorarium* infused Roman law with new vigour and a fresh direction, transforming an introverted, parochial body of law into an outward-looking, cosmopolitan system"[46]. The new praetorian *juris dictio* had to deal with an increasing amount cases, characterized also by an increasing complexity. Then, these aspects began to require more elaborate form of logic and rationality to handle the proliferation of judicial demand, along with its evolving complexity.

Right now, during the thirties and forties of the second century b.C., there are all the conditions to put in balance the disruptive forces capable of encouraging *the invention of the Law in the West*. The introduction of the new way in handling the Law occurs with the early attempts of Junius Brutus, Manius Manilius and Publius Mucius Scaevola. The chronicles tell us that they *founded* the *ius civilis*.[5]Within the space of one generation, Quintus Mucius Scaevola (his father was Publius Mucius) was the first that tried to "establish" (*constituere*) the *ius civilis per genera*, by abstracting categories and dividing up *genus* and *species* "that structured broad headings *capita* into which the *responsa* of previous times were fit."[27]. The last 'hero' of the scientific revolution was Marcus Antistius Labeo, a famous jurist of the Augustan ages, who was one of the greatest *innovators* of the *ius*. The path followed by those jurists, individually and independently from each other, can be reconstructed through the words of Pomponius: *fundare, primus constituere, plurima innovare*. Through these words, Pomponius tells us that this is the century of the breakthrough.

[5]Please, note that some scholars of the Roman Law do not agree with Schiavone's arguments on the importance of these jurists regarding the work on the systematization of Law. For those who think that the statement concerning the foundation of the *ius civile* lacks relevance, see[141].

The history of those men tells us of "the laborious emergence of new conceptual parameters, of a 'rational' and 'formal' law for the first time conceived abstractly and in terms of a *true juridical ontology*" [126].[6]

With his *de oratore*, written about forty years later the *ius civile* of Mucius, Cicero can be considered as the most radical supporter of this change in conceiving the *ius*. In his work, he imagined the project of a *Hellenistic* regeneration of the *ius civile*: it is here, at this point in history, indeed, that Platonic-Aristotelian ideas become the reference point for the 'scientific revolution of the Law'. The project of Cicero was not realized mainly because of the opposition of Servius Sulpicius Rufus and his disciples (Alfenus Varus and Aulus Ofilius, among the others). The dialogue between these two remarkable jurists, Cicero and Servius, sobering still today. Servius focuses his attention on the mechanism of the *responsum* in a completely new way, probably unknown to the same Mucius. Servius' knowledge is largely a cognition of the specific cases and his attention is on to detail, on the particular. Nevertheless, the specific cases do not find their rules and their definitions in pre-defined abstract concept, rather is the *analysis* of the particular that produces the formulation of a principle, a rule or a definition (for example on the fraud). It seems that, at the end, Servius succeeded in convincing even Cicero on the value of this approach.

On the other hand, the history of those men, –we can now refer to them as– the *jurists*, tells us also of

> "the progressive fragmentation, under the burden of the political crisis that stuck the *nobilitas*, of the link between political primacy and juridical knowledge, the symbol of all aristocratic jurisprudence. [...] this group [of jurists] was of course still an expression of the dominant strata, but it was no longer totally and unmediatedly identical with the groups that successively held power." (*ivi*, p.94-95)

The rest of the history will revolve almost exclusively on the relationship between law and political power. The jurists become, at first, staunchest opponents of the imperial legislation's predominance: Labeo was a tenacious defender of –as Schiavone says–"the "jurisprudentiality" of Roman law against any tendency on the part of the regime to shift the ancient balance in a "legislative" direction (an idea that may have entered the mind of the last of the Caesars)" (*ivi*, 96). Afterwards, the role of the jurists was increasingly consolidated: they started to become friends and then jurists-counselors of the Princeps, but then this 'collaboration' marks the end of the jurisprudentiality of

[6] My emphasis

Roman law and the beginning of the imperial chancellery's primacy in the production of law. Julianus is the most luminous example of that "jurist-counselor" (id.) figure.

Ulpianus, instead, was the prototype of "jurist-high-functionary" (id.) and it is no coincidence that I have decided to recall in the introductory part of this thesis, exactly a sentence of Ulpianus. In some sense, he is the founder of the administrative law to which the public procurement law belongs. So, here, the circle closes.

2.2 The evolving space of legal ontology

The history of Roman Law shows how controversial has been the history of the moves made, many centuries ago, for equipping the legal knowledge of an autonomous rationality, of its own logic. The process that led to that result is basically a ceaseless search for an intrinsic systematic coherency of Law. The Romans have invented the method for conducting this search, and then, the application of that method has stayed alive down the centuries. This is the most valuable heritage of the Roman Law, namely the method to analyze the categories of Law.

The *summae divisiones* that Gaius makes for each of the three parts in which his work is divided (namely *personae, res, obligationes*) reveal, primarily, that the Plato's method of definition, the *dihairesis*, had been fully adopted also by the Roman jurists of that time.[7] The whole method and arrangement of the Gaius' work formed the basis of the Digest and of the *Institutiones* of Justinian, which were part of the *Corpus Juris Civilis*: in those two books indeed are contained many quotations of the Gaius' textbook. Furthermore, the platonic method of the division of a genus into its parts, was very popular in the Middle Ages to illustrate consanguinity and affinity according to family law, servitudes, types of interdiction or of exceptions and also of jurisdiction (an example of *Arbor Servitutum* is shown in the figure 2.1).[8]

Nevertheless, the work of the Roman jurists has been so vast and excellent that its influence has been deep in history of legal ontology, even beyond the invention of that method. The contemporary jurists belonging to civil law systems are used to recall the conceptual systematization and classifications of Law which have been developed by Gaius. In fact, we remember the *Institutiones* of Gaius mainly because of the way in

[7] The *Institutiones* (from the Latin *instituere*, i.e. "to establish") of Gaius, written about 161 a.d., is the only classical law book that has survived nearly complete and unchanged from the time of Justinian. The *Institutiones* comprise four books. The first concerns the legal status of *personae* (*ius quod ad personas pertinet*); the second and third, property rights, including inheritance (*ius quod ad res pertinet*); and the fourth, the *obligationes* and the form of *actio per legal actiones* (*ius quod ad obligationes pertinet*). The text was lost until 1816, when a manuscript, probably of the fifth century, was discovered at Verona, Italy.

[8] You may find more information about the *arbores* also here http://mosaico.cirsfid.unibo.it/.

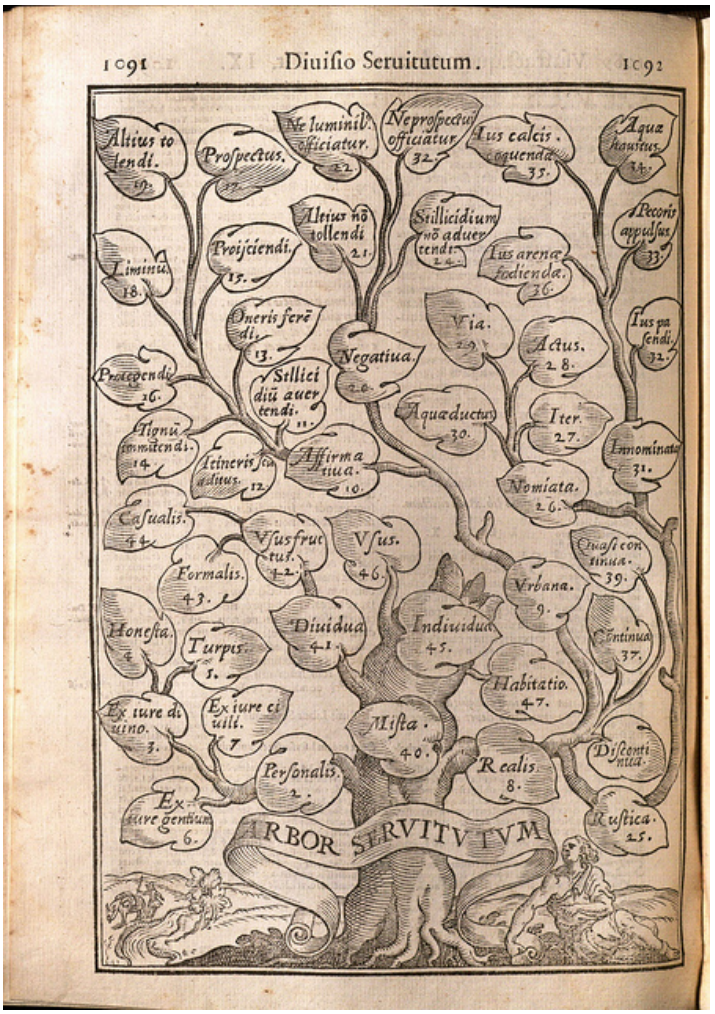


FIGURE 2.1: *Arbor Servitutum* in *Digestum vetus, seu Pandectarum iuris civilis tomus primus* (*Venetiis: Apud Iuntas*, 1592). For this and other legal trees see: Legal Trees - Yale Law Library

which that work organizes the legal categories of civil law. Strikingly, those categories of the *ius civilis* make sense still today. Every textbook of private law employed in the universities of countries belonging to the civil law system's tradition reproduces in its summary that division expounded by Gaius about two thousand years ago: the legal status of persons and their rights; the property rights and inheritance issues, and then the obligations. In addition, and above all, that division is reproduced also by several current Codes regulating the matter of private law. For instance, the Italian *Codice Civile* is organized, precisely, according to the Gaius' summary.

However, obviously, the Law Gaius refers to, is no longer the same of today. For instance, the main division of persons that Gaius makes, namely that all men are either free or slaves (*quod omnes homines aut liberi sunt aut servi*), reflects no longer our categorization. Thus, the nowadays commonly adoption of the Gaius' legal categories is,

largely, an expression of our cultural heritage and of our historical acceptance of the categories arising from the Roman Law[9]. For the remainder, it is mandatory to take into account that, just as the legal systems change and evolve, so the legal categories and the legal concepts change and evolve.

That major consideration, in my opinion, marks the most distinguishing feature of *Legal Ontology*. Indeed, the inventory that has to be drafted for answering the question concerning "what legal entities exist", contains a list of categories which are not immutable, rather, they are placed in the continuously evolving space of Law and the legal systems. Legal concepts evolve in such a way that it is almost impossible to recognize, define and categorize them once and for all, as well as once and for anyone. Let it be clear. I am not referring to categories very popular in legal theory, such as "legal agent", or "law" understood as "social object" or "document" or "legal text". Those categories are so general and, let me say, so *foundational*, that one could reasonably claim that they are largely shared in –and independently from– any type of legal system. I obviously agree with that claim. The categories I am referring to are, instead, those which are peculiar, unique and relevant only to the legal domain, i.e. those categories which make up the cultural background and the Law's awareness employed everyday by the jurist. This is, at the end, for me, the 'universe' that legal ontology aims to recognize.

Then, metaphysical inquiry on the 'ultimate nature' of those peculiar "legal entities" is largely a discovery of the *space-and-time-dependent rules* defining what they are. Those rules are not absolute, nor 'intrinsically written' *in rerum natura*, because the Law is a social phenomena and as a consequence, legal categories are predominantly rooted in the so called social reality. Ultimately, we must admit that social reality changes and then, legal categories change as well.

In general, legal systems discard old rules and adopt new ones by recognizing the existence of social needs that current laws do not satisfy. Hence, the Law changes to improve its social adequacy and this change may be more or less apparent[167]. Normally the change is deliberate and entirely clear, other times it is almost imperceptible, even for the 'law-implementers'. As Levi emphasized in his seminal paper *An Introduction to Legal Reasoning*, the change process of Law is like a "wonderful mystery possibly reflecting an higher law, by which the law can remain the same and yet change. The law forum is the most explicit demonstration of the mechanism required for a moving classification

[9] Alan Watson, in his *The making of the civil law* argues that the basic division between civil law and common law systems, along with the changes that have characterized differently the two systems across the centuries, derives primarily by the tradition. He states, indeed, that "[the]basic difference between civil law and common law systems are explained in terms of the legal traditions themselves; that is, the differences result from legal history rather than from social, economic, or political history. Above all, the acceptance of Justinian's *Corpus Juris civilis*, in whole or in part, as authoritative or at least as directly highly persuasive determined the future of civil law systems and made them so distinctive."[166]

system"[84]. It is true that the Law changes also for other reasons. Being an autopoietic system, indeed, a legal system is governed by its inner rules, that must be connected to each other in such a way to preserve *coherence*. So, it could happen that a change is needed to harmonize rules among each other, even regarding formal aspects of the Law. However, the changes brought about by coherence among formal rules may affect also the substance. In some cases, it could happen that reasons about formal consistency are juxtaposed as expedients, or means, to foster changes of a substantive nature. In that way, the substantial change appears as justifiable, because required by the legal technicality.

2.2.1 The Blackstone's *Commentaries* and the world of 'thinkable thoughts'

Regardless of (the reason) why and (the means) how the legal systems change, legal ontology keeps track of the change. The evolving space of legal system is unavoidably the evolving space of legal ontology. But this dependency not necessarily is one-way (i.e. from legal system to legal ontology), it could be also a mutual dependence.[10] In some cases, it may happen that legal ontology drives the changes of legal system and vice versa. It might sound strange, but this happens more frequently than expected. Just think of the Gaius' categorization of Law. It could be argued that such a systematic organization of the Law impacted, in turn, the authoritative production of Law and, indeed, Gaius' work formed largely the basis of the Digest and of the Institutiones of

[10]Even Fernández-Barrera and Sartor argue that changes in the legal systems affect change in legal ontology. They, indeed, state that "legal change may question the validity of conceptual hierarchies. As the law evolves, new inferential links are introduced –by the legislator, by precedents, by custom– newly associating a legal concept to a certain condition or a certain effect, or dissociating the concept from one of its pre-existing conditions or effects. In introducing such new inferential links, conflicts with existing conceptual structures, as resulting from definition and from taxonomic inheritance, are inevitable, and inevitably legal evolution is to prevail over static conceptual hierarchies."([48], p.22). They also argue that "legal concepts are [dependent] on legal norms since they may be expressly defined by legal norms, or since they may be implicitly defined by them", but then, they identify this dependence as a mutual dependence, recognizing the crucial role of the legal doctrine in the interpretation of norms. They, indeed, state that"legal semantics is determined (among other things) by legal doctrine, to the extent that doctrine determines, identifies or constructs legal norms on the basis of the sources of law. The discussion concerning the meaning of a legal concept in a legal system concerns establishing what norms –leading to, or departing from, the term expressing the concept– hold in that system. Since the inferential links holding in a legal system represent, or are derivable from, norms of such a system, this discussion is inseparable from the doctrinal issues concerning what legal norms belong to a legal system (given the available legal material, such as legislation, precedent, custom, and so on) and consequently constitute correct premises of legal reasoning with regard to that system" (*ivi*, p.20).

Obviously, I agree with authors' arguments on the role of legal doctrine. Nevertheless, what I would like to emphasize in the discourse I am expounding, is the mutual dependency between broad classifications of Law and the legal systems, while I suspect that Fernández-Barrera and Sartor refer mostly to the interpretation of specific norms and particular legal concepts by the legal doctrine, and the acceptance of that interpretation by judges and legal practitioners. In other words, the type of dependence they refer to is immediately recognizable, instead the type of mutual dependence I am referring to, is subtle and not immediately recognizable, or, at least, not in the short run.

Justinian, namely of the real sources of Roman Law. Not surprisingly, at that time, the Roman jurists were also counselors of the *Princeps*.

Nevertheless, the most interesting demonstration of the mutual dependance between legal ontology and legal system, comes probably from the Common Law's history, and concerns one of the most celebrated works of the Anglo-American legal tradition, namely the William Blackstone's *Commentaries on the Laws of England*[21]. I can not (and, rather, I do not want) disguise the fact that what I am going to tell you is not a novelty. The influence that the Blackstone's Commentaries have had in the development of both English and American legal systems is a well-known fact.

The *Commentaries* were composed between 1765 and 1769 by Sir William Blackstone, an English jurist, judge, Tory politician and first Vinerian Professor of English Law. Born in London, in a family belonging both to the middle class (his father was a merchant) and to the landed gentry (his mother's family was the Biggs of Wiltshire), Blackstone received the typical education that was given to the people of his status: he, indeed, attended the Charterhouse and Pembroke College in Oxford. After switching to and completing a Bachelor of Civil Law degree, he was made a Fellow of All Souls, Oxford on 2 November 1743, admitted to Middle Temple, and called to the Bar there in 1746. On 3 July 1753 he formally gave up his practise as a barrister and embarked on a series of lectures on English law, the first of their kind, at the Oxford University.

Those lectures were not part of the regular course about Roman and Civil law then taught at Oxford. They were, instead, lessons on the common law as practiced in England, mainly directed to young aristocracy and gentry, which needed to know the basic notions of common law for understanding how to administer their property well. Hence, the lectures of Blackstone had the purpose to provide a sort of knowledge tool to laymen, rather than to specialists. Strangely enough, indeed, the common law was practiced in the courts, but not studied in the Academia. There was, in short, a divergence between the Law as practiced and the Law as taught by the scholars. Furthermore, Blackstone was Professor at Oxford during a period traversed by significant social tensions. The middle class was consolidating its economic power and so, it was becoming increasingly pretentious towards the England's ruling elite. Despite his mixed origins, but mainly because of the education he received, Blackstone was openly sided with the aristocracy's interests. He was convinced that political power should remain in the hands of those who possessed property. He tried to defend these interests in Parliament, but "the ultimate tool for Blackstone was the law, and the *Commentaries* became his principal forum for teaching the elite of England how they should use the law to safeguard their positions"[76]. His aim was "not to make all of these people practicing lawyers. Rather, by educating these men in at least 'a few leading principles' of law, he sought to protect

them from 'inferior agents' and 'gross and notorious imposition'. Blackstone's aim was to give the nonlawyer ruling classes of England sufficient legal training to protect their economic and political power base –their possession of property"(*ivi*, p.45). Is it therefore, not surprising that the cornerstone of the *Commentaries* is the supremacy of the right to property.

The Blackstone's work, divided into four volumes (on the rights of persons, the rights of things, of private wrongs and of public wrongs), was *de facto* the first systematic, methodical and comprehensive treatise on the common law. No attempt to do so, had been made until this, and for the remainder of Middle Ages. Blackstone "took messy smorgasbord of common law doctrine and practice and organized it into a comprehensible series of propositions"[17].

> "He supplied *a structure of categories and concepts that fit the existing data*. Just as important, his explanation of how things worked was clear and easy to understand. [...] Blackstone organized and systematized the common law so that it could be logically approached. [...] Now the system made sense."(*ivi*, p.308)[11]

Blackstone's *Commentaries* met a need: since the common law was based on precedents more than on the statute or on the codifications, the search for an organization of the Law was much more complicated than in the civil law, already developed by the Romans. The Commentaries became more than a treatise of the common law, they were not a code, nor a source of Law, but surprisingly, once their authority was accepted, "for most lawyers *they constituted all there was of the law*"[24]. They became the "bible of American legal institutions"(*ivi*, p.XV). One could argue, by using the words of Schiavone, that Blackstone *invented* the common law. As Boorstin emphasizes in his essay on Blackstone's *Commentaries*, this acceptance of the *Commentaries* as *the* Law, makes the *Science of Law* somewhat *mysterious*. Nevertheless, Berring argues that the acceptance of Blackstone's *Commentaries* as the Law, is not all that mysterious. Rather, this acceptance might be intimately connected with the importance of classification, that is, with categorization and its consequences.

When the law was obscure, Blackstone sought to make it seem rational and logical; when a legal issue was regulated through a messy amount of precedents, he sought to make order. Finally, he achieved his purpose so well that the resulting categorization of Law appeared to be inevitable, the only possible one. The original decisions made to reconcile competing claims in the *Commentaries*'s construction became almost *invisible* to its users. The resulting acceptance was an expression of the determinative power

[11] My emphasis

of classification. As Star and Bowker point out in their seminal work titled *Sorting Things Out*, indeed, "Good, usable systems disappear almost by definition. The easier they are to use, the harder they are to see"[138]. Therefore, those who use a good, usable system tend "to conceptualize in terms of the system and as [the] system matures, it becomes authoritative, the classification system simply describes the universe. Researchers mature using it, organize their thoughts around it, and it then defines the world of "*thinkable thought*"[17].

Today, technology has not only invaded the world of legal information. Technology is putting more and more under pressure the Law. The legal knowledge has been almost entirely outsourced on the web, while it was remaining apparently the same. The textual information of the legal sources is becoming more and more a 'legal data'; the messy amount of authoritative and not-authoritative legal information's sources is determining information overload and reliability's issues; the real, democratic opening of the Law to all the (non-lawyers) citizens has been not yet achieved. We can not delude ourselves thinking that these major changes do not require solutions to *re-invent* once again the Law.

Because of that pressure, Berring, in his provocative and outstanding paper, argues that

> "[w]e need a new Blackstone. We need someone, or more likely, a group of someones, who can reconceptualize the structure of legal information.(*ivi*, p.315)
>
> [...] the crucial point is that the legal information system needs a new set of definitive authorities. We need authorities that can create *a new world of thinkable thoughts*. It need not to be a perfect model, but it has to be one that meets the characteristics of a good classification systems. This is especially urgent because there are other possibilities(*ivi*, p.316).
>
> [...] This is a call to arms.[*Sic!*] *The legal profession must seize control of its own information destiny.* The time is now [and] the stakes are enormous."(*ivi*, p.308)[12]

The year of Berring's paper was 2000. You would be forgiven for wondering:

have we succeeded over the last thirteen years?

The rest of this Chapter is nothing but an attempt to give an answer to this question.

[12]My emphasis

2.3 Early conceptualizations of the legal domain in computer science

With the advent of computer science and automation in the 70s, the idea that computers could have process the Law to determine legal solutions, slowly took foot, giving rise to an autonomous field of research, namely Artificial Intelligence and Law (AI&Law). The representation of norms through logic theories and languages adequate at being processed by a machine, has attracted the computer scientists long before the jurists. The Law became a subject of experiments to test the potential of automated computation in legal problem solving and the idea that computers would enable the solution of legal cases, the application of the norms, replicating the way of thinking of a lawyer or a judge, started to fascinate generations of computer scientists, long before the jurists would realize these possibilities. Arguably, for the first time in the history of Law, the legal knowledge management is not more an exclusive prerogative of its specialists. This, in itself, is already something revolutionary.

Because of norms' recurring formulation in terms of *if-then* statements, it is natural to expect that the earliest and most obvious computer's applications in the management of the legal knowledge, have appeared in terms of logic programming and in the construction of the so called 'legal expert systems'. Notable examples of systems based on a formalization of the relevant written law are the formalization of the British Nationality Act in the programming language PROLOG by Sergot, Kowalsky and colleagues[131], and the formalization of supplementary benefit legislation by Bench-Capon and others[13]. In practice, these formalizations were entirely based on a one-to-one correspondence of the programming rules to the legal source texts (isomorphism principle)[11], i.e. to the written legislation they formalized.

Although that correspondence to the legal sources represented a guarantee for faithfulness in the formalization, such a way of representing legal knowledge shared almost immediately its limits, because the Law, as argued by the authors, is 'silent' in certain crucial issue of its application and because norms, sometimes, are far from being clear and plain. Rather, they include also "obscure terms and terms redolent with vagueness"[10] in their formulation. So, these considerations led into conclusion that "systems which simply execute rules derived from legislation and case law operate at a syntactic level, and the kind of reasoning required here will often depend crucially on *the semantic features of the terms involved*"(*ivi*, p.41).

More or less, the same consideration emerged also by the experience gained by McCarty in a project that is another classical piece of AI & Law literature, namely TAXMAN [97], whose goal was capturing legal reasoning in the corporate reorganization taxation

domain (as regulated by the 1954 US Internal Revenue Code). To achieve this goal, McCarty defended the need of rendering explicit the structure of relevant legal concepts by means of "deep conceptual models" [98] to properly address the issue of the co called 'open textured concepts', literally, of concepts apparently "too open" to be properly defined, because indicated through words of extremely vague meaning.[13]

Therefore, in 1989, McCarthy introduced a *knowledge representation language* which would have faithful mirrored "the common sense categories underlying the representation of a legal problem domain: space, time, mass, action, permission, obligation, causation, purpose, intention, knowledge, belief, and so on". In other words, according to McCarty's claim, the categories typically required to develop a legal application. The language was called *Language for Legal Discourse (LLD)*. LLD was a formal language, featured by a compositional syntax, a precise semantics and a well-defined inference mechanism. The semantic interpretation was conceived to generate exactly those entailments that ordinary people ("and ordinary lawyers!") generate in similar situations, while the inference mechanism was complete and robust, though certain compromises were needed to enable the computational tractability. The language was implemented in Common LISP. An interesting aspect of that work, was that in LLD every relationship such as 'ownership 01' was treated as an individual object (either a constant or a variable). The technique is well-known as *reification*. McCarty claimed that the reification of relationships was particularly useful to reach a correspondence with common language linguistic practice; to represent changes in states and, in general, to represent events, actions, obligations, beliefs, etc. Though with some distinctions, the technique of reification was adopted later also by some foundational ontologies (for example DOLCE). Another interesting aspect was that the deontic statements were formed by the combination of a name, a modal operator, a condition, and an action. The nature of the McCarty's product is controversial: Visser and Bench-Capon, though being aware that McCarty would have rejected the description of LLD as an ontology, include it in their comparison of four ontologies[163]. Valente and Breuker refers to LLD as an ontology too[152]. it is indeed described as a language for representing the legal domain, not as

[13]The discussion around the 'open texture' of language in general, an then specifically in the legal language, starts with the seminal work of H. L. A. Hart *The Concept of Law*[68], which, in turn comes from the work of Friedrich Waismann[165]. In a chapter of his book called 'Formalism and Rule Scepticism', Hart argued that legal rules generally have a core of plain meaning, "the general terms seem to need no interpretation [...] the recognition of instances seems unproblematic or 'automatic', [...] there is a general agreement in judgement as to the applicability of the classifying terms" (*ivi*, p.123). Nevertheless, there are also cases of "penumbra" of the term's meaning, which determine uncertainness in defining whether the rule expressed in the legal source should be apply or not. In those cases, the problem is that there are reasons "both for and against our use of the general term, and no firm convention or general agreement dictates its use"(*ivi*, p.124). This tendency of rules to have "a fringe of vagueness", such that their application become indeterminate, was defined "open texture" of legal rules. That feature of Law not necessarily is a disadvantage in its application, rather, for Hart, it should be considered and advantage, because "it allows rules to be reasonably interpreted when they are applied to situations and to types of problems that their authors did not foresee or could not have foreseen".[20]

a representation of the legal domain in itself. Nevertheless, the semantic's richness of that language is quite impressive, also by an ontological point of view.

Afterwards, in an interesting paper titled *The Role of Semantics in Legal Expert Systems and Legal Reasoning*, Stamper claimed that "so-called 'legal expert systems' that fail to handle the problems of interpretation do not deserve the epithet 'expert'. At best they can be called 'bureaucratic expert systems,' which is not to deny their potential value, only to recognise honestly their limitations."[137] Therefore, Stamper affirmed the need to "examine the extent to which expert systems can handle meanings, the root of all problems of interpretation [and] to uncover the semantics of the system, those principles, tacit or explicitly stated, that link the elements of a knowledge-base or the text of a body of rules to the features of the world they signify" (*ivi*, p.220). In the same work, Stamper offered an overview on propositional logic and first order logic to specify the semantics of legal concepts, criticizing their use for the representation of legal knowledge because of some important semantic problems. Briefly, Stamper argued that, relying on symbolic representations and on notions such as truth, individuality, and identity, traditional logics have only a very weak connection to the real-world concepts they intend to denote. As a consequence, the author claimed that expressing legal knowledge in the form of rules results in an over simplification of what legal knowledge is about. To overcome these problems, in 1991, Stamper proposed a language, based on the perception of invariants, namely on the basic assumptions that there is no knowledge without a knower, and that the knowledge of a knower depends on its behavior. The new language, called NORMA, was defined "a logic of norms and affordances", specifically conceived as a specification language for legal systems. The novelty claimed by Stamper, was that in NORMA the entities in the world were described by their behavior, rather than by assigning them an individuality and truth values. The main ontological concepts taken into account for the NORMA's semantic specification, were agents, behavioral invariants and realizations. The basic assumption was, in other words, that agents realize situations by performing actions and that the realization of a situation was specified as the combination of an agent and a behavioral invariant[136]. Though the insights inspiring the NORMA work were originals and interesting, in my opinion, the Stamper's critiques to the use of first order logic for representing the legal knowledge were a bit exaggerated. Researchers, indeed, use still today predicate logic to express legal knowledge. Besides, the same considerations regarding McCarty's LLD, could be carried out also for NORMA's Stamper. NORMA, indeed was presented as a language for representing the legal domain, not as a representation of the legal domain in itself. The strange convergence of ontological assumptions with the structure of the language does not allow a broader generalization of the represented knowledge.

Paradoxically, one of the oldest piece of the AI&Law literature, at least in its intentions, is also the work that comes closest to the idea of legal ontology, until the 1990s. This work is well-known as the Hafner's *Semantic Network of Legal Concepts*. Hafner emphasized that the role of 'expert systems' should not be focused "on 'solving problems by computers, but rather on *helping a human problem solver organise and apply a complex body of knowldege*"[67].[14] Therefore, her research's goal was "to characterize the semantic of information retrieval requests, and to develop methods for representing and using subject area knowledge" in a 'expert' document retrieval system, which she called the *Legal Research System (LRS)*. LRS was a knowledge-based computer retrieval system,"intended to be used by lawyers and legal assistants to retrieve information about court decisions (cases) and laws passed by legislatures (statutes)" (*ivi*, 2). The subject of knowledge was the Negotiable Instruments Law, an area of Commercial Law dealing with cheques and promissory notes. In LRS were represented four kinds of knowledge about legal concepts and their relationships, namely functional knowledge, structural knowledge, semantic knowledge and factual knowledge. The semantic knowledge was described as a semantic network model of Negotiable Instruments Law used to make inferences about the meanings of queries, in terms of "a collection of nodes defining subject area concepts, such as holder, forged and endorsement, connected by links representing a small set of semantic structures, such as classification and attribution". On the other hand the network contained six basic concepts, namely party, legal instrument, liability, legal action (case), account and amount of money. The work of Hafner, is strikingly similar to that of an ontology as it is currently conceived. The path towards the computational legal ontologies has only just begun.

2.4 Legal ontologies in computer science

Presumably, the term 'ontology' was introduced in AI literature by John McCarthy, in 1980 [15]. In his paper on *Circumscription*[96], McCarthy uses the term discussing about what kinds of information should be included in our understanding of the world. Nevertheless, the most frequently cited earlier definition of 'ontology' is probably that of Gruber: an ontology is a "specification of a conceptualization"[63].

Afterwards, the definition of Gruber was discussed by Guarino and Giaretta, arguing that, in order for it to have some sense, "a different, *intensional* account of the notion of conceptualization has to be introduced"[65]. Briefly, Guarino and Giaretta criticized the

[14] My emphasis

[15] Therefore, the same year of the Hafner's *Semantic Network of Legal Concepts* and before the works of Thorne McCarthy –not to be confused with this McCarthy, John McCarthy!– and Stamper's NORMA. They, indeed, speak of "deep conceptual models" or "semantic networks", not yet of "ontologies".

confusion between state of affairs and conceptualizations, as it emerged by the classical AI literature (precisely in the work of Genesereth and Nilsson[56]). Rather, according to Montague's semantics, they argued that the formal structure used for a conceptualization should account for the meanings of the terms used to denote the relevant (intensional) relations between entities. These meanings typically remain the same, also if the actual extensions of those relations change, due to different states of affairs.

Then, Guarino further expounded these notions, making definitively clear the relationship between an *ontology*, its *intended models* and *conceptualization*, introducing, in addition, the notion of *ontological commitment*, in a seminal work about ontologies, namely *Formal Ontologies in Information Systems*[64].[16]

As shown in the figure 2.2, "the intended models of a logical language reflect its commitment to a conceptualization. An ontology indirectly reflects this commitment (and the underlying conceptualization) by approximating this set of intended models"(*ivi*, p.5). That is, a language L commits to an ontology O, if it commits to some conceptualization C such that O agrees on C.

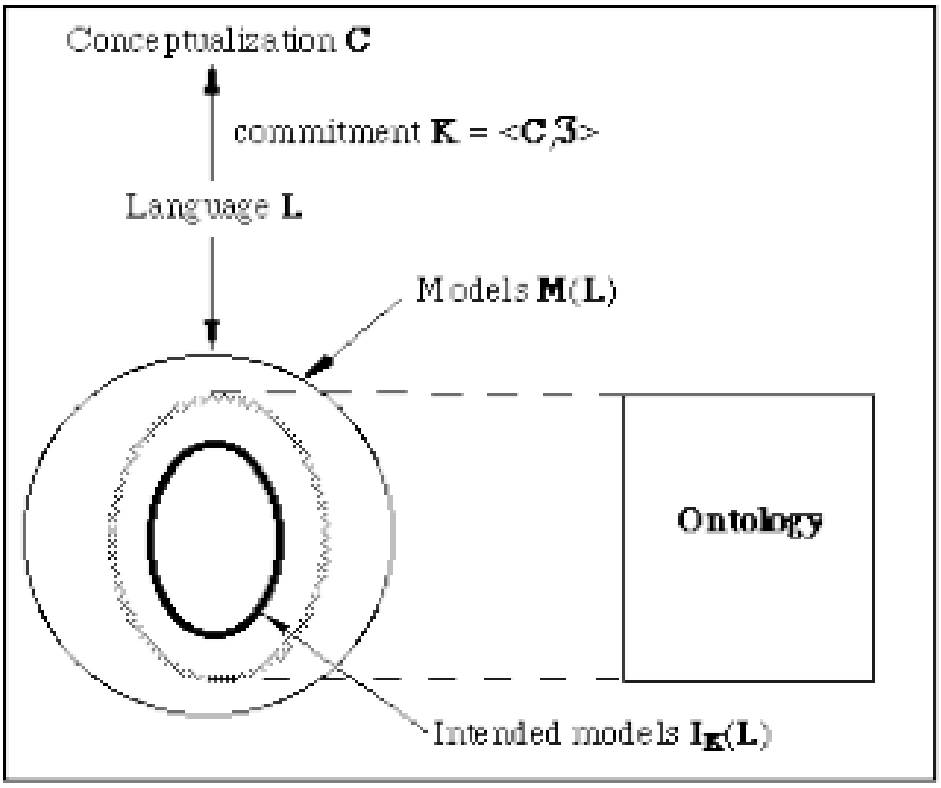


FIGURE 2.2: The relationships between vocabulary, conceptualization, ontological commitment and ontology by Guarino (*id*)

[16]The previous version of the paper appeared in the Proceedings of the first *Formal Ontology in Information System Conference*, FOIS, founded exactly by Nicola Guarino, which took place in Trento, Italy, 6-8 June 1998.

Hence, Guarino define an ontology as

> "a logical theory accounting for the intended meaning of a formal vocabulary, i.e. its ontological commitment to a particular conceptualization of the world. The intended models of a logical language using such a vocabulary are constrained by its ontological commitment. An ontology indirectly reflects this commitment (and the underlying conceptualization) by approximating these intended models."(*id*)

A couple of years later, Sowa, who already in 1984, mentioned ontology in connection with knowledge engineering[134], suggested the following definition:

> "The subject of ontology is the study of the categories of things that exist or may exist in some domain. The product of the study, called "an ontology", is a catalog of the types of things that are assumed to exist in a domain of interest, D, from the perspective of a person who uses language L for the purpose of talking about D."[135]

For an exhaustive list of the other definitions of ontology provided so far by the scholars, organized in a tabular summary, see: Nuria Casellas, *Legal Ontology Engineering*.

2.4.1 What is a legal ontology?

Within the scope of our investigation, the majority of legal ontology's definitions are merely adaptations of the general definition of ontology to the legal domain. For instance, for Visser and Bench-Capon, a legal ontology is a "conceptualisation of the legal domain"[163]; similarly for Schweighofer a legal ontology is "an explicit specification of a conceptualization of a legal domain"[130].

In addition, the authors, most of the times, do not perceive a need for defining precisely what is a legal ontology. They limit their self, recalling the general definitions, as those listed above. Strangely enough, no emphasis is placed on defining explicitly legal ontology neither in the book of Casellas *Legal Ontology Engineering*, nor in the book titled *Approaches to Legal Ontologies*, whose subject is exactly legal ontology.

The only attempt I find in this latter book, is that of Fernández-Barrera and Sartor. The authors, by relying on the the definition provided by Antoniou and Van Harmelen[5], state that "legal ontologies can be considered the formal description of a domain discourse"[48]. Consequently, the problem there is to decide "what counts as

legal discourse", due the difficulty to identify one single legal discourse. As highlighted by Tiscornia, indeed, we can identify different levels of legal language such as, (i) the discourse of the legislator; (ii) the discourse of the judges; (iii) the discourse of the doctrine; (iv) the discourse of legal theory[147].

A certain emphasis on the legal discourse is also reflected in one of the most interesting definitions of legal ontology. Namely, that of Valente & Breuker, who argue that

> "[a legal ontology] is an ontology of the domain of law, i.e. of legal phenomena. As such, every ontology of law contains an account of what legal phenomena is, and a perspective to see it"[153]

The authors, then argument that

> "because legal knowledge is closely associated to the formal sources of law (statutes, jurisprudence, etc.), ontologies of law may adopt (and frequently do so) as a phenomena not the legal phenomena in legal practice but these sources. An alternative perspective would be to describe law as the phenomena of "what is decided in court", a thesis known in Legal Theory as *legal realism*. The ontological focus on legal sources seems to be a characteristic of *positivism*. Yet another alternative is to describe law as the *legal discourse*, i.e. the language used by legal practitioners."(*id*)

The paper of Valente and Breuker is well-known in the literature about legal ontologies, also because there the authors claimed that the *missing link* between Legal Theory and Artificial Intelligence and Law can be provided exactly by the specification of ontologies.

The definition of Valente and Breuker reveals two important things. First: the perspective assumed in representing the legal phenomena inevitably affects the resulting representation, in a recursive manner. Second: two basic perspective can be adopted in viewing at the legal phenomena. Namely: the analytical (or positivistic) perspective, which grounds on the formal sources of law as the unique and indisputable instrument to know the legal phenomena, or the socio-empirical (or realistic) approach, which grounds on the observation of the legal reality as it is. Of course, it is difficult to admit that the legal reality as it is, could be something totally different from the legal phenomena as it is described and regulated by the Law. Rather, there may be some differences more or less important, or more or less evident.

My attempt to define a legal ontology is closed to that of Valente and Breuker, but also to that of Guarino:

by 'legal ontology' I mean a set of highly-structured natural language assertions (whose basic features can be summarized also through a taxonomic hierarchy), a logical theory or an engineering artifact (included a diagram or a drawing), describing a reality pertaining to a legal system or to a system of laws, made up by following, alternatively or jointly, a philosophical or legal theoretic investigation, a socio-cultural observation, or an analytic study of the sources of Law. A legal ontology would be therefore committed in drafting a finite catalogue of entities and concepts pertaining to that legal system or to that system of laws, plus a set of explicit assumptions regarding the description of those entities and concepts, as they are understood and accepted by a community of users, or as they ought to be according to the interpretation of the sources of Law. In both the cases, such a description could be so explicit that it would represent the concrete application or the ideal application of that legal system or of that system of laws, in terms of a definition of legal assets or states, or of an adjudication, by rendering clear certain rational assumptions at the basis of legal security, and as they result by applying the legal reasoning.

2.4.2 Framing the boundaries of legal ontology

It is not an easy task to define what is a 'legal ontology', the boundaries of what ought to be or has to be 'legal' under an ontological perspective, and of what ought to be or has to be considered an 'ontologic assumption' in the description of 'the legal universe', are quite difficult to determine. Any attempt to delineate these boundaries is thrown in crisis by many issues, pertaining proper to the legal domain. Without claiming to be thorough, I delineate here some of these issues.

Legal Ontology vs legal ontologies

As well known, in the traditional philosophical perspective, (*the* capital 'O') Ontology is constructed as one singular system of categories. In the works of Aristotele, Lorhard, etc. the term Ontology is understood as an attempt to describe the reality as it actually is. Therefore, the systems of thought constructed by the philosophers have the same subject matter and, because of this, they are also quite stable and easily comparable among each others. In computer science, instead, since an ontology is understood as a fragmented description of a domain (eventually used for certain specific purposes), we are allowed to use the plural to indicate the ontologies (the little 'o' ontology). That is, in the AI and knowledge representation perspective, ontologies are mostly conceived as information tools, and attempts in describing the particular domains, not necessarily claiming a degree of truth outside of the perspective adopted according to the need for which they are designed.

In the previous part of this Chapter, I have used the capital 'O' Ontology to define the systems of categories developed by the Roman jurists (and also Schiavone uses the word 'ontology' instead of 'ontologies' to indicate them). I think, indeed, that these kind of ontologies share the same assumption of the Ontologies as understood in philosophy, but, limiting to the legal domain. The legal Ontology indeed is understood as an intended attempt to describe the legal reality as it actually is. Today, one would argue that this kind of Ontology relies mostly on legal theory, and, since it concerns only the legal reality, it can be conceived as a domain ontology, because it deals with a subset of the whole reality as it is. On my opinion, the legal ontologies, are not only typical of the computer science. Rather, I think that ontologies as 'information tools' are used by the jurists, also in their everyday business, to organize and structure the legal knowledge pertaining to a specific area of the Law.

Finally, both the legal Ontology and the legal ontologies are inevitably subject to change, since, as said the Law continuously evolves.

Ontology and Epistemology in legal domain

In general it is important to avoid the confusion between ontology and epistemology. The first, as pointed out by Varzi and as recalled in the previous pages of this chapter, concerns with the question of 'what entities exist' and, under a metaphysical perspective -which seems that adopted in the so called 'applied ontology'- seeks to explain, of those entities, 'what they are'. Epistemology, instead, concerns with the different kinds of knowledge which exist, and with the way in which knowledge can be acquired or, with the extent to which any given subject or entity can be known. Therefore, the legal ontology would concern with concepts like: legal object, legal process, legal event, legal state, legal quality and so on. On the other side, legal epistemology would concern with the definition of concepts like: belief, intention, assertion, wrong knowledge, case knowledge (revision of knowledge, uncertain knowledge, factual knowledge) and so on. The distinction between ontology and epistemology covers issues which are of the outmost importance in the legal domain[101].

The Law usually refers to the epistemological dimension. Consider, for instance, the importance of *errors* (e.g. *error in personae*), or *intentions* (e.g. to propose a contract), or *declarations* (e.g. the tax declaration). Consider also, that in the legal realm, the jurists are used to refer to *facts*. Are we sure that the facts share the same ontological nature of events or states? The ontological status of facts is quite debated in philosophy and, for instance, a precedence relationship between two events is a fact, but does not correspond to an event itself. In addition, case law's knowledge relies mostly on a processual revealed truth, rather than on an objective truth. Indeed, it can happen that the epistemological reconstruction of an event by a court of Law, can be revised by

another court. An adjudication is, in some sense, the expression of what a court of Law can say about a certain event or a certain state, but not the ultimate truth on that event or on that state. Is, therefore, needed to keep trace also of these issues in an ontological description of the Law? Does make sense to represent reality as it is, without taking into account the way in which this reality is known? Are the ontological and epistemological perspective reconcilable?

In my opinion, to a certain extent, yes. It is, indeed, possible to represent ontologically what a concept pertaining to epistemology is. For instance, we can say that a belief, or an intention are kinds of abstract objects, with some properties, some qualities, etc. On the other hand, the epistemological view can help us to define ontologically the types of knowledge belonging to the legal domain (e.g. factual knowledge vs. normative knowledge). Some of the legal ontologies I am going to illustrate, deal exactly with these kind of issues.

Inferential nodes vs Ontological categories

The legal knowledge, as everyone can observe, is largely defined according to an *if(condition) - then(consequences)* schema. In fact, normally, the Law defines a concept by means of a definition, but also by means of the consequences which are attached to the recognition of the concept according to its existential (definitional) conditions. Therefore, an ontological representation of the legal concepts grounded only on their existential conditions would be quite restrictive, and not really attractive from an inferential point of view. The issue has been investigated by Sartor[124], who, mostly relying on the Ross' theory[117] concerning the inferential and eliminative analysis of legal concepts (but also on the theories of Ramsey and Carnap), compares two views of legal concepts: as nodes in inferential nets and as categories. He discusses the nature of the legal concepts, questioning about their representation as ontological categories. He argues, indeed, that the legal concepts' nature is rather that of inferential nodes. Consequently, any ontological representation of the Law, based only on taxonomical hierarchies and conceptual definitions would be quite poor and not meaningful. Furthermore, according to Sartor, since the Law evolves, the changes may question the validity of conceptual hierarchies, and, in addition, the value-oriented or teleological aspect of legal reasoning determines further difficulties in the ontological definition of legal components.

In a certain sense, therefore, these issues (but also others) require for a sort of compromise between the real nature of the legal concepts and their ontological representation. Certain strategic solutions, in terms of design decisions and ontological approaches, are also needed to mitigate the problem of the frequent changes in the conceptualization of the Law.

Law and language

When one relies on the sources of Law to determine the semantics of the legal categories, the issues concerning the language are particularly relevant. Since Law is closely related to language, the interpretation of Law depends, first, by the interpretation of language. As thought in every course of Law, the first type of legal sources' interpretation that a jurist has to do, is that related to the lexical and syntactic dependencies, namely on the legal terms and the relations among the sentences (so called *vox iuris*).[17] Therefore, not surprisingly, the discourse on legal ontologies is intertwined with linguistics and with natural language processing (NLP) techniques. Nevertheless, the relationship between the language and the Law, shows also another important feature of legal ontologies, namely that "Contrary to e.g. a biological taxonomy, a legal ontology is not language and country independent"[85].

Some of these issues have generated, in a sense, a branch of computational and formal legal ontologies. Indeed, so called "core legal ontologies" aim at represent the legal reality as it is, mostly relying on the legal theory. This kind of ontologies has dominated the trend in legal ontology engineering in the 1990s and in 2000s. I think that today this trend is in crisis, because, at the state of the art, there are many core legal ontologies which are also quite accepted by the community. One may certainly argue that they could be not *perfect*. However, there must be a good reason, today, to defend the need for another core legal ontology. On the other hand, the Linked Data paradigm, which is ruling the scene, and the current evolution of the Semantic Web, are questioning the need for such kind of ontologies. I discuss this latter issue in the Chapter 5.

In contrast, the number of legal domain ontologies, namely ontologies describing a particular piece of the legal reality is increasing. For instance, you may note that, even the work I am describing in this thesis, concerns a particular legal domain, namely public procurement.

Linguistic ontologies are another branch of legal ontologies. These ontologies are developed hand in hand with the advancements of NLP techniques. Therefore, the trend is quite stable.

[17] For instance, during my first year at the faculty of Law, I have learned that, according to the art. 12 of the so called *Preleggi al Codice Civile*, literally the laws before the (Italian) Civil Code, *Nell'applicare la legge non si puo' ad essa attribuire altro senso che quello fatto palese dal significato proprio delle parole secondo la connessione di esse*. This means that, when you apply the Law, you are not allowed to interpret it differently from the plain meaning of its words, as it results from the connections among terms.

2.4.3 Legal ontologies in the 1990s

Basically two relevant legal ontologies appear in the 1990s, namely the *The Frame-Based Ontology of Law* (FBO) by van Kralingen et al. (1993) and the *Functional Ontology of Law* (FOLaw) by Valente and Breuker (1994).

The Frame-Based Ontology of Law

The Frame-Based Ontology of Law[156] is a semi-formal[18] legal ontology aimed at representing "the conceptual primitives used to model the legal domain". It relies largely on the classical pieces of the legal theory (Kelsen, Ross, Aarnio, von Wright, and many others) and has, therefore, a strong theoretic background. In a sense, it summarize in sorts of tabular structures the most relevant insights of the legal theory, called "frame structures" (defined as a data-structure for representing a stereotyped situation). Basically, three frame structures are defined by the Frame-Based Ontology, namely the norm frame, the act frame and the concept-description frame.

Regarding the norm frame, the FBO's authors identify a set primary and auxiliary elements which characterize a norm, namely: the 'deontic modality', the 'deontic operator', the 'norm character', the 'function of a norm', the 'directive operator' or the 'legal modality'. Regarding the act they identify also its 'theme', the 'act-identifier'.In addition to the afore-mentioned elements of a norm, Van Kralinger and his colleagues, recognize also the existence of 'conditions of application' or 'norm conditions'. The resulting frame structure is shown in the figure 2.3

	Element	Typification
1	Norm identifier	The norm identifier (used as a point of reference for the norm).
2	Norm type	The norm type (norm of conduct or norm of competence).
3	Promulgation	The promulgation (the source of the norm).
4	Scope	The scope (the range of application of the norm).
5	Conditions of application	The conditions of application (the circumstances under which a norm is applicable).
6	Subject	The norm subject (the person or persons to whom the norm is addressed).
7	Legal modality	The legal modality (ought, ought not, may, or can).
8	Act identifier	The act identifier (used as a reference to a separate act description).

Figure 2.3: A norm frame in the Frame-Based Ontology of Law

[18]The authors, indeed, state that "little attention is spent on the development of legal-knowledge systems in general, the description of legal-reasoning tasks, a formal version of the ontology, comparisons of ontologies, etc."

In order to represent the action frame, the authors, declare that an act has the following aspects: an agent; an act type; a modality, divided into a modality of means; and a modality of manner; a setting, divided into a temporal aspect; a spatial aspect; and a circumstantial aspect; a rationale, divided into a cause; an aim; an intentionality and a final state.

Particularly interesting in the FBO is the description of the type of concepts (not to be confused with the description of the concepts) that the authors identify. Concept types in FBO are four: legal definitions, deeming provisions, factors, and meta concepts. "Deeming provisions are used to introduce legal fictions. Deeming provisions allow things which are not true to be treated as if they were, and things which are true to be treated as if they were not. The concept type 'factor' is used when we are not dealing with necessary and sufficient conditions. A factor merely contributes to the applicability of a concept; it assigns a weight factor to properties that play a role in the determination of the meaning of a concept. Factors can be positive or negative. A positive factor increases the likelihood of applicability of a concept, a negative factor decreases the likelihood of applicability. Finally, meta concepts are used to deal with textual constructions such as application provisions and (some types of) exceptions. Application provisions make provisions operative, or render others inoperative"(*ivi*, p.20).

I think that this distinction is really interesting. The notion of factor, for instance, is widely adopted in the argumentation theory (for all see:[111]). Furthermore, the notion of meta concept, I believe is particularly useful for the purposes of ontological analysis. I recall this notion in the description of the LOTED2 ontology. Nevertheless, the rest of the ontology is not particularly interesting to me. The description of actions, in particular, is quite basic and not really focused on the notion of legal action. They use also the term 'promulgation' in the action-frame, but I do not agree with the use of this term, which pertains to norms, for describing actions.

Functional Ontology of Law

The Functional Ontology of Law[47] was developed in 1994 with the declared intention to open up the domain of AI and Law for the concerns of ontological investigation. Even the FOLaw, as FBO, is related to central issues in legal theory. As the name suggests, FOLaw "is based upon a functional perspective on legal knowledge". The basic assumption on which FOLaw relies is that the "legal system as a whole exists to accomplish a certain function and that the main function of a legal system is basically to react to social behavior.[154]. The authors distinguish several primitive "categories of knowledge, based upon the role they play in law": normative knowledge, world knowledge, responsibility knowledge, reactive knowledge, creative knowledge, and meta-level knowledge. Normative knowledge is the type of knowledge which has the function to

prescribe behavior and to define a standard of comparison for the social reality. The Meta-level knowledge is the knowledge required to solve conflicts between norms. The World knowledge, instead, comprises two type of knowledge: the definitional knowledge (used by normative knowledge) and the causal knowledge (which pertain to responsibility knowledge). Responsibility knowledge had the function of assigning or limiting the responsibility of an agent over certain state of affairs. The Reactive knowledge specified which action ought to be taken and how. These diverse types of knowledge interact in the *operation* of the legal system as shown in the figure 2.4.

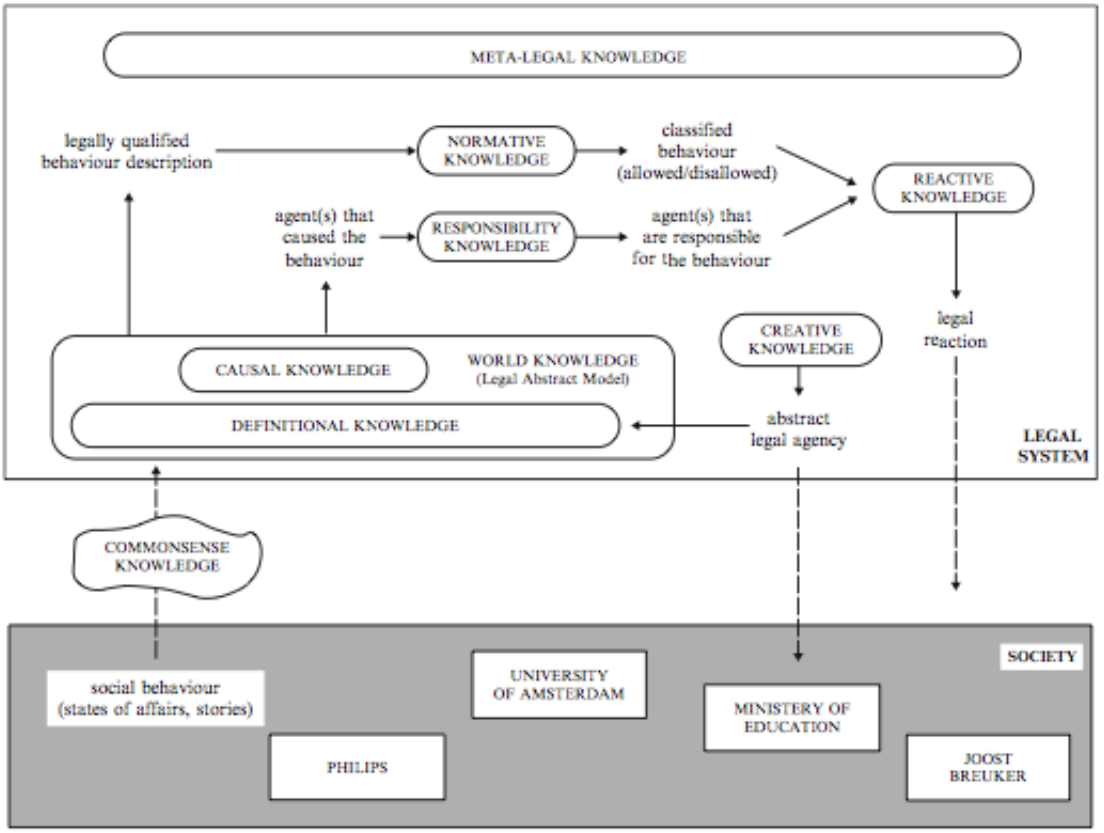


FIGURE 2.4: Functional roles of legal knowledge in the operation of the legal system in FOLaw

FOLaw is one of the best example of the confusion between epistemology and ontology in Law. Nevertheless, I think that FOLaw is one of the most interesting models of the functioning of a legal system. It, indeed, captures almost all the basic features of the legal system into operation by mean of a drawing. For the purpose of my research, I think that this ontology shows also how a legal system converts inputs in output. That is exactly the *function*of the procurement system.

A LEGAL ONTOLOGY BY KUREMATSU AND YAMAGUCHI Another legal ontology of the 1990s is the one which appears in a paper of Kurematsu and Yamaguchi[80]. The

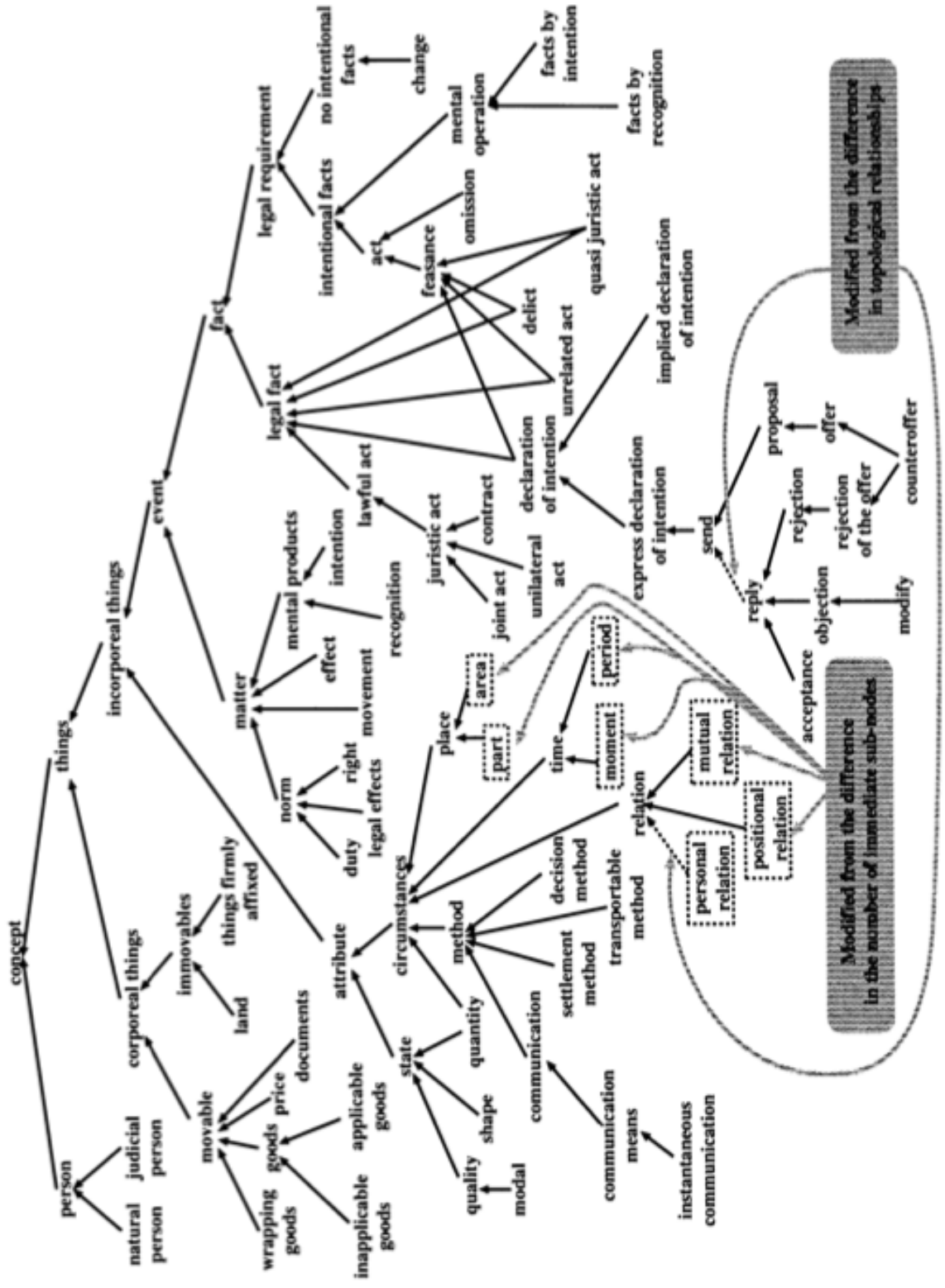


FIGURE 2.5: The hierarchy structure in an 'refined' legal ontology by Kurematsu and Yamaguchi

ontology is not listed into the tables of Breuker (which are shown also here: [33] and here: [35]), but is listed as 'legal ontology' by Poli[110]. The disregard for this ontology is probably due the fact that the authors do not describe the ontology in their paper, which is, indeed, focused not on the ontology, but on the refinement process of a given initial legal ontology. Nevertheless, the ontology is very articulated and not at all trivial. It is intended to describe the field of Contracts for the International Sale of Goods, but it represents also many relevant general legal concepts. As shown in the fig. 2.5, the ontology is an articulated taxonomy representing legal facts, acts, events, states, corporal things and also the concepts pertaining the process of contract formation (proposal, offer, counteroffer, acceptance). It is, therefore, interesting for the scope of my research.

2.4.4 Legal ontologies in the 2000s

The 2000s are the 'golden ages' of computational legal ontologies. The word 'ontology' takes on a different meaning from the traditional philosophical one, and, indeed, exactly from this time begins the 'true' history of computational ontologies. This major change is due, in particular, to the publication of the seminal paper by Berners Lee, Hendler and Lasila, *The Semantic Web*[16]. The Semantic Web, as envisioned by its three authors twelve years ago, is conceived an evolution of the (still) current Web, capable to enable machines to "understand" and respond to complex human requests on the basis of their *meanings*. To foster that vision, the authors outline a set of formats and languages, which combined together in a composite architecture, would have enabled the structuring of the information sources' semantics. As shown in the figure 2.6, at the heart of this architecture there are ontologies.

Tim Berners-Lee expounded the original vision of the Semantic Web with these words which are nowadays widely known:

> "I have a dream for the Web [in which computers] become capable of analyzing all the data on the Web the content, links, and transactions between people and computers. A "Semantic Web", which makes this possible, has yet to emerge, but when it does, the day-to-day mechanisms of trade, bureaucracy and our daily lives will be handled by machines talking to machines. The "intelligent agents" people have touted for ages will finally materialize."[15]

This 'dream' impacted on legal ontologies (as well as on many other field or domains, e.g. the medical domain) in such a way that, starting from this time, the way of conceiving legal ontologies radically changed. I will expand the discussion about the relationship between legal ontologies and the Semantic Web in the Chapter **??** and, there, I will

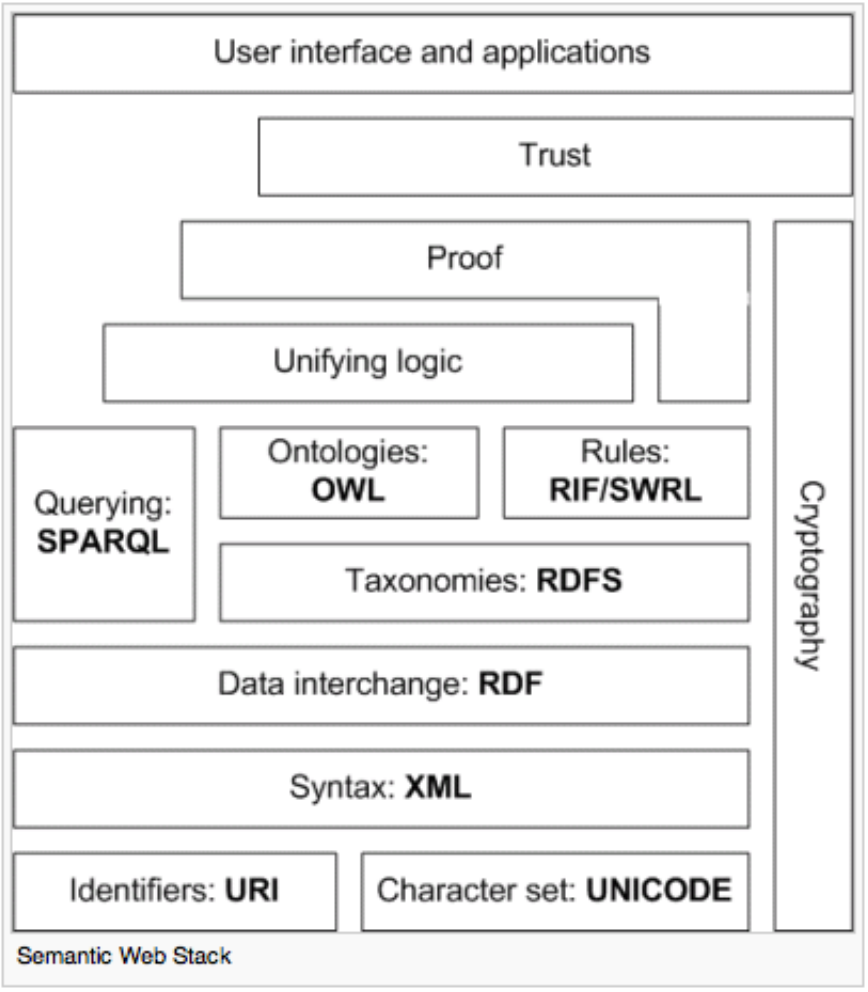


FIGURE 2.6: The Semantic Web Stack, also known as Semantic Web Cake or Semantic Web Layer Cake, illustrates the architecture of the Semantic Web by Tim Berners Lee

argue that this change has not yet completed. For now, suffice it to say that most of the legal ontologies developed in the 2000s have been conceived as "legal ontologies for the Semantic Web", therefore they have been written according to the languages of the Semantic Web, specifically (but not exclusively), in OWL, the Ontology Web Language. A discussion concerning this language and its expressivity for the legal domain is provided in the Chapter **??**, as well.

Starting from 2001, the number of legal ontologies has exponentially increased (for an exhaustive overview of - I believe - all the existing computational legal ontologies see, once again, Casellas *Legal Ontology Engineering*). Hereafter, I will describe to the most relevant computational legal ontologies, especially, those which have been (or could have been) a source of meaningful inputs for my research objective, namely the development of ontologies for the public procurement domain.

Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE)

Before going into detail of legal domain's ontologies, I would spend here some words in describing the *Descriptive Ontology for Linguistic and Cognitive Engineering*, DOLCE. Part of the study carried out in this thesis, indeed, will rely on DOLCE, an already existing foundational ontology that has been developed at the Laboratory for Applied Ontology (LOA) of the Institute for Cognitive Sciences and Technology of the Italian Research National Council (see [93]). DOLCE is a descriptive ontology aimed at capturing "the ontological stands that shape natural language and human cognition. It is based on the assumption that the surface structure of natural language and the so-called commonsense have ontological relevance. As a consequence, the categories refer to cognitive artifacts more or less depending on human perception, cultural imprints and social conventions"(*ivi*, p.13).

DOLCE was developed under the WonderWeb (library of foundational ontologies) project. The authors motivated the importance to have a library of foundational ontologies (reflecting different commitments and purposes) on the assumption that "the most important challenge for the Semantic Web is not so much the agreement on a monolithic set of ontological categories, but rather the careful isolation of the fundamental ontological options and their formal relationships"(*ivi*, p.3). Therefore, in the author's view, each module of the library was conceived basically in terms of such fundamental options. Since its first development, DOLCE was not intended "as a candidate for a "universal" standard ontology, but rather as a reference module, to be adopted as a starting point for comparing and elucidating the relationships with other future modules of the library"(*ivi*, p.5).

The basic notions of DOLCE are based on the traditional philosophical insights. Among the others, the most basic are two: *endurant* and *perdurant*. Endurants (also called *continuants*) are "entities that are *in time*, [because] they are *wholly* present (all their proper parts are present) at any time of their existence"(*ivi*, p.17). On the other hand, perdurants (also called *occurrents*) are entities that *happen in time*, [because] they extend in time by accumulating different *temporal parts*, so that, at any time t at which they exist, only their temporal parts at t are present" (*ibidem*).[19] For example, *the PhD thesis* you are holding now can be considered an endurant because (now) it is wholly present, while *your reading of this PhD thesis* is a perdurant because, your "reading" of the previous section is not present now. According to DOLCE, both states and events are perdurant. Other DOLCE's notions are time location, agentive physical object and social object.

[19] My emphasis

"Leaf" Basic Category	**Examples**
Abstract Quality	*the value of an asset*
Abstract Region	*the conventional value of 1 Euro*
Accomplishment	*a conference, an ascent, a performance*
Achievement	*reaching the summit of K2, a departure, a death*
Agentive Physical Object	*a human person (as opposed to legal person)*
Amount of Matter	*some air, some gold, some cement*
Arbitrary Sum	*my left foot and my car*
Feature	*a hole, a gulf, an opening, a boundary*
Mental Object	*a percept, a sense datum*
Non-agentive Physical Object	*a hammer, a house, a computer, a human body*
Non-agentive Social Object	*a law, an economic system, a currency, an asset*
Physical Quality	*the weight of a pen, the color of an apple*
Physical Region	*the physical space, an area in the color spectrum, 80Kg*
Process	*running, writing*
Social Agent	*a (legal) person, a contractant*
Society	*Fiat, Apple, the Bank of Italy*
State	*being sitting, being open, being happy, being red*
Temporal Quality	*the duration of World War I, the starting time of the 2000 Olympics*
Temporal Region	*the time axis, 22 june 2002, one second*

FIGURE 2.7: Examples of "leaf" basic categories in DOLCE

With respect to social objects, they are -I believe- intended by the authors as objects (endurants) produced by communities (generally the society), in the sense that they depend, for their existence, on intentional agents that conventionally create them and accept them. In DOLCE they are divided in agentive or non agentive on the basis of their possession of intentionality. Therefore, as you can note in the fig. 2.7, *a legal person* is a 'social agent' and *a law* is a non agentive social object. DOLCE has proven very useful in addressing various problems and the paper is part of a collection of works aimed at extending DOLCE as to make it suitable for many distinct specific domains.

DOLCE has been described using a full first-order logic with modality; then part of the axiomatization was converted in OWL and the remaining part was expressed through the KIF comments attached to the OWL concepts.

Over the years, DOLCE has been extended and used in several ways. DOLCE+ is an extension of DOLCE with a theory on descriptions and situations (D&S)[52]. D&S is an ontology of contexts, "which provides a principled approach to context reification through a clear separation of states-of-affairs and their interpretation based on a non-physical context, called a description" (*ivi*, p.II). The ontology of descriptions also offers a situtation-description template and reification rules for the principal categories of DOLCE.

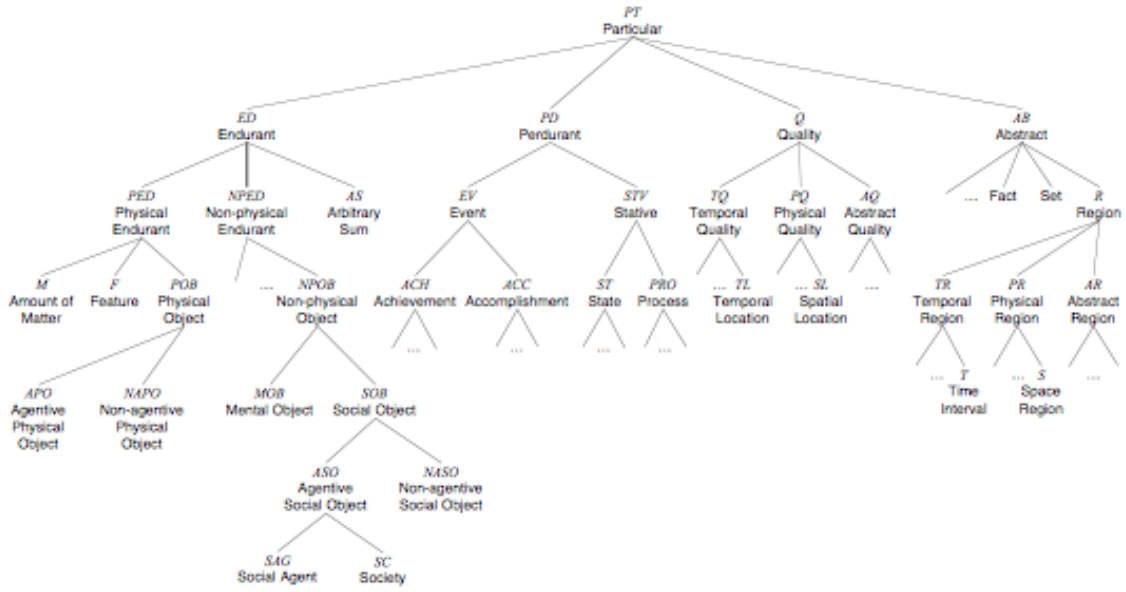


FIGURE 2.8: Taxonomy of DOLCE basic categories

CORE LEGAL ONTOLOGY (CLO)

CLO, the Core Legal Ontology[55] is an extension of DOLCE+ for the definition of core legal concepts. The authors define it a *constructive* ontology, because "it allows to reason over the contextual constraints that can be intentionally adopted by a cognitive agent when recognizing or classifying a state of affairs" (*ivi*, p.98). The ontology, indeed, was designed to support three kinds of legal tasks in the Civil Law countries, namely: *conformity checking, legal advice* and *norm comparison*. In the context of CLO, the D&S distinction became *legal* description or *conceptualisation* –which encompass norms, regulations, crime types, etc.– vs situation or *legal facts or cases* –which encompass legal state of affairs, non-legal states of affairs that are relevant to the Law, and purely juridical states of affairs.– The authors state that the ontology enables to build a complex, *functional* representation of the Law and of its facts. Every legal description classifies and constrains a state of affairs. More precisely, a legal description is the reification of a theory that formalizes the content of a norm, or a bundle of norms. A legal case is the reification of a state of affairs that is a logical model of that theory. A description is satisfied by a situation when at least some entity in the situation is classified by at least some concept in the description.

Hoekstra and colleagues are quite negative in their review of CLO. In fact they say:

"Classification in CLO is [...] not DL classification, and it is unclear as to what extent the two interpretations are compatible. Viewing the legal system as description, or rather prescription, of reality is not new [...]. However, the CLO distinction between

descriptions and situations is rather one dimensional in that it does not commit to an ontological view of the kinds of descriptions involved. [...] Although it introduces new levels of abstraction by reification, it does not provide ontological categories that can be used to describe the knowledge at these levels. In a language that itself can be conceived as providing the means to construct descriptions of reality (situations), such as OWL DL, it is unclear what the epistemological status of the classes 'description' and 'situation' themselves is. For instance, what is the difference between an individual description being classified-in-the-OWL-sense as some description class, and a situation class being classified-in-the-CLO-sense by that same description?" [1]

Moreover, they argue that "lack of ontological commitment at the level of descriptions undermines its suitability for knowledge acquisition support in a legal setting as well. Although for sure a norm can be described as some description of a situation, it is not the norm-as-description that uniquely characterises what a norm is".

To a large extent, I agree with these claims. First, it is true that a norm is a description of reality or of certain state of affairs. However, if you take in account only this view, I wonder how are you able to explain that the law constitutes also the 'things', the reality, the state of affairs which "describes". I believe that there are certain type of norms which could be considered as description, while other types, i.e. the so called 'constitutive norms' are not simply description. Of course, you may say that this is only a terminological issue. Nevertheless, we are discussing not only terminological issues, but rather on the ontological nature of norms. So, in my opinion, from an ontological point of view, a norm could not considered a mere *legal description*. Consider also another aspect. Is an adjudication a legal description as well? Is an interpretation of a fact described e.g. in a writ of summons written by a lawyer a legal description as well? If yes, what is the distinguishes feature of a norm intended as a legal description from other kinds of legal descriptions? It could be interesting, instead, to interpret the notion of legal description as an interpretation of the norm. That is, a norm could have different interpretations, which are essentially different descriptions of its content. However, it is not clear if in CLO this class could be intended also in this way. Furthermore, I think that too much modeling efforts are required to represent both the content of the norm and the situation that the norm describes and, to a large extent, I suspect that the result would be a mere duplication.

Moreover, an interesting attempt has been made in comparing the normative structure of EC and national texts (implementations) through CLO. Selected sets of norms have been conceptualized in two domain ontologies, as represented in fig. 2.9: EC directives and national laws are represented in separate ontologies with CLO; the ontology of the

content domain (social world) addressed by the directives is also based on the foundational ontology used to build CLO. "The national implementation of directives should inherit both from EC directives and from the national laws, without being inconsistent. Rules of conduct and codes of practice typical of the directives domain should inherit from (and to be consistent with) the national implementation of the directive. Any compliant application ontology will inherit from all those ontologies, besides the basic service and task ontologies addressed by the application"(*ivi*, p.118).

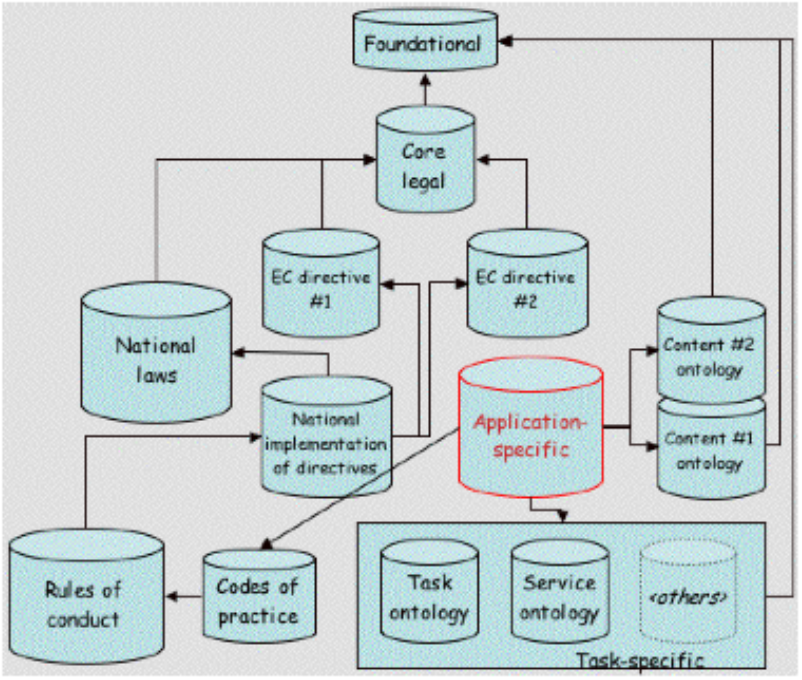


FIGURE 2.9: An ontology library for EC Directives and applications (arrows mean "inherits from")

It is necessary to recall also the Jur-Wordnet (Jur-IWN) project[118], whose outcome was an ontology-based extension to the legal domain of the Italian version of EuroWordNet. Jur-IWordnet ontology is both a linguistic ontology (terms are linked to each other throughout lexical relation) and a content description model because "the concepts are organised according to stronger assumptions about the ontological nature of entities that populate the legal domain, and about their relationship"[54] using the DOLCE framework and CLO.

Other examples of linguistic legal ontologies are those developed under the DALOS[50] and the LOIS projects[109, 148]. Jur-IWN work was taken into account also by the LOIS project. It is worthwhile to stress that "legal linguistic ontologies" are large scale lexical resources that cover words of a language with regard to the legal domain, aimed at represent the linguistic relations between legal terms. Therefore, linguistic legal ontologies mainly differ from formal and proper "legal content" ontologies, since

their scope and purposes are focused at the legal lexicon level more than at the inquiry on the ontological nature of the legal concepts expressed through legal terms. As a consequence, linguistic legal ontologies are very large but 'lightweight'.

LKIF Core Ontology

The LKIF Core Ontology[72] is a legal core ontology developed in the Estrella project as part of the Legal Knowledge Interchange Format: a knowledge representation formalism that enables the translation of legal knowledge bases written in different representation formats and formalisms. LKIF combines two different knowledge representation formalisms, namely OWL 2 DL, and LKIF Rules[58, 59]. The LKIF Core Ontology, which has been conceived as "an ontology that can be used as central knowledge component for legal knowledge systems", is therefore, written in OWL 2 DL. As stated by the authors, the aim of LKIF- Core is to represent the basic concepts of the legal knowledge. The ontology is directed at supporting legal inference, knowledge acquisition, knowledge exchange and semantic annotation. The approach followed to build the ontology is a sort of middle out, as that outlined by Uschold and Gruninger in a seminal paper[151]. The authors decided to follow this approach because they recognize that basically there are three group of users of the legal knowledge: citizens, legal professionals and legal scholars. Because of this, the identification of the basic concepts (and terms denoting those concepts) which a core legal ontology should cover, is not at all easy. The authors indeed, recognize that: "although legal professionals use the legal vocabulary in a far more precise and careful way than laymen, for most of these terms there exists a sufficient common understanding to treat them more or less as similar [...]. Nonetheless, a number of basic terms have a specific legal-technical meaning, such as 'liability' and 'legal fact' "[1].

Therefore, the Estrella consortium decided to include representatives of these three kinds of experts. Each partner was asked to supply their 'top-20' of legal concepts. Combined with terms collected from literature (jurisprudence and legal text-books) the authors obtained a list of about 250 terms. Then they asked partners to assess each term from this list on five scales: level of abstraction, relevance for the legal domain, the degree to which a term is legal rather than common-sense, the degree to which a term is a common legal term (as opposed to a term that is specific for some sub-domain of law), and the degree to which the expert thinks this term should be included in the ontology. According to the relative position with respect to these scales, they, finally, included a set of terms in the basic clusters.

The ontology has a modularity structure and the sets of modules are intended to represent different layers. The modules and their dependency are shown in the fig. 2.10. The

layers are three: the top level, the intentional level and the legal level. The first borrows most classes from another core legal ontology, namely LRI-Core[26]; the Intentional Level includes concepts and relations which describe behavior of rational agents that can be effectively influenced by the law; and Legal Level includes legal agents, actions rights and powers.

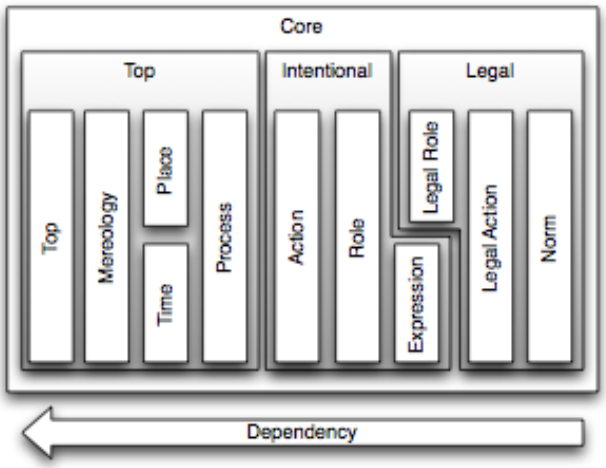


FIGURE 2.10: Dependencies between LKIF Core modules[1]

The ontology is highly axiomatized and, on my opinion, is not at all easy to use. On the other hand, at the state of the art is probably one of the most complete existing legal ontology. It is largely based on the legal theory and its ontological commitments (the representation of basic concepts of Law) are translated in a consistent, well-structured categorization of the most relevant legal categories. LKIF Core is also widely accepted by the community of scholars, and is used in many applications and by some important institutions (e.g. the UK Parliament). Not surprising, therefore, part of this thesis' work is aimed at extending LKIF-Core ontology, as to make it suitable also for the public procurement domain. Nevertheless, such a purpose has revealed also that the integration of legal core ontologies (and in particular of LKIF Core ontology) with other ontologies (especially non legal ontologies) is not at all an easy task. In the rest of this thesis I will develop further the analysis of specific features of LKIF Core ontology.

Part II

LEGAL ONTOLOGIES FOR PUBLIC PROCUREMENT MANAGEMENT

Chapter 3

Ontological approaches to the procurement system

3.1 The public procurement system: a conceptual framework

It is not a simple task to define what is the exact meaning of the expression *public procurement system*. In general, the word "system" indicates the existence of a certain number of inter-dependent elements, connected in such a way as to form an unitary and well identifiable set. Typically, we argue that a composite set of elements has a systematic nature only when we are able to recognize the existence of some close relationships among those elements, according to the well defined ideological approach we adopt in the observation of such relations. Not necessarily this ideological approach has to be a theory; it can be also just an unifying principle from which depends every single part of the system, in the sense that it inspires, in a continuous, the inner 'laws' governing the connections between those parts. The existence of such an unifying principle implies, as a consequence, also the recognition of a logical coherence in the constitution of all the parts of the system and in their interaction under the same framework.

The notion of "system" is very common in the legal domain and for long time, the diverse schools of legal theorists have proposed their re-construction of *the legal system* according to the theoretical approaches they were defending. [1]

[1] This is not the place for summarizing such an historical excursus, which certainly deserves much more attention. My intention is rather to emphasize that the notion of legal system during the century has been created and modified in several ways, depending on the legal theory that ruled the trend during the different historical periods. Consider how many different notions of the legal system have been formulated by legal theorists according once to the Jus Naturalism approach, once to the Historical School of Law, once to the Pure Theory of Law and once to the Legal Positivism school, just to name

Usually legal scholars define also the whole body of normative knowledge in term of *the normative system*, emphasizing not only that any single norm is part of a system, but also that norms can be grouped in many clusters or sets at various levels of granularity depending on the matter, the field, the specific domain they regulate. Furthermore, a norm belongs to a system in the sense that it is involved in several relations with all the others norms of the system, according to specific legal rules (namely norms about norms) which regulate how a single norm interacts with each other on the basis of the general principles of completeness, non-contradiction and coherence of the normative system. Such kind of rules are for example those solving the antinomies. [2]

Apart from the general notions of legal system and normative system, the idea that some areas of law govern other sorts of systems is fairly common. Consider, for example, the notion of "fiscal system", by which is usually indicated the body of laws governing the fiscal domain (as a subset of the normative system at large) but also, more generally, the way in which norms, taxes, taxpayers and the treasury are connected in a web of relationships.

Such a notion of "system", as it is adopted in defining both the legal or the normative domain at large and some specific legal domains (such as the fiscal domain or the procurement domain), suggests not only the idea of a combination among the elements belonging to those domains.

It suggests also the existence of a sort of *environment* in which some definite elements (including norms) interact with each others in order to achieve a certain goal or to produce a specific outcome. Second, the notion of system evokes an idea of *dynamism* which is, from a certain point of view, an intrinsic feature of the legal domain.

The public procurement system is a striking, radical example of a system featured by all these aspects. In his seminal work on the re-examination of the public procurement knowledge after years (probably centuries) of scarce consideration by academics and legal scholars in investigating the matter, Thai [145] emphasizes persistently the systematic nature of procurement. The author distinguishes, in this respect, between the institutional approach used to examine elements of public procurement and the procurement system in action, i.e. the public procurement as a dynamic process. In his paper

a few. For an exhaustive summary of the diverse concepts of the legal system in the history please see [82].

[2] Antinomies are contradictions among legal rules. Since the normative systems are composed by an huge amount of norms, which are produced at different times, it can happen (and it happens very frequently) that two (or more) norms regulate the same issue in different ways. In order to solve these contradictions in the normative knowledge, there are some general rules which govern the relationship among norms on the basis of the hierarchical criterion (*lex superior derogat inferiori*), the temporal criterion (*lex posterior derogat anteriori*) and the criterion of speciality (*lex specialis derogat generali*).

entitled *Public Procurement re-examined* he explain in a clear way this dual nature of public procurements system.

He argues:

> Traditionally, a system is defined as 'an assembly or set of related elements' [] or 'institution'. But systems, particularly the public procurement system, are so dynamic that they cannot be understood just in terms of their elements or parts that make up an institution. Checkland and Scholes [...] stated: "The vehicular potential of a bicycle is an emergent property [...] of the combined parts of a bicycle when they are assembled in a particular way to make the structured whole. Likened to a bicycle, public procurement should be defined by its emergent property, namely system in action. According to this systems view, a system in action be it business process, public policy process, procurement process, or budgetary process can be operationally defined as an abstract paradigm that represents the conversion of inputs into outputs. (*ivi*, p.16)

In fact, part of this normative system defines the *static aspects of public procurements*. Notion such as contract notice, or contracting authority or eligible economic operator are indeed created and defined by the law: they are 'constituted' by law. These 'things' do not exist without the law that defines them and recognizes their existence upon the occurrence of certain facts or conditions. However, the static knowledge is not a standing alone knowledge; it is involved in a dynamic scenario that concerns processes (procedures) devoted to achieve the goals for which the public procurement normative system has been created. Procedures are an important aspect of the legal domain and are a very important aspect of the procurement system. Nevertheless, I believe that there is a lack of research on the ontological analysis and representation of legal procedures. Indeed, is not at all easy to understand how the issue can be approached from an ontological point of view.

3.2 The dynamic face of legal system: on procedures and their relevance

The procurement system, as we have seen before, includes both a dynamic and a static setting. This is not an exclusive feature of the public procurement domain. Rather, in the public procurement domain this distinction is really evident, but in general we can observe that, more or less, dinamicity characterizes many others legal domains and, in

some sense, the legal system itself at large. In fact, besides those norms defining first what is the law itself and, secondary, what are legal agents, legal documents and in general legal objects (in other words, the things that Thai defines "elements"), the legal system regulates also the way in which these kinds of entities are combined together dynamically in order to achieve proper legal outcomes, the *institutional socio-material effects of the legal system.*

The area of the legal system I am referring to is the one that regulates *procedures.* Procedures are the explicit specifications of legal proceedings. They are explanations and descriptions of the actions to be done, of the events that must happen in order to produce a certain institutional goal, defined by the law. This is the dynamic face of the normative system, namely *the legal system in operation.*

Every lawyer (or legal professional) is aware of the importance of procedures in the legal system, because usually he or she knows very well how a single misstep, albeit minimal (for example, the time expiration for bringing an action) could affect irretrievably the substance of things. Rights, powers as well as a duties are mostly vacuous and useless if they don't match to the right proceeding needed for their existence, or are not followed by precise commitments in the form of actions required for their implementation. It is not about primacy of the so called formal law on the substantial law, there is rather a sort of interdependence between the two bodies of knowledge.

A very relevant part of the legal system is made of norms governing procedures. Procedures are, indeed, descriptions of the institutional path to follow for obtaining a certain legal result or effect. And ultimately, the legal system exists properly to create its effects. These effects can be either material (actual changes in the natural reality, empirically recognizable) or abstract and social (actual changes at social reality layer, recognizable among agents at pure abstract level). But what is important to notice is that those effects are obtained only if one acts according to a procedure which can take various forms depending on their legal description (the area of law, the context in which they are placed) and on the type of objectives that the legal system intends to produce.

In my opinion, there are four main types of legal procedures which are the behavior patterns that the legal system requires for producing legitimate results, or clusters of legal effects. I argue that we can recognize the existence of three main types of procedures:

- the first type of procedures is the one which defines the legal system's reaction to *contra legem* acts or facts, as well as the legal compulsion to comply with duties and obligations;

- the second type of procedures regulates how intentional objectives of the political institutions can be materialized, even, but not exclusively, through the actions of the administrative action;
- the third type of procedures regulate behavior patterns of the administrative entities, i.e. the way in which they operate and act;
- finally, another type of procedure regulate how legal states of affairs or legal positions (rights, duties, etc.) are recognized (but also created, generated), or have to be recognized by the legal system. I am referring here to a wide catalogue of procedures and legal effects, such as the generation of a contract (or of a contractual state of affairs) and in general of an obligation, or the acquisition of rights, such as the right to property. Of course, in these cases, the term procedure is intended in a broader sense, i.e. not necessarily defined in every details.

The most noticeable expression of the legal system's dinamism is, on my opinion, the whole area of law regulating the judicial processes, namely the 'procedural law', also known as 'adjective law'. Procedural law deals with the practical, operative, technical aspects of the law enforcement and prescribes how civil or criminal lawsuits are conducted. In contrast, substantive law creates the legal categories rooted in the so called 'social reality', such as the category of legal person, of contract and so on. Since, according to Ross [117] and Sartor [123] theory, legal categories are inferential nodes more than pure ontological categories, also those norms which prescribe duties or liabilities, as well as those recognizing rights, belong to the substantive part of the normative system.

Substantive law and procedural law are not completely disjoint. Rather the procedural law serves to make concrete and effective the consequences of the recognition of a certain legal category. It is the way in which the commitments defined and promised in substantive law's rules are kept. Legal procedure provides the means by which substantive legal rules are ultimately enforced by declaring and certifying binding and institutional legal facts, or by constituting and creating the socio-material effects legally prescribed.

The Functional Ontology of Law is probably the only one legal ontology which takes into account the dynamic aspect of the legal system, mostly related to the this type of procedural law, the adjective law. The effects obtained according to a procedure are in the FOL called *legal reaction*. The legal reaction, for the FOL authors, is a function that takes as inputs the classified situations and the responsible agents (according to both the normative and responsibility knowledge) and pours in the society-layer world the results of the legal system enforcement.

However, adjective law does not regulate only the legal reaction upon the occurrence of an anti-legal fact or act, or the enforcement of responsibility situations. It regulates also

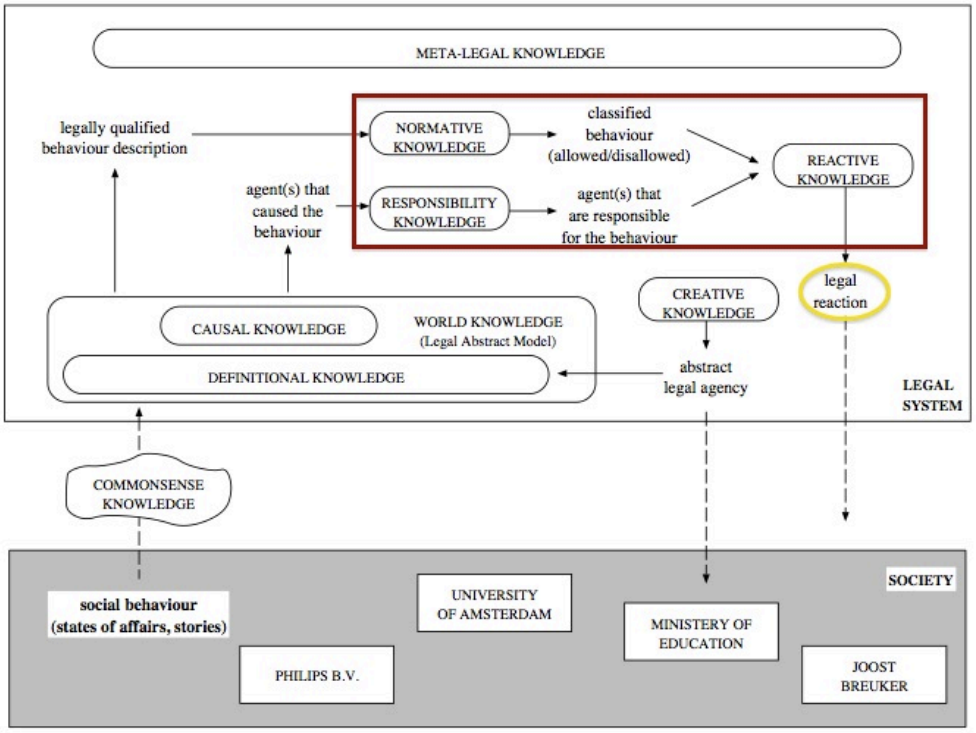


FIGURE 3.1: The figure shows the relationship between normative knowledge, responsibility knowledge and the reactive knowledge

the way in which the legal system certifies and declares some states or facts, which are not related to any sort of responsibility. Simply these states or facts are doubtful and a judge response is needed to make them clear and legally truthful. Consider for example the resolution of boundary disputes between neighbors or lawsuits to declare a marriage or a contract void, but also inheritance lawsuits or cases of not-litigious proceedings (voluntary jurisdiction).

Procedures are not only those governing the conduct of lawsuit (e.g. litigations). Even the way in which laws are made is a matter of procedures which constitute the *legislative process*. In fact, the law itself (usually the Constitutional law for statutory laws in civil tradition countries) prescribes how the lawmaking process has to be conducted and defines the steps through which the source of an idea for a legislative proposal becomes a statute. The result of the lawmaking process, namely the law, does not depend by the reactive knowledge of the legal system. It rather depends on the society that, by means of its representatives, feels the need to regulate a certain matter or to change a given legislative text. The lawmaking process belongs to that type of procedures regulating how intentional objectives of the political institutions can be materialized.

Administrative procedures are in many cases related to political objectives. The public procurement system is a good example for explaining this link, because usually political

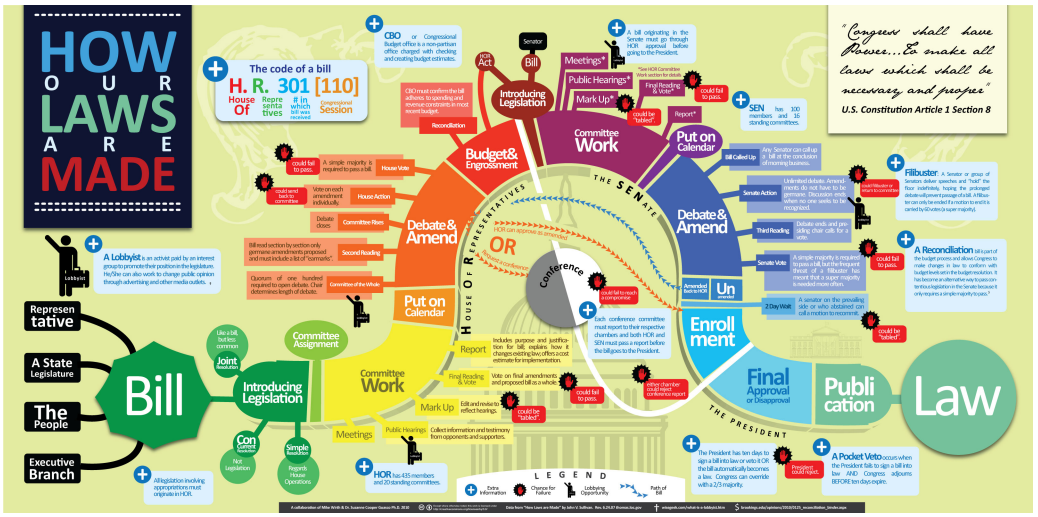


FIGURE 3.2: The figure shows the steps of the legislative process in the USA (by a collaboration of Wirth M. and Guasco S. M.) Source: http://www.mikewirthart.com

bodies deliberate to acquire a certain good or to make a certain public work, but then the 'operational harm' which implements the practical effects of this political decision becomes the public administration.

Even the public administrations have to do always with procedures. As emphasized in the introduction of this thesis, public procurement procedures exist because each administrative action is driven only by the pursuit of public interest, or more generally, of public function. In general, the path to follow for accomplishing public function, is rigidly established by law, to meet compliance with values and factors of the legal system, as well as transparency, and security of law.

For instance, even the normative knowledge on taxes can be examined from a dynamic vs a static approach perspective. There are indeed norms aimed at define certain types of fiscal documents (such as tax declaration or invoice); certain types of taxable entities (such as economic operators or simply natural persons), or certain types of events which are considered as relevant events for the purposes of a specific tax (for example the supply of goods or services by economic operators in the case of the Value Added Tax).

On the other hand, even the concept of a tax in itself can be considered as a "static concept" by focusing only on its *constitutive aspects* which are defined by means of both the *constitutive norms* and the *regulative norms*. This is what Sartor calls *the Q's inferential meaning* constituted by the links between *Q-conditioning* and *Q-conditioned* legal facts.

Looking at the fiscal domain, one can not ignore that the tax collection process is a very relevant aspect of tax law. In fact, besides those norms defining what is a taxable

person, what is a chargeable fact and, more generally, what is a specific type of tax, the legal system needs to regulate also the way in which *practically* the tax is effectively payed by the taxpayer and then collected by the Inland Revenue.

3.3 The ontological representation of procedures in the AI & Law literature

In the literature on legal ontologies, the ontological description and representation of legal procedures is mostly a non-addressed issue. Despite the importance of legal procedures and the fact that norms about procedures are a relevant part of normative systems, the ontological analysis, description and representation of such knowledge is a neglected field of research in the AI & Law literature. In their paper on the comparison between four legal ontologies, Visser and Bench-Capon, observe that:

> "None of the ontologies appears to have an adequate solution for norms that describe legal procedures (e.g., procedural norms of competence). Possibly, the researchers have not addressed this kind of legal knowledge in their ontologies because there was no role for such knowledge in the legal sources that were used in the construction of their ontologies. Possible, they did not address legal procedures because there are severe problems with the (declarative) specification of procedural knowledge. One of the difficulties is to find a language to express procedural knowledge in a declarative way. Related to this difficulty is the question whether legal procedures should be regarded as control knowledge or as domain knowledge" [162, 163]

I largely agree with Visser and Bench-Capon's assessments of the issue. I think that, arguably, the researchers do not address this kind of knowledge in legal ontological modeling. While, I think that many legal domains deal with procedures, not only the public procurement domain or, in general, legal domain belonging to the administrative domain. So, I suspect that the researchers do not address this kind of legal knowledge because they have the idea that an ontological representation is not adequate to represent this kind of knowledge.

The other words I want to quote are those of Casellas. The sentence of Casellas is neither an assessment, nor an evaluation. Is a question, that question:

> *How may we formalize legal concepts and* procedures *in a machine-understandable form?*[3]

[3]Source: the Nuria Casellas' Blog, available here: http://blog.law.cornell.edu/voxpop/author/nuria$_c$*asellas*/.

3.4 Some general comments concerning ontological patterns for procedures

A tender could be considered as a complex event, composed by a series of atomic events, whose existence and dependence among each others, is determined by the law. More specifically, the whole tender's event takes place according to a procedure which is the legal specification of the way in which the procurement system, dynamically converts inputs into outputs.

Henceforth I will refer to the European rules on procurement to clarify my assertions. According to the European Directive 2004/18/EC there are types of procedures governing European tenders. These are: open procedures, restricted procedures, competitive dialogue, negotiated procedures and design contests.

Open procedures means those procedures whereby any interested economic operator may submit a tender.

Restricted procedures means those procedures in which any economic operator may request to participate and whereby only those economic operators invited by the contracting authority may submit a tender.

Competitive dialogue is a procedure in which any economic operator may request to participate and whereby the contracting authority conducts a dialogue with the candidates admitted to that procedure, with the aim of developing one or more suitable alternatives capable of meeting its requirements, and on the basis of which the candidates chosen are invited to tender.

Negotiated procedures means those procedures whereby the contracting authorities consult the economic operators of their choice and negotiate the terms of contract with one or more of these.

Design contests means those procedures which enable the contracting authority to acquire, mainly in the fields of town and country planning, architecture and engineering or data processing, a plan or design selected by a jury after being put out to competition with or without the award of prizes.

Through the analysis of the whole content of the Directive, we can draw the following conclusions:

1) The first point that deserves to be emphasized is that *a procedure dictates the course of events.*

2) The second point is that the application of *different procedures generates a different course of events.*

3) Each single event depends by the course of events as described and regulated by the Law.

4) Each single event depends exactly by one and only one course of event

5) Finally each single event, depending on only one course of events, is disjoint by other events which depend on other courses of events.

The concept of event is intended according to the DOLCE ontology. In other words, it is a perdurant. This analysis is summarized in the fig. 3.3

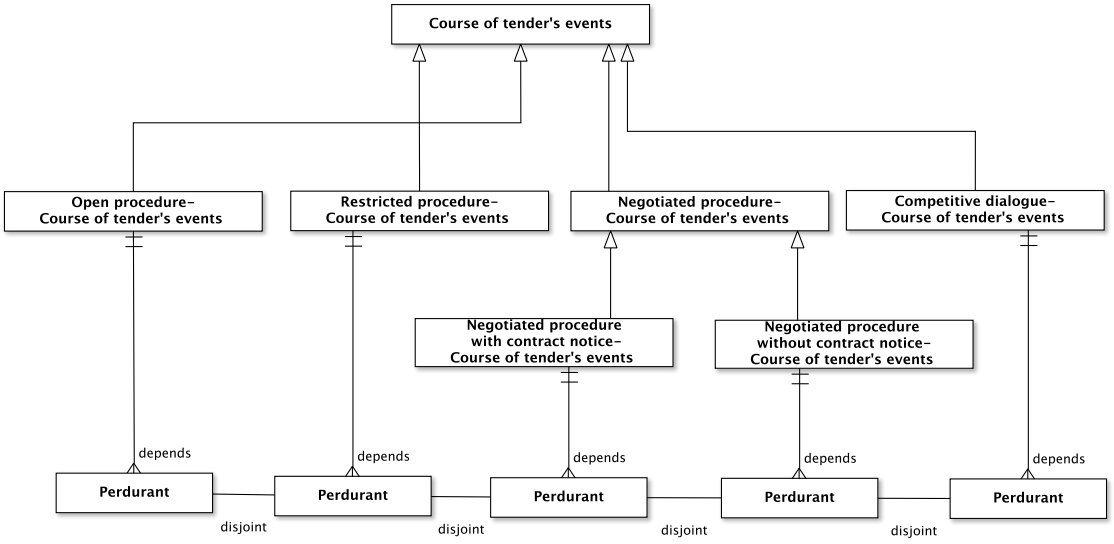


FIGURE 3.3: The figure shows the representation of the invitation to offer event in Crow's foot notation

3.5 On the ontological nature of tender's events

In his paper on *Ontological requirements for analogical, teleological, and hypothetical legal reasoning*, Kevin Ashley pints out an interesting issue:

> "A primary task of the ontology is to enable the system to distinguish from the context between the factual and the legal senses of apparently identical terms. In law, as is well known, one needs to coordinate *the ordinary and legal institutional descriptions of events.* Some intermediate legal concepts may look identical to general factual concepts, but, in the legal domain, they

> are technical concepts whose meaning are subject to argument. For instance, "causing " has both an ordinary sense in the case facts and a technical legal sense in the context of a rule-like justification for deciding a case." [6][4]

I substantially agree with the assertion of Ashley and I argue that, for the definition of the ontological nature of tender's events, we need to capture their real nature according to their meaning in the context of the Law. In my opinion, *tender events* are basically relations that hold between a public administration and economic operators.

For instance, in the open procedures, this relation holds:

- at the first stage (time 1), between the public administration which issues a contract notice and the entire set of economic operators, namely with *all* the economic operators;

- at a second stage (time 2) - intermediate stage- between the public administration (contracting authority) and a limited number of economic operators (i.e. the economic operators, which have submitted an offer);

- at a third stage (time 3), between the public administration and with only one economic operator (i.e. the economic operator which has submitted the best offer, namely the successful tenderer).

Consider for an example a world where there are no more economic operators and then consider the case of an invitation to offer (a call for tenders) made by a public authority. Does such particular event of invitation to tender make sense? It is still an invitation to tender without the participants to whom the invitation is directed? What is the existential reason of such an event?

The insight that legal events (but also states) could be considered as relations holding between agents, namely *personae*, and between an agent, or more than one, and an economic resource, namely a *res*, or more than one, is not new. It comes largely from our Roman Law's background. Regarding this, Samuel states:

> "The codifications are all framed around institutions which [...] [act] as the starting point of what is called the 'institutional system'. Law is about *persona, res* and *actiones*. *Res* can loosely be translated as 'thing' [...] and, like *persona*, represents another focal point around which legal propositions can be grouped. That is to say, things, like people, exist both in the real world and in the legal world and thus *res* acts as a bridge between social fact and legal conceptualization. 'Things' [...] also act as a counterpoint to 'person' and, accordingly, the law of things cannot be understood divorced

[4] My emphasis

> from persons. *Persona* and *res* represent a legal structure upon which almost the whole of substantive law is founded"[119]

Another author who, in my opinion, considers events or states as relations is Ramsey. Sartor recalls the work of Ramsey to substantiate the theory of Ross, about the role of terms and legal concepts as intermediate nodes. According to Ramsey, indeed, theoretical terms can be replaced by means of variables. Basically, according to Ramsey[115], "given a theory (which for simplicity we can assume to consist of inferential links of the kind described above) containing a certain theoretical term, we can substitute that term with an existentially quantified variable. This substitution makes the assumption explicit that there exists some predicate that, substituted for the variable, yields true or valid propositions"[122]

For instance, a 'Ramseyfied' inferential theory concerning the concept of ownership consist in the claim that *there exist a category Z* which is a relation characterized by certain inferential links, as shown in the fig. 3.4.

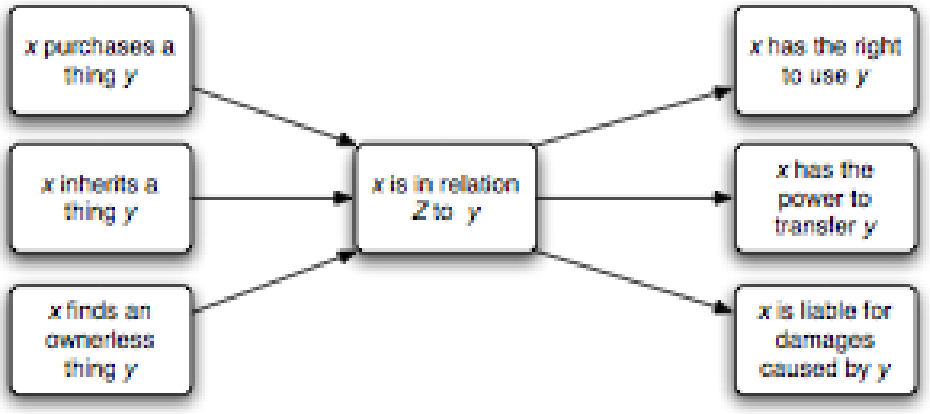


FIGURE 3.4: The Ramseyfication of ownership by Sartor

3.6 An ontological pattern for modeling tender's events

Therefore, according to these insights grounded in the Legal theory, I consider the tender's events as relations which hold among participant to a single event. Participants (in the sense of DOLCE) can be either natural persons, legal persons, things or social objects, in other words, endurants.

The conception of tender events as relations between public administrations and economic operators is quite similar to the Kim's conception of *events*[78]. In a previous work

with Guarino and Masolo[44][5] concerning the ontological modeling of personal income tax, we represent states which are relevant for the fiscal law, as DOLCE perdurants, in the same sense of the Kim's theory. For Kim, an event is the exemplification of a prop-

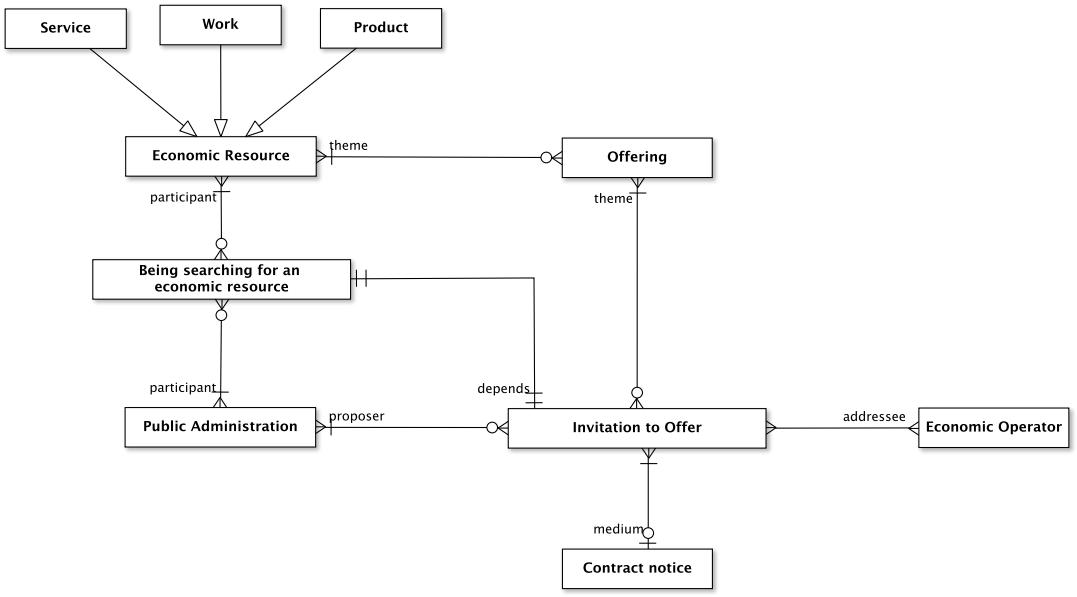


FIGURE 3.5: The figure shows the representation of the invitation to offer event in Crow's foot notation

erty P (a relation R) by a 'substance' s (several substances $s_1, \ldots, s_n$) at a given time t and it is noted $[s, P, t]$. For instance, in "the collision of the Titanic with the iceberg", s_1 = Titanic, s_2 = the iceberg, R = colliding with. An event $[s, P, t]$ exists if and only if 's has P at t', i.e. in a logical perspective, if and only if $P(s, t)$. The events $[x, P, t]$ and $[y, Q, t']$ are identical if and only if $x = y$, $P = Q$, and $t = t'$. From the logical perspective this implies that we need to specify the identity condition of predicates. In general one assumes logical equivalence, but more intensional identity criteria could also been considered. It is possible to represent in DOLCE the events as conceived by Kim, by 'simulating' the identity criterion of events through the following constraint, where S is a leaf subclass of states (of the DOLCE class ST) and pc is the standard (non-total) participation relation of DOLCE:

$$S(s_1) \wedge S(s_2) \wedge \forall xt(PC(x, s_1, t) \leftrightarrow PC(x, s_2, t)) \rightarrow s_1 = s_2$$

As shown in the fig. 3.5, therefore, an event which is, under a legal perspective, an invitation to offer, is a perdurant. Participants in this events are (all the) economic

[5]Please note that the logical axiomatization in the paper is due mainly to the efforts of Masolo and Guarino.

operators, which play the thematic role of addresses of the proposal, a public administration, and a theme (of the invitation to offer) which is basically the commitment to provide a good, a service or a work.

In turn, the theme of the offering is an economic resource, namely, a resource which could have an economic value. That resource is what the public administration is seeking.

With the work I have outlined here, I have the intention to provide only some theoretical foundations for modeling public procurement procedure. The work, indeed, can be extended to model all the other events (relations) which there are at the subsequent steps of the procedure. An ontological model of procedure could be very useful for managing the public procurement processes and could serve also as a basis for checking the compliance of the conduct of the tender according to statutory law.

Chapter 4

LOTED2: an Ontology of European Public Procurement Notices

4.1 Premise: the Semantic Web for the legal domain and legal ontologies for the Semantic Web

Up to now, this thesis work have been focused on the ontological representation of tender events based on a foundational approach. It seems to me, that this ontological approach is precisely what is needed to represent the events which occur in the procurement processes (procedures) together with their participants and the roles they can play in each stage of a tender, on the basis of their respective initial/previous role and of their intrinsic features. However, this is certainly only *one of the possible approaches* you can adopt in legal knowledge representation. In addition, it is also true that the goodness of a modeling choice depends also on what the ontology is meant to be used for.

Years of advancements in Artificial Intelligence & Law have revealed how challenging and difficult is the task of representing legal knowledge in a computable manner and, above all, have shown that there is not *the right way* to make the task better or easier. Nevertheless, the huge amounts of textual and unstructured data produced today by legislative institutions at all various levels (European, national and local), by public administrations, courts, etc. stored in large repositories, as well as on the Web – in the latter case and for specific types of those documents, with a particular care, due the respect of fundamental personal rights, privacy issues, trade marks protection, and so on – requires ways of bringing order and handle in the right way this unstructured

information. The Semantic Web seems to provide the strategic solution to make effective this major challenge of our times.

The legal domain is inherently a 'documental domain', or indeed, it is the 'realm of documents' and therefore the transition from the 'web of documents' into the 'web of data' assumes a very peculiar sense when it means also the switch from the 'legal documents' to the 'legal data'. The Semantic Web infrastructure seems definitely fit to accommodate also legal knowledge into the Web of Data because its standards find their precise *raison d'être* even for the legal domain, at its various degree of "structural" and "substantial" semantics.

Essentially for this reason, the "*one web*" vision expounded twelve years ago in the seminal work by Tim Berners Lee, Jim Hendler and Ora Lassila[16] has been widely accepted by legal scholars and recognized as suitable to generate a simultaneous "*one legal-web vision*", namely a vision where "*everyone on any kind of device will be able to obtain reliable legal information, and where legal information will be enriched with machine-processable data, so that accessing information and performing legal transactions are facilitated by computer support.*"[125].

In the Legal Semantic Web vision by Sartor[125](fig. 4.1) [1], indeed:

- the general standards for identifying univocally resources in the web (URIs naming convention) provide solutions for identifying *legal resources* (especially, but not exclusively, legislative documents);
- XML is specialized into *Legal Markup Languages* to define specific tags for mapping the structure of legal documents along with metadata models which enable the inclusion of further information in the same documents;
- *ontologies* provide the way for enabling computers to represent (statements –RDF– and) the conceptual information contained in the legal texts, namely legal concepts, at the same time allowing reasoning and inferences capabilities;
- specific logic languages, such as those belonging to *defeasible logic*, permits us to handle non-monotonic reasoning which intrinsically features the legal knowledge base, because it includes exceptions, exclusions, legal antinomies, etc.;
- finally we can use the logical information of the previous levels to derive inferences and arguments about specific legal information (*proof*), while the *trust* layer

[1] For a similar picture but more centered on the defeasible logic, on arguments and cases cfr. also [59]; instead cfr. [105] for a representation of legal knowledge modeling layers compliant with the Semantic Web stack.

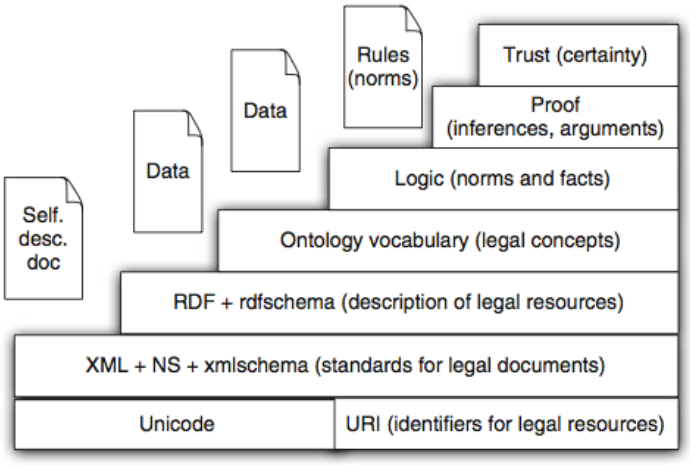


FIGURE 4.1: Levels of the Legal Semantic Web by G. Sartor[125]

guarantees confidentiality (such as that needed for information concerning personal data), authenticity (to ensure, for instance, the provenance of data from the competent authority or from the effective contracting party), integrity (assurance regarding the non-corruption and the non-manipulation of data by third parties) as well as reliability (in large part obtainable through the previous aspects).

Up to now, several XML legal document standards have been proposed for the specification of legislative documents and for their interchange between institutions, enabling at the same time better access to legislation by citizens. Among the others[2], Akoma Ntoso[9, 164] will become arguably the most popular Legal XML standard since, at the precise time I am writing this thesis, it is following the process for becoming an OASIS[3] standard under the name of LegalDocumentML (LegalDocML)[4]; it is widely and officially adopted by several Institutions across the world (the European Parliament for marking up the amendments of the proposals coming from the European Commission, the Senate of Italy for the bills and also the Library of Congress of Chile for the debates, just to name a few); it provides a common legal document standard for legislative documents as well as for other various types of legal documentation (e.g. gazette, parliamentary documentation, judgments, case-laws) and aims to provide a format for long-term storage and preservation of legal resources.

[2]Just to name a few: CEN MetaLex[22], NormeInRete[90], LexDania, CHLexML, eLaw, LegalXML, SDU BWB (for all these see[91]).

[3]OASIS (Organization for the Advancement of Structured Information Standards) is a non-profit consortium that drives the development, convergence and adoption of open standards for the global information society. For further information see: OASIS Open ORG

[4]LegalDocML OASIS Commitee

Moreover, several Web rule interchange languages such as RuleML[23], SWIRL[74] or RIF[77] have been adopted in legal knowledge modeling (legal rules), as well as languages specifically designed for the legal domain according to its requirements[60], such as LKIF-rule[58] or LegalRuleML[7, 106] [5] and some of them have proved their effectiveness in solving relevant legal problems.[6]

Strangely enough, looking at the explosion of the field in the 2000s, the legal ontologies are still seeking their precise and concrete role at the intermediate level of the Semantic Web overall picture. However, to tell you the truth, this is not at all strange. No matter how many legal ontologies have been developed so far, they are still not enough for the needs of our time. Furthermore, legal ontologies for the Semantic Web are still, and from many points of view, an unexplored field of research, since we (as jurists, lawyers, legal practitioners, etc.) are not prepared enough for a so radical change in categorizing legal knowledge, as the Semantic Web is asking us to do, and also in predicting risks and opportunities that such a switch of paradigm implies. Anyway, let us try to recap.

Up to now, legal informatics scholars have focused their attention and efforts in trying to provide a shared and suitable conceptualization of the fundamental legal categories and of specific legal domain knowledge through ontologies (see the rich catalogue of both legal core and domain ontologies developed at the state of the art in Chapter 3). The aim of core legal ontologies is to provide an interoperability framework from which other legal ontologies could inherit general categories, and in that way trying to overcome also comparative and multilingualism issues, among diverse legal systems. Instead, legal domain ontologies are built with a specific application-perspective in mind, usually grounded in closed systems.

The experience gained so far shows that to deal with the complexity of legal knowledge through ontologies requires an intensive design process because legal ontology engineering has its own peculiarities [35], requiring particular conceptual structures for the representation of legal concepts, including notions of legal rules, preconditions, legal consequences, etc.[121]. For this reason, legal ontologies are usually made of a significant amount of axioms and restrictions upon classes, which represent legal concepts. In a certain sense, a legal system can be considered as the whole of all the relations among these concepts.

Moreover, the legal knowledge is based on legal sources (statutory and codified laws in the civil law legal systems and judge-made decisional laws –judicial precedents– in

[5] LegalRuleML is now following the process for becoming an OASIS standard in the same way of LegalDocML. I made a first attempt in combining ontologies and rules formalized through the LegalRuleML language, to represent the public procurement domain here:[43].

[6] Just to name a few, rules interchange languages have been used to represent business contracts[61], to check compliance in business processes[62], in monitoring and executing Service Level Agreements[107], in applying administrative rules to real cases[113], etc.

the common law systems) rather than on a "common sense" state of mind and so, the definitional dependence of legal concepts from the legal texts requires particular care, which, in turn, results in precise methodological choices, design decisions and approaches. In addition, legal knowledge is country and language-specific dependent[85] and therefore the task of representing in an unified paradigm and unique conceptual model the fundamental legal categories has proved particularly difficult.

As a consequence of all those aspects, though some distinctions are mandatory[7], legal ontologies are typically large and highly axiomatized; furthermore, they are not easily comparable, nor to each other, nor to the non-legal ontologies. These aspects make tasks requiring interoperability quite difficult and the usage of legal ontologies more fit to local systems than to large scale systems such as the Web.

Besides these considerations that strictly relate to the legal domain, others equally relevant, concerning the actual trends of the Semantic Web at large, deserve to be taken into account.

As a matter of fact, the Linked Data trend is today the prominent one and its pragmatics is putting even more in question the need of highly axiomatized ontologies, as the legal ontologies are. Furthermore, Semantic Web research appears to be virtually locked at the lower levels of the stack: lack of concrete experiences in the effective and integrated use of reasoning, unifying logics and proof solutions are generating a decrease of confidence in the full realization (at the state of the art) of the original Semantic Web vision. Both the Linked Data trend and the emergence of Second Generation Semantic Web [39] (now Next Generation Semantic Web) applications are emphasizing the significance of intelligence arising from the integration of disperse and heterogeneous data from many sources, rather than from closed knowledge based systems capable of "applying sophisticated logical reasoning to tackle complex real-world tasks"[8]. As a side effect, in these new semantic web systems, logical reasoning, compared to other technologies (e.g. statistics and NLP), has not a primary importance (fig. 4.2[9]) because these systems use

[7] Generalizations are always dangerous and often partly wrong. As highlighted in the Chapter 2, many diverse types of ontologies are usually included in the broad catalogue of the "legal ontologies" and so, it is necessary to specify at which of those types of ontologies I am referring to. The subject of the analysis I am going to explaining in this Chapter are legal ontologies which define legal concepts, namely: the fundamental categories of the legal knowledge which are at the basis of (arguably) any legal system (core legal ontologies), or the particular set of concepts pertaining to a specific domain and described by determined legal sources (domain ontologies). I obviously include the legal ontologies for public procurement in the latter group. There are others 'legal ontologies' which differ substantially from those I have just described. For example, the so called "legal linguistic ontologies" which are large scale lexical resources that cover words of a language with regard to the legal domain, aimed at represent the linguistic relations between legal terms.

[8] The words and the table are an excerpt of the talk "*What does it mean to be semantics? (On the role of semantics in the Semantic Web)*" held by Prof. Enrico Motta at the European Semantic Web Conference, 2013 in Montpellier (FR).

[9] *Ivi*

semantics "*as an analytical tool to identify distinctions and give meaning to regularities in the data to support problem-solving, sense-making or decision-making*".[10]

	Classic KBS	NGSW Systems
Intelligence	A function of applying sophisticated logical reasoning to tackle complex real-world tasks	A side-effect of the ability to reason with large scale data and heterogeneous quality and representation, typically integrating (a bit of) logical reasoning with other technologies –e.g., statistics and NLP

FIGURE 4.2: Major shift in the type of reasoning between Classical Knowledge Based Systems and the Next Generation Semantic Web Systems by E. Motta

It seems to me that these three purposes of NGSW are not at all different from the classical AI&Law systems: legal problem-solving support and legal decision-making assistance (indirectly by making sense of legal concepts) are, coincidentally, just the purposes of prototypical automated legal systems. However, legal systems mainly differ from NGSW because they are not 'open' nor scalable: they impose semantics only on a set of controlled data, known in advance. In addition, they focus primarily on complex reasoning performances rather than on a "knowledge-acquisition-from-outside" perspective. Basically, AI legal systems differ from NGSW systems in their way of thinking at what does it mean to be "an intelligent system". Furthermore, the majority of legal ontologies up to now developed aims to define fundamental legal concepts, which are very useful in a perspective of large scale data integration, but are not exactly what is useful to support problem-solving or decision-making.

Given these considerations, is a change needed in the design of legal ontologies? And why?

Today, the e-Government sector is one of the major drivers in the emergence of Open Linked Data (fig. 4.3) and governments are making accessible a large amount of datasets, about a wide range of topics, such as spending reports, administrative staff organizations, public healthcare, etc.

[10] *Ivi.* My emphasis.

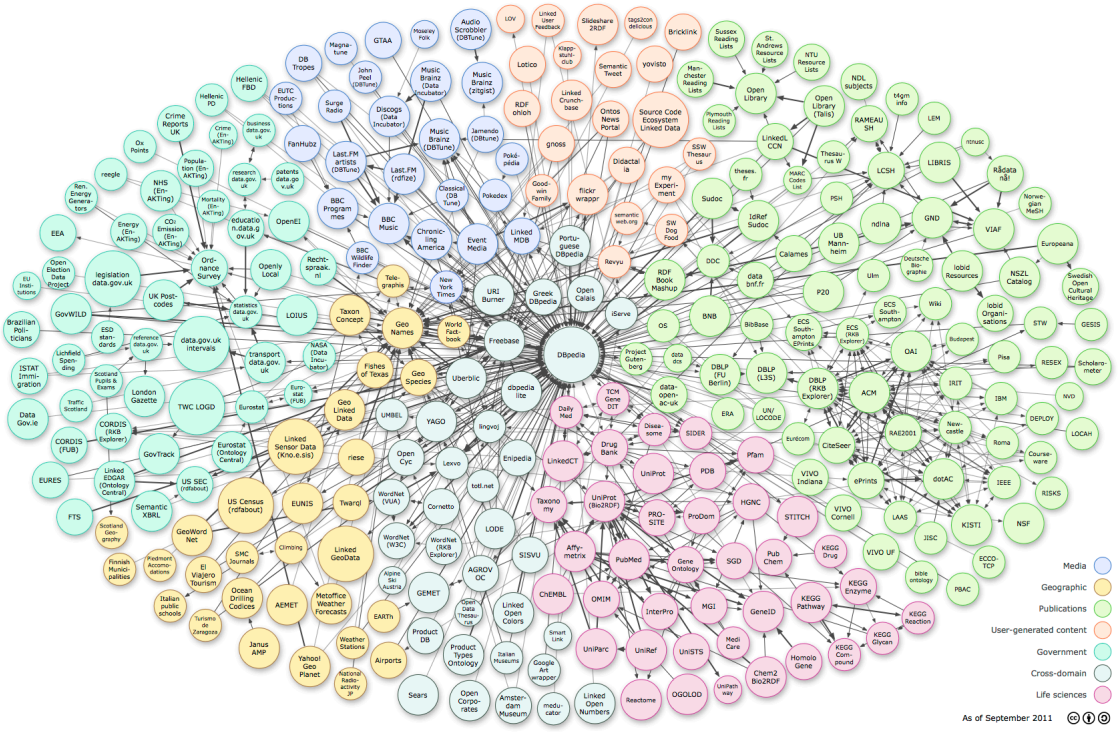


FIGURE 4.3: Instance linkages within the Linking Open Data datasets at 2011 (Source: Wikipedia). The aquamarine color bubbles on the left side indicate the datasets released by governments.

Government Open Data are in many cases related to the legal domain and, as a result, legal ontologies may play a key role uncovering the semantics of these data and driving the integration of this information with other datasets. Without the right interpretation, indeed, data are only raw data, which by themselves may not provide useful information. In the majority of cases, the right interpretation, *the semantics* of Open Government Data (i.e. *what they really mean*) is a matter of legal knowledge.

Thus, disclosing the semantics of these data through legal ontologies, it would be possible to build semantic e-Government applications, which may provide a significant contribution in bridging the gap between citizens and institutions [57]. This is in line with the three challenges for "the development of Law and the Semantic Web" identified by [32], namely: "(i) the relationship between the Social Web (Web 2.0) and the Web of Data (Web 3.0); (ii) *evolving legal ontologies* [...], (iii) *and the construction of Semantic Legal Web Services*[11] (SWLS)". In other words, since law impacts and affects the everyday life of all individuals, representing legal knowledge in the Semantic Web scenario is both a timely need and a challenge.

[11] My emphasis

Nevertheless, as recently emphasized by some scholars, this consideration implies to *re-think* the role and the nature of legal ontologies, "*questioning the need for a highly axiomatised and unified knowledge representation*" and conceiving instead "*a new way of designing legal ontologies and of embedding them into architectures for legal information systems and other web services*"[33], because for such architectures there is a need for flexible and modular ontologies, which can be easily integrated to discover non trivial connections between data.

4.1.1 Finding a place for legal ontologies into the Web of data

While observing the Linked Open Data picture, you may notice that so called 'lightweight' (and relatively simple) ontologies like FOAF[12] seems to rule the scene. And therefore, given their complexity, there seems to be *no room* for legal ontologies in the Linked Data scenario; they seem to be destined to dedicated and closed systems, performing complex tasks, but not integrating themselves into the web of data.

The main difference between ontologies widely used by the Linked Data community (like for example FOAF or GeoNames[13]) and legal ontologies, is that the first type of ontologies is based on propositional logic. Instead, legal ontologies need (at least) first order logic, even though some authors have invoked the use of propositional logic for representing legal texts, such as[2], in order to avoid syntactical ambiguities.[14] There are various reasons why powerful representation languages are needed for legal ontologies.

First of all, legal knowledge cannot be bridled into propositional structures (atomic propositions and propositional connectives): the truth preservation in law does not make sense, because categories of true or false cannot be applied to normative propositions.

Secondly, only a small part of legal knowledge may be expressed through propositional logic, which is not adequate to support legal reasoning[120]. The reason is that the first step of legal reasoning is to identify a legal concept and the utility of ontological legal concept representation is precisely to provide a way to classify individuals.

Thirdly, the conclusions that we reach (namely the classification of individuals, also known as 'instances') in law are typically not preserved. In FOL, we could only reject an earlier conclusion if we reject the truth of the set of premises, as well as its extensions

[12] http://xmlns.com/foaf/spec/

[13] http://www.geonames.org/ontology/ontology$_v$3.1.*rdf*

[14] As is known, First-Order Logic (FOL) is widely used as the basis for knowledge representation and also for theorem proving in Artificial Intelligence. The widespread use of FOL arises from its expressiveness: indeed, FOL allows users to formalize a wide range of expressions concerning any domain, including law. In addition, first-order logic has strong logical properties which guarantee that consistency (which is a syntactic notion) is equivalent to the existence of a satisfying interpretation (which is a semantic notion).

according to every interpretation on which all sentences of the premises are true. This type of reasoning is called *monotonic reasoning*. Instead legal reasoning is intrinsically *non–monotonic* [102] because it draws conclusions *tentatively*, reserving to retract them in the light of further assertions which identify other concepts (other rules) as defeaters of the previous conclusions.

Now, taking everything into account, is there a place for legal ontologies in the Linked Data trend? If yes, how can we switch from a rigid axiomatic representation of legal knowledge to a "ready-to-use" legal knowledge ontological representation? Is Ontology Web Language (OWL) adequate to fit the complexity of legal knowledge? To what extent legal ontologies are compatible to Linked Data paradigm? And to what extent they can be integrated with other (even non-legal) ontologies?

As known, from a logical perspective, Ontology Web Language (OWL)[99] (which is an ontology language specifically fit for the Semantic Web), is basically an expressive Description Logic. Description Logics are subsets of FOL, less expressive than FOL but full decidable. Thus, on one hand, they are not enough expressive for representing the legal knowledge; but on the other hand, their use allows some logical inferences which are useful in the legal domain.

In DL systems, information is stored in a knowledge base, which is a set of axioms. It is divided in (at least) two parts: TBox (terminology) and ABox (assertions). The ABox contains assertions about objects and relates objects (constants in FOL) to concepts (unary predicates in FOL) and roles (binary predicates in FOL). The TBox describes the terminology by relating concepts and roles.[15]

Through the use of appropriate reasoners such as Hermit[132] or Pellet[133] (which are designed to support even the new OWL 2.0)[16] individuals populating the ABox are classified according to the TBox specifications.[17]

[15]Note that the Web Ontology Language (OWL) mostly uses FOL terminology, in spite of being an implementation of a description logic.

[16]http://www.w3.org/TR/owl2-overview/

[17]OWL2.0 is compatible with the Description Logic $\mathcal{SROIQ}$[73], more accurately, it is equivalent to the $\mathcal{SROIQ}(\mathcal{D})$ DL). $\mathcal{SROIQ}$ is an extension of $\mathcal{ALC}$ [8] Description Logic, which can be considered the basic DL of OWL. $\mathcal{ALC}$ enables individual and property assignments in the ABox, as well as

- SubClass relationship ($\sqsubseteq$),
- equivalence assertions among Classes ($\equiv$),
- conjunction ($\sqcap$),
- disjunction ($\sqcup$),
- negation ($\neg$),
- and property restrictions (existential $\exists$ or universal $\forall$) in the TBox.

So, the reasoning capabilities that today can be applied to OWL languages may be very useful because these capabilities may 'simulate' a very basic, but useful, legal reasoning on legal knowledge ontologically represented.

However, OWL does not meet also the other need required in modeling legal knowledge (and therefore legal reasoning), namely its *defeasibility*. As well known, the Semantic Web paradigm differs substantially from the one featuring classical systems such as databases. In the Semantic Web environment, data are incomplete and partial; they can be also *not known in advance*, but not known data are not considered as *false*, they are just *unknown*. Instead, databases work on the assumption that all the facts related to their domain-subject are contained in their models and that everything not contained in their models (i.e. unknown) is assumed to be *false*. The latter paradigm is known as *Closed World Assumption*, which is contrary to the *Open World Assumption* paradigm that features the knowledge bases builded through the Semantic Web ontology language, namely OWL. OWL reasoning follows the assumption that contradictory facts are *not* also each other *inconsistent*. Therefore, OWL language (and therefore the reasoners which work by means of its syntax and semantics) is based just on the opposite paradigm to the way in which legal reasoning applies to legal knowledge.

However, rules interchange languages compatible with the Semantic Web stack, such as RuleML[23] can provide solutions for solving this problem. Moreover, the new LegalRuleML[7, 106] emerging standard, which adds to RuleML the requirements needed to represent legal rules, looks promising. This last language, indeed, allows to meet the requirements of isomorphism[12] (i.e. the one-to-one correspondence between the atomic rule and the fragment of natural language text in which the rule is expressed), the specification of normative effects (such as deontic, qualificatory or potestative, just to name

The Description Logic $\mathcal{SROIQ}$ extends the $\mathcal{ALC}$ logic with many useful features, such as roles (properties) hierarchies, nominals (closed classes), qualified cardinality restrictions and also others. All of these new features are very relevant for legal knowledge representation, but the most relevant one, on my opinion is the role chains feature – Role Inclusion Axiom – (resulting in $\mathcal{SR}$), also known as "property chains". Property chains are very important for legal knowledge modeling, since they can be used to express *rules* and so also (very basic but useful)*legal rules*. Property chains basically enable the representation of this sort of FOL axioms:

- (a) $\forall$x,y,z.R(x,y)$\wedge$S(y,z)$\rightarrow$T(x,z).

So, for example, the following FOL axiom, which express the fact that through a contract notice is announced a tender and that, since a tender is made for the award of a (proposed) public contract, then through a contract notice is announced a tender for the award of a public contract, is compatible with $\mathcal{SROIQ}$ and then with OWL2.0:

- (b) ContractNotice(x)$\wedge$Tender(y)$\wedge$ProposedContract(z)$\wedge$throughWhichIsAnnounced(x,y) $\wedge$forAward(y,z)$\rightarrow$throughWhichIsAnnouncedTenderForAwardOf(x,z).

In the work I am going to present in this Chapter, namely the ontology for the Semantic Web LOTED2, I make large use of this feature of OWL2.0 (see the formal description of LOTED2 ontology in Appendix **??** for others DL axioms examples of property chains) and I am convinced that it represents a (little but) significant improvement of the expressivity of OWL, which can be of great utility in legal ontologies modeling from now on.

a few) and the reification of legal rules (rules are like objects with relevant properties, such as jurisdiction, authority and temporal constraints).

So, going back to the questions, the typical features of legal ontologies (high axiomatization and emphasis on legal rules to produce consequences–inferences) not necessarily are incompatible with the Linked Data requirements.

On the one hand, the representation of legal concepts and relations among them is useful to verify and fix the correctness of Linked Data statement on legal content, through the use of the reasoners. On the other hand, the new triples generated, i.e. inferred or materialized, can be written back into the RDF model, adding a new level of granularity in the data. This type of information is just what is useful to drive the integration of ontologies with other related ontologies and datasets and to produce an "added legal value" for the Linked Data scenario.

Finally, an emerging rule standard will be soon available and it will provide a contribution towards *taming* the complexity of legal knowledge representation. Hence, within certain limits, we can integrate also legal data into the web of data.

However, we will able to switch from a rigid axiomatic approach, to a ready-to-use legal knowledge ontological representation only if we will be able to find "a compromise" in balancing a rigorous (and *unified legal*) representation of legal content with the concrete needs required by the dynamic and open scenario of the Semantic Web. In other words, this major change implies that not necessarily we must aim at defining legal data by inheriting their complete ontological representation (and then their semantics) from fundamental legal concepts, such as those constituting core legal ontologies. Maybe, in that way, we will lose a few pieces of legal knowledge in our ontological representation, but we will be able to serve the purpose of making more accessible the legal knowledge.

4.2 Introducing the LOTED2 ontology

4.2.1 Procurement Data as Open Government Data

Data on public contracts notices are *Open Government Data*[18] by their nature.

[18] According to the so called *8 Principles of Open Government Data*, Government data shall be considered open if the data are made public in a way that complies with the principles below:

1. Data Must Be Complete All public data are made available. Data are electronically stored information or recordings, including but not limited to documents, databases, transcripts, and audio/visual recordings. Public data are data that are not subject to valid privacy, security or privilege limitations, as governed by other statutes.

2. Data Must Be Primary Data are published as collected at the source, with the finest possible level of granularity, not in aggregate or modified forms.

By law, they must be accessible, because the whole public procurement process should be based on transparency and the advertising of contract notices is an essential step of the public procurement transparent procedure. Indeed, public administrations must aim to get 'value for money' (public money, taxpayers' money) by choosing, through transparent procedures, the best offer among the largest possible number of candidates. Therefore, any contract notice is issued with the intention to reach the largest number of potential candidates, because more economic operators take part in the tender, more competition increases. And we all know that when competition increases, there are more likely to get better products and services.

Today, public institutions at all various level (regional, national or supranational) publish their procurement notices first and foremost on the web. In the vast majority of cases, the advertisement on the institutional web-sites is an essential, required by law, condition for the conduct of tenders. In the European Union, tender notices for the award of public contracts 'above the EU threshold'[19] are published on the TED (*Tenders Electronic*

3. Data Must Be Timely Data are made available as quickly as necessary to preserve the value of the data.

4. Data Must Be Accessible Data are available to the widest range of users for the widest range of purposes.

5. Data Must Be Machine processable Data are reasonably structured to allow automated processing of it.

6. Access Must Be Non-Discriminatory Data are available to anyone, with no requirement of registration.

7. Data Formats Must Be Non-Proprietary Data are available in a format over which no entity has exclusive control.

8. Data Must Be License-free Data are not subject to any copyright, patent, trademark or trade secret regulation. Reasonable privacy, security and privilege restrictions may be allowed as governed by other statutes.

Finally, compliance must be reviewable. A contact person must be designated to respond to people trying to use the data. A contact person must be designated to respond to complaints about violations of the principles. An administrative or judicial court must have the jurisdiction to review whether the agency has applied these principles appropriately. For any further information cfr. OpenGovData.org.

[19]The European thresholds differ on the basis of the object of the contract (work, service or supply of product) and on the basis of the type of entity which awards the contract. European law, indeed, distinguishes between entities operating in ordinaries sectors (e.g. general public services, education, environment, health, etc.) and entities operating in utilities sectors (water, gas, energy, transport services, etc.). I will discuss in more detail this important distinction in the rest of the thesis. My intention, here, is to provide an overview on the main features of public contracts of European relevance, according to the European Directive 2004/18/EC (concerning public contracts awarded by entities operating in ordinaries sectors, namely *contracting authorities*, and the European Directive 2004/17/EC, concerning public contracts awarded by entities operating in utilities sectors, namely *contracting entities*).

Public contracts with European relevance are public contracts "which have a value exclusive of value-added tax (VAT) estimated to be equal to or greater than the following thresholds:

(a) EUR 162000 for public supply and service contracts others than those covered by point (b), third indent, awarded by contracting authorities which are listed as central government authorities which are listed as central government authorities in Annex IV [...];

(b) EUR 249000 - for public supply and service contracts awarded by contracting authorities other than those listed in Annex IV, - for public supply contracts awarded by contracting authorities which are listed in Annex IV and operate in the field of defence, where these contracts involve products not covered by Annex V, - for public service contracts awarded by any contracting authority in respect of the services listed in Category 8 of Annex IIA, Category 5 telecommunications services the positions of which in the CPV are equivalent to CPC reference Nos 7524, 7525 and 7526 and/or the services listed in Annex II B;

Daily) website [20].

The TED system is the online version of the "Supplement to the Official Journal of the European Union" dedicated to European public procurement. It is updated five times a week with approximately 1500 public procurement notices from the European Union, the European Economic Area (EEA) and beyond, providing free access to business opportunities for economic operators interested in participating to European tenders. Moreover, information about every procurement document is published in the 23 official EU languages, in that way guaranteeing the respect of the non-discrimination principle on the basis of nationality, which is one of the pillars of the procurement domain, according to the European Treaties vision.

The TED system is certainly the main source of information concerning European procurement notices for every business entity across the European Union. At the same time it is also one of the most impressive source of *governments open data* since it is continuously updated with procurement notices issued by several public institutions, authorities, public bodies, etc. from all the European and the EEA countries; it is maintained by an European Institution (the European Commission) which must guarantee the reliability of information, ensuring also the availability of 'data' 24/24h; indirectly the procurement notices provide also many information concerning the public institutions, authorities, etc. that have issued the contract notice and even more (e.g. where contracting authorities are located, in which sector they carry out their main activity, how many EU public contracts they award in a year, how much money a regional authority, a council, or even a country, spend on education, health, environment, etc.).

4.2.2 Why an ontology of European public procurement notices?

Procurement notices are published according to standard forms (Fig. 4.4(a)) defined by the European Commission. [21] On the TED system it is available a full version of each

(c) EUR 6242000 for public works contracts." (Art. 7 Directive 2004/18/EC).

Public contracts with European relevance are also those awarded by contracting entities "which have a value excluding value-added tax (VAT) estimated to be no less than the following thresholds:

(a) EUR 499000 in the case of supply and service contracts;

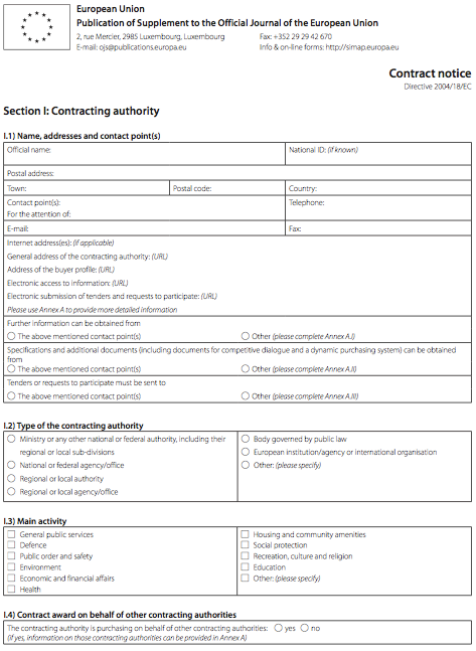
(b) EUR 6242000 in the case of works contracts" (Art. 16 Directive 2004/17/EC).

Please note that thresholds are revised every two years. So, the above quoted text has been amended by the Commission Regulation (EU) No 1251/2011 of 30 November 2011. Therefore, for the current values of the thresholds, see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:319:0043:01:EN:HTML.

Clearly, public contracts under the EU threshold are all those public contracts which do not meet these standards. This type of public contracts is basically not covered by the EU Directives (with some limited exceptions). So, they are covered only by the national laws of each Member state. Since public contract under the EU threshold are not covered by the European Directives, their advertising at European level is not required.

[20] http://ted.europa.eu/

[21] These forms are available at http://simap.europa.eu/buyer/forms-standard/index_en.htm



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Contract notice
Directive 2004/18/EC

Section I: Contracting authority

I.1) Name, addresses and contact point(s)

Official name:		National ID: *(if known)*
Postal address:		
Town:	Postal code:	Country:
Contact point(s): For the attention of:		Telephone:
E-mail:		Fax:

Internet address(es): *(if applicable)*
General address of the contracting authority: *(URL)*
Address of the buyer profile: *(URL)*
Electronic access to information: *(URL)*
Electronic submission of tenders and requests to participate: *(URL)*
Please use Annex A to provide more detailed information

Further information can be obtained from
○ The above mentioned contact point(s) ○ Other *(please complete Annex A.I)*

Specifications and additional documents (including documents for competitive dialogue and a dynamic purchasing system) can be obtained from
○ The above mentioned contact point(s) ○ Other *(please complete Annex A.II)*

Tenders or requests to participate must be sent to
○ The above mentioned contact point(s) ○ Other *(please complete Annex A.III)*

I.2) Type of the contracting authority

○ Ministry or any other national or federal authority, including their regional or local sub-divisions	○ Body governed by public law
○ National or federal agency/office	○ European institution/agency or international organisation
○ Regional or local authority	○ Other *(please specify)*
○ Regional or local agency/office	

I.3) Main activity

☐ General public services	☐ Housing and community amenities
☐ Defence	☐ Social protection
☐ Public order and safety	☐ Recreation, culture and religion
☐ Environment	☐ Education
☐ Economic and financial affairs	☐ Other *(please specify)*
☐ Health	

I.4) Contract award on behalf of other contracting authorities

The contracting authority is purchasing on behalf of other contracting authorities: ○ yes ○ no
(If yes, information on those contracting authorities can be provided in Annex A)

(a) An example of a standard form for a contract notice

TI	Title	UK-Milton Keynes: cleaning services
ND	Document number	382532-2011
PD	Publication date	08/12/2011
OJ	OJ S	236
TW	Place	MILTON KEYNES
AU	Authority name	The Open University
OL	Original language	EN
HD	Heading	Member states - Service contract - Contract notice - Restricted procedure
CY	Country	UK
AA	Type of authority	6 - Body governed by public law
DS	Document sent	05/12/2011
DD	Deadline for the request of documents	16/01/2012
DT	Deadline	16/01/2012
NC	Contract	4 - Service contract
PR	Procedure	2 - Restricted procedure
TD	Document	3 - Contract notice
RP	Regulation	5 - European Union, with participation of GPA countries
TY	Type of bid	1 - Global tender
AC	Award criteria	2 - The most economic tender
PC	CPV code	90910000 - Cleaning services 90911000 - Accommodation, building and window cleaning services 90919200 - Office cleaning services
OC	Original CPV code	90910000 - Cleaning services 90911000 - Accommodation, building and window cleaning services 90919200 - Office cleaning services
RC	NUTS code	UKJ12
IA	Internet address (URL)	www.open.ac.uk
DI	Directive	Classical Directive (2004/18/EC)

(b) An example of data summary for a contract notice

FIGURE 4.4: Summary of the figures: 4.4(a) An example of a standard form for a contract notice and 4.4(b) an example of data summary for a contract notice

tender document in the original language and a compact view in the language selected by the user. From the notices available in these formats, semi-structured data can be extracted in the form of a tabular summary, as shown in Fig. 4.4(b).

The HTML versions of both the full contract notices, published according to the standard forms, and their related data summaries can be accessed in two ways, from the main page, or through a faceted search system (see Fig. 4.5).

From the main page, procurement notices can be accessed:

- by searching all the types of current procurement notices (business opportunities);
- by searching the procurement notices related to a particular business sector;
- by searching the place of delivery or, more generally, of the execution of the next contracts to be awarded (i.e. where works have to be carried out; where services have to be executed, where products must be delivered).

The faceted search system, instead, supports:

- answers to natural language queries by returning a set of documents intended to match the search terms;

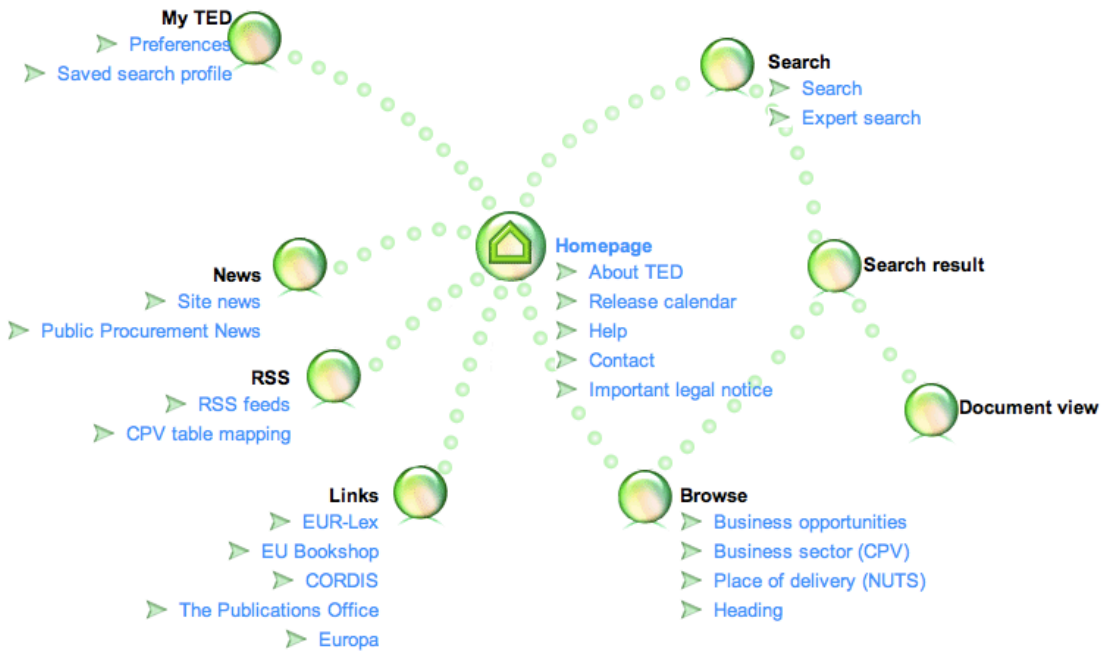


FIGURE 4.5: Site map of Tenders Electronic Daily (Source: TED site map)

- a search through a set of facets, which give to the user directions for query refinement (e.g. by specifying the type of procurement or tender document; the type of contract to be awarded –service contract, works contract or supply contract– ; the type of procedure regulating the conduct of the tender – open, restricted, negotiated, etc.–; the awarding authority name and so on).

Finally, another window can be opened for advanced searches through CCL queries[22], allowing the selection of the scope of the documents to be searched for, such as last edition, last 5 editions, all current notices and archives, providing also a statistics mode search.

Hence, there are various ways to access at the procurement notices. However, on my opinion, the TED website, by many points of view, misses its main purpose: ensure its users have a positive experience when performing searches on opportunities to tendering, particularly considering users who are not experts in the public procurement domain, which are after all the majority.

I will try to motivate these claims by means of a real case, as example. Giovanni is a young electronic engineer; he lives in Caserta, in the Campania region of Italy.[23] He

[22]Basically, Continuous Computation Language (CCL) is a language based on the Structured Query Language (SQL) Standard, but is not identical to SQL. Whereas SQL is designed to query data from static tables, CCL is adapted to the needs of processing and analyzing dynamic data.

[23]According to Wikipedia, the city is best known for the Palace of Caserta.

has a very brilliant curriculum vitae, nevertheless, because of the economic crisis, he has not been able to find a job during the last year. So, some months ago, he has decided, with a couple of friends, to open a small factory producing sort of e-books readers, equipped with the latest technology and the innovative features of tablet computers, suitably designed by him. Even though the product is really interesting, Giovanni and his friends have a lot of difficulties in advertising and in selling their e-book reader/tablet computers. Anyone of us can imagine how may be difficult the competition with the majors of the e-readers/tablet computers' market, such as Amazon, Apple, Samsung, etc. for a small factory, as that of Giovanni. Indeed, people usually looks at the brand, more than at the functionalities of the product. However, Giovanni knows that public administrations should be not swayed by the brand in their purchases, because they must aim to get "value for money", taking into account only the functionalities of a product plus its affordability. So, he decides to try at selling his product into the public sector. After getting some information, he tries to use the TED website to search procurement opportunities to sell his new product.

First, Giovanni tries with a natural language query by typing the words "`e-book reader`", but apparently there are no records matching his query. So, Giovanni tries to search by clicking on the "`business opportunities`" box. In addition to the record "`contract notice`", he finds some strange voices, such as "`periodic indicative notice`" or "`prior information notice`" (he is wondering "*what are they?*"). By clicking on the "`contract notice`" box, the TED website returns a list of records, but Giovanni discovers that this list shows *all* the current contract notices and it seems that no awarding authority is searching for e-book readers or tablet computers. He thinks that this type of search is not the right one for his purposes and then, he tries to search the procurement opportunities which are relevant for his business sector. He notes that there is a strange code near the string "`business sector`"... `CPV` (he is wondering "*what is this?*").

Giovanni finds the string "`Computer and Related Services`" that seems to be the right one. He discovers that business sectors are organized in a hierarchical structure, which looks like a taxonomy, but this is not really helpful. Indeed, he finds the "`tablet computer`" string, but only after clicking its four super-categories, namely "`Office and computing machinery, equipment and supplies except furniture and software packages`", "`Computer equipment and supplies`", "`Data-processing machines (hardware)`" and "`Personal computers`".

In any case, now Giovanni has found the category that seems to match his business sector. It probably does not include also the e-book readers category, but it is a significant step forward in his search. At this point, the TED system shows three records to Giovanni. Unfortunately the first three are not contract notices, but other kinds of documents

entitled "*Contract award notice*", while the third is a "*Prior Information Notice*" (again he is wondering "*what is this?*").

Giovanni tries also searching for the place of delivery, but when he opens the windows it appears a warning message: "If the awarding authority has not specified a NUTS code indicating the place of delivery of the contract, the notice is listed either under the entry of its country if the notice comes from a country belonging to the European Union, or under Other countries else".

The sense of frustration that is overcoming Giovanni does not disappear when he tries also through the faceted search system. He can easily combine the search criteria, but he does not know exactly how to combine them all together, and even if he knows how to formulate CCL queries, he is not an expert of the public procurement domain. So he does not know how to search.

At the end, after twenty minutes of search, Giovanni is definitely discouraged. He thinks that is too difficult understand how the public procurement market works. So, he forsakes the idea of selling his innovative product (which is also very cheap) to public administrations.

I think that this happens very frequently: every day a lot of citizens and many small and medium enterprises feel discouraged in their relationships with public administrations, not only when they try to enter in the procurement market.

In his interesting work on *Enterprise Ontology*[42], Dietz highlights precisely the kind of frustration I am referring to. He writes:

> "have you ever phoned the help desk of a company or a government agency in order to get the service they claim you will get in their advertisements? Mostly you end up not by having what you were looking for, but by being frustrated, maybe to the extent that you think of giving up. Why? Because the *operation of these institutions is completely opaque to you.* You do not know what to believe and what not to believe [...].
>
> And, in case you have succeeded in penetrating to the right place, there is a chance that the responsible person does not take on his or her responsibility and concludes your case by blaming the computer or any other thing that he or she uses as an aid. Most probably, he or she acts in this way not to hamper or frustrate you, but because *the institution is also opaque to him or her.*" [24] (*ivi*, p. 11).

[24] My emphasis.

Now, [Dietz continues]

> "*imagine that it is possible for you to acquire the right amount of the right kind of knowledge of the government agency* from which you are trying to get a license but have not succeeded yet."[25] (*ivi*, p. 12).

The goal is, then,

> "to offer *a new understanding* of [...] *public administrations such that one is able to look through the distracting and confusing appearance* [of them] *right into their deep kernel*. Its like *an X-ray machine* can let you look through the skin and the tissues of the body right into the skeleton. As a user of systems, *this understanding lets you become master again of your activities*. As a designer, it lets you design systems in such a way that the resulting design, in particular, the user dialogue and interface, reflects *the essence of the system*." [26] (*ibid.*).

And now, going back to the procurement system, imagine that is possible to design an ontology which (like an X-ray machine) enables Francesco to acquire the right amount of the right kind of knowledge he needs, namely which awarding authority is seeking for the product he sells. Imagine that Francesco will be able to look through the distracting, confusing and also complex appearance of the public procurement system right into its deep kernel.

In other words, imagine an ontology at the heart of an application that would allow the matching between demand and offer in the public sector market.

Certainly, that ontology would be a legal ontology, but the legal concepts described through it should serve the ultimate goal of enabling the understanding and the access into the 'kernel' of the world of procurement by its ultimate users, namely economic operators interested in participating to tenders. Furthermore, the ontology would be connected to other semantic resources in order to provide a nice interface and an *useful* search experience to its users, for example, showing the place of the delivery of a contract on a map, or providing additional information about the awarding authority, e.g. by looking up at its institutional website.

At the same time, the ontology may (or should) allow the linkage of the procurement 'dataset' with other relevant datasets, in order to discover new perspectives in investigating the public sector activities, trends and policies.

[25] My emphasis.
[26] My emphasis.

Consistently with these needs, in the rest of this Chapter I will describe a new ontology for the Semantic Web, called LOTED2[27].

LOTED2 is a legal ontology supporting the modeling of European procurement notices and the description of the data extracted from the TED system with the ultimate purpose to enable the match between demand and supply in the public procurement context. The name derives from LOTED[28] 'Linked Open Tenders Electronic Daily'[155], a project that pioneered the use of Linked Data to enrich the data about public procurement notices contained in RSS feeds of the TED system (Tenders Electronic Daily)[29]. The new ontology is called LOTED2 because it can be considered as an evolution of the LOTED1 ontology developed under the eponymous project.

Compared to the original LOTED ontology, LOTED2 aims to describe in a more expressive way the domain of procurement and, since LOTED2 is a legal ontology, it aims to provide also a representation of legal concepts related to the public procurement domain. Such an expressive modeling of the domain allows the discovering of connections with other domains, e.g., business domain, and the integration with other relevant ontologies, specifically GoodRelations[69]. As a consequence, the LOTED2 work investigates a novel path in designing legal ontologies, trying to combine the representation of legal concepts with the usability required for the description of the data, while also taking into account the issues arising from the integration of legal ontologies with other vocabularies and ontologies in the Semantic Web world at large.

The rest of this Chapter is structured as follows: in Section 4.3 I outline related work on reusing linked open data associated with the European public procurement notices and on other existing ontologies on public contracts; then, in Section 4.4, I present the LOTED2 ontology, discussing its design, its modules and the inferences it supports. Furthermore, in Section 4.6 and in Section 4.5, I describe the integration of LOTED2-core with the most widely used ontology for describing e-commerce scenarios, namely GoodRelations ontology[69]. The resulting ontology is called LOTED2-extended. Finally, in Section 4.7 I evaluate the main results from the work on LOTED2 ontologies, while outlining, at the same time, some future directions of the work.

[27] LOTED2 ontology has been described also in the paper authored with M. d'Aquin and E. Motta, *LOTED2: An Ontology of European Public Procurement Notices*, to be appear in a Special Issue of the Semantic Web Journal entitled *"The Semantic Web for the Legal Domain"*. The LOTED2 ontology has been developed during my four months stage, supported by the "Marco Polo" grant of the University of Bologna, as visiting research student under the supervision of Prof. Enrico Motta and Dr. Mathieu d'Aquin, at the Knowledge Media Institute (KMi), The Open University, UK. I would like to thank Enrico Motta and Mathieu d'Aquin for their valuable inputs during the development of the ontology. Furthermore, I would like to thank my Supervisor, Prof. Monica Palmirani, and also Gioele Barabucci and Silvio Peroni for their comments on earlier version of this work.

[28] http://loted.eu

[29] http://ted.europe.eu

4.3 Related work

4.3.1 LOTED project and LOTED(I) ontology

The LOTED ontology[30] was developed inside the eponymous project, in order to introduce an additional level of structure on top of the data extracted from the RSS feeds of the TED system. It has been conceived for the need of the platform and structured to enrich procurement notices data with automatically discovered links to GeoNames[31] and DBpedia[32]. So, it is a lightweight ontology, realized to match the semi-structured representation (namely the tabular summary of data) of tender notices as published by the TED website. The LOTED ontology satisfies the requirement of usability and is very suited to the purpose for which it has been designed, but it does not actually represent knowledge about the domain, as it merely defines the structure of data objects in the domain. A more expressive representation of the domain of procurement was planned as part of future work on the LOTED project, and in fact, now, it has been done.

Nevertheless, the very interesting part of the LOTED work was the way in which linked data were exploited, obtaining (and visualizing) useful statistic information and, at the same time, exploring new viewpoints in the analysis of the procurement data. First, LOTED's authors define an interesting notion of *tender profile*. They argue that a tender profile "corresponds to the proportion of each sector in terms of the number of tenders being published in a particular place or by a particular group of organizations" [33]. In that way, they were able to discover, for example, that the "financial and related services" sector was the one with of the greatest discrepancies between countries. In particular, Belgium was the country with the larger proportion in this area, while countries such as Malta and Slovakia were almost absent from such a market. Then, they applied the same approach in analyzing tender profiles of the twenty Italian Regions, discovering that Calabria was the most active Italian region in the "Construction and Real Estate" Sector, while Emilia Romagna was the most active region in both "Education" and "Research and Development".[34]

[30] http://loted.eu/ontology
[31] http://www.geonames.org/ontology/documentation.html
[32] http://dbpedia.org/About
[33] *Ivi*, p. 7
[34] I find particularly interesting these results. In fact, one may wondering why Calabria region was the most active in the construction sector. A possible answer can be that Calabria is an Italian region which historically suffers a lack of infrastructures (see the 'Salerno-Reggio Calabria highway long story' for example), so it is obvious that public bodies try to fill this gap by tendering public works. However, it is also necessary to emphasize that, unfortunately, public works contracts are the type of public contracts which is more affected by corruption phenomenas and by criminal organization's interference. Hence, as a research matter, it may be useful to compare data on public works contracts with statistical data pro-regions about convictions by final judgments for corruption, fraud damaging the State, bid rigging, money laundering and so on.

However, the most interesting result of LOTED work was, on my opinion, the enrichment of the initial dataset with additional information obtained from DBpedia about the political affiliations of cities (under the property `party`), in that way showing the chart of the tender profile in a given country (namely France, see fig. 4.6) by relating with its political parties.

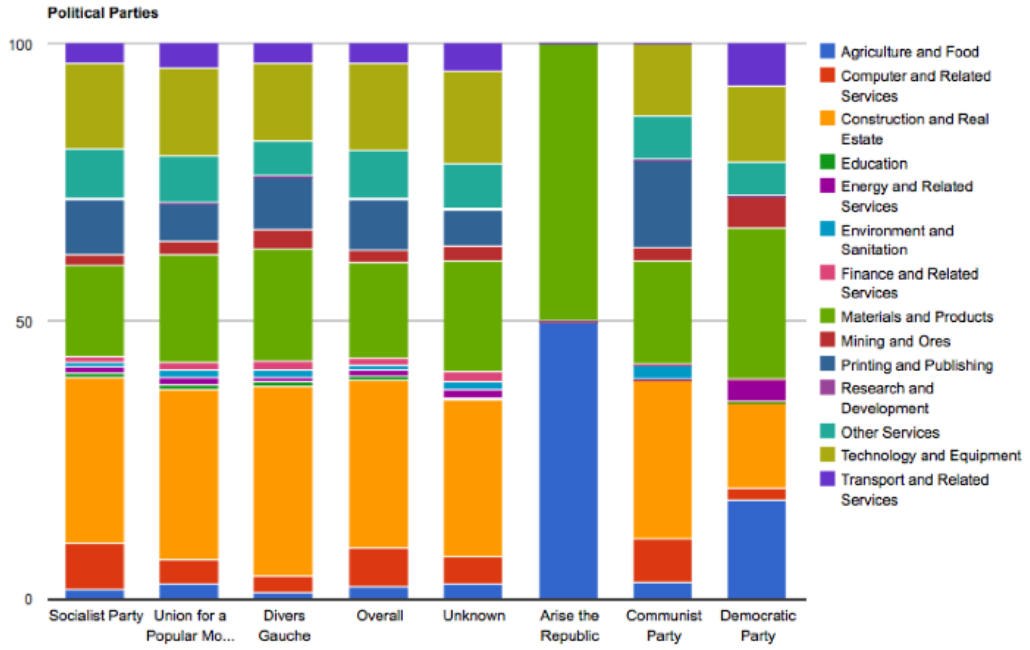


FIGURE 4.6: Chart representing the tender profiles of political parties in France in LOTED

4.3.2 The Public Contracts Ontology (PCO) developed under the LOD2 project

LOD2[35] is a large-scale Integrated Project co-funded by the European Commission within the FP7 Information and Communication Technologies Work Program, with the overall aim to creating knowledge out of interlinked data and to develop tools and methodologies for exposing and managing very large amounts of structured information on the Data Web and to test and bootstrap a network of high-quality domains, also based on multi-lingual ontologies, from sources such as Wikipedia and OpenStreetMap.

A work package of this project, the WP9A ("*LOD2 for a Distributed Marketplace for Public Sector Contracts*") is dedicated to exploring and demonstrating how the application of linked data principles for procuring contracts in the public sector may help to bridge the gap between advanced countries and countries with low online participation

[35] http://lod2.eu

of enterprises in public tenders. So, the main purpose of this work package is to build a linked data infrastructure in order to produce a "business impact and achieve an effective resource allocation through emulating the market process of meeting supply and demand"[36].

At the heart of this infrastructure there is the Public Contracts Ontology (PCO)[37]. The authors state they are not interested in modeling every aspect related to a contract, but only "information which is available in existing systems on the Web" and "which will be usable for matching public contracts with potential suppliers"[75]. In other words, the goal of this ontology is to model a public contract as a whole, but without going into details of the domain. PCO is more articulated than LOTED ontology: it is not built to model the data structures of a particular system (such as the TED), but rather tries to represent a variety of aspects of the domain, taking into account the integration with other ontologies (GoodRelations, Call for Anything, VCard, Payments Ontology and also LOTED). It therefore provides a broader vision of the domain compared to LOTED: some relevant aspects of the domain, such as lots, are represented in this ontology. Furthermore, it has been built with the specific purpose of integrating as much as possible all the ontologies relevant for the domain, following a pure Linked Data approach.

Nevertheless, the Public Contracts Ontology shows some weaknesses that cannot be ignored, even while keeping in mind that it is not a legal ontology. It seems to me that the aim of linking together all the ontologies listed above takes the upper hand on the aim to represent in a correct way the domain.

For example, the ontology describes both the tendering phase and the phase of the execution of the contract.[38] However, there is not a clear conceptual distinction between these different scenarios in the Public Contracts Ontology. Indeed, in the ontology the different concepts of call (call for tenders, such as contract notice) and contract (public contract) are often confused, if not totally merged. First of all, the class `pc:Contract` is modeled as SubClass of `c4n:Call`, namely of the class 'Call' of the Call for Anything[39] RDF vocabulary, developed by the DERIs Linked Data Research Centre for expressing demand, such as calls for tenders or calls for papers. In some sense, a contract notice can be considered as a 'call', a call through which it is announced a competitive bidding for the award of a public procurement contract, but I wonder how it is possible that a contract can be considered as a call... I totally disagree. In other words, a contract

[36] http://lod2.eu/WorkPackage/wp9a.html
[37] http://purl.org/procurement/public-contracts#
[38] Please note that this is my impression looking at the ontology. Instead PCO authors state in the cited Deliverable that "Public Contracts Ontology provides a guidance on modeling the domain *covering the pre-realization stage* of public procurement."
[39] http://vocab.deri.ie/c4n

notice is a call-for-tenders, which may be submitted for the award of a public procurement contract. The (public) contract, instead, is 'the stakes' of the competitive bidding announced through a notice (i.e. a call), not the call itself!

Secondly, the Contract so modeled in the Public Contracts Ontology has both an estimated and actual price, at the same time. When the notice is published the price is only an estimated one. The final price will be set only at the end of the competitive bidding, on the basis of the award criterion (for an example the lowest price) and of the tender bids submitted. So, it would be appropriate to keep strictly separate the different phases of contract notice publication from the tendering phase, from the award phase of the contract and then from its execution, preferably by representing also the different time intervals in which each single phase takes place.

Conceptual confusion increases by defining the Class `pc:Contract` as equivalent to the Class `loted:Tender`.[40] Why the Contract should be equivalent to the Tender? I definitely can not agree on this point. The declared aim of the ontology is to match awarding authorities' demand and traders' offering; in my vision, this aim cannot be achieved simply declaring that a (proposed) contract - demand - is equivalent to the tender bid - offering. It is not correct, from a conceptual point of view, as well as potentially harmful.

In the Public Contracts Ontology, there is not a specific definition of the class of awarding entities; they are just identified as business entities. From the point of view of the market, this is true and also useful in order to achieve integration with the GoodRelations ontology. However, forgetting the ontological definition of this important aspect of the domain entails also forgetting that the procurement domain concerns the PA2B (Public Authorities to Business Entities) scenario and not the B2B (Business to Business) one. Summarizing, this ontology seems to tackle complex subjects through a too simplistic approach. Observing this ontology, I realized that legal knowledge is often simplified to such an extent as to be distorted.

4.3.3 The 10ders Information Services Project

'10ders Information Services'[41] is a Project co-financed by the Spanish Ministry of Industry, Commerce and Tourism and by the European Regional Development Found. It is led by Gateway Strategic Consultancy Services[42] and is developed in collaboration

[40] Within the Public Contract Ontology this term denotes the tender bid submitted by the economic operator, that in the same ontology is called "Supplier".

[41] http://rd.10ders.net

[42] http://gateway-scs.es/en

with ExisTI[43] (both commercial companies) and the Web Semantica Oviedo (WESO) Research Group[44].

The aim of this project is to exploit information about public procurement notices using Semantic Web technologies and Linked Open Data approach, in order to build many services, especially targeted to Small and Medium Enterprises (SMEs). The set of services produced by the research group is currently available on a proprietary platform, Euroalert.net[45][92], a brand owned by Gateway SCS.

Basically, the commercial services offered to small and medium enterprises span from tenders alerting systems on the basis of the subscriber profile model, to the offer of reports on the major public buyers for their products and services. It also provides a customized data mining analysis of public procurement tailored to the interest of each client. Aside from the commendable purpose to provide an unique access point ('a pan-European platform') both for EU relevant tender notices published on TED, and for notices below EU threshold published on a wide range of buyer profiles of national, regional and local levels, it should be considered that there are many services providing mail alerts about tenders, on the basis of the subscribed profile, and other mechanisms of this kind. However, the novel approach of this project is that the platform system is built using structured open data instead of screen-scraping's techniques.

From the same research academic group (WESO) comes also the MOLDEAS ('Methods on Linked Data for E-procurement Applying Semantics') work [3]. This project can be considered as a broader framework, which includes also the experience gained in developing Euroalert.net. Indeed, MOLDEAS aims to apply the semantic web and Linked Open Data approaches to public procurement notices, defining a set of goals.

The first goal is to transform government controlled vocabularies such as CPV[46], CPC[47] and Eurovoc[48] (now available in SKOS[49]) into RDF, SKOS or OWL.

The second one is to enrich and model information inside public procurement notices with these controlled vocabularies but also with geographical information available in the Linked Data cloud. Then, procurements information is published in a SPARQL endpoint providing a node for the linked data cloud and enhanced services (search and sort, matchmaking, geo-reasoning, statistics, etc.) on data.

[43] http://www.exis-ti.com
[44] http://www.weso.es
[45] http://euroalert.net
[46] http://simap.europa.eu/codes-and-nomenclatures/codescpv/codescpv_en.htm
[47] http://simap.europa.eu/codes-and-nomenclatures/cpc/index_en.htm
[48] http://eurovoc.europa.eu/
[49] http://www.w3.org/2004/02/skos

The main advantages claimed by authors of Euro-alert and MOLDEAS are essentially the decreasing of information's dispersion (arising from the different sources where contract notice above and under EU threshold are published); the unification of data models and formats and the support to multilingual issues (through EUROVOC resources used for the enrichment of public procurement notices). An ontology about public contracts is still in development, as part of WESO group's future work.

4.4 LOTED2-core: design decisions

In the previous part of this Chapter, I have asserted that both LOTED and PCO are *not* legal ontologies. I support my assertion with the observation of their features. Both LOTED and PCO do not represent legal knowledge of *the procurement domain*, or part of it (e.g. the procurement notices), as such. Rather, the two ontologies' authors provide us conceptual models on the public procurement matter, *by relying mostly on their intuitions* on what legal terms, within the domain, mean. In regards to LOTED, this approach does not lead to conceptual misunderstandings or inaccuracies in the representation of the domain knowledge. Being its design very minimal, the LOTED ontology manages knowledge about the domain, without producing blatant errors, or mismatches between the ontological representation of the domain and the content of norms which define it.

Contrarily, on my opinion, the Public Contract Ontology (PCO) contains a skewed description of many key aspects of the domain. Why does this happen?

For many reasons. Last but not least, this happens because of the widespread Linked Data's practice "of forcing" (more or less implicit) equivalence assertions among classes or properties belonging to different ontologies, which carry radical different meanings. The resulting mappings between data, along with their ontological schemas, produces factual information useless (because not really informative), or unusable (because incorrect). If the main (and commendable) purpose of PCO was the integration of different ontologies relevant for the procurement domain, why not use a foundational approach, by composing the disparate conceptual schemas under the framework of a foundational ontology, such as DOLCE?

The second reason concerns me, as a jurist, more closely. You may certainly build an ontology about a legal domain (namely about a domain whose definitions are contained in legal norms), by relying on your intuition to derive the semantics of legal terms. Unfortunately, in many cases, those intuitions will be wrong. Why?

Because the legal knowledge is normatively qualified, the definitions of legal terms are contained in legal sources, as well as the descriptions of legal domain's conceptual structures, which, as a consequence, are imposed by law. So, the analysis of legal texts (in particular, of the sources of law) is mandatory for building *formal legal ontologies*. As well emphasized by Fernandez-Barrera & Sartor, the challenges in building legal ontologies are related to "the dependency of legal concepts on legal norms [...]; the dependency of legal norms on (the interpretation of) terms in authoritative documents [and] the dependency of interpretations of legal norms on the pragmatics of the different situations in which norms have to be applied"[48]. Because of this dependence, the legal discourse can never escape from its own textuality [108]. We do not have the permission to modify the way in which norms impose us to conceptualize statutory legal knowledge.

4.4.1 A *backward path*: exploring a novel approach in *re-constructing* semantics of the procurement data

In regards to the European public procurement domain, its description, as well as the definitions of its relevant terms' meaning, are contained in two European Directives, namely: the Directive 2004/18/EC[50] and the Directive 2004/17/EC[51]. The first regulates the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts by contracting authorities (i.e. authorities operating in the so-called 'ordinary sectors'); the second one regulates the procurement procedures of entities operating in the water, energy, transport and postal services sectors (i.e. 'utilities sectors').

Hence, these two legal sources represent the reference point to derive the exact meaning of terms used to describe the procurement domain, and to extract information needed to build any logical theory which would formalize the domain knowledge. Besides this, almost obvious, consideration, another aspect concerning specifically the European tender notices deserves attention. As we have seen, tender notices are sent by contracting authorities/entities to the Commission, and then published, according to standard forms.[52]

Since the Directives prescribe which information must be included in each kind of notice, the standard forms approved by the EU Commission are the result of a standardization

[50] http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32004L0018:en:HTML

[51] http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32004L0017:en:HTML

[52] According to the Directives, notices sent by contracting authorities to the Commission shall be sent either by electronic means in accordance with the *format* and procedures for transmission indicated in specific Annexes. Just to give you an idea, the art. 36 of the Directive 2004/18/CE refers to the Annex VIII (of the same Directive, namely the 2004/18/CE), whose art. 1 states that notices [...] are sent by the contracting authorities to the Office for Official Publications of the European Communities in the format required by Commission Directive 2001/78/EC of 13 September 2001 on the use of standard forms in the publication of public contract notices.

process of all the procurement notices, according to the requirements imposed by the Directives.[53]Then, the TED semi-structured data are extracted from each notice, which is compiled according to those standard-forms.

When there are standard forms for drafting a certain type of document, these can be used as starting point for the analysis of each individual document drafted according to the established format. In a certain sense, model forms are descriptions of classes of documents and, each new document drafted, is an instance of one of these classes. The analysis of these model forms may tell us information about the terms identifying constitutive part of the document and the interrelationships among each other. In many cases those terms identify ontological classes and the structural relationships between terms can be considered as object properties or data-type properties. Thus, filling out a new document means the creation of new instances for each class.

On the other side, we can derive the exact meaning of terms contained in standard forms only through the analysis of the authoritative sources: the sources of law, indeed, contain the definitions of the relevant terms pertaining to the domain they cover (explicit knowledge), and at the same time, they provide us many information about the nature of legal concepts: what are their features (or properties) and their relations with other concepts, in the whole context of the domain (implicit knowledge). The first is a plain literal analysis, the latter, instead, is the result of the domain-expert's interpretation.

As discussed in the Chapter I, various approach and methodologies have been adopted in legal ontology engineering. In general, core legal ontologies are mostly made from scratch following a top-down approach and ontological patterns are typically grounded in legal theory. Instead linguistic ontologies are normally built following a bottom-up approach, enhanced by terminology extractors and others NLP tools.

However, both the two approaches show some weaknesses, as well as points of strengths. Ontologies built following a top-down approach, may be reused across different application scenarios, because they provide sorts of conceptual frameworks, as well as fundamental legal ontological patterns, suitable for being specialized by other ontologies (especially domain ontologies), enhancing at the same time interoperability issues. However, core legal ontologies are not always suitable for real knowledge management applications, since they contain many theoretical definitions, whose reuse in practical

[53]The Annex VII of the Directive 2004/18/EC determines the information which must be included in public contract notices; the Annex VII B of the same Directive determines the information which must appear in public works concession notices; the Annex VII C of the same Directive determines the information which must appear in works contract notices of concessionaires who are not contracting authorities and so forth.

scenarios is quite difficult; in addition they are not adequately linked to the textual information and, as a consequence, a lot of efforts is needed to refine the ontology, according to definitions contained in the legal texts.

Instead, following a bottom-up approach (e.g. by means of NLP techniques), it is possible to discover useful terminological information at a larger scale and a faster price, and this feature makes this approach particularly useful when you have to update existing ontologies with new knowledge, because it can be automatically parsed and extracted from texts. However, most of the times, following a bottom-up approach, the obtained result is a too much detailed knowledge. As a consequence, it becomes extremely difficult to find commonalities between related concepts, and, at the same time, the risk of inconsistency dramatically increases[49]. (for a comprehensive overview of the two different ontological approaches, see the seminal work of Uschold & Gruninger[151]).

All things considered, LOTED2-core ontology has been designed following another approach, which, in some sense, capitalizes on past experiences in legal ontology engineering, trying to combine their best insights.

The LOTED2 approach follows a sort of *backward path*, by combining an analysis of the approved standard-forms of notices and of the data structure of the tabular summaries (bottom-up), with an analysis of the legal sources covering the domain (top-down approach). The first parsing has been conducted manually, and, obviously, also the latter (by me, as domain expert). On my opinion, in this way, it is possible to achieve a better match between language and conceptualization and then, a good level of correspondence between terms, which identify data, and ontological classes.

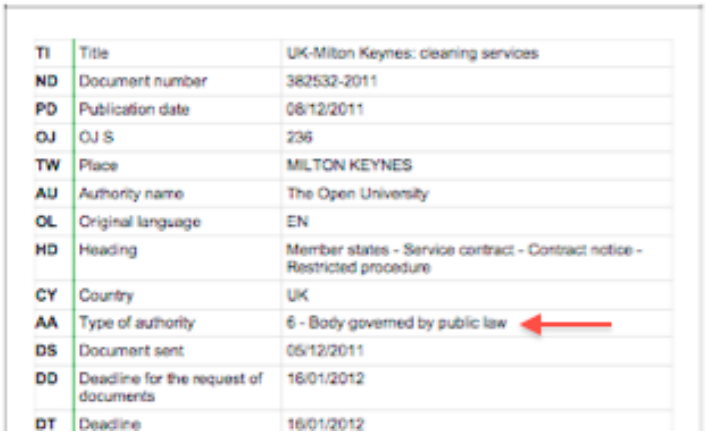
The approach is almost intuitive for a legal scholar, who uses continuously legal sources as references for extracting the legal knowledge, so it is quite difficult for me to describe explicitly the methodology. However, I will try to explain it, as much as possible.

Firstly: the raw data structure, as shown in the tabular summaries, is *re-placed* in its context. More precisely, data are matched with their corresponding entries in the (standard-forms) notices, from which they are extracted.

Secondly: the entries contained in the standardized notices are interpreted according to the articles of the Directives, where they are described in detail (explicit knowledge), and also, through a comprehensive analysis of the domain, as it emerges from the interpretation of the whole legal sources covering the domain (implicit knowledge).

Thirdly: the resulting re-composed "puzzle" is formalized as much as possible through the language used for coding the ontology.

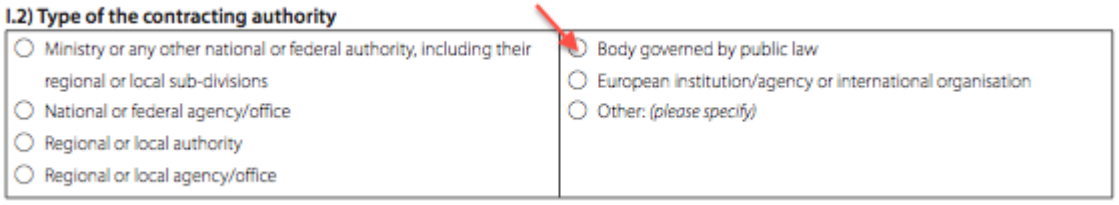
I make here an example of such an approach. Consider for example, this excerpt of the tabular summary related to the contract notice n. 382532-2011:



TI	Title	UK-Milton Keynes: cleaning services
ND	Document number	382532-2011
PD	Publication date	08/12/2011
OJ	OJ S	236
TW	Place	MILTON KEYNES
AU	Authority name	The Open University
OL	Original language	EN
HD	Heading	Member states - Service contract - Contract notice - Restricted procedure
CY	Country	UK
AA	Type of authority	6 - Body governed by public law
DS	Document sent	05/12/2011
DD	Deadline for the request of documents	16/01/2012
DT	Deadline	16/01/2012

FIGURE 4.7: Excerpt of the tabular summary related to the contract notice n. 382532-2011

The data 'AA', labeled "Type of Authority", is extracted from the entries of this form (which is an excerpt of a standard form for contract notices):



I.2) Type of the contracting authority

- ○ Ministry or any other national or federal authority, including their regional or local sub-divisions
- ○ National or federal agency/office
- ○ Regional or local authority
- ○ Regional or local agency/office
- ○ Body governed by public law
- ○ European institution/agency or international organisation
- ○ Other: *(please specify)*

FIGURE 4.8: Excerpt of a standard form for contract notices

Then, an analysis of the Directives is conducted in order to search definitions or other kind of information pertaining to the "Type of Authority" record (or ontological class), especially by analyzing *why* this kind information is relevant and why it must be included in contract notices. In this specific case, a definition of types of authorities empowered to issue contract notices is contained in the the Article 1 no. 9 of the Directive 2004/18/CE. This specification is relevant because these types of authorities, by issuing a contract notice, play the role of "contract authorities"; they can issue also other types of notices (aside from contract notices). Finally, all those notices, the awarding procedures contracting authorities have to follow and the public contract they award are covered by the Directive 2004/18/EC. [54]

[54]The Article 9 no. 9 of the Directive 2004/18/EC states that "Contracting authorities means the State, regional or local authorities, bodies governed by public law, associations formed by one or several of such authorities or one or several of such bodies governed by public law. A "body governed by public law" means any body: (a) established for the specific purpose of meeting needs in the general interest,

The resulting ontological representation is described in the following sections.

Such an adopted approach (analysis of data ⇒ analysis of standard-forms ⇒ analysis of legal sources) is, in some way, documented inside the LOTED2-core ontology, through the annotation properties. In fact, a comment (`redfs:comment`) is attached to the majority of classes, object and data properties, in order to provide the legislative reference which has been used to derive the ontological (interpretation) and definition of that class, object property and data property.

Then, other two annotation properties have been created specifically for the needs of providing a guideline to match the classes and the properties of the ontology with the corresponding entries in the full text of notices (which are the same of those encoded in the TED faceted search system) and also with the data identifiers. The first annotation is available through the `Loted2:tedLabel`, which allows to attach in the ontology a reference to the corresponding HTML labels of classes (e.g. `6 - Body governed by public law` or `3 - Contract notice`), properties and in certain cases, and also of specific typologies of instances (fixed individuals). The second annotation, instead, is available through the `Loted2:dataID`. In this case the annotation refers to the "short" identifier of data (e.g. `AA, AU, TI` and so on).

It is necessary to emphasize that the semi-structured data rendered by the TED system represent only the essential part of all the information contained in the full versions of tender documents. Other relevant information is lost. This is the case, for example, when a proposal for the acquisition of similar or related supplies/works/services may result in contracts being awarded at the same time in the form of separate lots. Since in some cases, economic operators may submit an offer for a single lot only (in those cases in which it is admitted a partial type of bid, for example) this type of information may be very helpful for participation in tenders of small and medium enterprises (SMEs). An XML standard for legal documents, which allows also RDFa assertions in order to link the structural part of the text with ontological classes, such as Akoma Ntoso[9, 164], may be used in order to tag the full content of tender documents.

not having an industrial or commercial character; (b) having legal personality; and (c) financed, for the most part, by the State, regional or local authorities, or other bodies governed by public law; or subject to management supervision by those bodies; or having an administrative, managerial or supervisory board, more than half of whose members are appointed by the State, regional or local authorities, or by other bodies governed by public law. Non-exhaustive lists of bodies and categories of bodies governed by public law which fulfill the criteria referred to in (a), (b) and (c) of the second subparagraph are set out in Annex III. Member States shall periodically notify the Commission of any changes to their lists of bodies and categories of bodies. 10. A "central purchasing body" is a contracting authority which: - acquires supplies and/or services intended for contracting authorities, or - awards public contracts or concludes framework agreements for works, supplies or services intended for contracting authorities."

4.4.2 LOTED2-core and LOTED2-extended modularization

LOTED2-core is a large ontology, up to now it represents 180 classes related to the public procurement domain.[55] In order to facilitate maintenance, LOTED2 has been designed with a modular approach. Modules have been conceived to be 'self-containing', 'independent' and 'reusable'[40].

Ten modules (fig. 4.9) compose LOTED2-core ontology. An extended version of LOTED2 ontology is composed by LOTED2-core ontology, GoodRelations4Tenders and VCard[56]. GoodRelations4Tenders is a version of the GoodRelations ontology compliant with the public procurement domain, while, as well known, VCard describes a mapping of the VCard specification to RDF/OWL. The goal of the integration of LOTED2-core ontology with VCard is to promote the use of vCard for the description the description of 'points of contacts' and addresses of awarding authorities. GoodRelations4Tenders, instead, represents the *key link* between demand and supply side of public procurement. It will be described in details in the Section 4.6. Both LOTED2-core ontology and its extended version (called LOTED2-extended) are available at http://loted.eu/ontology2 and at http://codex.cirsfid.unibo.it/ontologies/.

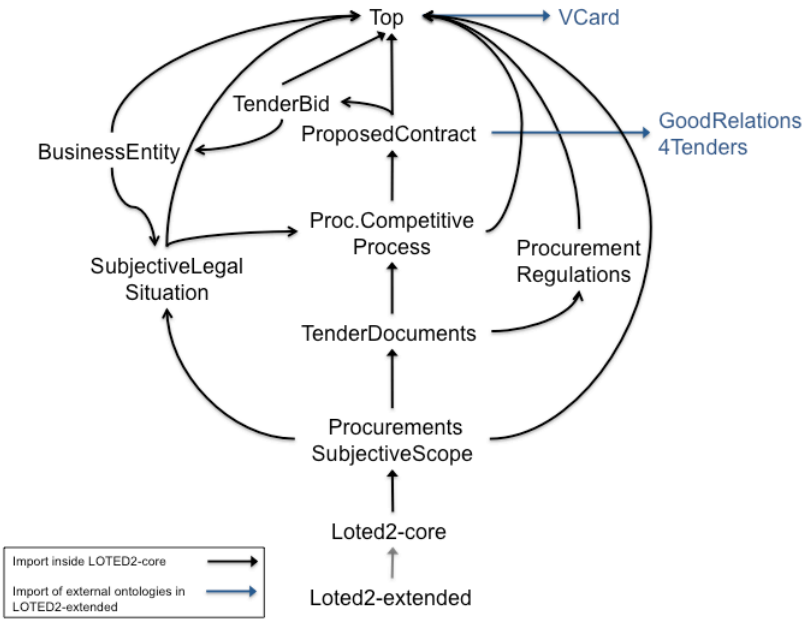


FIGURE 4.9: Dependencies between LOTED2-core modules and external ontologies (GoodRelations4Tenders and VCard) in LOTED2-extended

[55] I have used both TopBraid Composer (http://www.topbraidcomposer.com) and Protégé 4.1 (http://protege.stanford.edu) to build LOTED2-core and its extended version. The ontology has been written in OWL DL 2.0.

[56] http://www.w3.org/TR/vcard-rdf/

Such a modularization of LOTED2 ontologies, at the same time offers the possibility to reuse the ontologies (or pieces of them) for other purposes, by extending or reducing their scope. LOTED2 indeed, besides its ultimate goal of supporting Legal Semantic Web applications for improving the meeting of demand and offer in public procurement, potentially may serve also other tasks, for example:

- to express the (main) legal concepts of the domain of public contracts notices as defined in legal sources (European Directives on public contracts);
- to serve as a framework for representing public contracts, as defined in the legal codes or laws, implementing the Directives at national levels in the different EU countries;
- to support rich semantic annotation, indexing, search and retrieval of tenders documents, such as contract notices;
- to make possible the reuse of semi-structured data extracted from the TED system, by linking data about procurement to other relevant/pertaining open data;

4.5 LOTED2-core modules description

In this Section I describe the LOTED2-core modules.

4.5.1 LOTED2-core and LOTED2-extended modules

Loted2-core is a framework module (as well as Loted2-extended module). Its function is to hold together the modules by which is composed LOTED2-core ontology.

4.5.2 Procurements Subjective Scope

Procurements Subjective Scope module describes the classes of legal persons who are empowered to issue a tender notice (generally called 'call for tenders') and to award a public procurement contract, i.e. to play the role of awarding legal entities. An enumeration of these entities is contained in art. 1 (9) Directive 2004/18/EC and in art. 2 of Directive 2004/17/EC (fig. 4.10).

The first type of entities may play the role of contracting authorities; the second type of entities may play the role of contracting entities. Although both the Directives (as well as the standard forms) refer to 'contracting authorities' and 'contracting entities'

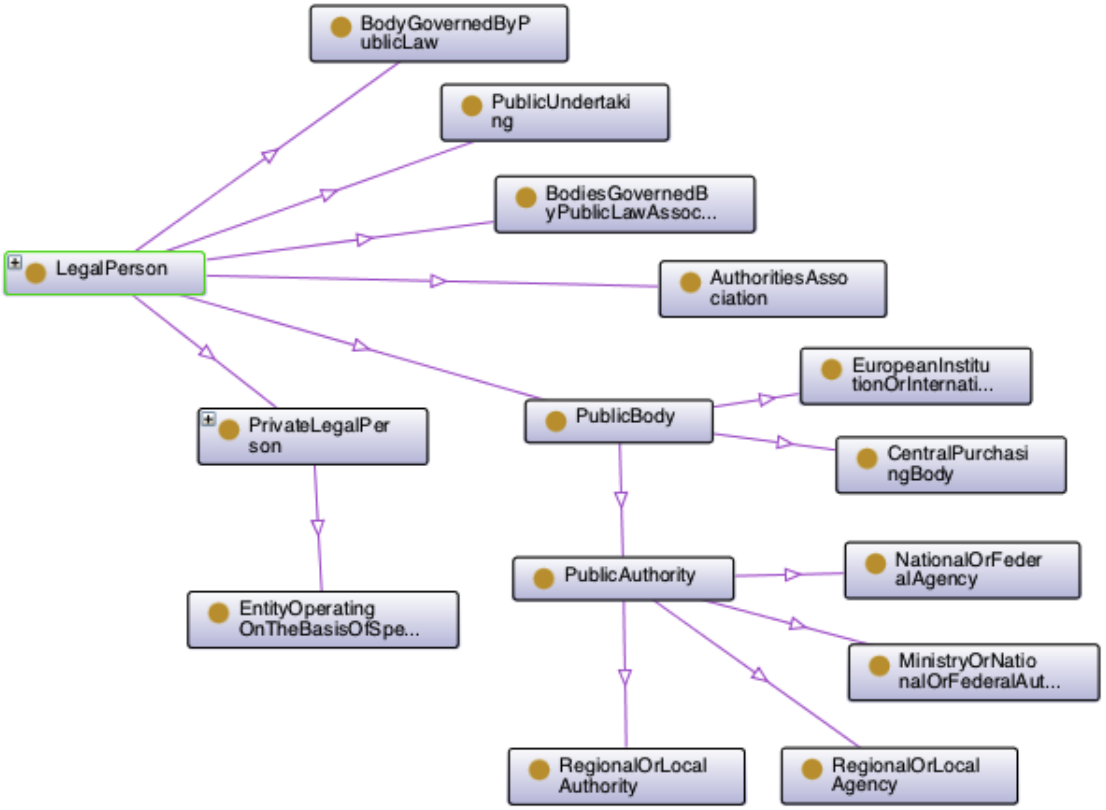


FIGURE 4.10: A taxonomy of the types of entities empowered to issue tender notices

as two different types of entities, these terms denote, from an ontological point of view, rather a role than a type of entities.

Consider for an example the case of a body governed by public law[57], that, on one hand, issues a notice for the award of a public contract and, one the other, may submit a tender bid in a tender announced by another entity.[58]

Furthermore, any public authority or public body cannot be considered *per se* a contracting authority or entity. It assumes this feature only when it issues contracts notice

[57] "A 'body governed by public law means any body:
(a) established for the specific purpose of meeting needs in the general interest, not having an industrial or commercial character;
(b) having legal personality; and
(c) financed, for the most part, by the State, regional or local authorities, or other bodies governed by public law; or subject to management super vision by those bodies; or having an administrative, managerial or supervisory board, more than half of whose members are appointed by the State, regional or local authorities, or by other bodies governed by public law." (second subparagraph of Art. 1 (9) Directive 2004/18/EC).

[58] The forth whereas of Directive 2004/18/EC and the eleventh of Directive 2004/17/CE, in this regard, state that Member States should ensure that the participation of a body governed by public law as a tenderer in a procedure for the award of a public contract does not cause any distortion of competition in relation to private tenderers. Thus, implicitly, the Directives admit bodies governed by public law in participating to tenders, as tenderer.

or another type of call for tenders. In other words, this is an anti-rigid property[66], since every instance of a public authority, body governed by public law, ministry, etc. is not essentially a contracting authority or entity.

However, for the purposes of the European legislator, the distinction between types of entities, which may play the role of contracting authority, and entities, which may play the role of contracting entities, is very relevant. From this distinction, in fact, depends the application of Directive 2004/18/EC (on ordinary sectors) or of Directive 2004/17/EC (on utilities sectors). Hence, LOTED2 includes two classes that refer to *meta-legal concepts*, namely 'entity operating in ordinary sectors' and 'entity operating in utilities sectors'.

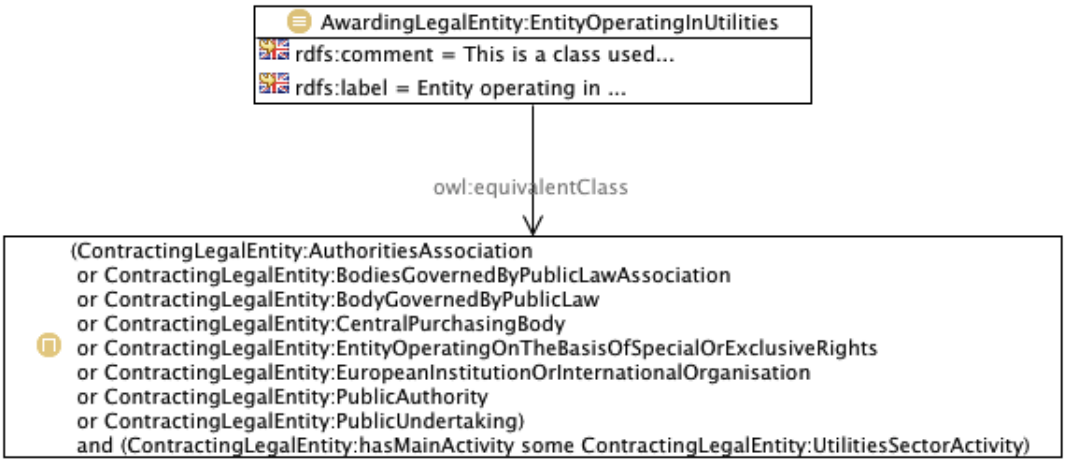


FIGURE 4.11: An example showing the graph representation of "entity operating in utilities sectors" class in LOTED2-core ontology

I call these types of concepts *meta-concepts*, according to the Van Kralingen's[79] terminology[59], because by the recognition of those concepts, recursively, depends also the recognition of the legal rules which are applicable to them, and then, these two concepts determine the applicability of other concepts. If an entity falls in the class of the first

[59] As far as I know, a definition of *meta-concepts* is provided only by the work of Van Kralingen. In his work on the *Frame-based conceptual models of statute law* he distinguishes seven items which specify the (ontological) nature of legal concepts, namely the name of the concept, its type, its priority, its promulgation, the scope of application, its conditions, and some instances of the concept. I find this distinction really useful and I agree with Van Kralingen on that distinction. I, indeed, tried to represent the majority of these features of legal concepts in the LOTED2 ontology. However, the very interesting aspect of Van Kralingen's work, on my opinion, is the distinction of four types of legal concepts: definitions, deeming provisions, factors, and *meta-concepts*. This interesting distinction was emphasized also by Mommers[100], who took, as a starting-point for his work, these definitions provided by Van Kralingen. Mommers summarizes in this way Van Kralingen's types of legal concepts: "definitions contain the conditions for a legal concept to apply (possibly deviating from the normal – ndr. or *intuitive* – meaning of that concept), deeming provisions introduce legal fictions (e.g., a bike is deemed a motor-vehicle), a factor determines the applicability of a concept statistically, and thus it is in fact one of the application conditions of a concept, not a concept itself, and meta-concepts determine the applicability of other concepts".

type of entity, then it may play the role of contracting authority. Instead, if an entity falls in the second type, then it may play the role of contracting entity.

The definition of these classes is based on the main activity carried out by an entity. A detailed list of ordinary sector activities and utilities activities is obtained by standard forms, but should not be considered as a *numerus clausus*. For each type of these activities and for each type of legal person which issues a notice, is provided the corresponding label of TED data through an annotation property (`Loted2:tedLabel`). This annotation property is provided with the purpose to drive the user in the implementation of the ontology by using the TED data as instances.

4.5.3 Tender Documents

The Procurement Subjective Scope module is connected to the Tender Document module through the object property `Loted2:issues`. In this module are described the majority of tender documents available on the TED system, issued by the entities defined in the Directives. The aim of this module is to provide a full description of tender documents, which represent notices.

A set of class restrictions is defined to specify which kinds of entities are empowered to issue a certain type of tender document (e.g. a *contract notice-utilities* may be issued only by an *entity operating in utilities sectors*).

Other types of tender documents, such as specification and descriptive documents, are described because they are strictly related to the tender notices. Indeed, these documents are attached to a contract notice, in order to describe in details the type of services, goods or works which the awarding entity is seeking, and the manner in which the competitive bidding will be conducted.

You may argue that the terms *attached tender document* may denote a role, rather than a substantial category. However I disagree on this point, because the existence of these documents depends on the existence of a contract notice (or of another type of notice through which is announced a competitive procurement process). In other words, the identity criterion of these documents is, precisely, their *being attached to a contract notice*; they cannot exist without the contract notice to which they are attached. Moreover, a contract notice, *together* with its attached documents, constitutes the so called *lex specialis* of the tender, i.e. the set of rules governing the conduct of the tender.[60]

[60]To be honest, I was not able to find a good English translation of the Italian definition *documenti a corredo del bando*. On my opinion, the expression *a corredo* means something more than *attached*; in some sense, it means that they complement each other.

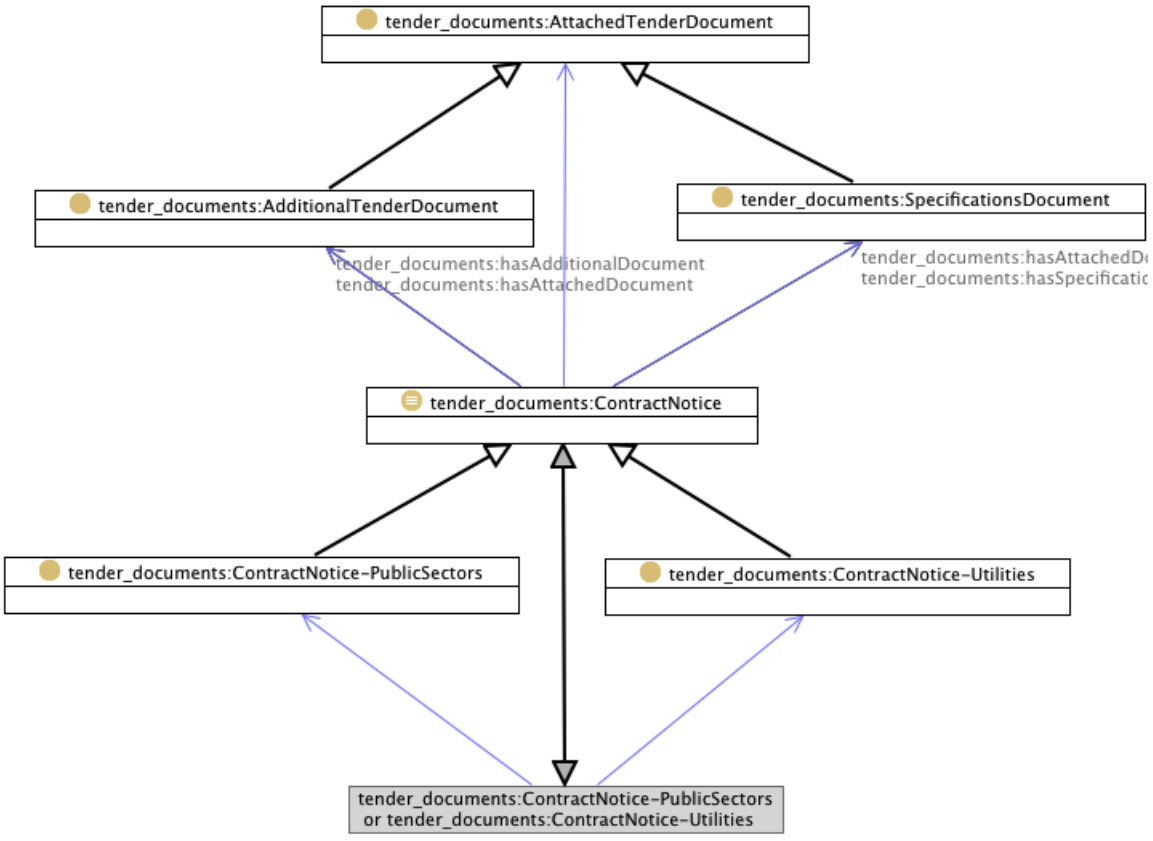


FIGURE 4.12: The contract notice class and its attached documents in LOTED2-core

Data contained in the tabular summaries of TED are basically related to tender notices. So, this module, more than others, has been built emphasizing the bottom-up approach. As in the Procurement Subjective Scope module, also in the Tender Document module the annotation property `Loted2:tedLabel` is used. Another annotation property, `Loted2:tedDataID` is used for providing a reference to the ID of the data to which a data-type property refers.

4.5.4 Procurement Regulation

In this module are described the legislative sources regulating public procurement domain. Apart from the Directives, many other legislative sources regulate the European procurements domain. The most important is the Government Procurement Agreement (GPA), a pluryilateral treaty signed by a number of WTO (World Trade Organization) parties (fig. 4.13), with the purpose to open up as much as possible public procurement business to international competition[25, 41]. The scope and coverage of GPA is based on the type of procurement, the type of entity and the monetary threshold defined

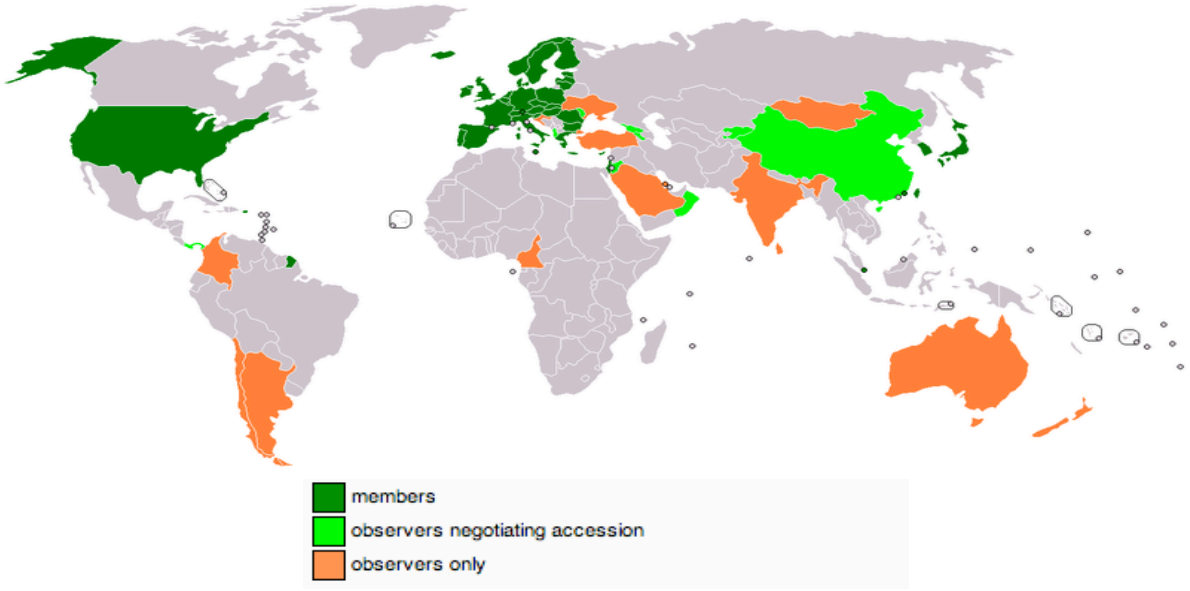


FIGURE 4.13: WTO Members and observers in Government Procurement Agreement (source: Wikipedia)

in Appendix I of the Agreement. It is worthwhile to emphasize that signatories may negotiate the coverage of GPA with other parties, on the basis of reciprocity.

For example, the utilities sector is not covered by GPA with respect to Canada and there are many limitations with respect to USA and Japan too, just to name the most relevant.

This means that we cannot consider the GPA as a unique treaty for each signatory, since there are rather many bilateral agreements (Canada-EU, USA-EU, et.) negotiated by parties under the GPA framework. Thus, simply saying that a tender is within the coverage of the GPA is not enough to clarify the geographical scope of the application of each single bilateral agreement to the single contract notice.

These significant divergences in the application of GPA entail a considerable complexity in defining which specific regulation covers a tender document. I am convinced that is almost impossible to represent such a complex scenario, determining which legal source covers a specific notice, through OWL, or in general, through Description Logic. Maybe, neither First Order Logic alone would be sufficient. In this case, it is necessary to use also Defeasible Logic, for representing this *intricate* legal matter.

Unfortunately, the TED system's data do not provide an effective help in this direction since they are articulated in an incoherent manner. In fact the field of 'Regulation' data is referred once to the political geographical area of the country in which is based the entity that issued the tender notice (`European Union, European Economic Area`); once

to the type of authority that issued the notice (`European Investment Bank, European Bank for Reconstruction and Development, European Monetary Institute, European Institution/Agency or International Organization`); once to the reason for which the notice is issued (`External aid` and `European Development Fund`) and finally once to the actual regulation, although not always identified with the exact wording (`Agreement between the European Community and the Swiss Confederation, GPA`, etc.).

Procurement Regulation module of LOTED2-core ontology aims to provide the exact wording of all the procurement regulations, i.e. standardizing the labels of the legal sources which typically cover the single tender documents (e.g. Directive 2004/18/EC instead of European Union). This type of information is necessary to define the jurisdiction of the regulation, namely the geo-political reference within the norm is applied and its effects are binding[31, 60]. However, no inferences are supported by means of the very basic knowledge represented in this module. Further work is needed, by combining the use of OWL and a rule interchange language supporting defeasibility reasoning, such as LegalRuleML, for trying to represent better this part of the procurement domain.

4.5.5 Procurement Competitive Process

A notice is issued by an entity acting as contracting authority or contracting entity in order to announce a competition. There are many types of competitions, based on the type of notice. The most relevant type of competition is the tender (i.e. the competitive bidding) that is announced through a contract notice (but not only).

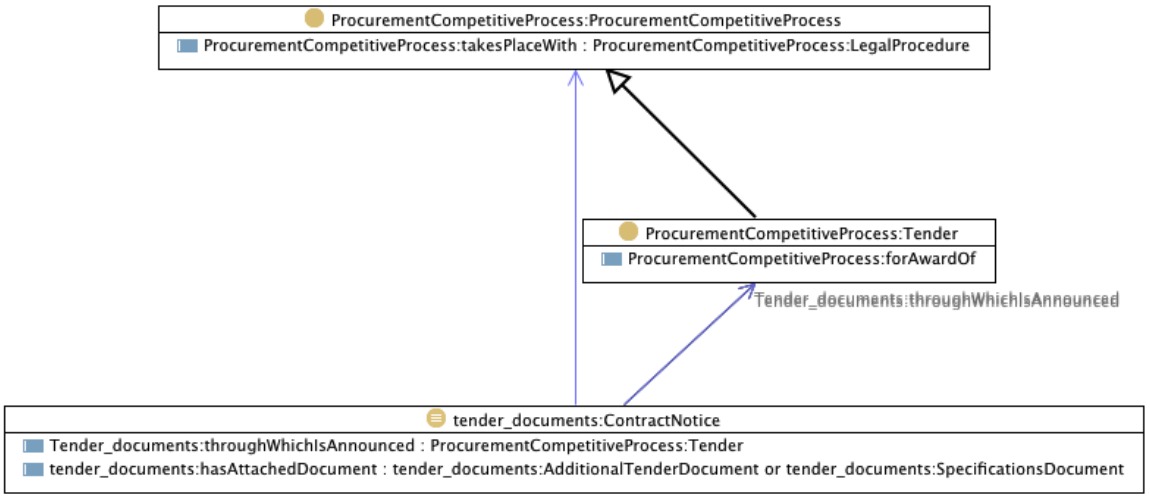


FIGURE 4.14: The relationship between a contract notice and the tender in LOTED2-core

Instead, a design contest is announced through a design contest notice. A qualification system is announced through a notice on the existence of this type of system, that we can consider as a competitive procurement process. This system, in fact, is used by only entity operating in utilities, for seeking qualified economic operators, which meet predefined qualification criteria that must be satisfied by potential providers of specific types of works, services and supplies. An applicant of this type of notice, which satisfies these criteria, is registered in the system as potential candidate or contractor for the particular type of contract. A notice on the existence of a qualification system with call for competition is a notice through which is announced both a qualification system and a tender, in which may participate only operators recognized as qualified according to the system.

A procurement competitive process takes place with an established administrative procedure, the award procedure that can be of different types (open, restricted, negotiated, etc.). LOTED2-core ontology does not describe award procedures.

4.5.6 Subjective Legal Situations

This module describes roles played by agents in procurements competitive processes and in organizations. As highlighted describing the Procurements Subjective Scope, terms such as *Contracting Authority* or *Contracting Entity* denote roles rather than types of entities. In particular they denote roles than only certain entities may play: only entities operating in ordinary sectors may play the role of contracting authority, while only entities operating in utilities sectors may play the role of contracting entities.[61] The two terms indicate basically the same concepts, namely a property that an entity assumes when awards a public contract and when carries out all the set of actions required for the

[61] One may argue that also *entity operating in ordinaries sector* and *entity operating in utilities sectors* are roles. However, once again, I disagree. Why? Here the argument is more tricky, but I think that it worth to spend a few words about it. I do not reject the argument in abstract: those terms, certainly, denote roles, under a foundational perspective. However, from a strictly legal point of view, the classification of an entity on the basis of the activity it carries out, is so relevant that, in some sense, it transforms this role in a category (or class). As a meta-concept, indeed, its function is precisely to recognize what are the norms which are applied to that entity and this function makes it, in some way, 'atypical'. I limit myself to the analysis of "legal person", I wan't consider here "natural person".

I think that the (main) activity of an institutional (and recognized) legal entity is a fundamental feature which characterizes that legal entity. The institutional activity, indeed, is the reason why that entity has been created, established and legitimated by the legal system.

Consider the following example: the Italian National Council of Research (CNR) has been established exactly for carrying out research studies in Italy. If, strangely enough, tomorrow, the CNR stops to carry out research and starts to sell pizza, it will be no more the same CNR, legitimately created according to the law. Firstly, it *must* change its name; secondly, it will become another type of entity, maybe a (... private?) business entity, but certainly its new activity will be not justified according to the public law, neither to its *constitutive act*. In other words, in this case (and in all the others), the activity carried out by a legal entity denotes a rigid property, since when it ceases, the entity will be no longer the same, or it will cease to exist as well.

awarding process of a contract. The first action is to issue a notice.[62] So, by issuing a contract notice certainly an entity starts to play the role of awarding legal entity. Apart from the role of awarding legal entity, this module of LOTED2 enables us to describe also roles played by 'business entities' in procurement processes. For example, a natural or legal person (operating on the market as 'economic operator') who has submitted a tender bid for the award of a proposed public contract is a natural or legal person who plays the role of *tenderer*. And if this agent has submitted the best tender bid, then assumes the role of *successful tenderer*.

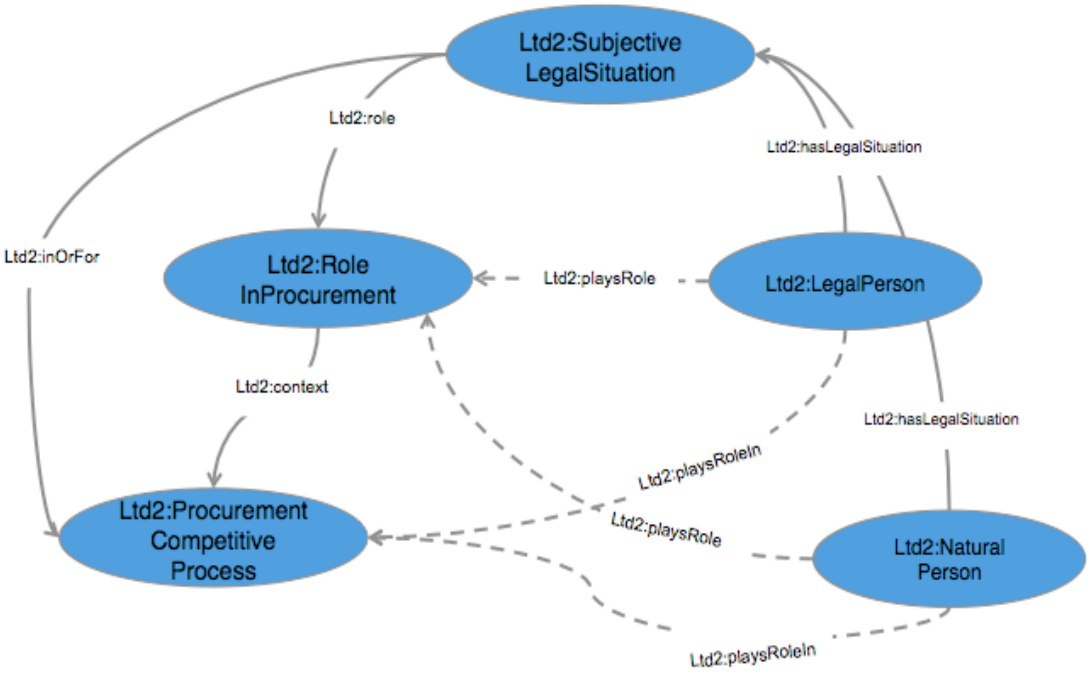


FIGURE 4.15: Subjective Legal Situations and Roles in LOTED2-core

Another important aspect in procurements' role modeling deserves to be emphasized. Just as a body governed by public law may play the role of both awarding legal entity and tenderer (of course, in diverse tenders), so business entities may play many roles in different procurements competitive processes.

Consider that the eligible customers of many business entities are public authorities and so their core activity is precisely the participation in tenders, even more than one at the same time. Then, this matter is not trivial.

[62] Please note that in some specific cases public authorities may award a contract without issuing a notice: this is the case in which a tender takes place with a negotiated procedure without contract notice. Of course, this case is not examined in this paper, since LOTED2 is an ontology for describing tenders notices published on TED.

In order to represent also these cases, the LOTED2 module described in this section represents (legal) situations more than simply roles. An agent may have more than one subjective legal situation that is related to a role played in a context. In the case of procurement, the context is the procurement competitive bidding. These concepts and relationships have been modeled reusing and adapting the "Social Reality pattern"[70, 71], one of the proposed content patterns available from the catalogue of Ontology Design Patterns initiative[51, 53, 112]. Such an ontological representation is shown in the Fig. 4.15 (the dashed lines represent the inferred axioms).

4.5.7 Proposed Contract

Since LOTED2 is an ontology of public procurement notices, it does *not* represent public contract per se. LOTED2 aims to describe semantics of notices concerning the award of public contracts. A contract notice is the means whereby is announced a competitive bidding for the award of a public contract. So, the commitment of the ontology is to capture the information of public contract to be awarded (or proposed contract) not of the public contract awarded or in its execution.

For this reason in the ontology is specified the class of Loted2: ProposedContract rather than of Contract. The exact term should be *proposal for a public procurement contract to be awarded*, however it would have been too long and too verbose for the needs of the LOTED2 ontology.

Consider the case in which the tender has been declared unsuccessful: can we speak about a contract or not? Of course not, because the contract has not been awarded and then has not been signed by parties. So, in the stage of notice publication there is not a contract, but a contract to be awarded. This is also clear if we consider that a contract notice is also known in legal doctrine as *invitatio ad offerendum*, namely an invitation to make offer for a proposal of contract. And only the successful bidder will be party of the contract. The connection between the contract notice (the *invitatio ad offerendum*) and the proposed public procurement contract module is via a property chain:

`Loted2:throughWhichIsAnnounced o Loted2:forAwardOf SubPropertyOf Loted2:throughWhichIsAnnouncedTenderForAward.`[63]

Every contract or proposed contract has an object, namely the subject matter of the contract. A law-full object is an essential of a contract, or proposed contract. According to legal doctrine, object of contract can be intended either as the commitment that parties agree to assume (and the consequently transfer or creation of rights and/or

[63] See the Appendix **??** for the axiomatization in DL

modification or settlement of existing bonds) or as the description of the real object (good or service) to which relates the contract (i.e. the substantial content of the contract)[18]. The analysis of standard forms for contract notices and of the other tender documents shows that the object of contract is intended in the second sense, i.e. as a description of the type of good, service or work that the entity issuing the notice seeks.

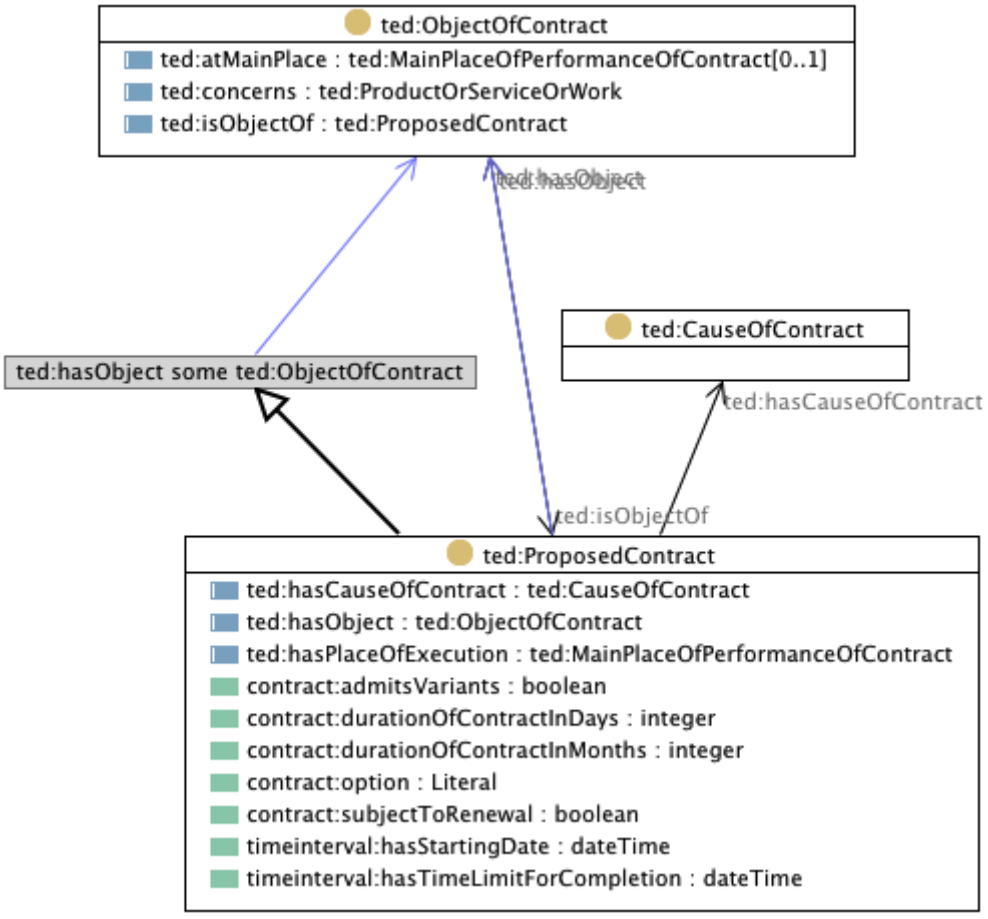


FIGURE 4.16: UML representation of the proposed contract in LOTED2

The object property `hasObject` connects the public procurement contract to its subject (Work, Supply, or Service) - i.e. connects the `Loted2:ProposedPublicProcurementContract` with `Loted2:ObjectOfTheContract`, as shown in the fig. 4.16.[64] Then every object of contract concerns (or, speaking with the words of GoodRelations, 'includes') a Product or a Service or a Work.

An example may be helpful to clarify. Take for instance a proposed contract which has as object the supply of laser printers and A4 paper for the Ministry of Health. This means that the Ministry of Health is searching for a Supply of printing products which includes

[64] Please, note that the correct namespaces of the LOTED2 ontology should be `loted2` and not `ted`. This is a typo.

the Loted2:Product printers and printing paper (instances). The products which are included in the object of the contract are known thanks to the CPV (Common Procurement Vocabulary) nomenclature, which is indicated in the tender document (contract notice, periodic indicative notice, etc.). The Common Procurement Vocabulary identifies more than 9400 products with a code composed of 8 numbers. The aim of the CPV is to standardize, by means of a single classification system for public procurement, the terms used by contracting authorities and entities, describing the object of contracts through an uniform nomenclature. The CPV is translated into 22 official languages of the European Communities. It simplify the task of drafting notices, since it describes the subject matter of contracts, and helps also the drafting of statistics on public procurement, since the CPV is compatible with trade monitors used throughout the world (especially those used by the United Nations).[65].

Coming back to our example, the CPV codes of the two products are:

- Cpv code of Laser printers is 30232110
- Cpv code of printing paper is 30197630.

and the object of the proposed contract (Supply of printing products) concerns both the first and the second product.

Each proposed contract will be executed in a main place. Every location is defined through the Nomenclature of Territorial Units for Statistics (NUTS) established by Eurostat in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union.

A rather significant aspect of procurement domain is the division of proposed public contract in lots. In some cases and under certain conditions, entities issuing a contract notice for the acquisition of similar or related supplies/works/services may decide to split the proposal into separate single proposed contracts to be awarded with the same tender. These single proposals that are also parts of a general proposal are called lots.

Since in some cases, economic operators may submit an offer for a single lot only (namely in all the cases in which is admitted a partial type of bid) this type of information may be very helpful for participation in tenders of SMEs. In fact, usually a small enterprise is specialized in one particular sector with one main offering and so it might be interested in bidding for the single lot rather than for the global proposal. Therefore, one of the commitments of LOTED2 ontology is to accurately model this particular aspect of the

[65]See Guide to Common Procurement Vocabulary (CPV) available at: http://simap.europa.eu/codes-and-nomenclatures/codes-cpv/cpv$_2$008$_g$*uide*$_e$*n.pdf*

domain, namely *lots*, even by ensuring that through ontology were made possible certain inferences.

Given these premises, in LOTED2-core ontology this aspect has been modeled in this way. First of all, proposed public contracts may be of three types: *proposed contracts divided into lots, proposed contract not divided into lots* and *lots*. A lot is a proposed contract that is also part of a proposed contract divided into lots. When a proposed contract is divided into lots through the contract notice is announced a tender for award also single lots. Through LOTED2, it is possible to infer that through the same contract notice is announced a tender for award each single lot. This result has been achieved through the use of General Class Axioms, combined with property chains.

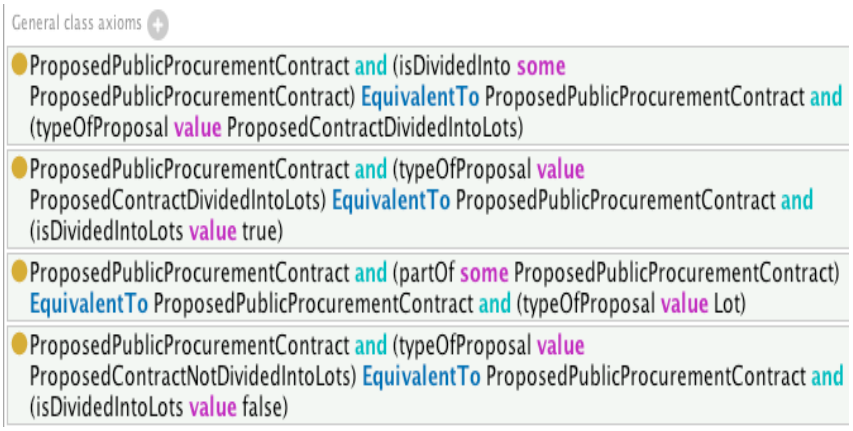


FIGURE 4.17: General Class Axioms declared in Proposed Contract module of LOTED2-core ontology

In fact, two object properties are inferred in order to show which lots will be awarded through the same tender:

```
 Loted2:  forAwardOf o Loted2:isDividedInto
SubPropertyOf Loted2:forAwardLot
```

and which lots to be awarded are announced through the same contract notice:

```
Loted2:throughWhichIsAnnouncedTenderForAward o Loted2:isDividedInto
SubPropertyOf Loted2:throughWhichIsAnnouncedTenderForAwardLot
```

An example in the published version of LOTED2 ontology shows the inference so described (see individual `Loted2:Notice1`).

4.5.8 Tender Bid

This module describes the tender bid, namely the offer that may be submitted by the economic operator in the competitive bidding for awarding a public contract. Note that, in english, the same word 'tender' denotes the 'race', i.e. the 'competition' for the public contract, and also the meaning of the offer for a public contract. It is an ambiguous term and I think that precisely this ambiguity has led PCO developers to confuse the 'race' with the 'offer'. For this reason, I have decided to call the offer *tender bid*, because it is a bid made in the context of a tender. So, the tender bid class aims to describe the offers submitted by economic operators in a tender for the award of public contracts.

An important aspect is about the type of bid, namely, if an offer may be submitted for exactly one lot, for one or more than one lot, or necessarily for all lots. A tender bid, indeed, may be either a *partial tender bid*, a *global or partial tender bid*, or a global tender bid. This is a sort of quality that a tender bid has in a single tender, and it has only one of these quality in each tender.

The type of tender bid is, then, strictly related to the lots' issue, because both a partial tender bid type and a global or partial type imply the existence of a proposed contract divided into lots; instead the global tender bid type may be admitted both in tenders through which are awarded contracts not divided into lots and in tenders through which are awarded contracts divided into lots. I again decided to use General Class Axioms to design these features of tender bids, but in this case I think that the a more powerful language is needed to represent these aspects. OWL DL is not enough. However, a failure in the ontological representation of this aspect does not affect the utility of the expressivity of the rest of the ontology. Simply, there is a small gap in the full representation of the domain.

A tender bid is evaluated on the basis of an award criterion: the lowest price or the most economically advantageous offer. The first is based only on the criterion of price; the second one is based on a set of combined criteria defined by the authority issuing the contract notice. Furthermore a tender bid will be opened in a certain place (defined into the contract notice) and at a certain date-time; and it may be drawn up in a specific EU language or not.

4.5.9 Business Entity

This module describes the class of the entities playing the role of economic operators (to simplify hereinafter called 'economic operators'). Economic operators are the subjects to whom is addressed the invitation to submit an offer for a proposed public contract. In

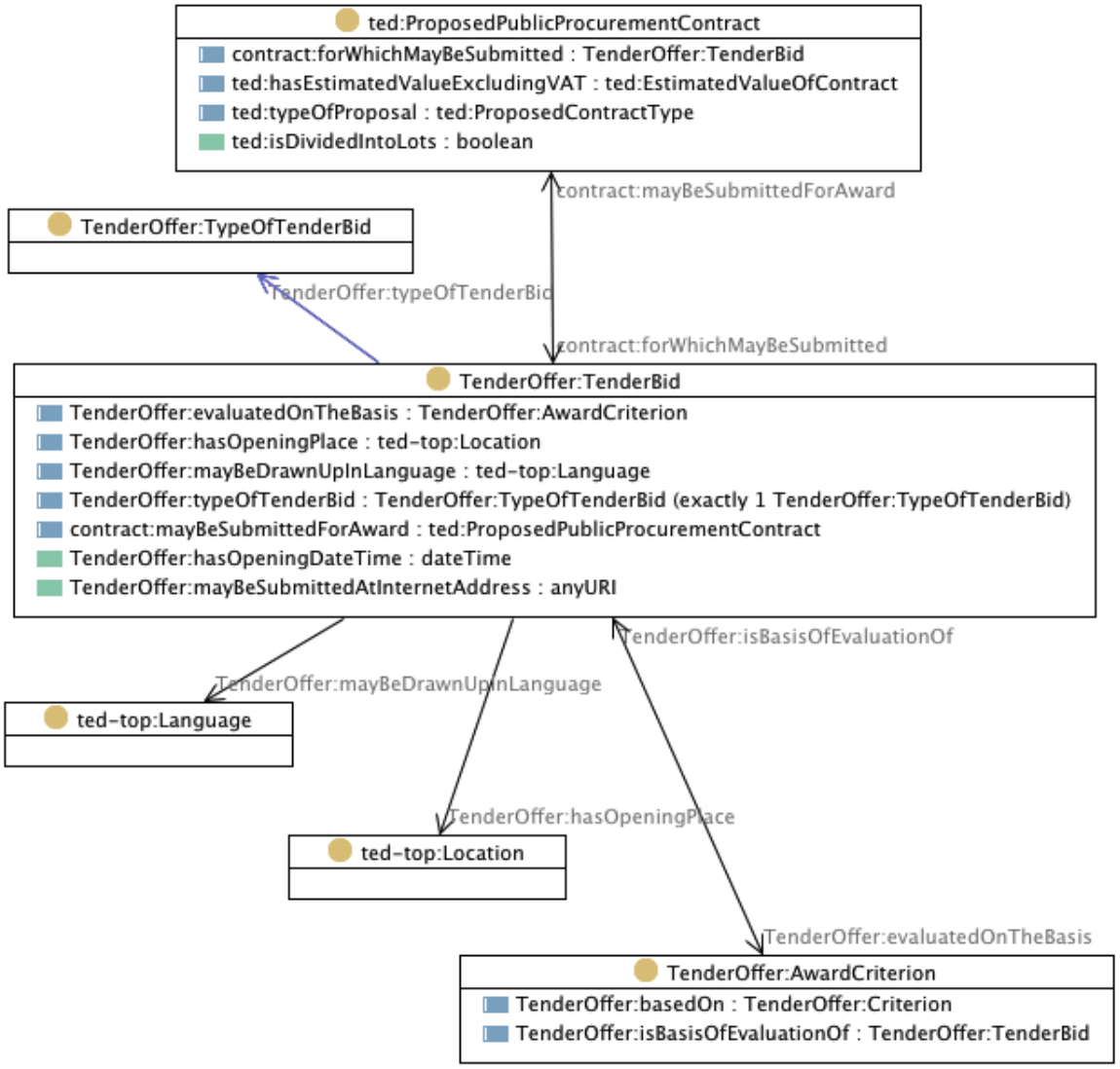


FIGURE 4.18: UML representation of the tender offer in LOTED2-core ontology

other words, an economic operator is the potential counterpart of the awarded contract. However, not every economic operator can sign a public contract. There are several eligibility requirements, based on certain criteria that must be fulfilled by an economic operator in order to participate in a competitive bidding.

This module describes private legal persons who are business entities, since they assume the legal form of 'incorporates', 'society', 'cooperative', etc. These classes are modeled following the taxonomy of LKIF-core ontology.

4.5.10 The upper module: LOTED2-Top

This is a sort of upper module in which are contained abstract classes, even useful to match the LOTED2 ontology with core ontologies and in particular with core legal ontologies, in order to foster interoperability. In particular, many classes of Procurement Top Classes module are modeled following the LKIF-core ontology schema.

This relationship between LOTED2-core ontology and LKIF-core is what I call *a compromise* accepted in designing LOTED2-core ontology. Indeed the initial aim of LOTED2 project was to build an ontology of European public procurement notices integrated with both GoodRelations and LKIF-core ontology. However, there is one main problem that has prevented us from integrating the two ontologies together with LOTED2: the time representation.

Given the importance of time factor in legal domain, LKIF-core represents time (such as 'date of publication') as classes, while GoodRelations represents time through data type properties such as `xsd:dateTime`.

Another problem was that LKIF-core ontology has been mostly conceived for representing legislative documents and not also administrative documents, such as tender notices. Furthermore, every legal document is also a legal source and there is not a clear distinction between legislative sources (which are sources of law in the proper sense) and legal sources, such as a contract (or a proposal of contract), which are sources of law only *inter partes*, i.e. only among the contractual parties. The point was emphasized also by Casellas in her PhD thesis[34].

Moreover, in GoodRelations, a business entity is a "*legal agent* making a particular offering" and it can be "*a legal body* or a person"([69], p. 332). This natural language statement is translated in the GoodRelations ontology by representing Organization and Person as SubClasses of BusinessEntity. I understand that for the purposes of the e-commerce scenario, this ontological representation is not entirely wrong because it is tailored to the needs of e-commerce Semantic Web applications.

However, this ontological representation implies also that *all* the persons and *all* the organizations are also intrinsically *business entities*, and it is obvious that, from the point of view of the legal domain, this ontological representation is not acceptable, neither for LKIF-core, nor for LOTED2-core, because a legal body in the legal domain is not a business entity. Certainly, a legal body can act also as a business entity, but there is something more to it than its buying activity.

First: a business entity in the legal domain is only that particular type of organization which is recognized by the law as a business entity, according to well defined criteria.

Second: it is hard to accept the idea that a Parliament, a Ministry or an European Institution are primarily business entities. It is true that they buy products and services in the market, but their buying activity is not the main activity they carry out, it is only an instrumental activity, functional to the achievement of their institutional goals. This is precisely the point I wanted to highlight since the introduction of this thesis: public procurement is instrumental to the institutional activities of public bodies. An hospital buys drugs and machinery for diagnostic, because it needs them to serve its institutional function, namely to provide health care to citizens; an university buys books or desks only because it needs to ensure access to education. I can make hundreds of these examples. This is *the purpose, the aim, the goal* of the public procurement system. The fact that a legal body is the agent of this system does not change its essence and does not transform it in a business entity. Absolutely not.

Third: in general, natural persons are not primarily business entities.

All things considered, a full integration of LOTED2 with the two ontologies (LKIF-core and GoodRelations) together, was not possible, and because of that my accepted compromise was to define in the top module classes represented in LKIF-core ontology. In that way, I used LKIF-core ontology as a source of patterns for modeling legal content of procurements domain.

4.6 LOTED2-extended: the integration of LOTED2-core with GoodRelations4Tenders

Works carried out until now[4, 75], bring up the integration of ontologies about public procurements with GoodRelations ontology. In particular, as we have seen in Section 4.3, LOD2 ontology reuses some classes of GoodRelations (Offering, Business Entity, etc.) and also WESO Research group pays attention to an integration with GoodRelations, as part of its future works. Even the creator of GoodRelations, Martin Hepp often makes reference to procurements as an interesting application domain for his ontology.[66]

It is generally agreed that the object property `gr:seeks` could play a key role in in encouraging the opening up of procurements domain to large scale Semantic Web applications. However, the matter, in our opinion, deserves more attention for many reasons. Good Relation is, currently, the best candidate ontology to complement an ontology of public procurement notices because it represents a strategic domain, such as the e-commerce in a non trivial way, addressing a complex domain and covering "the

[66] See for example Martin Hepp's keynote *Ontology Engineering for Linked Data. What makes for a Good Ontology?*, KIELD 2010, Lisbon, Portugal.

many intricate situation that this domain requires", "it is widely used currently in the e-commerce and linked data communities", "it is easily applicable, actually applied and recommended by the stakeholders from the targeted domain"[38].

This is certainly true and in addition, we think that GoodRelations ontology inspires also the recognition of some isomorphic patterns between legal and economic concepts, namely between the market and its legal superstructure. Nevertheless, it should be remembered that GoodRelations is an ontology built with the purpose to meet the needs of B2C (Business to Consumer) or B2B (Business to Business) scenarios. In other words, GoodRelations has been developed bearing in mind only the private sector. Therefore, is not fully adaptable to the PA2B (Public Administration to Business) scenario, because public procurement domain has its own peculiarities that cannot be ignored, if you want to build a Semantic Web that doesn't distort principles of EC law.

Take for instance the principle of equality of treatment on which is inspired the Art. 23 of Directive 2004/18/EC. This article states that, unless justified by the subject-matter of the contract, technical specifications shall not refer to a specific make or source, or a particular process, or to trade marks, patents, types or a specific origin or production with the effect of favoring or eliminating certain undertakings or certain products. Such reference shall be permitted only on an exceptional basis, where a sufficiently precise and intelligible description of the object of the contract is not possible; such reference shall be accompanied by the words "or equivalent". So, on my opinion, the integration of an ontology about public procurements like LOTED2 with GoodRelations could result in potentially law distorting effects. Why?

Because GoodRelations, according to its purposes, describes brands, types of products (such as models), and obviously also the origin of products. These aspects come overtly into conflict with EC procurement principle of equality of treatment, but there are also other aspects whose incompatibility with the principles of the law is less clear, even though equally harmful.

For example, GoodRelations defines the object property 'image≡depiction', through which it is possible to link a product to its image available on the web. This is a very useful class in the private market scenario. In the PA2B context, instead, the use of this class may create problems. Indeed, with an extensive interpretation of the Article 23 one may argue that a link to a certain image could be used in order to indicate exactly one specific type of product. This can be a sort of trap that may lead into a conflict with principles of the European procurement law.

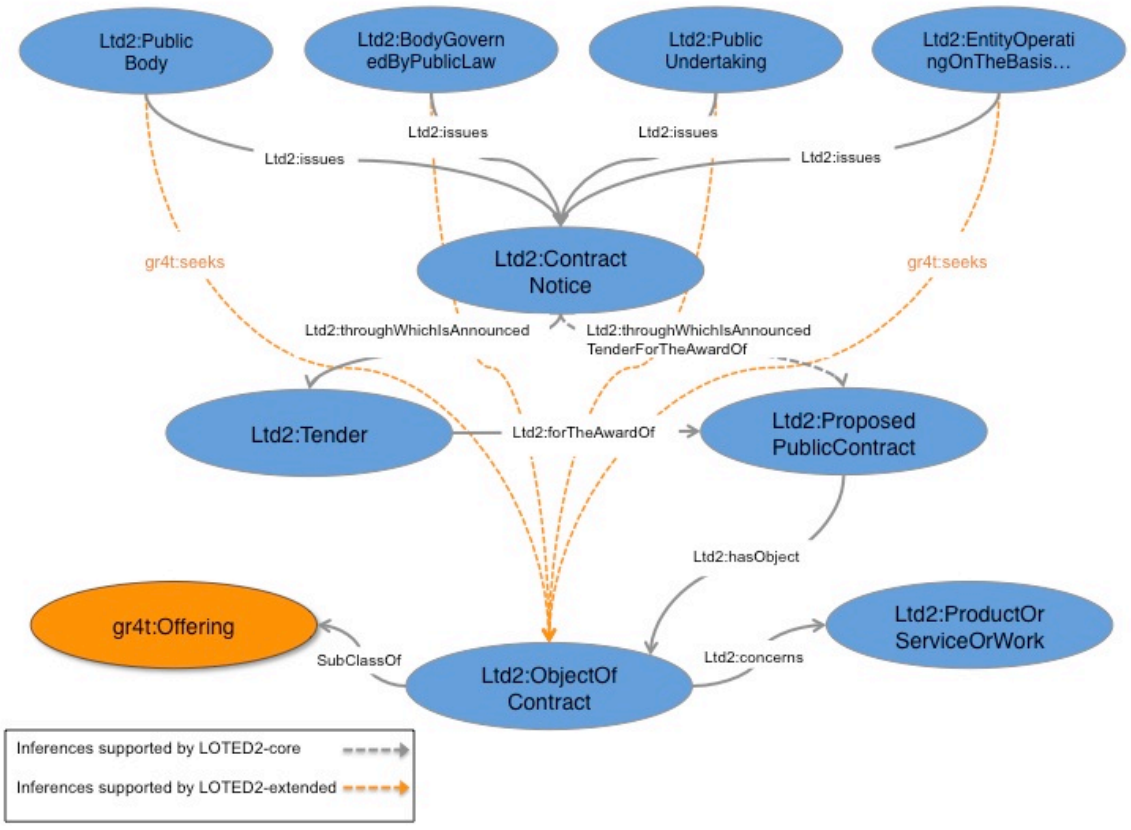


FIGURE 4.19: Inferences supported through the integration between LOTED2-core and GoodRelations4Tenders in LOTED2-extended

Given these remarks, I decided to amend GoodRelations ontology, removing all parts non compliant with EC procurement principles. I have called this version 'GoodRelations 4 Tenders'. Apart from EC Directives-non compliant classes like `gr:Brand`, `gr:ProductOrServiceModel`, etc. and related properties like `gr:hasBrand`, `gr:hasMakeAndModel`, `gr:hasManufacturer`, etc., I have removed also other classes and properties not required by the procurement domain such as `gr:acceptedPaymentMethods`, `gr:OpeningHoursSpecification`, etc. Changes in this release compared to the original GoodRelations ontology consist of just the elimination of certain classes and properties. The original structure of GoodRelations has been preserved.

Another point on which is worth dwelling is about how should be understood an integration between an ontology of public contracts and GoodRelations. For example, Public Contracts Ontology (PCO) developed by LOD2 group adheres completely to conceptual model of GoodRelations, detrimental to the particular (and different) domain of public contracts. Instead the aim of LOTED2 ontology is to represent as closely as possible legal concepts pertaining procurements domain. Such a conceptual analysis allows the discovering of the possible connections with concepts of other domains. So, by explicitly

specifying concepts of proposed contract and of *invitatio ad offerendum* (namely call for tenders or contract notice, etc.), the connection between GoodRelations ontology and an ontology of procurement becomes clear... so clear that this connection can be inferred.

Consider the use of property`gr:seeks` in the procurements domain. When an entity issues a contract notice through which announces a tender for the award of a proposed contract, actually is seeking the object of the contract. So the object of the contract is the Offering that this entity invites to offer. In LOTED2-extended this aspect is automatically inferred using a reasoner such as Pellet[133], through a property chain (as shown in the fig. 4.19). Given that the class object the contract in LOTED2-extended is SubClass of `gr:Offering`, the use of the property 'seeks' is perfectly compatible with GoodRelations4Tenders.

In LOTED2-core ontology, also the subject matter of lots is inferred as object of contract (precisely of those contracts which are part of the main proposed contracts), so, through LOTED2-extended it is possible to produce automatically the same inference also for objects of lots. For instance, if a contracting authority issues a contract notice through which is announced a tender for the award of a public supply contract divided into lots, then through the ontology it is possible to show all the supplies the contracting authority is seeking.

Finally, in LOTED2-extended, business entities and all the entities empowered to issue contract notices are kept separate.

4.7 Evaluation of LOTED2 ontology

LOTED2-core ontology, as well as its extended version, captures in an effective way the domain of European public procurement notices. Its representation of the domain, indeed, provides useful inferences which are the result of some basic legal reasoning applied to its classes and properties.

LOTED2 ontology has been under development for more than eight months and, during that time, several versions (up to ten) of it has been tested in order to achieve this result. It has been tested with real instances extracted from the TED system and, during these tests, a lot of attention has been given to the supported inferences. LOTED2 ontology has been designed using all the functionalities of OWL2.0 ontology language (property chains, keys, definition of object properties through transitive and functional axioms, etc.). Because of those features, at the state of the art, LOTED2 is one of the most powerful existing legal ontologies, in terms of the inferences it supports.

The design choice to split into modules LOTED2 ontology make it easier to maintain, in spite of its size. The large size of the ontology, however, depends on the purpose of the ontology to cover all the key aspect required by a complex domain, as is the public procurement domain. Furthermore, besides the ultimate purpose of building an ontology for Semantic Web applications, it has been developed looking also at its possible extensions for several uses (data retrieval, linkage between open government data, basic check compliance applications and so on). The representation of the Services which are defined in the Annex A and in the Annex B has been provided exactly considering its extensions in modeling also contract notices which are not fully covered by European Directives, namely contract notices under the EU threshold.

LOTED2 ontology is also full annotated. The majority of classes, object properties and data-type properties are annotated with explanations and examples of their use. Furthermore, the annotations inside LOTED2 serve many purposes at the same time.

Firstly, they provide a reference for the *expert users*, by making an explicit reference to the legal text (European Directives) from which have been extracted the definitions of the classes of the ontology. The same has been made also for object properties (e.g. how has been interpreted the action of 'issuing a notice') and data-type properties (e.g. why the date of publication of the contract notice is important), which are described in the law.

Secondly, they provide a guidance also for the *non-expert users* through two specific annotation properties, namely `Loted2:tedLabel`, which provides a reference of classes or properties of the ontologies to the corresponding HTML labels of the TED system and of the full text of notices, and `Loted2:dataID`, which provides a reference to the "short" identifier of data (e.g. `AA, AU, TI` and so on).

However, up to now, LOTED2 ontologies have not yet been fully tested in a real application. The use of the ontology in a Semantic Web application, indeed, will be part of LOTED2 project's future work.

4.8 Now, what we can do with LOTED2 ontology?

Through the integration of LOTED2-core ontology with GoodRelations4Tenders ontology, it would be possible to build a Semantic Web Legal application for matching public demand side with the offerings side of the market, i.e. the *X-ray machine* needed by people like Giovanni for accessing the *kernel of public procurement notices*. Recently has been released the 'Open Database of the Corporate World' (OpenCorporates)[67]. This

[67] http://OpenCorporates.com/

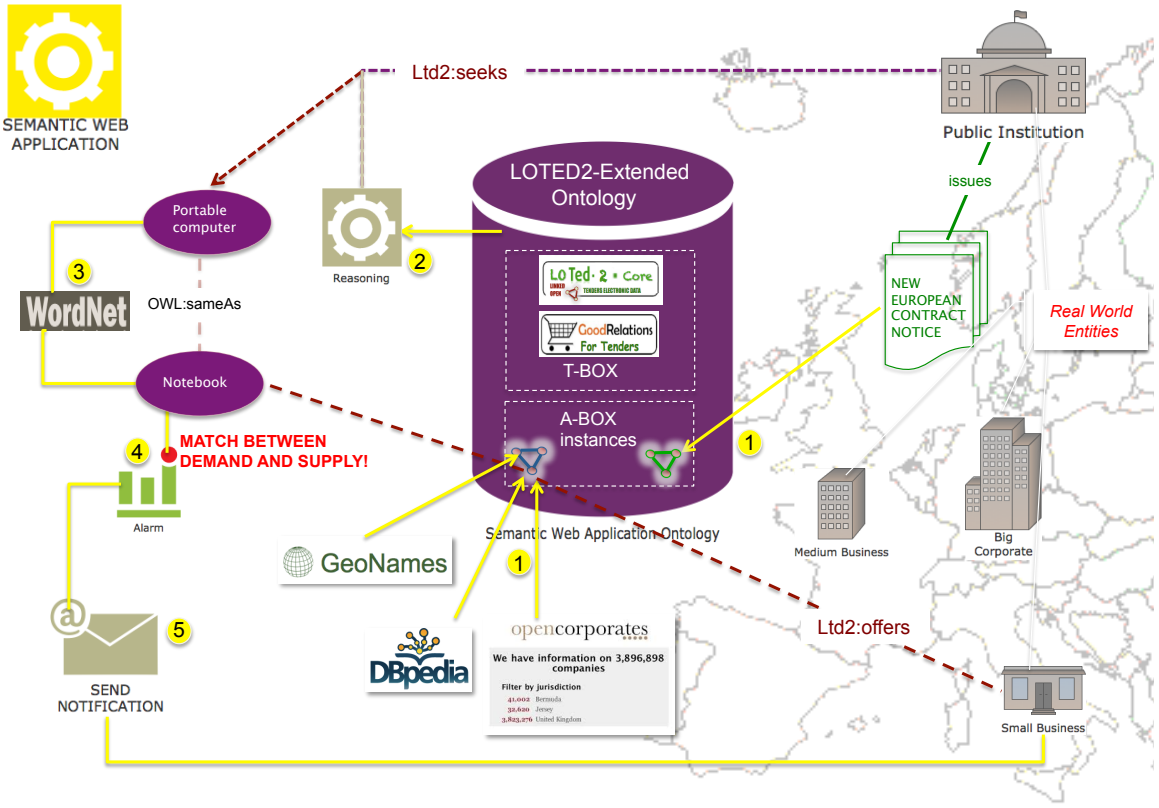


FIGURE 4.20: The picture describes a possible use of the LOTED2-extended ontology in a Semantic Web application

database contains data about more than 44 millions of companies around the world. To each registered company is associated the corresponding Standard Industrial Classification (SIC) code, even useful for define the type of 'offering' that a company offers. However, it must be emphasized that, at the state of the art, the information about jurisdiction is essential for such kind of application if you want avoid the *semantic noise* that can be generated by linking data of companies from states not involved within the scope of application of regulation that covers the contract notice. Nevertheless, LOTED2 can be surely used within the context of the European Union, excluding then its use in extra-EU jurisdictions.

Linking procurements data with the OpenCorporates data should allow the matching between demand and supply side, by alerting every company, which offers the same type of product or service sought by an entity issuing a public procurement contract notice. Furthermore, resources such as WordNet, DBpedia and GeoNames may provide an enrichment of the procurement dataset, in order to show additional information to the user of a Semantic Web application, as well as a nice web interface. A sketch of a Semantic Web applications is outlined in the fig. 4.20.

4.9 LOTED2 ontology: lesson learnt

A fairly unexplored field concerns the integration of legal ontologies with ontological resources related to different domains. A sort of *rigidity*, which derives from the fact that authoritative sources drive the conceptual model, characterizes ontologies about legal contents.

It is no accident that legal ontologies are mostly conceived in closed systems rather than in open ones. In open systems the heterogeneity, the scale, the data quality, the reliability of information raise significant problems to control the legal effects of heterogeneous linked data, or *smart data*. And because of this, building Legal Semantic Web applications will require the ability to foresee and to cope with all kinds of risks that may emerge, in order to avoid that the challenge will turn into a danger.

Re-thinking legal ontologies in the Semantic Web is a challenging task, not at all simple.

In the legal domain, an exciting research field is emerging on the use of ontologies for checking compliance of legal documents or processes with norms regulating them[36], even by combining ontologies with rules formalized through interchange standards specific for the legal domain. Nevertheless, at the same time, it should be more emphasized in legal ontology engineering the aspect of compliance by design.

Ontologies for compliance and ontologies in compliance might be considered as two sides of the same coin. The attempt in integrating LOTED2-core and GoodRelations shows, indeed, many things.

First, through the property *seeks* and the mirror inverted *offers*, GoodRelations represents in an intuitive way the intents of parties when they issue an invitation to treat or a proposal for the conclusion of a contract (an 'offer' in legal terms). In a certain sense, GoodRelations shows the final part of the legal superstructure behind the terms seeks and offers.

Second, the integration of LOTED2 ontology with GoodRelations shows that also in the legal domain "a little semantics goes a long way".[68] However, we must keep in mind that in the legal domain this little semantics is just the superficial layer of the whole of legal knowledge upstream.

The variety of related works about procurements (up to now there are three ontologies of public contracts, including LOTED2, and another is in development) reveals the strong interest of the Semantic Web community in representing legal knowledge. Furthermore,

[68] J. Hendler, *Keynote at International Semantic Web Conference*, Sanibel Island, Florida, USA, 2003.

the Semantic Web community should consider the matter more carefully and the Legal Informatics community should try to take up the challenge.

It can be done more starting from the lesson learnt in building LOTED2. It can be done more, by using legal ontologies to promote the access of people to the *kernel* of the legal knowledge they need.

Up to now, many initiatives have been started by the European Commission in order to improve the access of traders (in particular of SMEs) to public procurement market in EU. Indeed, this kind of vision is now inspiring the Peppol EU Project[69], which aims to make possible electronic communication between any companies in the European Union with any governmental institutions for all procurement processes. Another initiative is e-certis[70], namely a system that helps authorities and economic operators in identifying the different certificates and attestations (that are evidences for requirements) frequently requested in procurement procedures across the 27 Member States, two Candidate Countries (Turkey and Croatia) and the three EEA countries (Iceland, Liechtenstein and Norway).

These two initiatives provide us many useful non-semantic resources for modeling requirements. In addition, further research in investigating how Regulations, such as Government Procurement Agreement, can be adequately represented in the Semantic Web will be particularly useful. These two aspects combined together may allow us to cover in an effective way the procurement domain.

Take for instance the contract notice 2011/S n. 236-382532[71] issued by 'The Open University' (that is a body governed by public law) for the award of a public contract concerning cleaning services. There are two key questions related to this contract notice, with not easy solutions for traders who are interested in the application for this notice. First: I am a company from Canada, can I apply for this notice issued by The Open University (UK)? Second: I am a company from Italy: what types of documents should I submit to The Open University for participating in the tender n. 236-382532? The answer to the first question depends on the type of 'Regulation' that covers the contract notice. In this specific case, the contract notice states that the Government Procurement Agreement covers this particular type of contract, but this is not enough to give an answer to the first question. It is necessary to consider all the exceptions agreed by single parties to the application scope of the GPA (in this case between Canada and EU).

[69] http://www.peppol.eu
[70] http://ec.europa.eu/markt/ecertis/login.do
[71] available from TED system at http://ted.europa.eu/udl?uri=TED:NOTICE:382532-2011:TEXT:EN:HTML

The answer to the second question, instead, depends on the criteria that must be met by business entities that want to participate in EU tenders. This example shows that in the law, question answering is not only information retrieval. Information retrieval is not enough, since "question requires some deduction or inference before an appropriate answer can be given" and "regulations may contain many different articles about the same topic and one can only assess whether something is permitted or not by understanding the full documentation". "A rather detailed understanding is required, in particular, because regulations generally contain complex structures of exceptions"[14]. In other words, question answering in the legal domain is not a trivial matter.

However, we all should try to face the challenge, starting from the lesson we have learned so far.

Chapter 5

Conclusion

5.1 Imagining the future of legal ontologies in the Semantic Web ages

When I started working on my PhD research, I enjoyed it and I did not minded too much the public procurement domain. However, to be honest, I was rather worried. I thought it was impossible to make an interesting research on a so specific and technical subject matter: *legal ontologies for public procurement management*. I have always thought that public procurement are an important topic but, for a long time, I was basically in agreement with the complaints of Thai[145], Callender and Matthews[29], Twyford[150] and Stewart[139] about the lack of regard in public procurement domain, as research field.

I do not know if it happened to these scholars too, but while I was complaining as them, in truth, I was also thinking that public procurement was really "*reactive, clerical, unimaginative*", a boring procedure conducted by "*unglamorous individuals*" and just a complex accountability process of government. Sometimes I have not at all believed in the goodness of my PhD research topic. Sometimes I was thinking that a research on the fundamental legal categories or on legal argumentation theory, for example, was certainly much more interesting than mine.

But after this initial discouragement, I have started to consider this *reactive* administrative field as one of the most *active*, dynamic and innovative laboratory you can find, for testing *legal applied ontology* and legal informatics science at large; I discovered that rather than being *clerical*, public procurement world is asking more and more for innovative and *not-dogmatic* solutions to improve the efficiency of public administrations and to satisfy in a better way citizens' needs. In that way, I began to think at this (only

at a first glance) *unimaginative* topic, *imagining* the future of legal ontologies in the ages of the Semantic Web.

In fact, the public procurement domain reveals all the major need and challenges that legal ontologies have to face in the Semantic Web ages. The relevant questions are: how legal ontologies can provide a contribution to help public administrations in communicating with each other; how legal ontologies may help public administrations in interoperability issues; how legal ontologies may provide the right semantics in discovering information about Open Government Data... and many many others.

These questions, indeed, hide also some pitfalls and, the jurist of this century should be aware of them. This thesis in nothing but an attempt to give an answer to this question.

Today, technology has not only invaded the world of legal information. Technology is putting more and more under pressure the Law. The legal knowledge has been almost entirely outsourced on the web, while it was remaining apparently the same. The textual information of the legal sources is becoming more and more a 'legal data'; the messy amount of authoritative and not-authoritative legal information's sources is determining information overload and reliability's issues; the real, democratic opening of the Law to all the (non-lawyers) citizens has been not yet achieved. We can not delude ourselves thinking that these major changes do not require solutions to *re-invent* once again the Law.

At the end, I do not know if I have succeeded in providing my contribution to *re-invent* the Law.

I just tried to do it.

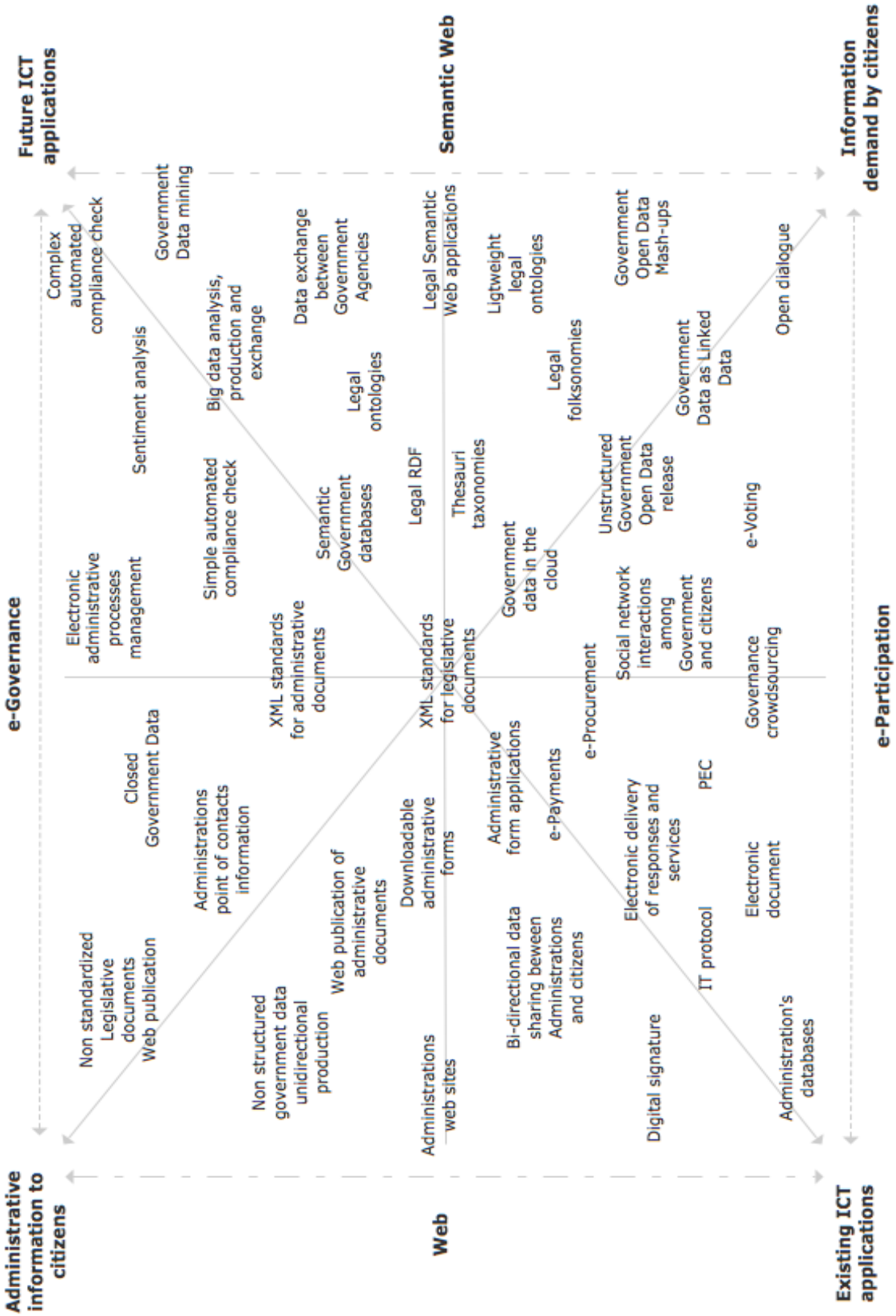


FIGURE 5.1: *e*-Governance Semiotic Square

Appendix A

LOTED2 Core DL Axioms

A.1 Formal description of *LOTED2-Core* most relevant axioms in Description Logic

Classes

Candidate

Candidate $\equiv$ RoleInProcurement $\sqcap \forall$ rolePlayedBy (LegalPerson $\sqcup$ NaturalPerson $\sqcap \exists$ hasSought InvitationToSubmitATender)

ContractNotice

ContractNotice $\equiv$ ContractNotice-PublicSectors $\sqcup$ ContractNotice-Utilities

ContractNotice $\sqsubseteq$ TenderDocument

ContractNotice $\sqsubseteq \forall$ throughWhichIsAnnounced Tender

ContractNotice $\sqsubseteq \forall$ hasAttachedDocument (AdditionalTenderDocument $\sqcup$ SpecificationsDocument)

ContractNotice-PublicSectors

ContractNotice-PublicSectors $\sqsubseteq \forall$ issuedBy EntityOperatingInOrdinarySectors

ContractNotice-Utilities

ContractNotice-Utilities $\sqsubseteq \forall$ issuedBy EntityOperatingInUtilities

ContractingAuthority

ContractingAuthority $\sqsubseteq$ AwardingLegalEntity

ContractingAuthority $\equiv$ RoleInProcurement $\sqcap \forall$ rolePlayedBy EntityOperatingInOrdinarySectors

ContractingEntity

ContractingEntity $\sqsubseteq$ AwardingLegalEntity

ContractingEntity $\equiv$ RoleInProcurement $\sqcap \forall$ rolePlayedBy EntityOperatingInUtilities

DesignContestNotice

DesignContestNotice $\sqsubseteq \forall$ throughWhichIsAnnounced (DesignContest $\sqcap \forall$ takesPlaceWith (AwardProcedure $\sqcap$ {RestrictedProcedure} $\sqcup$ {OpenProcedure}))

DesignContestNotice $\sqsubseteq \forall$ hasAttachedDocument (AdditionalTenderDocument $\sqcup$ SpecificationsDocument)

DesignContestNotice $\sqsubseteq$ TenderDocument

DesignContestNotice $\sqsubseteq \forall$ throughWhichIsAnnounced DesignContest

EntityOperatingInOrdinarySectors

EntityOperatingInOrdinarySectors $\equiv$ AuthoritiesAssociation $\sqcup$ BodiesGovernedByPublicLawAssociation $\sqcup$ BodyGovernedByPublicLaw $\sqcup$ CentralPurchasingBody $\sqcup$ EuropeanInstitutionOrInternationalOrganisation $\sqcup$ PublicAuthority $\sqcap \exists$ hasMainActivity OrdinarySectorActivity

EntityOperatingInOrdinarySectors $\sqsubseteq$ LegalPerson

EntityOperatingInUtilities

EntityOperatingInUtilities ≡ AuthoritiesAssociation ⊔ BodiesGovernedByPublicLawAssociation ⊔ BodyGovernedByPublicLaw ⊔ CentralPurchasingBody ⊔ EntityOperatingOnTheBasisOfSpecialOrExclusiveRights ⊔ EuropeanInstitutionOrInternationalOrganisation ⊔ PublicAuthority ⊔ PublicUndertaking ⊓ ∃ hasMainActivity UtilitiesSectorActivity

EntityOperatingInUtilities ⊑ LegalPerson

EntityOperatingOnTheBasisOfSpecialOrExclusiveRights

EntityOperatingOnTheBasisOfSpecialOrExclusiveRights ⊑ PrivateLegalPerson

LowestPrice

LowestPrice ≡ AwardCriterion ⊓ ∃ basedOn {Price}

LowestPrice ⊑ AwardCriterion

Organisation

Organisation ⊑ Agent

Organisation ⊑ ∀ member (NaturalPerson ⊔ Organisation)

PeriodicIndicativeNotice

PeriodicIndicativeNotice ⊑ ∀ issuedBy EntityOperatingInUtilities

ProposedContract

ProposedContract ⊑ LegalDocument

ProposedContract ⊑ ∃ hasObject ObjectOfContract

ProposedContract ⊑ ∀ hasObject ObjectOfContract

ProposedContractType

ProposedContractType ≡ ProposedContractType ⊓ {ProposedContractNotDividedIntoLots} ⊔ {Lot} ⊔

ProposedContractType ⊑ ∀ isTypeOfProposal ProposedPublicProcurementContract

ProposedPublicProcurementContract

ProposedPublicProcurementContract ⊑ ProposedContract

ProposedPublicProcurementContract ⊑ ∀ typeOfProposal ProposedContractType

ProposedPublicWorksContract

ProposedPublicWorksContract ≡ ProposedPublicContract ⊓ ∃ hasObject Work

ProposedPublicWorksContract ⊑ ProposedPublicContract

ProposedPublicServiceContract

ProposedPublicServiceContract ≡ ProposedPublicContract ⊓ ∃ hasObject Service

ProposedPublicServiceContract ⊑ ProposedPublicContract

ProposedPublicSupplyContract

ProposedPublicSupplyContract ≡ ProposedPublicContract ⊓ ∃ hasObject Supply

ProposedPublicSupplyContract ⊑ ProposedPublicContract

QualificationSystemNotice

QualificationSystemNotice ⊑ ∀ issuedBy EntityOperatingInUtilities

RoleInProcurement

RoleInProcurement ≡ LegalRole ⊓ ∀ context ProcurementCompetitiveProcess

TenderBid

TenderBid $\sqsubseteq$ LegalDocument

TenderBid $\sqsubseteq$ = typeOfTenderBid TypeOfTenderBid

Tenderer

Tenderer $\equiv$ RoleInProcurement $\sqcap \forall$ rolePlayedBy (LegalPerson $\sqcup$ NaturalPerson $\sqcap \exists$ has-Submitted TenderBid)

Object properties

atMainPlace

$\top \sqsubseteq \leq 1$ atMainPlace Thing

$\exists$ atMainPlace Thing $\sqsubseteq$ ObjectOfContract

$\top \sqsubseteq \forall$ atMainPlace MainPlaceOfPerformanceOfContract

basedOn

$\exists$ basedOn Thing $\sqsubseteq$ AwardCriterion

$\top \sqsubseteq \forall$ basedOn Criterion

concerns

$\exists$ concerns Thing $\sqsubseteq$ ObjectOfContract

$\top \sqsubseteq \forall$ concerns ProductOrServiceOrWork

contactPoint

$\exists$ contactPoint Thing $\sqsubseteq$ OrganisationalUnit $\sqcup$ NaturalPerson $\sqcup$ Organisation

$\top \sqsubseteq \forall$ contactPoint VCard

context

$\exists$ context Thing $\sqsubseteq$ Role

$\top \sqsubseteq \forall$ context (Process $\sqcup$ Organisation)

covers

$\exists$ covers Thing $\sqsubseteq$ LegalDocument

$\top \sqsubseteq \forall$ covers LegalDocument

evaluatedOnTheBasis

$\exists$ evaluatedOnTheBasis Thing $\sqsubseteq$ TenderBid

$\top \sqsubseteq \forall$ evaluatedOnTheBasis AwardCriterion

evaluatedOnTheBasisOfCriterion

Property chain axiom: evaluatedOnTheBasis o basedOn $\sqsubseteq$ evaluatedOnTheBasisOfCriterion

forAwardLot

$\top \sqsubseteq \forall$ forAwardLot (ProposedPublicContract $\sqcap \exists$ typeOfProposal {Lot})

Property chain axiom: forAwardOf o isDividedInto $\sqsubseteq$ forAwardLot

forAwardOf

$\top \sqsubseteq \forall$ forAwardOf ProposedPublicProcurementContract

forWhichMayBeSubmitted

$\exists$ forWhichMayBeSubmitted Thing $\sqsubseteq$ ProposedPublicProcurementContract

$\top \sqsubseteq \forall$ forWhichMayBeSubmitted TenderBid

hasActivity

$\exists$ hasActivity Thing $\sqsubseteq$ Agent

$\top \sqsubseteq \forall$ hasActivity Activity

hasAdditionalDocument

hasAdditionalDocument $\sqsubseteq$ hasAttachedDocument

$\top \sqsubseteq \forall$ hasAdditionalDocument AdditionalTenderDocument

hasAttachedDocument

$\exists$ hasAttachedDocument Thing $\sqsubseteq$ ContractNotice $\sqcup$ DesignContestNotice $\sqcup$ PeriodicIndicativeNoticeWithCallForCompetition $\sqcup$ PublicWorkConcessionNotice $\sqcup$ QualificationSystemWithCallForCompetitionNotice $\sqcup$ QualificationSystemWithoutCallForCompetitionNotice $\sqcup$ SimplifiedContractNoticeOnADynamicPurchasingSystem $\sqcup$ WorksContractAwardedByTheConcessionaireNotice

$\top \sqsubseteq \forall$ hasAttachedDocument AttachedTenderDocument

hasAuthor

$\exists$ hasAuthor Thing $\sqsubseteq$ Document

$\top \sqsubseteq \forall$ hasAuthor Agent

hasCauseOfContract

$\exists$ hasCauseOfContract Thing $\sqsubseteq$ ProposedContract

$\top \sqsubseteq \forall$ hasCauseOfContract CauseOfContract

hasCountry

$\exists$ hasCountry Thing $\sqsubseteq$ Agent

$\top \sqsubseteq \forall$ hasCountry Country

hasEstimatedValueExcludingVAT

$\exists$ hasEstimatedValueExcludingVAT Thing $\sqsubseteq$ ProposedFrameworkAgreement $\sqcup$ ProposedPublicProcurementContract

$\top \sqsubseteq \forall$ hasEstimatedValueExcludingVAT EstimatedValueOfContract

hasLegalSituation

$\exists$ hasLegalSituation Thing $\sqsubseteq$ LegalPerson $\sqcup$ NaturalPerson

$\top \sqsubseteq \forall$ hasLegalSituation SubjectiveLegalSituation

hasMainActivity

hasMainActivity $\sqsubseteq$ hasActivity

hasMainPlaceOfDelivery

hasMainPlaceOfDelivery $\sqsubseteq$ atMainPlace

$\top \sqsubseteq \leq 1$ hasMainPlaceOfDelivery Thing

$\exists$ hasMainPlaceOfDelivery Thing $\sqsubseteq$ Supply

$\top \sqsubseteq \forall$ hasMainPlaceOfDelivery MainPlaceOfDelivery

hasMainPlaceOfPerformance

hasMainPlaceOfPerformance $\sqsubseteq$ atMainPlace

$\top \sqsubseteq \leq 1$ hasMainPlaceOfPerformance Thing

$\exists$ hasMainPlaceOfPerformance Thing $\sqsubseteq$ Service

$\top \sqsubseteq \forall$ hasMainPlaceOfPerformance MainPlaceOfPerformance

hasMainPlaceOfWorks

hasMainPlaceOfWorks $\sqsubseteq$ atMainPlace

$\top \sqsubseteq \leq 1$ hasMainPlaceOfWorks Thing

$\exists$ hasMainPlaceOfWorks Thing $\sqsubseteq$ Work

$\top \sqsubseteq \forall$ hasMainPlaceOfWorks MainPlaceOrSiteOfWorks

hasObject

$\exists$ hasObject Thing $\sqsubseteq$ ProposedContract

$\top \sqsubseteq \forall$ hasObject ObjectOfContract

hasOpeningPlace

$\exists$ hasOpeningPlace Thing $\sqsubseteq$ TenderBid

$\top \sqsubseteq \forall$ hasOpeningPlace Location

hasPlaceOfExecution

$\exists$ hasPlaceOfExecution Thing $\sqsubseteq$ ProposedContract

$\top \sqsubseteq \forall$ hasPlaceOfExecution MainPlaceOfPerformanceOfContract

Property chain axiom: hasObject o atMainPlace $\sqsubseteq$ hasPlaceOfExecution

hasSought

$\exists$ hasSought Thing $\sqsubseteq$ LegalPerson $\sqcup$ NaturalPerson

$\top \sqsubseteq \forall$ hasSought InvitationToSubmitATender

hasSpecificationsDocument

hasSpecificationsDocument $\sqsubseteq$ hasAttachedDocument

$\top \sqsubseteq \forall$ hasSpecificationsDocument SpecificationsDocument

hasSubmitted

$\exists$ hasSubmitted Thing $\sqsubseteq$ LegalPerson $\sqcup$ NaturalPerson

$\top \sqsubseteq \forall$ hasSubmitted TenderBid

inOrFor

$\exists$ inOrFor Thing $\sqsubseteq$ SubjectiveLegalSituation

$\top \sqsubseteq \forall$ inOrFor Process

involvesTheEstabilishmentOf

$\top \sqsubseteq \forall$ involvesTheEstabilishmentOf ProposedFrameworkAgreement

isActivityOf

$\exists$ isActivityOf Thing $\sqsubseteq$ Activity

$\top \sqsubseteq \forall$ isActivityOf Agent

isAdditionalDocumentOf

isAdditionalDocumentOf $\sqsubseteq$ isAttachedDocumentOf

$\exists$ isAdditionalDocumentOf Thing $\sqsubseteq$ AdditionalTenderDocument

isAttachedDocumentOf

isAttachedDocumentOf$\exists$ isAttachedDocumentOf Thing $\sqsubseteq$ AttachedTenderDocument

isBasisOfEvaluationOf

$\exists$ isBasisOfEvaluationOf Thing $\sqsubseteq$ AwardCriterion

$\top \sqsubseteq \forall$ isBasisOfEvaluationOf TenderBid

isDividedInto

$\exists$ isDividedInto Thing $\sqsubseteq$ ProposedPublicProcurementContract $\sqcap \exists$ typeOfProposal {ProposedContractI

$\top \sqsubseteq \forall$ isDividedInto (ProposedPublicProcurementContract $\sqcap \exists$ typeOfProposal {Lot})

isFollowingPublicationOf

$\exists$ isFollowingPublicationOf Thing $\sqsubseteq$ TenderDocument

$\top \sqsubseteq \forall$ isFollowingPublicationOf TenderDocument

isMainActivityOf

isMainActivityOf $\sqsubseteq$ isActivityOf

isMainPlaceOf

$\top \sqsubseteq \leq 1$ isMainPlaceOf$^-$ Thing

isMainPlaceOfDeliveryOf

isMainPlaceOfDeliveryOf $\sqsubseteq$ isMainPlaceOf

$\top \sqsubseteq \leq 1$ isMainPlaceOfDeliveryOf$^-$ Thing

isMainPlaceOfPerformanceOf

isMainPlaceOfPerformanceOf $\sqsubseteq$ isMainPlaceOf $\top \sqsubseteq \leq 1$ isMainPlaceOfPerformanceOf$^-$ Thing

isMainPlaceOfWorks

isMainPlaceOfWorks $\sqsubseteq$ isMainPlaceOf

$\top \sqsubseteq \leq 1$ isMainPlaceOfWorks$^-$ Thing

isObjectOf

$\exists$ isObjectOf Thing $\sqsubseteq$ ObjectOfContract

$\top \sqsubseteq \forall$ isObjectOf ProposedContract

isPlaceOfExecutionOf

Property chain axiom: isMainPlaceOf o isObjectOf $\sqsubseteq$ isPlaceOfExecutionOf

isPurchasingJointlyWith

$\exists$ isPurchasingJointlyWith Thing $\sqsubseteq$ BodyGovernedByPublicLaw $\sqcup$ PublicAuthority

$\top \sqsubseteq \forall$ isPurchasingJointlyWith (BodyGovernedByPublicLaw $\sqcup$ PublicAuthority)

isPurchasingOnBehalfOf

$\exists$ isPurchasingOnBehalfOf Thing $\sqsubseteq$ AuthoritiesAssociation $\sqcup$ BodiesGovernedByPublicLawAssociation $\sqcup$ BodyGovernedByPublicLaw $\sqcup$ CentralPurchasingBody $\sqcup$ EuropeanInstitutionOrInternationalOrganisation $\sqcup$ PublicAuthority

$\top \sqsubseteq \forall$ isPurchasingOnBehalfOf (AuthoritiesAssociation $\sqcup$ BodiesGovernedByPublicLawAssociation $\sqcup$ BodyGovernedByPublicLaw $\sqcup$ CentralPurchasingBody $\sqcup$ EuropeanInstitutionOrInternationalOrganisation $\sqcup$ PublicAuthority)

isSpecificationsDocumentOf

isSpecificationsDocumentOf $\sqsubseteq$ isAttachedDocumentOf

$\exists$ isSpecificationsDocumentOf Thing $\sqsubseteq$ SpecificationsDocument

isTypeOfProposal

$\exists$ isTypeOfProposal Thing $\sqsubseteq$ ProposedContractType

$\top \sqsubseteq \forall$ isTypeOfProposal ProposedPublicProcurementContract

isTypeOfTenderBid

$\top \sqsubseteq \leq 1$ isTypeOfTenderBid^{-} Thing

issuedBy

issuedBy $\sqsubseteq$ hasAuthor

$\exists$ issuedBy Thing $\sqsubseteq$ TenderDocument

issues

issues $\sqsubseteq$ isAuthorOf

$\top \sqsubseteq \forall$ issues TenderDocument

laysDownTermsAndConditionFor

$\exists$ laysDownTermsAndConditionFor Thing $\sqsubseteq$ ProposedFrameworkAgreement

$\top \sqsubseteq \forall$ laysDownTermsAndConditionFor ProposedPublicContract

legalContext

legalContext $\sqsubseteq$ context

$\exists$ legalContext Thing $\sqsubseteq$ LegalRole

mayBeDrawnUpInLanguage

$\exists$ mayBeDrawnUpInLanguage Thing $\sqsubseteq$ TenderBid

$\top \sqsubseteq \forall$ mayBeDrawnUpInLanguage Language

mayBeSubmittedForAward

$\exists$ mayBeSubmittedForAward Thing $\sqsubseteq$ TenderBid

$\top \sqsubseteq \forall$ mayBeSubmittedForAward ProposedPublicProcurementContract

member

$\exists$ member Thing $\sqsubseteq$ Organisation

$\top \sqsubseteq \forall$ member (NaturalPerson $\sqcup$ Organisation)

partOf

$\exists$ partOf Thing $\sqsubseteq$ ProposedPublicProcurementContract $\sqcap \exists$ typeOfProposal {Lot}

$\top \sqsubseteq \forall$ partOf (ProposedPublicProcurementContract $\sqcap \exists$ typeOfProposal {ProposedContractDividedInt

playsLegalRoleIn

playsLegalRoleIn $\sqsubseteq$ playsRoleIn

$\exists$ playsLegalRoleIn Thing $\sqsubseteq$ LegalPerson $\sqcup$ NaturalPerson

$\top \sqsubseteq \forall$ playsLegalRoleIn (Process $\sqcup$ Organisation)

Property chain axiom: playsRole o legalContext $\sqsubseteq$ playsLegalRoleIn

playsRole

$\exists$ playsRole Thing $\sqsubseteq$ Agent

$\top \sqsubseteq \forall$ playsRole Role

Property chain axiom: hasLegalSituation o role $\sqsubseteq$ playsRole

playsRoleIn

$\exists$ playsRoleIn Thing $\sqsubseteq$ Agent

$\top \sqsubseteq \forall$ playsRoleIn (Process $\sqcup$ Organisation)

Property chain axiom: playsRole o context $\sqsubseteq$ playsRoleIn

publishedIn

$\exists$ publishedIn Thing $\sqsubseteq$ TenderDocument

$\top \sqsubseteq \forall$ publishedIn OJEU-SeriesS

relatesToThePublicationOf

$\exists$ relatesToThePublicationOf Thing $\sqsubseteq$ NoticeOnBuyerProfile

$\top \sqsubseteq \forall$ relatesToThePublicationOf (PeriodicIndicativeNoticeWithoutCallForCompetition $\sqcup$ PriorInformationNotice)

role

$\exists$ role Thing $\sqsubseteq$ SubjectiveLegalSituation

$\top \sqsubseteq \forall$ role LegalRole

rolePlayedBy

$\exists$ rolePlayedBy Thing $\sqsubseteq$ Role

$\top \sqsubseteq \forall$ rolePlayedBy Agent

subjectToTermsAndConditionsLaidDownWith

$\exists$ subjectToTermsAndConditionsLaidDownWith Thing $\sqsubseteq$ ProposedPublicContract

$\top \sqsubseteq \forall$ subjectToTermsAndConditionsLaidDownWith ProposedFrameworkAgreement

throughWhichIsAnnounced

$\exists$ throughWhichIsAnnounced Thing $\sqsubseteq$ ContractNotice $\sqcup$ DesignContestNotice $\sqcup$ PeriodicIndicativeNoticeWithCallForCompetition $\sqcup$ PublicWorkConcessionNotice $\sqcup$ QualificationSystemWithCallForCompetitionNotice $\sqcup$ QualificationSystemWithoutCallForCompetitionNotice $\sqcup$ SimplifiedContractNoticeOnADynamicPurchasingSystem

$\top \sqsubseteq \forall$ throughWhichIsAnnounced ProcurementCompetitiveProcess

throughWhichIsAnnouncedForthcoming

throughWhichIsAnnouncedForthcoming

$\exists$ throughWhichIsAnnouncedForthcoming Thing $\sqsubseteq$ PeriodicIndicativeNoticeWithoutCallForCompetition $\sqcup$ PriorInformationNotice

$\top \sqsubseteq \forall$ throughWhichIsAnnouncedForthcoming Tender

throughWhichIsAnnouncedTenderForAward

$\exists$ throughWhichIsAnnouncedTenderForAward Thing $\sqsubseteq$ TenderDocument

$\top \sqsubseteq \forall$ throughWhichIsAnnouncedTenderForAward ProposedPublicProcurementContract

Property chain axiom: throughWhichIsAnnouncedTender o forAwardOf $\sqsubseteq$ throughWhichIsAnnouncedTenderForAward

throughWhichIsAnnouncedTenderForAwardLot

$\exists$ throughWhichIsAnnouncedTenderForAwardLot Thing $\sqsubseteq$ TenderDocument

$\top \sqsubseteq \forall$ throughWhichIsAnnouncedTenderForAwardLot (ProposedPublicContract $\sqcap \exists$ typeOfProposal {Lot})

Property chain axiom: throughWhichIsAnnouncedTenderForAward o isDividedInto $\sqsubseteq$ throughWhichIsAnnouncedTenderForAwardLot

typeOfProposal

$\exists$ typeOfProposal Thing $\sqsubseteq$ ProposedPublicProcurementContract

$\top \sqsubseteq \forall$ typeOfProposal ProposedContractType

typeOfTenderBid

$\top \sqsubseteq \leq 1$ typeOfTenderBid Thing

$\exists$ typeOfTenderBid Thing $\sqsubseteq$ TenderBid

$\top \sqsubseteq \forall$ typeOfTenderBid TypeOfTenderBid

Data properties

CPVcode

$\top \sqsubseteq \leq 1$ CPVcode

$\exists$ CPVcode Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ ProductOrServiceOrWork

$\top \sqsubseteq \forall$ CPVcode Datatypehttp://www.w3.org/2001/XMLSchemainteger

NUTScode

NUTScode

$\sqsubseteq$ topDataProperty

$\top \sqsubseteq \leq 1$ NUTScode

$\top \sqsubseteq \forall$ NUTScode Datatypehttp://www.w3.org/2001/XMLSchemastring

OJEUnumber

OJEUnumber

$\exists$ OJEUnumber Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ OJEU-SeriesS

$\top \sqsubseteq \forall$ OJEUnumber Datatypehttp://www.w3.org/2001/XMLSchemainteger

admitsVariants

admitsVariants

$\exists$ admitsVariants Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ Proposed-Contract

$\top \sqsubseteq \forall$ admitsVariants Datatypehttp://www.w3.org/2001/XMLSchemaboolean

categoryNumber

categoryNumber

$\top \sqsubseteq \leq 1$ categoryNumber

$\exists$ categoryNumber Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ Service

$\top \sqsubseteq \forall$ categoryNumber Datatypehttp://www.w3.org/2001/XMLSchemainteger

deadline

deadline

$\top \sqsubseteq \forall$ deadline Datatypehttp://www.w3.org/2001/XMLSchemadateTime

description

description

$\top \sqsubseteq \forall$ description Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral

documentTitle

documentTitle

$\top \sqsubseteq \forall$ documentTitle Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral

durationOfContractInDays

durationOfContractInDays

$\exists$ durationOfContractInDays Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ ProposedContract

$\top \sqsubseteq \forall$ durationOfContractInDays Datatypehttp://www.w3.org/2001/XMLSchemainteger

durationOfContractInMonths

durationOfContractInMonths

$\exists$ durationOfContractInMonths Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ ProposedContract

$\top \sqsubseteq \forall$ durationOfContractInMonths Datatypehttp://www.w3.org/2001/XMLSchemainteger

hasCurrency

hasCurrency

$\top \sqsubseteq \forall$ hasCurrency Datatypehttp://www.w3.org/2001/XMLSchemastring

hasCurrencyEstimatedValue

hasCurrencyEstimatedValue

$\sqsubseteq$ hasMaxCurrencyEstimatedValue

$\sqsubseteq$ hasMinCurrencyEstimatedValue

$\exists$ hasCurrencyEstimatedValue Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ EstimatedValueOfContract

$\top \sqsubseteq \forall$ hasCurrencyEstimatedValue Datatypehttp://www.w3.org/2001/XMLSchemafloat

hasMaxCurrencyEstimatedValue

hasMaxCurrencyEstimatedValue

$\exists$ hasMaxCurrencyEstimatedValue Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ EstimatedValueOfContract

$\top \sqsubseteq \forall$ hasMaxCurrencyEstimatedValue Datatypehttp://www.w3.org/2001/XMLSchemafloat

hasMinCurrencyEstimatedValue

hasMinCurrencyEstimatedValue

$\exists$ hasMinCurrencyEstimatedValue Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ EstimatedValueOfContract

$\top \sqsubseteq \forall$ hasMinCurrencyEstimatedValue Datatypehttp://www.w3.org/2001/XMLSchemafloat

hasOpeningDateTime

hasOpeningDateTime

$\exists$ hasOpeningDateTime Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ TenderBid

$\top \sqsubseteq \forall$ hasOpeningDateTime Datatypehttp://www.w3.org/2001/XMLSchemadateTime

hasStartingDate

hasStartingDate

$\exists$ hasStartingDate Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ ProposedContract

$\top \sqsubseteq \forall$ hasStartingDate Datatypehttp://www.w3.org/2001/XMLSchemadateTime

hasTimeLimitForCompletion

hasTimeLimitForCompletion

$\exists$ hasTimeLimitForCompletion Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ ProposedContract

$\top \sqsubseteq \forall$ hasTimeLimitForCompletion Datatypehttp://www.w3.org/2001/XMLSchemadateTime

hasWeighting

hasWeighting

$\exists$ hasWeighting Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ Criterion

$\top \sqsubseteq \forall$ hasWeighting Datatypehttp://www.w3.org/2001/XMLSchemainteger

heading

heading

$\exists$ heading Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ TenderDocument

$\top \sqsubseteq \forall$ heading Datatypehttp://www.w3.org/2001/XMLSchemastring

isDividedIntoLots

isDividedIntoLots

$\exists$ isDividedIntoLots Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ ProposedPublicProcurementContract

$\top \sqsubseteq \forall$ isDividedIntoLots Datatypehttp://www.w3.org/2001/XMLSchemaboolean

mayBeSubmittedAtInternetAddress

mayBeSubmittedAtInternetAddress

$\exists$ mayBeSubmittedAtInternetAddress Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ TenderBid

$\top \sqsubseteq \forall$ mayBeSubmittedAtInternetAddress Datatypehttp://www.w3.org/2001/XMLSchemaanyURI

option

option

$\exists$ option Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ ProposedContract

$\top \sqsubseteq \forall$ option Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral

originalCPVcode

originalCPVcode

$\top \sqsubseteq \leq 1$ originalCPVcode

$\exists$ originalCPVcode Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ ProductOrServiceOrWork

$\top \sqsubseteq \forall$ originalCPVcode Datatypehttp://www.w3.org/2001/XMLSchemainteger

publicationDate

publicationDate

$\top \sqsubseteq \forall$ publicationDate Datatypehttp://www.w3.org/2001/XMLSchemadateTime

publicationDate

publicationDate

sendingDate

sendingDate

sendingDate

sendingDate

∃ sendingDate Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral ⊑ TenderDocument

⊤ ⊑ ∀ sendingDate Datatypehttp://www.w3.org/2001/XMLSchemadateTime

subjectToPayment

subjectToPayment

∃ subjectToPayment Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral ⊑ AttachedTenderDocument

⊤ ⊑ ∀ subjectToPayment Datatypehttp://www.w3.org/2001/XMLSchemaboolean

subjectToRenewal

subjectToRenewal

∃ subjectToRenewal Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral ⊑ ProposedContract

⊤ ⊑ ∀ subjectToRenewal Datatypehttp://www.w3.org/2001/XMLSchemaboolean

tenderDocumentNumber

tenderDocumentNumber

∃ tenderDocumentNumber Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral ⊑ TenderDocument

⊤ ⊑ ∀ tenderDocumentNumber Datatypehttp://www.w3.org/2001/XMLSchemastring

timeLimitForRequestOrForAccessing

timeLimitForRequestOrForAccessing

∃ timeLimitForRequestOrForAccessing Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral ⊑ AttachedTenderDocument

$\top \sqsubseteq \forall$ timeLimitForRequestOrForAccessing Datatypehttp://www.w3.org/2001/XMLSchemadateTime

topDataProperty

topDataProperty

valueAddedTaxIncluded

valueAddedTaxIncluded

$\exists$ valueAddedTaxIncluded Datatypehttp://www.w3.org/2000/01/rdf-schemaLiteral $\sqsubseteq$ EstimatedValueOfContract

$\top \sqsubseteq \forall$ valueAddedTaxIncluded Datatypehttp://www.w3.org/2001/XMLSchemaboolean

Appendix B

LOTED2 Core ontology coding in OWL Manchester Syntax

B.1 *LOTED2-Core* ontology coding in OWL Manchester Syntax

```
1
2  Prefix: owl: <http://www.w3.org/2002/07/owl#>
3  Prefix: rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
4  Prefix: xml: <http://www.w3.org/XML/1998/namespace>
5  Prefix: xsd: <http://www.w3.org/2001/XMLSchema#>
6  Prefix: rdfs: <http://www.w3.org/2000/01/rdf-schema#>
7
8
9
10 Ontology: <http://www.semanticweb.org/ontologies/2012/7/LOTED2-core.owl>
11
12 Import: <http://www.semanticweb.org/ontologies/2012/6/LOTED2-core/
       ProcurementsSubjectiveScope.owl>
13 Import: <http://www.semanticweb.org/ontologies/2012/7/
       SubjectiveLegalSituationsInProcurements.owl>
14 Import: <http://www.semanticweb.org/ontologies/2012/3/Tender_documents.owl>
15 Import: <http://www.semanticweb.org/ontologies/2012/0/ProposedContract.owl>
16
17 Annotations:
18     rdfs:label "LOTED2-core"@en,
19     owl:versionInfo "1.0"@en,
20     rdfs:comment "LOTED2 is a legal ontology of European procurement notices and
       for describing the data extracted from TED system. "@en
21
22 AnnotationProperty: owl:versionInfo
23
24
25 AnnotationProperty: rdfs:label
26
```

```
27
28 AnnotationProperty: rdfs:comment
29
30
31 AnnotationProperty: <http://www.semanticweb.org/ontologies/2012/7/
       ProcurementCompetitiveProcess.owl#forAwardOf>
32
33
34 Datatype: rdf:PlainLiteral
35
36
37 ObjectProperty: <http://www.semanticweb.org/ontologies/2012/3/Loted2-TenderOffer.
       owl#typeOfTenderBid>
38
39
40 ObjectProperty: <http://www.semanticweb.org/ontologies/2012/7/LOTED2-core.owl#
       throughWhichIsAnnouncedTenderForAwardLot>
41
42     Annotations:
43         rdfs:label "through which is announced tender for award lot (0..*)"@en
44
45     SubPropertyChain:
46         <http://www.semanticweb.org/ontologies/2012/7/LOTED2-core.owl#
       throughWhichIsAnnouncedTenderForAward> o <http://www.semanticweb.org/
       ontologies/2012/0/ted.owl#isDividedInto>
47
48     Domain:
49         <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents.owl
       #TenderDocument>
50
51     Range:
52         <http://www.semanticweb.org/ontologies/2012/0/ted.owl#
       ProposedPublicContract>
53          and (<http://www.semanticweb.org/ontologies/2012/0/ted.owl#
       typeOfProposal> value <http://www.semanticweb.org/ontologies/2012/0/Loted2-
       contract.owl#Lot>)
54
55
56 ObjectProperty: <http://www.semanticweb.org/ontologies/2012/3/Tender_documents.
       owl#throughWhichIsAnnounced>
57
58
59 ObjectProperty: <http://www.semanticweb.org/ontologies/2012/0/Loted2-contract.owl
       #mayBeSubmittedForAward>
60
61
62 ObjectProperty: <http://www.semanticweb.org/ontologies/2012/4/Loted2-
       EconomicOperator.owl#hasSubmitted>
63
64
65 ObjectProperty: <http://www.semanticweb.org/ontologies/2012/3/
       ProcurementsTopClasses.owl#context>
66
67
```

```
68  ObjectProperty: <http://www.semanticweb.org/ontologies/2012/3/Loted2-
        tender_documents.owl#isCoveredBy>
69
70
71  ObjectProperty: <http://www.semanticweb.org/ontologies/2012/0/ted.owl#
        isDividedInto>
72
73
74  ObjectProperty: <http://www.semanticweb.org/ontologies/2012/0/ted.owl#
        typeOfProposal>
75
76
77  ObjectProperty: <http://www.semanticweb.org/ontologies/2012/7/BusinessEntity.owl#
        hasSought>
78
79      Range:
80          <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents.owl
        #InvitationToSubmitATender>
81
82
83  ObjectProperty: <http://www.semanticweb.org/ontologies/2012/7/
        ProcurementCompetitiveProcess.owl#forAwardOf>
84
85      Range:
86          <http://www.semanticweb.org/ontologies/2012/0/ted.owl#
        ProposedPublicProcurementContract>
87
88
89  ObjectProperty: <http://www.semanticweb.org/ontologies/2012/3/Tender_documents.
        owl#issuedBy>
90
91
92  ObjectProperty: <http://www.semanticweb.org/ontologies/2012/7/
        ProcurementCompetitiveProcess.owl#forAwardLot>
93
94      SubPropertyChain:
95          <http://www.semanticweb.org/ontologies/2012/7/
        ProcurementCompetitiveProcess.owl#forAwardOf> o <http://www.semanticweb.org/
        ontologies/2012/0/ted.owl#isDividedInto>
96
97      Range:
98          <http://www.semanticweb.org/ontologies/2012/0/ted.owl#
        ProposedPublicContract>
99           and (<http://www.semanticweb.org/ontologies/2012/0/ted.owl#
        typeOfProposal> value <http://www.semanticweb.org/ontologies/2012/0/Loted2-
        contract.owl#Lot>)
100
101
102 ObjectProperty: <http://www.semanticweb.org/ontologies/2012/3/
        ProcurementsTopClasses.owl#rolePlayedBy>
103
104
105 ObjectProperty: <http://www.semanticweb.org/ontologies/2012/7/LOTED2-core.owl#
        throughWhichIsAnnouncedTenderForAward>
106
```

```
    Annotations:
        rdfs:comment "This property is a shortcut to express for the award of
    which contract is issued the notice."@en,
        rdfs:label "through which is announced tender for award (1..*)"@en

    SubPropertyChain:
        <http://www.semanticweb.org/ontologies/2012/3/Tender_documents.owl#
    throughWhichIsAnnounced> o <http://www.semanticweb.org/ontologies/2012/7/
    ProcurementCompetitiveProcess.owl#forAwardOf>

    Domain:
        <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents.owl
    #TenderDocument>

    Range:
        <http://www.semanticweb.org/ontologies/2012/0/ted.owl#
    ProposedPublicProcurementContract>


Class: <http://www.semanticweb.org/ontologies/2012/0/ted.owl#
    ProposedPublicProcurementContract>


Class: <http://www.semanticweb.org/ontologies/2012/7/
    SubjectiveLegalSituationsInProcurements.owl#Candidate>

    EquivalentTo:
        <http://www.semanticweb.org/ontologies/2012/7/
    SubjectiveLegalSituationsInProcurements.owl#RoleInProcurement>
         and (<http://www.semanticweb.org/ontologies/2012/3/
    ProcurementsTopClasses.owl#rolePlayedBy> only
            ((<http://www.semanticweb.org/ontologies/2012/3/ted-top.owl#
    LegalPerson>
             or <http://www.semanticweb.org/ontologies/2012/3/ted-top.owl#
    NaturalPerson>)
             and (<http://www.semanticweb.org/ontologies/2012/7/BusinessEntity.
    owl#hasSought> some <http://www.semanticweb.org/ontologies/2012/3/Loted2-
    tender_documents.owl#InvitationToSubmitATender>)))


Class: <http://www.semanticweb.org/ontologies/2012/7/
    SubjectiveLegalSituationsInProcurements.owl#RoleInProcurement>

    EquivalentTo:
        <http://www.semanticweb.org/ontologies/2012/3/ProcurementsTopClasses.owl#
    LegalRole>
         and (<http://www.semanticweb.org/ontologies/2012/3/
    ProcurementsTopClasses.owl#context> only <http://www.semanticweb.org/
    ontologies/2012/7/ProcurementCompetitiveProcess.owl#
    ProcurementCompetitiveProcess>)


Class: <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents.owl#
    ContractNotice-Utilities>

```

```
143     SubClassOf:
144         <http://www.semanticweb.org/ontologies/2012/3/Tender_documents.owl#
        issuedBy> only <http://www.semanticweb.org/ontologies/2012/6/Loted2-
        AwardingLegalEntity.owl#EntityOperatingInUtilities>
145
146
147 Class: <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents.owl#
        QualificationSystemNotice>
148
149     SubClassOf:
150         <http://www.semanticweb.org/ontologies/2012/3/Tender_documents.owl#
        issuedBy> only <http://www.semanticweb.org/ontologies/2012/6/Loted2-
        AwardingLegalEntity.owl#EntityOperatingInUtilities>
151
152
153 Class: <http://www.semanticweb.org/ontologies/2012/7/
        SubjectiveLegalSituationsInProcurements.owl#ContractingAuthority>
154
155     EquivalentTo:
156         <http://www.semanticweb.org/ontologies/2012/7/
        SubjectiveLegalSituationsInProcurements.owl#RoleInProcurement>
157          and (<http://www.semanticweb.org/ontologies/2012/3/
        ProcurementsTopClasses.owl#rolePlayedBy> only <http://www.semanticweb.org/
        ontologies/2012/6/Loted2-AwardingLegalEntity.owl#
        EntityOperatingInOrdinarySectors>)
158
159
160 Class: <http://www.semanticweb.org/ontologies/2012/6/Loted2-AwardingLegalEntity.
        owl#EntityOperatingInOrdinarySectors>
161
162
163 Class: <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents.owl#
        InvitationToSubmitATender>
164
165
166 Class: <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents.owl#
        ContractNotice-PublicSectors>
167
168     SubClassOf:
169         <http://www.semanticweb.org/ontologies/2012/3/Tender_documents.owl#
        issuedBy> only <http://www.semanticweb.org/ontologies/2012/6/Loted2-
        AwardingLegalEntity.owl#EntityOperatingInOrdinarySectors>
170
171
172 Class: <http://www.semanticweb.org/ontologies/2012/7/
        ProcurementCompetitiveProcess.owl#Tender>
173
174
175 Class: <http://www.semanticweb.org/ontologies/2012/3/ted-top.owl#LegalPerson>
176
177
178 Class: <http://www.semanticweb.org/ontologies/2012/3/ted-top.owl#NaturalPerson>
179
180
```

```
181 Class: <http://www.semanticweb.org/ontologies/2012/3/Loted2-TenderOffer.owl#
        TenderBid>
182
183
184 Class: <http://www.semanticweb.org/ontologies/2012/7/
        ProcurementCompetitiveProcess.owl#ProcurementCompetitiveProcess>
185
186
187 Class: <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents.owl#
        PeriodicIndicativeNotice>
188
189     SubClassOf:
190         <http://www.semanticweb.org/ontologies/2012/3/Tender_documents.owl#
        issuedBy> only <http://www.semanticweb.org/ontologies/2012/6/Loted2-
        AwardingLegalEntity.owl#EntityOperatingInUtilities>
191
192
193 Class: <http://www.semanticweb.org/ontologies/2012/0/ted.owl#
        ProposedPublicContract>
194
195
196 Class: <http://www.semanticweb.org/ontologies/2012/6/Loted2-AwardingLegalEntity.
        owl#EntityOperatingInUtilities>
197
198
199 Class: <http://www.semanticweb.org/ontologies/2012/3/ProcurementsTopClasses.owl#
        LegalRole>
200
201
202 Class: <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents.owl#
        TenderDocument>
203
204
205 Class: <http://www.semanticweb.org/ontologies/2012/7/
        SubjectiveLegalSituationsInProcurements.owl#ContractingEntity>
206
207     EquivalentTo:
208         <http://www.semanticweb.org/ontologies/2012/7/
        SubjectiveLegalSituationsInProcurements.owl#RoleInProcurement>
209          and (<http://www.semanticweb.org/ontologies/2012/3/
        ProcurementsTopClasses.owl#rolePlayedBy> only <http://www.semanticweb.org/
        ontologies/2012/6/Loted2-AwardingLegalEntity.owl#EntityOperatingInUtilities>)
210
211
212 Class: <http://www.semanticweb.org/ontologies/2012/0/ted.owl#ProposedContract>
213
214
215 Class: <http://www.semanticweb.org/ontologies/2012/7/
        SubjectiveLegalSituationsInProcurements.owl#Tenderer>
216
217     EquivalentTo:
218         <http://www.semanticweb.org/ontologies/2012/7/
        SubjectiveLegalSituationsInProcurements.owl#RoleInProcurement>
219          and (<http://www.semanticweb.org/ontologies/2012/3/
        ProcurementsTopClasses.owl#rolePlayedBy> only
```

```
220             ((<http://www.semanticweb.org/ontologies/2012/3/ted-top.owl#
    LegalPerson>
221              or <http://www.semanticweb.org/ontologies/2012/3/ted-top.owl#
    NaturalPerson>)
222              and (<http://www.semanticweb.org/ontologies/2012/4/Loted2-
    EconomicOperator.owl#hasSubmitted> some <http://www.semanticweb.org/
    ontologies/2012/3/Loted2-TenderOffer.owl#TenderBid>)))
223
224
225 Individual: <http://www.semanticweb.org/ontologies/2012/0/
    ProposedContractNotDividedIntoLots>
226
227
228 Individual: <http://www.semanticweb.org/ontologies/2012/7/LOTED2-core.owl#Tender1
    >
229
230     Annotations:
231         <http://www.semanticweb.org/ontologies/2012/7/
    ProcurementCompetitiveProcess.owl#forAwardOf> <http://www.semanticweb.org/
    ontologies/2012/0/Loted2-contract.owl#ProposedContract1>
232
233     Types:
234         <http://www.semanticweb.org/ontologies/2012/7/
    ProcurementCompetitiveProcess.owl#Tender>
235
236     Facts:
237      <http://www.semanticweb.org/ontologies/2012/7/ProcurementCompetitiveProcess.
    owl#forAwardOf>  <http://www.semanticweb.org/ontologies/2012/0/Loted2-
    contract.owl#ProposedContract1>
238
239
240 Individual: <http://www.semanticweb.org/ontologies/2012/0/Loted2-contract.owl#Lot
    >
241
242
243 Individual: <http://www.semanticweb.org/ontologies/2012/3/Loted2-TenderOffer.owl#
    GlobalTenderBid>
244
245
246 Individual: <http://www.semanticweb.org/ontologies/2012/0/
    ProposedContractDividedIntoLots>
247
248
249 Individual: <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents
    .owl#Notice1>
250
251     Facts:
252      <http://www.semanticweb.org/ontologies/2012/7/LOTED2-core.owl#
    throughWhichIsAnnouncedTenderForAward>  <http://www.semanticweb.org/
    ontologies/2012/0/Loted2-contract.owl#ProposedContract1>,
253      <http://www.semanticweb.org/ontologies/2012/3/Tender_documents.owl#
    throughWhichIsAnnounced>  <http://www.semanticweb.org/ontologies/2012/7/
    LOTED2-core.owl#Tender1>
254
255
```

```
256 Individual: <http://www.semanticweb.org/ontologies/2012/3/Loted2-TenderOffer.owl#
        PartialTenderBid>
257
258
259 Individual: <http://www.semanticweb.org/ontologies/2012/3/Loted2-TenderOffer.owl#
        GlobalOrPartialTenderBid>
260
261
262 Individual: <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents
        .owl#Directive2004/18/EC>
263
264
265 Individual: <http://www.semanticweb.org/ontologies/2012/0/Loted2-contract.owl#
        ProposedContract1>
266
267
268 Individual: <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents
        .owl#Directive2004/17/EC>
269
270
271 Individual: <http://www.semanticweb.org/ontologies/2012/3/Loted2-tender_documents
        .owl#4-EuropeanUnion>
```

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