OPJK modeling methodology

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abstract

In the legal domain, ontologies enjoy quite some reputation as a way to model normative knowledge about laws and jurisprudence. Several methods have been used and are well-known qua ontological methods. However, no previous attempt to construct ontologies based on professional knowledge exists, capturing judicial practical expertise. This paper shows the preliminary ontology development for the second version of the prototype Iuriservice, a web based intelligent FAQ for judicial use, containing a repository of professional judicial knowledge. The iFAQ system will focus on such knowledge and will base on OPLK —Ontology of Professional Legal Knowledge— developed by UAB. Profesional Legal Knowledge refers to the core of professional work that contains the experience of the daily treatment of cases and is unevenly distributed within individuals as a result of their professional and personal experiences. The knowledge acquisition process has been based on an ethnographic process designed by the UAB team and the Spanish School of the Judiciary within the national SEC project, to efficiently obtain useful and representative information from questionnaire-based interviews. Nearly 800 competency questions have been extracted from these interviews and the ontology is being modelled from the selection of relevant terms. Regarding ontology modelling issues, we have followed the DILIGENT argumentation methodology to control the discussion and trace the arguments used in favor or against the introduction of a concept X as part of the domain ontology. This paper presents the preliminary Ontology of Professional Judicial Knowledge (OPJK) that has been extracted manually from the selection of relevant terms from nearly 200 competency questions and affirms that the modelling of this professional judicial knowledge demands the description of this knowledge as it is perceived by the judge and the abandonment of dogmatic legal categorizations.

1. Introduction

The development of *Iuriservice* prototype II will provide Spanish judges with access to frequently asked questions (FAQ) through a natural language interface. The system will respond to the question posed by the judge with a list of question-answer pairs that offer solutions to the problem and a set of related and relevant case rulings. Thus, the software will be capable of clearing up doubts concerning judicial practice and caseload resolution by providing justified and uniform answers to the questions raised by newly recruited judges, avoiding possible inconsistencies. Ontologies are being used to provide a more accurate search than the basic keyword search.

The accuracy and the validity of the knowledge repository is critical. For this reason, two national surveys have been conducted as a primary source of data regarding both the context of use and the contents of the questions to which the system.[1] These surveys have offered interesting and important data to elaborate the user's profile. There are three aspects of the professional profile of judges most relevant to our project. The first one involves the frequency with which the new judge talks about the cases he is dealing with. Only 4.71% of the judges interviewed stated that they never exchange information concerning their cases with others, usually peers. Secondly, judges offer an interesting answer to the question of "which would you like to find if judges were given a web service system?". The majority of them proposed a site where doubts regarding professional cases could be put in common and discussed. Finally, the surveys allowed us to identify questions related to three

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main areas which presented some difficulties to new judges: (i) the organization and management of judicial staff (clerks working in judicial units); (ii) the interpretation and implementation of new procedural statutes; (iii) the "on-duty" period.

These competency questions obtained from the judges are analyzed using two different software applications TextToOnto[2] and ALCESTE[3], in order to extract relevant terms and identify knowledge domains, respectively. Finally, we follow the Distributed, Loosely-controlled and evolving Engineering of oNTologies (DILIGENT) methodology during the ontology engineering process (Pinto et al. 2004). The visualization of the arguments takes place on a wiki-based environment which allows them to be traced.

2. Legal Ontologies

Legal ontologies have played a part in the process to help structure legal knowledge and create knowledge management tools. Many legal ontologies have been built so far.[4]

In the legal field, the modeling process usually requires an intermediate theoretical level in which several concepts are implicit or explicitly related to a set of decisions about the nature of law, the kind of language used to represent legal knowledge, and the specific legal structure covered by the ontology. There is an *interpretative* level that is commonly linked to general theories of law. This intermediate level is a well-known layer between the upper-top and the domain-specific ontologies, especially in the so-called "practical ontologies".[5]

The interpretative middle level in which all fundamental concepts are defined is usually known as a *Legal-Core Ontology*. Breuker & Winkels (2003) have recently distinguished between legal ontologies originally based on normative knowledge (legal theory) and legal ontologies –or "with an ontological flavour"- in which modalities play the role of knowledge categories. This would be the case for McCarty's LDD or for deontic logic formulations applied to the legal domain (rethinking the hohfeldian conceptions[6] or based on modal linguistic functions: obligatory, forbidden, permitted…). However, in both cases, the fundamental concepts are epistemologically set within a Legal-Core Ontology, that is to say, an ontological representation of basic legal knowledge, in which the theoretical representation of abstract rights and duties count much more than the practical aim of a hypothetical user. Legal reasoning prevails over practical purposes.

2.1. Professional Legal Knowledge

We could say that a counsel shares with the judge, the prosecutor or other court staff only a portion of the legal knowledge (very likely the legal language and the most general acquaintance of statutes and previous judgments). But there is another kind of legal knowledge, the one having to do with personal behavior, practical rules, corporate beliefs, effect reckoning and perspective on similar cases, which remain implicit and tacit within the relation among judges, prosecutors, attorneys and lawyers.

Although the legal domain remains very sensitive to the features of regional or national statutes and regulations, some of the Legal-Core Ontologies (LCO) are intended to share a common kernel of legal notions. Therefore, LCO remain in the domain of a general knowledge shared by legal theorists, national or international jurists and comparative lawyers. Our data indicate that there is a kind of specific legal knowledge, which belongs properly to the expert domain and that is not being captured by the current LCO.

What is at stake here is a different kind of legal knowledge, a *professional legal knowledge* [PLK] (Benjamins et al., 2004a, 2004b, 2005).

In this regard, the design of legal ontologies requires not only to represent the legal, normative language of written documents (decisions, judgments, rulings, partitions…) but also those chunks of professional knowledge from the daily practice at courts.

One of the main features of PLK is that it is context-sensitive, anchored in courses of action or practical ways of behaving. In this sense, it implies: (i) the ability to discriminate among related but different situations (e.g. when is it really needed or required to issue an injunction of protection to prevent a woman of being injured or murdered by her husband?); (ii) the practical attitude or disposition to rule, judge or make a decision; (iii) the ability to relate new and past experiences of cases; (iv) the ability to share and discuss these experiences with the peer group.

2.2. Professional Legal Knowledge

Especially in the judicial field PLK presents two additional features: (i) the attunement process produced in the everyday decision making with previous "organizational memory" of senior peers (institutional process); (ii) the need to ground each new ruling on past jurisprudential decisions (legitimacy process). The first process is almost completely tacit, but the second is totally explicit in the judicial ruling: there is a substantial part for it within the written ruling named *fundamentos de derecho* [legal grounds]. To accomplish the ruling task it is required to carry out this two parallel information processes.

In order to build ontologies of professional legal knowledge, we believe that we have to take into account the kind of *situated knowledge* that judges put into practice when they store, retrieve and use their knowledge to make their most common decisions. We use "situated knowledge" in a similar way in which W.J. Clancey (1998) talks about "situated cognition": the concrete use of knowledge which is partially shared and unequally distributed through a certain "community of practice" who is able to use and reuse this same knowledge while transforming it.[7]

Building ontologies means entering a process in which this tacit knowledge is made conceptually explicit in a formal machine-readable language. But, because of its own nature, this is not made without some tensions.

On the one hand, for all practical purposes there is no such thing as absolute *meaning*: everything must ultimately be the result of agreements among human agents such as ontology engineers, domain experts and users (Jarrar & Meersman 2001). On the other hand, in ontology knowledge modeling a concept is neither a class nor a set: the concepts which represent the meaning of the terms are structured into binary trees based on couples of opposite differences (Roche 2000).

3. Capturing Professional Judicial Knowledge

Previous work have shown that ontology modeling methodology makes an extended use of many underlying assumptions about the user, about the task and about the domain (Visser 1998). Following CommonKADS, Visser's methodology for Legal Knowledge-Based Systems (LKBS) divides the design process into four separate phases: (i) an analysis phase, (ii) a conceptual modeling phase, (iii) a formal modeling phase, and (iv) an implementation phase. (Visser et al. 1997).

We think that there is a previous phase, concerning the social knowledge acquisiton. Capturing professional knowledge is a time consuming and often painstaking process implying different types of social techniques (usually surveys, interviews, participant observation, focus groups and expert panels). This means inferring social knowledge from protocols. The way in which this set of tasks is performed usually influences the ontological modeling. This problem deserves a separate reflection on what we will call "pragmatic integrated cycle" (from knowledge acquisition and ontology construction to the users' validation plan). We will just point it out in this paper, without going further.

4. OPJK development

Ontologies of Professional Legal Knowledge would model the situated knowledge of professionals at work. In our particular case we have before us a particular subset of Professional Legal Knowledge belonging specifically to the judicial field. Therefore, we will term the conceptual specification of knowledge contained in our empirical data Ontology of Judicial Professional Knowledge (OJPK). Modeling this professional judicial knowledge demands the description of this knowledge as it is perceived by the judge and the attunement of dogmatic legal categorizations. The way in which judges produce a different kind of knowledge through dogmatic legal categorizations it is not clear yet. But the assumption that their reasoning process follow some specific dogmatic patterns is not required.

To model this ontology, first, we have had to acquire the judicial professional knowledge as it can be collected and reconstructed from regular data. The work on the ethnographic field offered us a set of protocols (literal transcriptions of the interviews, the completed questionnaires and the extracted questions) containing this knowledge.[8]

Once the knowledge is obtained, the construction of the ontology is based on the term and relation extraction from the questions regarding judicial practical problems posed by the judges during their interviews. Due to the fact that at that time semi-

automatic extraction software for Spanish was not available, the extraction is performed manually, nevertheless, tools such as TextToOnto and ALCESTE were used to support manual term extraction. Finally, in order to model the ontology, decisons are taken following the DILIGENT argumentation model.

4.1. Question-based discussion

The method used to build up the ontology has focused on the discussion within the UAB legal experts team over the terms which appear on the competency questions. It starts with the selection (underlying) of all nouns (*usually* concepts) and adjectives (*usually* properties) contained in the competency questions. Once the terms had been identified, the team discusses the need to represent them within the ontology and their place within the taxonomy. We follow the *middle-out strategy* (Gómez-Pérez et al. 2002) so, first, we identifie the terms and then we specifie and generalize them if necessary. Finally, the relevant relations between those terms are also identified.

As an example of the use of the middle-out strategy in the legal case study ontology.and in relation to the competency questions analyzed above, modelers considered that the concepts *auto* [interlocutory decision], *recurso* [appeal], *demanda* [private/civil lawsuit] and *querella* [public/criminal lawsuit] needed to be represented in the ontology. Moreover, a concept *documento* [document] had to be created as all those terms *auto*, *recurso*, *demanda* and *querella* described documents. The result was the construction of a more general concept from the specific terms found in the competency questions. However, the team also agreed that *demanda*, *auto*, *recurso* and *querella* were not only instances of *documento* but also constituted a specific class of documents used only within the judicial process. For that reason, *documento_processal* [procedural document] had to be created as a subconcept of *documento*. At the same time, there are different types of appeals and court orders stated in the questions, that have to be considered instances of *recurso* and *auto*. In this case, the terms where specified, not generalized. However, difficulties in reaching consensual decisions and the lack of traceable lines of argumentation was slowing down the construction of the ontology. For that reason, the introduction of the Distributed, Loosely-controlled and evolving Engineering of oNTologies (DILIGENT), provided by the AIFB research team, offered a reliable basis for a controlled discussion of the arguments for and against a modeling decision. The introduction of DILIGENT proved the need to rely on guidelines for the decision-making process within ontology design. The use of DILIGENT speeded up the modeling process, as decisions were more easily reached and more concepts were agreed upon.

4.2. DILIGENT methodology

A methodology can be defined as an organised, documented set of procedures and guidelines for one or more phases of the life cycle, such as analysis or design. Many methodologies include a diagramming notation for documenting the results of the procedure; a step-by-step "cookbook" approach for carrying out the procedure; and an objective (ideally quantified) set of criteria for determining whether the results of the procedure are of acceptable quality.[9]

Currently, a number of methodologies are available: CommonKADS, Cyc, DOGMA, The Enterprise Ontology, KACTUS, SENSUS, TOVE, HCOME, METHONTOLOGY, Otc Methodology, etc.[10]

From our point of view argumentation visualization is mature from the research perspective. First attempts were made to combine findings from argumentation visualization and ontology engineering. However, as it is argued in (Potts & Burns 1988, de Moor & Aakhus 2003) argumentation is best supported when the methodology such as IBIS is customized with respect to the domain which is argued about. Hence, research is moving into the following directions:

- Identify the most relevant arguments in ontological discussions.
- Support synchronous as well as asynchronous discussions.

We will now describe the general process, roles and functions in the DILIGENT process. It comprises five main activities: (1) build, (2) local adaptation, (3) analysis, (4) revision, (5) local update (see figure 1 below). The process starts by having domain experts, users, knowledge engineers and ontology engineers building an initial ontology.

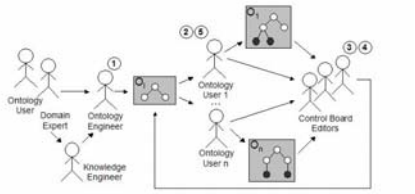

Figure 1. General process, roles and functions in DILIGENT

In contrast to known ontology engineering methodologies available in the literature (Gangemi et al. 1998, Gómez-Pérez et al. 2002, Pinto et al. 2001, Uschold & King 1995) we focus on distributed ontology development involving different stakeholders with different purposes and needs and usually not at the same location. Therefore, they require online ontology engineering support.

A central issue in the DILIGENT process is keeping track of threads of exchanged arguments.

We can identify several stages in which arguments play an essential part:

- Ontology is defined as "a shared specification of a conceptualization" (Gruber 1995). Although "shared" is an essential feature, it is often neglected. In DILIGENT experts exchange arguments while **building** the initial shared ontology in order to reach consensus;
- When users make comments and suggestions to the control board, based on their **local adaptations**, they are requested to provide the arguments supporting them;
- While the control board **analyses** the changes introduced and requested by users, and balances the different possibilities, arguments are exchanged and balanced to decide how the shared ontology should change.

There is evidence that distributed ontology development can be rather time consuming, complex and difficult, in particular getting agreement among domain experts. Therefore, one needs an appropriate framework to assure it in a speedier and easier way. In order to provide better support, we identify the kind of arguments that are more relevant and effective to reach consensus and restrict the discussion accordingly. The Rhetorical Structure Theory (RST) was applied to classify the kinds of arguments most often used and identify the most effective ones.

Previous experiments performed[11] provide strong indication—though not yet full-fledged evidence—that a restriction of possible arguments can enhance the ontology engineering effort in a distributed environment. Moreover, middle-out combined with appropriate argumentation and management can be used to quickly find a shared, consensual ontology even when participants must provide all and only written arguments.

The process could certainly be enhanced with better tool support. Besides the argumentation stack, an alternatives stack would be helpful. Arguments, in particular **elaboration**, **evaluation & justification** and **alternatives**, were discussed heavily during the experiments. However, the lack of appropriate evaluation measures made it difficult, at some times, for the contradicting opinions to achieve an agreement. The argumentation should then be focused on the evaluation criteria. The evaluation can take place off-line, or can be based on modelling advices from practical experience.

The argumentation stack was captured and tagged after the discussion in order to trace the arguments. As suggested for the discussion process, an accessible web based interface was offered in order to track the discussion. A standard wiki was used which supports seamless discussion and offers ease of use.

The ontology discussion wiki made all decisions transparent, traceable and available to all members of the team. However, the tool did not provide several features such as: visualization of the graphical representation of the ontology being built or a system of e-mail notifications when arguments had been added. To solve the recquirement of graphical visualization, the ontology modelling team extended the wiki with screenshots from the relevant parts of the ontology build with KAON OiModeler.

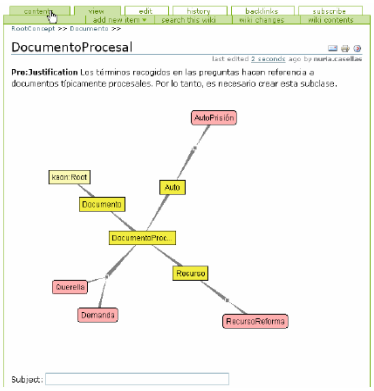

Figure 2. Screenshot of OPJK wiki discussion page

The wiki was the tool of choice because of the ease of use the technology promises and due to the availability of implementations of the technology. Keeping the argumentation stack up to date and discussing concepts was considered to be very easy with the help of the wiki. The success of projects like the Wikipedia was taken as an indicator towards the succesful use of the technology.

As we have seen the wiki technology allowed for a much better tracking of the argumentation than the previous approach. The effectively used engineering system was made up of several tools, used in parallel (thus leading often to work done more than once, due to the lack of interoperability of the tools). These tools were the wiki, used for the tracking of the argumenation, the KAON OI Modeler, used for the visualisation of the ontology, and Protégé, used for the formalisation of the ontology.

The experiences with this setup lead to the following requirements for a future tool for applying DILIGENT:

- more push-technolgies needs to be applied. Monitoring changes and the discussions of the ontology must be allowed: now, with the wiki, the user must actively look for changes in her domain of interest, but she cannot ask the system to actively tell her when a change occurs, either by an RSS-feed or by eMail-notification.
- a stronger integration with an ontology engineering environment will become crucial. For now the user had to keep the wiki up to date manually, as well as his formalised ontology in whatever tool he uses, be it Protégé or the KAON OI Modeler. The wiki is oblivious of its content and the relationship between the different pages.
- a visualisation is crucial. The users have gone great lengths to provide a visualisation manually, even if it meant a lot of manual work. A future tool must include some kind of visualisation and connect this to the captured argumentation.
- the data of the discussion is, due to the nature of the wiki, without enough structure. The system that will succeed the wiki must allow for a much stronger structure of the argumentation itself

Finally, to track the arguments and direct the discussion, DILIGENT suggests the role of moderator in the ontology development team. This role will be introduced in the further development of the and the change will be evaluated.

4.3. Ontology of Professional Judicial Knowledge (OPJK)

The Ontology of Professional Judicial Knowledge has, currently, nearly 50 concepts, 100 relations and more than 300 instances, as a result of a choice to minimize the concepts at the class level when possible in favor of creating instances and relations.

At the moment, some top classes of the domain ontology have been identified: *acto_procesal*, *órgano_judicial*, *calificación_jurídica*, *rol_procesal*, *documento_procesal*, *fase_procesal*, *jurisdicción*, *proceso_judicial*, *profesión_jurídica*, and *sanción*.

- *Acto_procesal* [procedural act] represents a specific action taking place in the course of a judicial procedure. A subclass of *acto_procesal* is *acto_de_comunicación* [communication act], a class that includes all those acts of communication made by the court.
- *Órgano_judicial* [court] is a subclass of *agente* [agent] from PROTON. It is a class of *organización* [organization] and can perform actions with or without consciousness. *Persona* [person] is also a subclass of agent.
- *Calificación_jurídica* [legal status] is a necessary class which consists of all those types of

crimes, felonies, misdemeanors or legal status regulated by norms or established by final rulings.

- *Fase_procesal* [procedural phase] is a important concept for the OPJK ontology as it represents the time phases in relation to the judicial process. This concept is subclass of fase [phase].
- Accordingly, *proceso_judicial* [judicial process] is a key concept for the OPJK ontology, as most of the questions are somehow related to procedural problems during on-duty periods or during normal opening hours.
- *Rol_procesal* [procedural role] is a subclass of role. A role is the part that an agent plays in a specific situation. The need for the *role* concept within the legal domain had also been contemplated in other relevant legal ontologies. In Breuker's et al. LegalCore Ontology, the LRI-Core is equipped with *role*, a subclass of *mental_entity*, described as a functional view on a *physical_object*, *agent_behaviour* or *mental_process*. For these authors, roles are played by persons who are agents (Breuker & Winkels 2003). Another approach to model *role* is the one presented by Gangemi et al. in the construction of Jur-(Ital)Wordnet (Jur-IWN) project, an extension to the legal domain of the Italian version of EuroWordnet. Jur-IWN has been based on the DOLCE foundational ontology. In the preliminary linking of legal concepts to DOLCE+, Jur-WordNet, contains that *natural_person* (considered a *physical_object*) is separated from functional roles. Under this point of view, judge, defendant and prosecutor would be functional roles, whether or not they are physical objects (Gangemi et al. 2003). We believe *role* to be a central concept to OPJK, although because of its complexity is still under revision. One *agente* [agents] might play several roles during a process or might have several opened processes where it plays different *roles*. The *role* played by the agent in the family has significance in the establishment of the sanctions.
- *Documento_jurídico* [procedural document] is a subclass of *documento* [document]. The argumentation has been already discussed above.
- Finally, *jurisdicción* [jurisdiction] and *sanción* [sanction] are relevant concepts regarding the geographical distribution of courts and the different types of sanctions (derived from civil or criminal liability), respectively.

Some properties/attributes of concepts and relations between concepts have also been identified and some are summarized in the following list:

Agente
− has_role
{instances of *rol*}
− is_involved_in
{instances of *hecho* [event]}
− has_state
{instances of *estado* [status]}
− has_location
{instances of *localización* [location]}

Acto_procesal
- has_document
{instances of *documento_procesal*}

Fase_procesal
− begins_with
− ends_with
− followed_by
{instances of *fase_procesal*}
− has_time_interval

Proceso_judicial
− has_phase
{instances of *Fase_procesal*}

Rol_procesal
− played_by
{instances of *agente* & instances of *profesión_jurídica*}
− has_time_interval

Nonetheless, the integration of this ontology into PROTON (Proto Ontology)[12], as part of the integration of SEKT technology, offers some constraints towards the engineering process. This integration implies that the Ontology for Professional Judicial Knowledge should include the System Module and Top Module from PROTON. The System Module *Entity*, *EntitySource*, *LexicalResource*, *Alias*, *SystemPrimitive*, *TransitiveOver* can be fully integrated and some Top Module classes such as *Entity*, *Agent*, *Document*, *Event*, *Organization*, *Person*, *Role* and *TimeInterval* are either being used already or could be easily integrated.

PROTON is a domain independent ontology and the specificity of the OPJK might require rearrangements. For that reason, although it is important to keep this two modules in mind, it is essential for the OPJK to model judicial knowledge as perceived by judges and that point of view has to be maintained when possible.

The ontology is still under construction, nearly 800 questions were obtained from the surveys, but more than 200 questions have already been discussed.

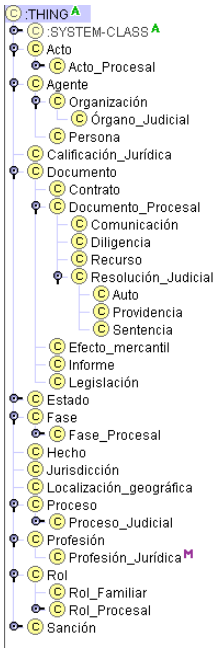

Figure 3. Preliminary structure of OPJK.

5. Conclusions

This paper has described the ontology development for the second version of the prototype *Iuriservice*, based on Ontologies of Professional Legal Knowledge developed by UAB. Professional Legal Knowledge refers to the core of professional work that contains the experience of the daily treatment of cases and is unevenly distributed within individuals as a result of their professional and personal experiences.

This paper presents the preliminary Ontology of Professional Judicial Knowledge that has been extracted manually from the selection of relevant terms from nearly 200 competency questions obtained through an extensive and complicated process of profesional knowledge acquisition. DILIGENT has been followed as a methodology to facilitate the decision among the terms and relations that had to be included within the ontology. The existence of a methodology and tool support has proved effective to speed up and ease the decision-making process. Nevertheless, specific requirements for tool support and methodology guidance, such as the moderator, have been identified and will be provided and integrated in the near future.

Above, we have described the main classes, concepts, instances, attributes and relations contained in the current version of the Ontology of Professional Judicial Knowledge. This ontology is still under development; first, there are still more than 500 competency questions to be analyzed. Second, the ontology, once integrated into the *Iuriservice II* prototype, will be tested for its efficiency in relation to the FAQ retrieval system. That will surely lead to an in-depth refinement process. Third, the competency questions will be analyzed with Text2Onto, when as a result of the work done within the SEKT Project, the Spanish components are integrated, then more information will be retrieved to refine the existing ontology.

OPJK modelling affirms that the modelling of professional judicial knowledge demands the description of this knowledge as it is perceived by the judge and the abandonment –or at least the attunement- of dogmatic legal categorizations.

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Endnotes

[1] For more information regarding the surveys and the prototypes see (Blázquez et al. 2004) and (Casanovas et al. 2004).The first prototype was developed from the data obtained during the first survey and the current prototype is being developed from the second ethnographic field work.

[2] TextToOnto is a tool embedded in the OiModeler platform which supports the semiautomatic creation of ontologies by applying text mining algorithms. Although TextToOnto is not currently provided with textual analyzer components in the Spanish language, it is able to identify important concepts and instances and also relevant relations (or associations) between those concepts that the judicial domain ontology has to take into account. Although TextToOnto will not be further developed, the Spanish GATE components, will be implemented into Text2Onto, a second version, with improved features (e.g. will allow the identification of synonyms and meronyms).http://ontoware.org/projects/text2onto.

[3] ALCESTE (Max Reinert 2002, 2003) classifies different subsets of a given textual corpus based on a hierarchical descending clustering algorithm. Successive dichotomies are carried out along the first axis of a factor analysis. Therefore, for a relative semantically homogeneous corpus, the program seeks the list of most characteristic words assembling subsets of "lexical worlds" according to a chi2 metric. This has proved to be useful to

flesh out the conceptual structure of the judicial competency questions.

[4] See (Valente 2005) for an insightful summary of the state of the art.

[5] "An interpretation is the mapping (semantics) from one application instance (conceptual schema) syntactically described in some language into the ontology base, which is assumed to contain conceptualizations of all relevant elementary facts. (…). The interpretation layer constitutes an intermediate level of abstraction through which ontology-based applications map their syntactical specification into an implementation of an ontology 'semantics'." (Jarrar & Meersman 2001).

[6] See the A-Hohfeld Language (Layman & Saxon 1995) and the extended LEGAL RELATIONS Language (Layman & Saxon 1997).

[7] "Situated cognition is an approach for understanding cognition that seeks to relate social, neural, and psychological views. From the social perspective, situated cognition provides insights about the content of knowledge, namely how people conceive of what they are doing in terms of their contribution to a community of practice and how this affects their attention and priorities over time. From the neural perspective, situated cognition provides insights about the physical structure of knowledge, namely how perception, conception and motor action are related through a self organizing coordination process with a memory. From a psychological perspective, situated cognition provides insights about how behaviour is improvised by resequencing and recomposing previous behaviours (Clancey et al. 1998)." See also Clancey & Menzies (1998), Menzies (1998), and Clancey (2002).

[8] For more information regarding the protocols and it's analysis consult Casanovas et al. (2004).

[9] See http://computing- dictionary-thefreedictionary.com/Methodology.

[10] For an extensive state-of-the-art overview of methodologies for ontology engineering can be found in (Gómez-Pérez et al. 2002).

[11] Consult Tempich et al. (2004) for more detailed information regarding the experiments.

[12] http://proton.semanticweb.org/