Discussion on the Requirements for a Workbench supporting Termontography

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Abstract
We focus on the unit-of-understanding approach 'Termontography' (Kerremans et al. 2003; Temmerman and Kerremans 2003) and on the requirements concerning a workbench supporting this approach. The main concern is to facilitate the creation of (multilingual) domain-specific dictionaries that hold information such as how a term or phrase is related to other terms in the same lexical field or semantic network of related terms. The need for such a workbench derives from the fact that although current terminology management systems incorporate principles for organising the conceptual structure of terminologies, little or no concern is given to the formal representation of the conceptual systems behind the terminologies of the corresponding domains (Vouros and Eumeridou 2002). Moreover, from our experience, it appears that many tools needed to support our terminological work are either not present in existing commercialised terminology management systems or are very difficult to handle due to the particular organisation of the software workbenches.

1. Introduction

We focus on the unit-of-understanding approach 'Termontography' (Kerremans et al. 2003; Temmerman and Kerremans 2003) and on our requirements concerning a workbench which is to support this approach. The main concern is to facilitate the creation of (multilingual) domain-specific dictionaries that hold information such as how a term or phrase is related to other terms in the same lexical field or semantic network of related terms (henceforward: termontological dictionary). The need for such a workbench derives from the fact that although current terminology management systems incorporate principles for organising the conceptual structure of terminologies, little or no concern is given to the formal representation of the conceptual systems behind the terminologies of the corresponding domains (Vouros and Eumeridou 2002). Moreover, from our experience in the FFPOIROT project in which we are developing a quadrilingual (English, Dutch, French and Italian), terminological database on the financial forensics and legal domains, it appears that many tools needed to support our terminological work are either not present in existing commercialised terminology management systems or are very difficult to handle due to the particular organisation of the software workbenches. Hence, we need a customised workbench that gathers the information of the different software tools supporting terminology work in a consistent, flexible and understandable manner.

This paper is further structured as follows: in section 2, we define the notion of ontology and discuss its relevance with respect to the development and maintenance of dictionaries. In the third section, we motivate the need for termontological dictionaries. The fourth section deals with the Termontography approach, a method for compiling such dictionaries. Finally, we discuss the requirements concerning a workbench which is to support the Termontography approach in particular. Some of the requirements will be further illustrated by examples taken from the value added tax (VAT) legislative domain.

2. Why Terminographers/Lexicographers may need Ontologies

In general, the word *ontology* can be defined as the specification of a conceptualisation, where more than one conceptualisation is possible (Gruber 1993). One can see in this light an ontology as a catalogue of the types of things that are assumed to exist in a domain from the perspective of a person who uses a language to talk about the domain (Sowa 1997). Apart from these general descriptions, the word *ontology* has several interpretations and meanings, (mainly) due to the different domains in which ontologies are applied and studied. For instance, whereas in the domain of philosophy the ontology is a specification of what exists (or may exist) in reality, in information science it "is often something that is ordered by a specific client in a specific context and in relation to specific practical needs and resources" (Smith 2000:22).

In this paper, we define an ontology as a formal and shareable knowledge repository in which categories (terms) as well as inter-categorial relationships are made explicit for computer processing. According to the IEEE Standard Upper Ontology Working Group[1], an ontology is in this sense "similar to a dictionary or a glossary, but with greater detail and structure that enables computers to process its content." An example of a formal ontology (i.e. an ontology in a formal knowledge representation language) is Cyc (Lenat and Guha 1990). Whenever the information is more of a linguistic nature, for instance in the case of WordNet (Miller 1995), we no longer speak of ontologies but of lexical databases[2]. EuroWordNet (Vossen 1998), structured in the same way as WordNet, is a multilingual lexical database covering the following languages: Czech, Dutch, English, Estonian, French, German, Italian and Spanish.

In the area of terminography, ontologies are particularly useful to support computer tasks in which different terminologies covering similar domains have to be consulted. For instance, in the domain of health care, terminologies used for patient data stored in clinical databases and the terminologies used in applications that require input of patient data are not the same (Steve and Gangemi 1996). In order to handle the diversity among terminologies, terminographers either try to align terminologies by providing links between synonymous terms, or to merge these terminologies into a new terminology database. However, these two approaches are very difficult to maintain, especially because terminologies are not static due to the everlasting changes in domains. Therefore, mapping terminologies to a common ontological framework will support the task of updating aligned or merged terminologies (Oliver et al. 1999; Steve and Gangemi 1996). With respect to lexicography, this idea is present in for instance the Duden project, a project which aims at developing and maintaining an ontology to support the automatic updating of lemmas occurring in different (electronic) Duden dictionaries (Alexa et al. 2002).

The forementioned examples show that ontologies are useful resources to support the task of developing and maintaining dictionaries in general. The next section will show in turn that dictionaries, if well structured, can become useful resources in ontology engineering. This idea motivates the development of the Termontography approach (section 4).

3. Why using (Multilingual) Termontological Dictionaries?

Several studies from different research areas have stressed the importance of termontological dictionaries. For instance, in the field of translation, the motivation for compiling the *Dictionnaire Analytique de la Distribution. Analytical dictionary of Retailing* (Dancette and Réthoré 2000) – a domain-specific, bilingual dictionary for French native speakers who need to translate texts on retailing into English – was that a translator benefits from being subdued in a wealth of information such as how a term or phrase is related to other terms in the same lexical field or semantic network of related terms (Dancette and L'Homme 2001). This belief has been confirmed by studies on the usage of dictionaries (Varantola 1994). Moreover, having such dictionaries available in electronic format should for instance allow users (i.e. terminographers, translators, students, domain experts, etc.) to discover the meaning of a given noun by traversing the semantic links of its superordinate term, to find the various relationships of a term to other terms (Dancette and L'Homme 2001) or even to find a word by formulating 'the idea' in natural language (Sierra and McNaught 2000).

Studies in natural language processing (NLP) describing research in the automatic compilation of semantic networks and ontologies by parsing dictionary definitions – e.g. the Dictionary Parsing Project[3] – also point out the advantage of having machine tractable dictionaries to be used for NLP tasks such as word sense disambiguation, question-answering and information extraction (Litkowsky 2000). However, research in (semi-)automatic knowledge acquisition shows that the results of these studies are still rather poor due to the poverty of the conceptual description one finds in dictionaries as this is often limited to natural language definitions of categories. For that reason, Aussenac-Gilles et al. (1995) stress the need to integrate an explicit part of conceptual modelling in terminological dictionaries/databases for knowledge acquisition.

We have adopted this suggestion in Termontography: depending on the requirements of ontology modellers, the termontological database will provide useful information about terms (such as definitions, co-texts, relations, etc.) which helps ontology modellers in formalising the domain of interest (Kerremans et al. 2003).

4. Termontography: a Unit-of-Understanding Approach

Termontography involves a "unit-of-understanding (UoU) approach" (Kerremans et al. 2003). We first explain what Termontography is and then expand on the advantages and limitations of a UoU analysis.

4.1 What is Termontography?

Termontography is a multidisciplinary approach in which theories and methods of the sociocognitive (multilingual) terminological analysis (Temmerman 2000) are combined with methods and guidelines for ontological analysis (Sure and Studer 2003). At first sight,

integrating theories from these two areas does not seem straightforward due to the many differences that exist between these two research areas. For instance, in terminography one tends to focus on the representation of knowledge in natural language, whereas in ontology building one is concerned with a formal representation of this knowledge. Furthermore, there is difference in the way domain-specific textual documents are used or the way a domain of interest is described. One can see differing views with respect to the application-(in)dependency of the knowledge bases developed in both disciplines, different criteria which are used to select terms and different purposes concerning interviews with field experts (Aussenac-Gilles et al. 1995).

The motivation for combining the research fields terminography and ontology engineering derives from our view that existing methodologies in terminology compilation (Sager 1990; Cabré 1999; Temmerman 2000) and (application- and task-driven) ontology development have significant commonalities. For instance, when building an ontology or compiling a terminological database, both ontologists and terminographers will start from the identification of their purposes, the restriction in the scope of the domain, the specification of the user requirements as well as the acquisition of domain knowledge from the same texts.

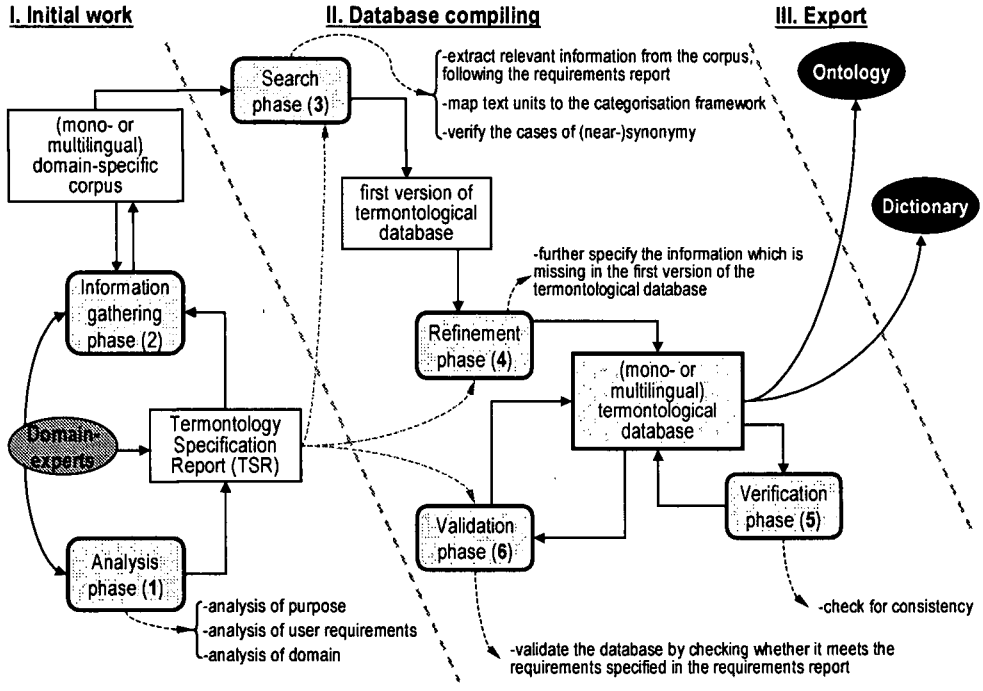

Figure 1: The Termontography workflow

Termontography is a 'functional' approach (Agirre et al. 2000; Temmerman 2000): the content and structure of the dictionary are the result of a careful analysis of the purpose of the dictionary, the requirements of its users and the scope of the domain of interest (i.e.

analysis phase). The analysis of the latter results in a categorisation framework, which is used as a reference for collecting multilingual, domain-specific texts (i.e. information gathering phase) and for extracting terminology and co-texts from the resulting textual corpus (i.e. search phase). This leads to a first version of a termontological database which may be further refined with other information, such as definitions of terms (i.e. refinement phase). After that, the database is checked for consistency (i.e. verification phase) and the 'termontographer' verifies whether the content of the database meets the requirements specified in the analysis phase (i.e. validation phase). The workflow is shown in figure 1. For more information, we refer to Kerremans et al. (2003).

4.2 What is a Unit-of-Understanding Approach?

Before building a domain-specific conceptual model or ontology, one needs to have substantial insight in the categories and intercategorial relationships that exist independent of any culture or language in the domain of interest. We refer to a culture-independent and human language-independent category as 'unit-of-understanding' (UoU), a notion which was first introduced in sociocognitive terminology theory in order to clarify the inadequacy of classical concept theory for the conceptual structuring of most specialised fields (Temmerman 2000). A preliminary insight in the different UoU's will prove useful in Termontography as the search for textual material and terms can be limited to what we know is relevant for the domain of interest. For instance, with respect to an application that needs to detect fraudulent intra-community transactions, it is essential to know beforehand what sections in the VAT legislation need to be included in the conceptual model of the domain. In order to acquire that insight, one may ask field experts to set up a visualisation of the VAT regulatory domain. This may be a semantic network-like structure which reflects the relevant culture-independent and human language-independent categories and intercategorial relationships. Termontography is said to be a UoU approach because it takes the categorisation framework of UoU's as a starting point for the extraction and mapping of multilingual terminological knowledge from a multilingual textual corpus. Consider figure 1 which shows an example of a representation of the UoU paraphrased in English as 'transactions for which no VAT is required'. This UoU is said to be culture-independent and human-language independent as all the European VAT legislations contain a section on particular transactions for which one does not have to pay VAT.

From the model visualised in figure 2 we can infer, by means of the relationships R.03 (i.e. 'has_subtype') and R.04 (i.e. 'is_kind_of'), that this category (ID-C.3.010301.01)[4] has four subcategories: transactions in which the supplier does not have the right to deduct VAT (ID-C.4.01030101.01); transactions in which the supplier has the right to deduct VAT (ID-C.4.01030101.02); transactions that occur outside the territory of the VAT legislation at stake (ID-C.4.01030101.03); and transactions that are outside the scope of VAT (ID-C.4.01030101.04). The multilingual terminology referring to all these categories will have to be searched for in the multilingual, domain-specific corpus.

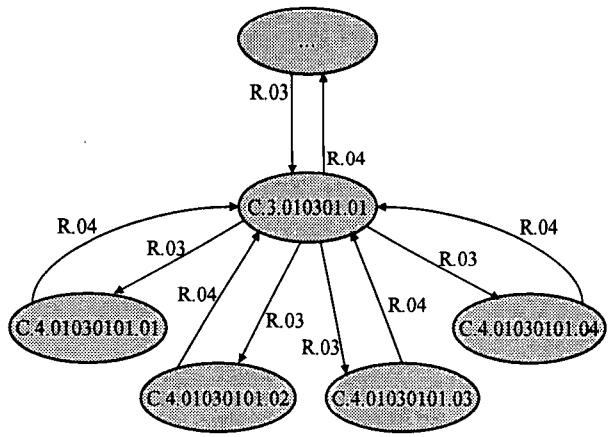

Figure 2: Example of a categorisation framework

'Transactions for which no VAT is required' is indicated by the unique identification code 'ID-C.3.010301.01'. Note that the description could be stated in any other human language as it denotes a culture-independent and human-language independent category (e.g. in Dutch *transacties waarvoor geen BTW vereist wordt* or in French *transactions qui n'exigent pas de TVA*). In figure 2, the English description merely serves as 'hub' language to which the terminology in all the languages is mapped during the search phase (section 3.1). In this respect, the Termontography approach offers a solution to the problem of multilingual diversity which is somewhat similar to the idea of Martin's (1998) "hub-and-spoke" model in the "Bridge" dictionary (Sinclair 2001). In order to account for the cultural diversity as well, the Termontography approach allows the framework to expand with a culture-specific layer during the search phase, provided that culture-specific categories (relevant for the purpose of the framework) are found in the textual material.

5. Requirements for a Workbench Supporting Termontography

In this final section we shall discuss the construction of a workbench which is to link a set of tools for semi-automating and supporting the manual development of termontological dictionaries. Note that some tools that we will mention in the sections below have already been made available to us either as prototypes or fully operational software systems. However, what is currently missing is a common interface that integrates these tools as separate software modules in one workbench that supports the process of manual dictionary compilation in a flexible and user-friendly way. This kind of architecture will guarantee the flexibility in the workbench: it can be reused in other projects related to the development of termontological dictionaries and we can always add, if needed, software modules for tasks which were originally not intended.

The Termontography approach can be divided into three important methodological steps: the development of a categorisation framework (section 5.1); the compilation of a

multilingual domain-specific text corpus (section 5.2) and the actual development of the termontological database from which to derive the multilingual termontological dictionary (section 5.3). These methodological steps incorporate the six phases introduced in section 4.1 (figure 1). In the following subsections we describe the tools that need to support each methodological step.

5.1 The Development of a Categorisation Framework

As was indicated in section 4.2, terminographers and ontology builders will more easily acquire insight in a certain domain if a field expert sets up a visualisation of the knowledge that needs to be present in both the terminological database as well as the conceptual model. The categorisation framework that results from this process, is then used by 'termontographers' to extract relevant multilingual termontological knowledge from the domain-specific, textual corpus.

To fully support the development of the culture- and language-independent categorisation framework, the workbench will include a tool – already in a prototypical stage – that allows a field expert to visualise in one way or another the relevant categories and inter-categorial relationships[5] (cf. figure 2). Each category and relationship is described in at least one natural language and receives a unique identification code which serves as key in the termontological database. The termontological database could be divided into separate modules (a module for co-texts, a module for definitions, a module for metaphors, etc.) in a later stage so that a change of a term in one of these modules will be directly modified in all the other modules in which that term (with the corresponding identification code) appears. We can find similar ideas described in for instance the Duden project (Alexa et al. 2002).

When culture-specific categories are added later on to the categorisation framework (section 4.2), the system will generate a unique identification code for each new category. New codes should also be inferred whenever one decides to import subparts of other categorisation frameworks.

5.2 The Compilation of a Multilingual Domain-Specific Text Corpus

A tool for the retrieval, storage and maintenance of the multilingual domain-specific text corpus, must be integrated in the workbench as well. The software tool must have a graphical interface showing the different folders and subfolders of the corpus and allowing users to easily add or delete texts. In order to support the process of corpus compilation and maintenance, several (semi-)automatic tools must be linked to the graphical interface as separate modules which are easily accessed by a user. Some of these tools are: a web crawler (for automatically retrieving on-line domain-specific texts), a keyword extractor (to give a user an idea about the content of each document), a text converter (which saves any electronic format to plain text), an automatic aligner (to align parallel texts so that only one version needs to be processed during the Termontography search phase) or a similarity measuring tool (which removes one version of two identical documents from the corpus in order to reduce noise for, for instance, the automatic term extractors). Note that the web crawler and keyword extractor have already been made fully operational[6].

5.3 Developing the Termontological Database

The third important step involves the manual and semi-automatic compilation of the termontological database. The software tool that should support the compilation process needs to communicate with the tools developed to support the tasks mentioned in sections 5.1 and 5.2. For the manual compilation of the database, the tool will probably have a graphical interface divided into (at least) three panes. One pane shows the categorisation framework. In the second pane, the user is able to load the texts from the corpus folders. While reading a text, he can select a lexicalised unit (a term or verbal expression) and map it (by means of 'drag and drop') to the corresponding category or inter-categorial relationship in the categorisation framework. Each lexicalised unit should receive as tag the unique identification code which has been assigned to the category or the relationship in the framework (section 4.2). The resulting semantically annotated text should be automatically stored in a different folder and may well serve as training corpus for different NLP applications such as document classification, word sense disambiguation or text summarisation.

The search for relevant lexicalised units may reveal references to categories which do not appear in the categorisation framework because they were overlooked by accident or are culture-specific. In this case, the user should have the possibility to store the lexicalised unit in a log file. From discussions with field experts, it should then become clear whether the lexicalised unit indeed refers to a UoU or a culture-specific category. In any case, the termontographer should always be able to add, after the approval of field experts, a category to the framework, thereby creating a new identification code.

Once a lexicalised unit has been mapped to a category in the framework, it should be added to the term list stored in the third pane of the graphical interface. This term list should contain all the entries of the termontological database, including the reference to the category (so that one can detect polysemous terms) as well as direct links to the different sections in which the term (given the categorial information) occurs. Moreover, if a text contains a definition of a term, the user should be able to select the definition in the text and connect it to the term which it defines in the third pane.

By linking terms to UoU's in the categorisation framework, the termontological database will automatically contain for each term the semantic and lexical relations to other terms in the database. These relations should be made explicit by means of hyperlinks which allow the user to navigate from one term of a category to another term denoting another category.

The compilation process can be further supported by for instance the following software tools: an automatic term identifier (which is able to highlight in a new text the lexicalised units which have already been extracted in previous texts), a smart concordancer (which is able to indicate for each term important co-texts from which one can learn about the meaning of the term), a term extractor (which is able to propose in a new text a list of term candidates, based on the mapping results in previous texts) or a translation extractor (which is able to find the translation equivalent of a given term in a bilingual, parallel corpus). Note that most of these tools have already been made fully operational as separate software systems. For instance, *Language and Computing nv* provided us with a smart concordancer (called *Co-textRetriever*) and a term extractor which it normally uses for its

ontology development workbench (Ceusters et al. 2004). *Knowledge Stones* developed another term extractor which was mainly used by us for the extraction of Italian terms from Italian domain-specific texts. The *Research Institute for Artificial Intelligence* developed the translation extractor *TREQ-AL* which we used for the extraction of translation equivalents in European directives, starting from a given English term list (Tufis et al. 2003).

Once the search or extraction phase has been completed, the result should be shown in a first version of a termontological database. The user should further refine the result by taking into account the requirements specified in the analysis phase (section 4.1). Based on that, the user should be able to add and remove information from the termontological database. The resulting termontological database should be exported to an XML file.

6. Conclusion

In this paper we described a set of requirements regarding a workbench which is to support the development of a (multilingual) domain-specific dictionary holding information such as how a term or phrase is related to other terms in the same lexical field or semantic network of related terms. Such a dictionary was called a multilingual 'termontological dictionary'. The motivation for creating this workbench derived from our experience that many required tools are either not present in existing commercialised terminology management systems or are very difficult to handle due to the particular organisation of the software workbenches. As a result, we proposed a workbench in which the required software tools are integrated as separate software modules. We noted that some of these software modules already exist as prototypes or fully operational tools but that a common interface is missing to which they are linked.

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Endnotes

1. see: http://ontology.teknowledge.com.
2. Note that Li et al. (2000) do not consider WordNet to be an ontology primarily because this database defines very few relations among concepts
3. More information on the Dictionary Parsing Project can be found at: http://www.isi.edu/natural-language/dpp/.
4. The unique identification code that each UoU receives point to the place of the UoU in the categorisation framework. To learn more about this specific type of coding, we refer to Kerremans et al. (2003).
5. For an overview of visualisation possibilities: see http://www.epistemics.co.uk/.

7. The tools were made available to us by *Language and Computing nv* and *Knowledge Stones*. The latter, for instance, has developed a web crawler which retrieves on-line documents based on the clustering of given keywords. For more information, we refer to: http://www.knowledgestones.com. To read more about the software tools of *Language and Computing nv*, we refer to Ceusters et al. (2004).

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