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Applying Ontologies to Terminology: Advantages and Disadvantages

Abstract

This paper aims at discussing the main advantages that ontologies bring to the field of terminology and its users, focusing on different aspects and needs. Throughout the paper ontologies are acknowledged as a valuable resource to improve quality of terminological projects as well as the content of terminologies, but it also seems appropriate to define the concept of ontologies more precisely and to outline their benefits and limitations. To do so, we firstly discuss the multidisciplinarity of ontologies and the main recent uses within different disciplines. Secondly, we focus on terminology studies and theories and depict the evolution of this resource in the terminology field during the last decades, which has brought about the appearance of new methodologies and applications. Next, we put forward the advantages that ontologies bring to terminology in general and to several linguistic phenomena in particular (multidimensionality, for example) so as to shed some light on their importance in this field and, finally, we conclude with the discussion of significant drawbacks encountered, along with some final remarks about the use of ontologies in terminology work.

1. Introduction

The issue at stake in this paper is **ontology** and the advantages that its application brings to the field of terminology. At present, ontologies are increasingly becoming a well-recognised means of building terminological resources and improving the content of terminologies and terminological resources as it is observed in the number of papers and research projects that are devoted to the study of this ontoterminological approach, along with international conferences that focus their discussion on this topic, such as the International Conference on Terminology and Artificial Intelligence (TIA), the Terminology and Knowledge Engineering Conference (TKE) or the Terminology & Ontology: Theories and Applications Conference (TOTh).[1] However, there is still some ambiguity regarding the concept of **ontology**.

According to Leonardi (2012: 19) this ambiguity can be partly attributed to the interdisciplinarity that characterises both terminology and ontology. Regarding the former, its 'endogenous' interrelation with other disciplines is clearly observed since its foundation (Wüster 1991), since it is a discipline in charge of studying specialised linguistic units of diverse knowledge fields. On the other hand, ontologies are also applied within different fields and, thus, can acquire different values according to the discipline they are applied in, the end purposes and the specific reference models adopted to define it (Leonardi 2012: 19). In this context, we encounter a great difference in the applicative facet and definition of ontologies within the framework of philosophy, computational linguistics, information science, artificial intelligence or terminology, to name but a few. As Guarino (1998) states:

> In some cases, the term 'ontology' is sometimes just a fancy name denoting the result of familiar activities like conceptual analysis and domain modelling, carried out by means of standard methodolo-

1 Information (including the proceedings in some cases) about these conferences can be found at http://flores.lipn.univparis13.fr/tia2013/Previous_editions.html, http://oeglia3.dia.fi.upm.es/web/guest/about and http://www.porphyre.org/toth/en, respectively.

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> gies. In many cases, however, so-called ontologies present their own methodological and architectural peculiarities.

Consequently, its multidisciplinarity and diverse applications and purposes hamper the achievement of a unique and unambiguous definition across disciplines, but this is also true within one single discipline such as terminology, as different theoretical models and purposes have been proposed so far (see next section).

In our paper, we focus our attention on terminology and the application of ontologies so as to shed some light on the specifications of the use of ontologies within this discipline and the advantages and disadvantages that this resource brings to it.

2. Ontologies in the terminology field

A significant shift has characterised the notion of **ontology** from its origin in the Greek philosophy to the current use within a great number of knowledge fields ranging from artificial intelligence to information science and applied linguistics, including terminology (cf. Leonardi 2012: 20).

In the domain of philosophy, **ontology** is considered the branch of metaphysics that deals with the nature and relations of being (*Merriam-Webster Dictionary*) and is supposed to make true statements about the conceptual structure of reality. In general terms, it is outlined as a language-independent system of categories that can account for a certain vision of the world (Guarino 1998: 2) and represent the abstraction of knowledge. A few decades ago computer science imported the concept of **ontology** from the philosophical domain, maintaining the essence of its meaning but incorporating many diverse aspects in order to create 'formal ontologies' (formalised, semantic, and logic-based models) for computer systems and (later on) for the Semantic Web (Øhrstrøm et al. 2005: 425). At present, the idea of **ontology** is widely spread in other disciplines and applications, such as information science, artificial intelligence or terminology. For the purposes of this article, we will understand **ontology** as Studer et al. (1998: 25) do: "An ontology is a formal, explicit specification of a shared conceptualisation." The authors explain the terms of this definition as follows:

> A 'conceptualisation' refers to an abstract model of some phenomenon in the world by having identified the relevant concepts of that phenomenon. 'Explicit' means that the type of concepts used, and the constraints on their use are explicitly defined. For example, in medical domains, the concepts are diseases and symptoms, the relations between them are causal and a constraint is that a disease cannot cause itself. 'Formal' refers to the fact that the ontology should be machine readable, which excludes natural language. 'Shared' reflects the notion that an ontology captures consensual knowledge, that is, it is not private to some individual, but accepted by a group. (Studer et al. 1998: 25)

Consequently, ontologies represent explicit, formal knowledge in the form of concepts, relations, and, usually, properties. They are not to be mistaken for *concept systems*, which are defined as a "set of concepts structured according to the relations among them" (ISO 1087-1:2000) and have been used in terminology work to model concept structures based on specialised knowledge of a field and clarify the relations between concepts, among other functions (ISO 704:2009). As Grabar et al. (2012: 376) note, "term organization is usually not constrained by any formal logic", and that is the case with concept systems: they are not governed by the rules provided by ontological languages and thus are not as expressive as ontologies, nor can they be easily processed by computer.

Although several examples of ontology application in the terminology field can be found for some decades, for example in the SNOMED CT project,[2] still it is not widespread among termi-

2 SNOMED Clinical Terms (CT) was a joint development between the NHS in England and the College of American Pathologists (CAP) formed in 1999. It provides the core general terminology for the electronic health record (EHR) and contains more than 311,000 active concepts with unique meanings and formal logic-based definitions organised into hierarchies. For more information, please follow this link: http://www.ihtsdo.org/snomed-ct/.

nologists and domain experts. Despite their limited application in this field, it is not possible to deny the use of similar knowledge representations since its foundation. However, this initial use had other purposes which have evolved over time. As it is well known, Wüster's aim was to clarify and standardise specialised concepts and their designations, especially in a multilingual dimension, to set unambiguously defined concepts associated with fixed designations. While this point is still valid to some extent, Leonardi (2012: 26) highlights that further needs have also arisen in the majority of modern terminological projects derived from communicative and cognitivist approaches to term analysis and representation. At present, terminologists also focus their attention on variation, communicative contexts, pragmatic needs, and specific domains, that is, they do not intend to achieve *a* true knowledge representation, although it occurs at an abstract level, but a possible representation, taking purposes, users, needs, and the like into account. Another remarkable difference between traditional knowledge representations and modern ones (called ontologies) are the number and types of concept relations. While traditional methods employed only logical (IS_A) and ontological relations (PART_OF) between concepts, modern terminology incorporates other relations, such as associative relations and *ad hoc* relations,[3] which depend on the working domain and project purposes, so as to provide the knowledge representation with more flexibility, complexity and capacity to represent reality.

At this stage, we clearly notice the evolution that knowledge representations within terminology have undergone throughout time, from the concept systems proposed by Wüster (1991: 22-32) to more complex and systematic representations of a specialised domain (concepts and the relations among them), namely ontologies, which are functional for the creation of terminological knowledge bases (Meyer et al. 1997, Faber et al. 2009) or ontoterminological resources (Durán-Muñoz 2012). These resources help terminologists reach better and more consistent results by facilitating the outline and organisation of the knowledge field, the elaboration of definitions, management of polysemy and multidimensionality, among other aspects which will be discussed below. Consequently, we claim that the application of ontologies within terminology should be widespread and generalised as they can be considered a useful resource to the terminographical work at the conceptual level and bring a number of advantages to this discipline.

In fact, in the last decade the use of ontologies, or at least knowledge-based approaches, in terminology work has increased and new methodologies that regard ontologies as an essential part of the terminological work have been proposed. Although this discussion is beyond the scope and space constraints of this paper, we name a few examples proposed so far: *Frame-based Terminology* (Faber et al. 2005), based on Fillmore's Frames Semantics (1976) and proposed by the LexiCon group; within the HUM-106 group, Durán-Muñoz (2012) proposes a methodology to elaborate ontoterminological resources for translators, and Bautista Zambrana (2013) adapts a Knowledge Engineering methodology (METHONTOLOGY, see Gómez Pérez et al. 2004) to create ontologies aimed at terminological and translational purposes; the Equipe Condillac proposes an onomasiological approach, called Ontoterminology (Roche et al. 2009, 2012); the Centrum voor Vaktaal en Communicatie, for its part, has designed Termontography, an approach that combines principles of Sociocognitive Terminology (Temmerman 2000) as well as premises of text-based, application-oriented ontology development (Temmerman/Kerremans 2003; Kerremans 2004).

3. Advantages of applying ontologies in the terminology field

Once we have briefly discussed the evolution of ontologies within the terminology domain, we move on to examine the main advantages that the application of these resources brings to the terminological field.

3 Associative relations are defined as non-hierarchical relations that exist when a thematic connection can be established between concepts by virtue of experience or with respect to their proximity in space or time (ISO 704:2009). They are domain-independent, such as cause-effect or producer-product. On the other hand, ad hoc relations are those non-hierarchical relations that are highly-domain dependent and, thus, cannot be generalised nor cross-used in different domains.

3.1. Clear organisation of specialised knowledge

One of the main advantages of using ontologies in terminology is the clarity they bring to the organisation and modelling of specialised knowledge, by means of the so-called *macrostructure*. León (2009: 125) explains that a *macrostructure* is a way of representing the conceptual structure that underlies, broadly speaking, a particular domain, so that it models the basic categories of that domain. Ontologies are regarded as one of the most relevant ways of expressing that macrostructure and, as such, they become valuable resources in terminology.

Several researchers (Vargas 2007, Aguado/Montiel 2007, Kerremans et al. 2008, Temmerman/Geentjens 2010) have studied the advantages that this kind of clear organisation offers for terminologists and translators.

As Vargas (2007: 51) states, a substantial part of the terminologist's work needs a conceptual approach, since it is necessary to understand the domain being explored in order to be able to structure it, classify it and define it. That is why the more formal and explicit approach provided by the application of ontologies in terminology can be useful for structuring the domain being studied. Kerremans et al. (2008: 177) share this view and highlight the importance of understanding terms for translators and terminologists: "understanding terms […] is essential for translators to propose suitable translations and for terminologists to develop different types of terminological resources." In order to understand terms it is useful to know how terms are related to one another, both on an intralingual and an interlingual level (Kerremans et al. 2008: 182).

Moreover, Temmerman/Geentjens (2010: 140) state that traditional dictionaries are often insufficient for translators with respect to properly understanding the structure of a given domain or to solve cross-linguistic and cross-cultural terminological problems, so it is necessary to provide them with conceptual links and extralinguistic/encyclopaedic information. This approach, which is applied in the *Dictionnaire Analytique de la Distribution* by Dancette/Rhétoré (2000), is also shared by Aguado/Montiel (2007: 11):

> If the translator knows that *cell-membrane*, *lysosome* and *chloroplast* are components of a *cell* (…), he or she will be much closer to identifying those terms accurately and finding the equivalent terms in the target language than if the translator just knows that those terms belong to the *Medicine* field. Sometimes, the real problem for translators is 'the inability to accurately describe or delimit the foreign concept in the source language in the first place' (Bonnono 2000: 660), which can be solved with the domain information ontologies offer.

As it has been observed, ontologies allow the representation of knowledge in a clear and comprehensive way thanks to their explicitness. An example of this feature can be observed in Maroto/Alcina (2009), where the authors build a terminological knowledge base by formally and explicitly defining concepts, relations and denominations of the ceramic domain by means of the *Protégé* ontology editor.

3.2. Possibility of choosing the level of specificity within the system

Apart from providing clear and consistent organisation, ontologies allow terminologists to choose the level of specification that should be represented, that is, they can focus on either more specialised or more general content according to the project purposes. Even when dealing with fine-grained ontologies, terminologists can choose to either display more general categories of the knowledge field under study (see Figure 1), or explore the field more deeply and add more specialised concepts by means of more categories and more complex concept relations (Figure 2).

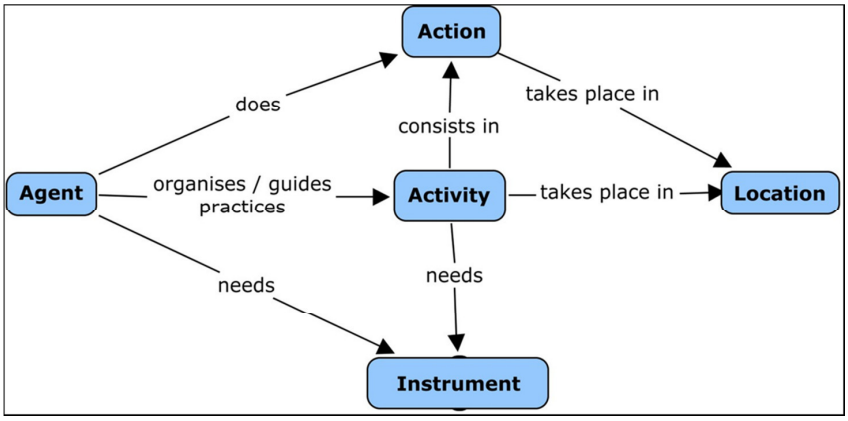

Figure 1. Initial conceptual representation or basic ontology

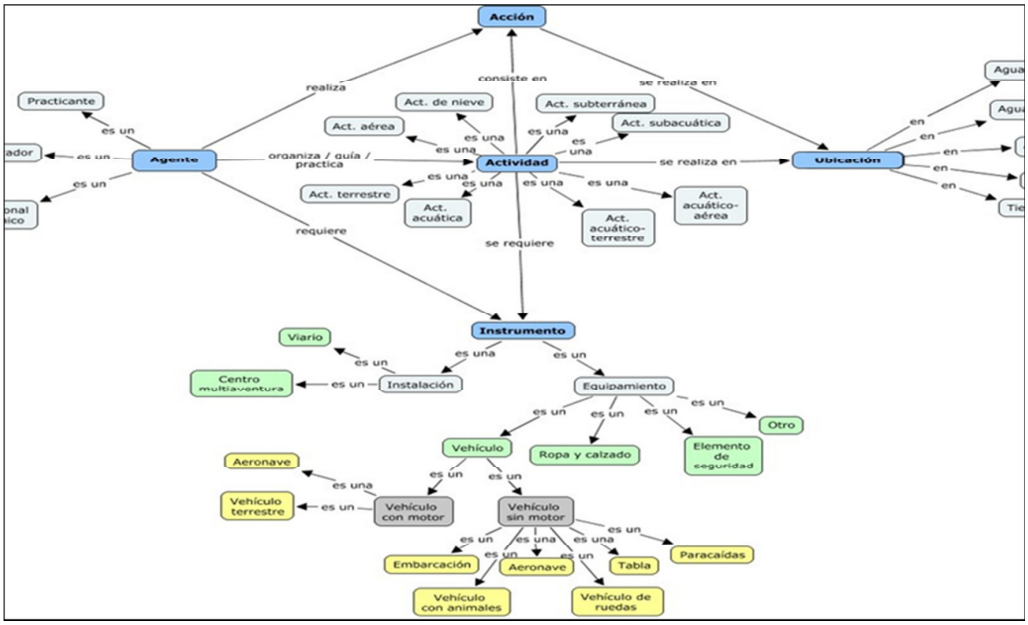

Figure 2. More specific ontology

This feature provides terminologists with the possibility to freely choose the type of representation they prefer according to the project purposes. Besides, this gradual representation becomes very useful as it can be developed throughout the project. As such, it can be represented in a simple way at the beginning and become more and more complex until it reaches its full complexity at the end of the project.

3.3. Systematicity in information retrieval

The clear and gradual organisation obtained by means of ontologies results also in more controlled, harmonised and systematic terminological resources, which are moreover built in accordance with the final users' needs.

In an ontology, a concept, which is language-independent, represents a single meaning, contributing thus to the unambiguity and consistency of the terms related to the ontological concepts. This view is shared by Pérez Hernández (2002), who points out that an ontology is a language-independent resource that serves as a meeting point among two or more languages, allowing for

a very specific conceptualisation, since it must be made explicit in a detailed way. She adds that creating an ontology imposes a good number of restrictions upon the working methodology, guaranteeing that each and every term is assigned to a given concept; each concept, for its part, must belong to a well-defined structure, and it must be possible to specify different types of relations among them, so they help to formally describe the specific domain to which the terms belong. We find evidence of the control and consistency provided by ontology-based terminological resources in that logical queries can be run to retrieve information from the ontology: for instance, to retrieve which concepts are part of a given class, or which the superordinates of a certain concept are. An example can be found in Faber et al. (2011: 373-374), who offer an example of a SPARQL query made to find which concepts are PART_OF the concept *sewer*.

3.4. Systematic and coherent definitions

According to Jiménez Hurtado and Seibel (2005), defining a specialised concept and all the terms associated with it involves the following steps: (i) reproducing the basic information within this concept and the information transmitted when this concept is activated in a text; and (ii) establishing the difference between this concept and other concepts. From our point of view, the use of ontologies in terminology satisfies both requirements as they provide the possibility to organise and clarify the conceptual information related to concepts and their differences with other similar concepts and, consequently, to elaborate systematic and coherent definitions.

Definitions can be regarded as mini-knowledge representations (Faber et al. 2006), that is, as representations of a specialised domain at a microstructural level, considering the categorisation (or conceptual organisation) of the specialised domain as the macrostructural level. As a matter of fact, definitions also need to transmit contextual information regarding other concepts and show the relations that are established among them and the defined concepts. In our opinion, the most appropiate way to carry out these mini-knowledge representations consists in establishing definitional templates for each hyperonym established in the domain ontology, which can be used to describe all of the concepts within that particular conceptual area, similar to a controlled language where the same patterns are repeated and there are gaps to be filled in, depending on the concept to be defined.

These assumptions are not present in the traditional types of definitions employed in terminology: intensional and extensional definitions, which become unfeasible and undesirable due to the impossibility of clearly delineating a unit in a functional way (Temmerman 2000: 76). Therefore their use is currently limited in modern terminology. Ontologies, whether in the form of frames, graphs, or alike, offer the possibility of overcoming these deficiencies of traditional definitions by providing complete contextual information (concepts and relations) in a very organised way.

As an illustration, we present the definition of the term *barranquismo* (canyoning, in English) as an adventure activity (Durán-Muñoz 2012: 213), so as to observe the methodology employed to elaborate definitions based on domain ontologies.

> Actividad terrestre [TYPE OF ACTIVITY] que consiste en descender caminando, saltando, deslizándose, nadando y manejando cuerdas [ACTION] a través de barrancos, cataratas, ríos, cañones, gargantas, desfiladeros, etc. [LOCATION] con un equipamiento básico formado por un traje de neopreno, guantes, escarpines [INSTRUMENT: CLOTHES AND SHOES], arnés de seguridad, mosquetón, casco y cuerda [INSTRUMENT: SECURITY ELEMENTS].

Following this methodology, two main constraints need to be taken into account: first, it is necessary to use the same definitional template to define concepts belonging to the same hyperonym within the domain ontology (in the case of the example, all the adventure activities will follow the same structure); second, it is required to elaborate different definitional templates to define concepts belonging to different categories. By doing so, we attain both coherent definitions, since all the definitions regarding the same categories would be defined in the same way, and systematic definitions, as the same method would be applied to all the concepts into consideration.

3.5. Representation of multidimensionality

Multidimensionality is considered as the classification of a concept in more than one way within a conceptual system (see Bowker 1997, Kageura 1997). According to this definition, we can find two types of multidimensionality:

a. different concept classifications, i.e. generic-specific vs. part-whole, combined in the same representation (Figure 3), and

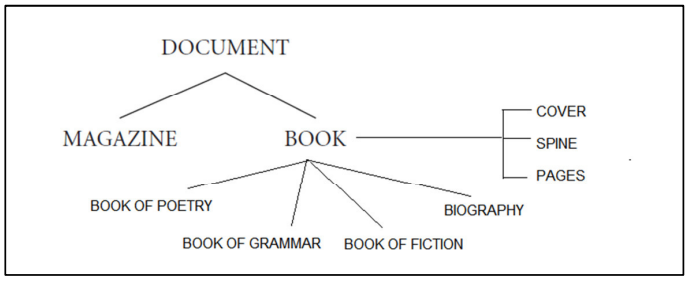

Figure 3. A multidimensional view of the concept BOOK incorporating logical and part-whole relations (Rogers 2004: 220)

b. different types of characteristics at the same level in the generic vs. specific structure (Figure 4).

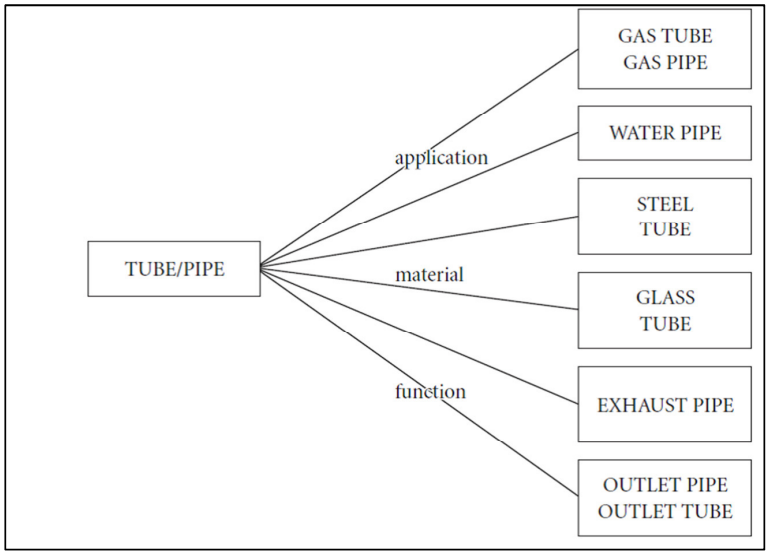

Figure 4. A multidimensional view of the concept TUBE/PIPE showing different ordering characteristics for logical relations (Rogers 2004: 219)

In both situations, ontologies, whether in the form of graphs, frames, or other type of representation, are proved to be a useful tool to deal with the multidimensionality phenomenon encountered in specialised domains since they facilitate the organisation and modelling of complex knowledge representations, and eliminate (or reduce) the negative effects pertaining to ambiguity, wrong translation equivalents, incomplete representation of domain, etc., which can prompt misunderstandings or confusion. An example of multidimensionality management can be found in the *Ecolexicon* project (http://ecolexicon.ugr.es) when dealing with concepts that can be represented differently according to the approach and subject fields such as 'erosion' (León et al. 2013: 217). One more time we notice the advantage of ontology explicitness.

3.6. Dealing with dynamicity

Contrary to Wüster's assumptions regarding the synchronic study of terminology, modern terminology defends a diachronic as well as a synchronic study, since concepts and terms evolve over time. These changes in concepts and terms are caused by several reasons: new realities to be named, new usages of terms, obsolescence of concepts/terms, among others. In this context, terminology needs to be prepared to deal with these types of changes and the new communicative situations that can occur. Accordingly, this dynamicity in terminology requires more flexible and dynamic specialised knowledge representation models that are better capable of managing and integrating information from different sources, and adapting the information to users' needs. Bearing this in mind, ontologies are seen as a great opportunity to represent knowledge domains and their evolution over time, since 1) they offer the possibility of employing a wider range of concept relations than the traditional generic-specific and part-whole relations; 2) they approach the conceptualisation carried out in the human mind and therefore, facilitate knowledge acquisition and adaptation to changes and new realities, and finally 3) they can be easily modified and further extended (if necessary), as proved in section 3.2.

3.7. Addition of multilingual information

Multilinguality, although it is frequently an essential aspect of terminological projects, can be considered a problem when structuring conceptual information, since concepts are language-independent but not culture-independent. Nevertheless, ontologies provide different solutions for the addition of multilingual information, depending on the purposes of the resource being built, and help terminologists and other users to find accurate data. Aguado/Montiel (2007: 12) emphasise the benefits of this for translators: "The translator can easily check the correspondence between terms in different languages or find out those nuances or variations between the different conceptualisations."

In the knowledge engineering field, multilingual information can be attached to concepts, relations and properties in an ontology, usually by means of the so-called *labels*. This labelling establishes a link between concepts and their corresponding terms in two or more languages (also called lexicalisation) and allows relations of synonymy within a given language.

With regards to the method used to incorporate multilingual information into ontologies, there are three main approaches (Montiel 2011: 203-210), which specifically refer to ontology localisation,[4] but they are also applicable to terminological purposes:

- *Including multilingual labels in the ontology.*
- *Combining the ontology with a mapping model.*
- *Associating the ontology with an external linguistic model.*

Regarding the third method, this author (Montiel 2011: 209-231) gives an account of some models designed with the objective of linguistically enriching ontologies, and proposes a new model, the Linguistic Information Repository (LIR), aimed at ontology localisation. As she explains, "the rationale underlying the LIR is not to design a lexicon for different natural languages and then establish links to ontology concepts, but to provide a linguistic layer in different natural languages that captures the conceptual knowledge represented in a specific domain ontology."

In the terminology field, several solutions have been proposed to deal with this problem. On the one hand, some authors, such as Maroto/Alcina (2009), use the instance editor of standard ontology applications to include designations in different languages; others employ the label functionality provided by ontology editors. On the other hand, some research groups have developed their

4 *Ontology localisation* is the "activity of associating linguistic descriptions in multiple languages to an ontology for its reuse in other linguistic and cultural settings" (Montiel 2011: 187).

own applications to represent ontologies with multilingual designations: it is the case, for example, of *ProTermino* (Durán-Muñoz et al. 2012) and *OntoDiccionario* (Bautista Zambrana 2013), both developed within the framework of the Ecoturismo project.[5]

Finally, we also encounter a significant possibility for the semi-automatic linguistic enriching of ontologies (that is, adding linguistic information to concepts, such as designations and definitions) with *Ontoling*, a plug-in[6] for the *Protégé* tool, which allows for browsing different linguistic resources and for using their information to enrich the formal content of ontologies (Pazienza/ Stellato 2005). This plug-in offers several advantages, such as 1. Search for term definitions and synonyms, 2. Separate different senses of the same term and 3. Explore resource-specific concept relations, but it also offers a valuable functionality concerning multilingual information as it automatically provides translation equivalents when browsing bilingual resources. Therefore, this system turns to be worthwhile in this multilingual context, since it reduces terminologists' time and effort compelling this task.

4. Some drawbacks of applying ontologies in the terminology field

Despite the remarkable advantages that ontologies have brought into the terminology field, or may bring in the future, we must also take into account some drawbacks that they present at the moment. From our viewpoint, most of those are caused by the lack of specific development within this discipline and mainly by the lack of suitable tools for terminological purposes, as we will see in section 4.4. Ontologies are still very close to artificial intelligence or knowledge engineering as well as their features, purposes and tools, what provokes a clear limitation for terminologists. Nevertheless, current research is coping with this matter and providing good possibilities for the application of ontologies in terminological projects. Bearing in mind the ever growing interest in the application of ontologies in the terminology field, we predict a fruitful development of these resources within this discipline in the short term.

Apart from these yet unresolved questions, there are other limitations that should not be dismissed in this context.

4.1. Great number of ontological languages

First of all, we encounter a great number of ontological languages for codifying or editing ontologies, such as RDF, RDF Schema, OIL, DAML+OIL and OWL. The existence of these languages facilitates the interchange of data among different applications related to ontologies (including those applications whose use has been adapted to terminological purposes), but, on the other hand, makes impossible the interchange or reuse of data between systems that do not share the same languages. This drawback would be easily solved if all ontological editors employed the same languages, for example the standard language OWL, but this is not always possible or has not been accomplished yet.

4.2. Difficulty of turning special knowledge into ontologies

The second one is related to the difficulty of transferring specialised knowledge from texts or domain experts to abstract and effective concept representations. At first sight, this action seems easy to attain as the required knowledge is reachable, either by experts or texts as information sources, but these sources are not always clearly understood, contradictions or misinterpretations between them can occur, problems to explain concepts or phenomena can arise, etc. Consequent-

5 Ecoturismo project stands for 'ECOSISTEMA: Espacio único de sistemas de información ontológica y tesauros sobre el medio ambiente. ECOTURISMO' (reference no. FFI2008-06080-C03-03/FILO).

6 A *plug-in* is "a small piece of software that supplements a larger program (as a browser)" (*Merriam-Webster Dictionary*).

ly, terminologists' work could be hindered in case the relationship established between them and domain experts were not close, constant and bidirectional throughout the whole process.

4.3. Representation of synonymy

Another drawback regards synonymy and its representation in ontologies. At present, two different ways of representing synonyms are observed: first, by a logical relation that represents an exact match; or second, by denominative variants. In the first case, both synonyms are considered different concepts and, thus, both are included in the ontology; but in the second case both units are considered one concept with two or more related terms (language-dependent), that is, two graphical representations at the terminological level but only one at the conceptual level. This lack of agreement about synonymy prompts disorganisation in knowledge representation, which hampers reutilisation and interchangeability of ontologies.

4.4. Lack of suitable tools

Another disadvantage regards the tools available for building ontologies. In that respect there are mainly two choices: either using standard ontology editing tools, such as *Protégé*, or an ontology-based terminological resource editor, e.g. *Ontoterm*. Regarding the first option, it is not always easy to adapt standard ontology editors to terminological purposes, and the work involved can be time-consuming, discouraging terminologists and translators from building this type of knowledge bases. Moreover, standard ontology editors include many technical features (e.g. logical inferences) that are not generally needed for terminological projects and that can slow down the work process because of the amount of learning needed: users have to learn what features are useful for their work (and then, how to use them), and what features can be ignored. Nevertheless, some researchers have been working to overcome this drawback: the above-mentioned Maroto/Alcina (2009) build an ontology for terminological purposes with the standard ontology editor *Protégé*, while Bautista Zambrana (2013) offers a simplified procedure to build a terminology-oriented ontology, using the standard editor *TopBraid Composer Free Edition*. As for the second option, there are some specific tools for creating ontology-based terminological resources, mainly developed within the framework of research groups or projects, such as *Ontoterm*, *TERMINAE*, or *Multilingual Categorisation Framework Editor*.[7] However, there are not, to the best of our knowledge, freely available tools for building ontology-based terminological resources that enable the inclusion of multilingual designations or that support enough features so as to comply with the advantages set out in this article. Besides, several present some technical problems or restrictions that are difficult to overcome (see Durán-Muñoz 2010).

Fortunately, there have been recent efforts to change this situation and provide domain experts or terminologists with tools that allow them to create suitable knowledge representations according to their needs and their limited background in knowledge engineering. This is the case of the *Semantic Turkey* tool (Pazienza et al. 2012), a free open-source platform for Semantic Bookmarking and Ontology Development developed by the ART Research Group at the University of Rome, whose aim is to provide a unifying platform for acquiring, building up, reorganising and refining knowledge addressed at both domain experts (and terminologists) and knowledge engineers. This system tries to fill in the existing gap and provides an "integrated solution which is able to combine the best of all worlds from visualisation, semantic annotation and ontology development" (Pazienza et al. 2012: 281). In this sense, the system eliminates the different frameworks previously required and allows domain experts and terminologists to directly sketch ontologies and keep track of the information they obtain from the Web, which may be examined and reused by knowledge engineers in continuous refinement circles. As said, this recent solution

7 *TERMINAE* (http://lipn.fr/terminae/index.php/Main_Page) was developed by the Représentation des Connaissances et Langage Naturel (RCLN) group (Paris Nord University), and *Multilingual Categorisation Framework Editor*, by the Centrum voor Vaktaal en Communicatie (Erasmushogeschool Brussels).

intends to open the ontology and knowledge representation world to terminologists and domain experts, insofar as it would fulfill their needs when they are carrying out semantic representation and research, even though it is not specifically addressed at building ontology-based terminological resources.

5. Conclusions

This paper intends to highlight the benefits that ontologies bring to terminology, and we have thus explained throughout the paper how ontologies are a valuable resource for terminological work. Although there are some drawbacks still to be overcome (see section 4 above), the application of domain ontologies in terminology provides a great opportunity to improve many aspects of terminological projects, enhancing their content: they are useful for dealing with multidimensionality and dynamism, building systematic and coherent terminological resources, clearly organising the macrostructure and microstructure (definitions) of a specialised domain, and reducing subjectivity and discrepancies among the domain experts working on the same terminological project. It is also worth highlighting that a domain ontology does not necessarily represent a general conceptual model, but just a model that is valid for a specific domain, a model that can possibly be incorporated into a top-level ontology and that, in terminological practice, often matches linguistic and conceptual schemes (Leonardi 2012: 29). In this sense, an ontology is not to be considered a static and fixed representation of a knowledge field but a dynamic system that can be adapted according to the project purposes and the evolution of the field.

To sum up, the terminological trend and interest to employ ontologies in terminological projects and to propose methodologies combining ontologies and terminology point to the advantages that these resources offer, as well as the significant benefits provided by the synergy of different specialists working together, in this case knowledge engineers, domain experts and terminologists.

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