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Web de la editorial

Description of the terminological concept in an ontology

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Abstract. Ontology editors are tools developed to classify and describe objects in a database that will be used by a computer program for any of a number of purposes. Since this tool allows elements to be grouped and classified, we decided it could be applied to the management of terminological concepts. To do so, we have formalised the description of the terminological concepts by means of characteristics and values, so that they match the form required by ontologies. Then, we show how to implement the conceptual information in the ontology editor Protégé, and more specifically how to represent concepts, descriptions of concepts and terminological definitions. We also analyse the advantages and drawbacks of this way of representing concepts, as well as outlining the future work that we are developing in relation to it.

1. Introduction

In this article we describe how the conceptual structure of a set of terms from the field of the ceramics industry and the description of a concept category have been represented in an ontology.

Within the framework of our lines of research on the development of electronic dictionaries that allow users to perform more flexible searches and which are machine-readable, we also address the automation of concept management and the production of terminological definitions.

Current terminographical tools, such as terminological databases, allow linguistic information to be introduced (grammatical category, definition, equivalences, etc.) but the management of terms as regards their conceptual relationships (e.g. generic-specific) is not possible. Hence, we have considered using ontologies as a way to advance in the representation of hierarchical and non-hierarchical conceptual relationships.

Ontology editors are tools developed to classify and describe objects in a database that will be used by a computer program for any of a number of purposes (e.g. the creation of a product website, etc.). Since this tool allows elements to be grouped and classified, we decided it could be applied to the management of terminological concepts. To do so, we have formalised the description of the terminological concepts by means of characteristics and values, so that they match the form required by ontologies.

In the first section, we discuss previous work concerning how to break the meaning of terms down into characteristics and values (Valero and Alcina 2015). In the second section, we show how to implement the conceptual information in the ontology editor Protégé and, more specifically, how to represent concepts, descriptions of concepts and terminological definition patterns. Likewise, we address the analysis of the advantages and drawbacks of this way of representing concepts, as well as the future work that we are developing in relation to it.

In conclusion, this work is another step forward in the use of ontologies in terminology, since in addition to representing the hierarchical relationships between concepts we also address the formalisation of other relationships so that they can be described conceptually and as an aid in the production of definitions.

2. Formalisation of the terminological definition

A definition in terminology is a linguistic description of a concept in a specialised domain. Traditionally, the description of the concept consists in enumerating the relevant characteristics for that concept (Felber, 1983, 124). Its classical structure is as follows:

Definiendum: genus + differentiae

The definition begins by stating the generic concept of the defined term and it is followed by the characteristics that differentiate it from other concepts at the same level of the system.

Definition writing is hard work both for experts and for terminographists. In Terminology, domain experts are usually those who have written definitions for dictionaries (Faber 2002b, Norman 2002). This may be partly due not only to excessive veneration of experts in dealing with the meaning of terms (Faber et al. 2006), but also to the absence of a specific methodology for the conceptual analysis (Meyer et al. 1997). Many authors claim the need to adopt lexicographical methods for terminological practice, in particular the use of corpora to analyse terminological units.

Furthermore, electronic dictionaries offer new possibilities for the management of entries and access to them. These possibilities can also be applied to the field of definitions. Several authors (Alshawi 1989, Barnbrook 2002, Barque and Polguère 2009, Faber et al. 2006, Sager and L'Homme 1994) argue that greater segmentation and explicitness of the information contained in a definition entails numerous advantages, firstly for the user, and also for information management.

Our first objective was to determine the definitional templates that can be used to write a group of definitions.

An example of this definitional template for the conceptual group ‘ceramic tiles’ was proposed by Alcina (2009: 45):

A ceramic tile whose shape is X and size is Y, and is decorated with Z to serve as Q

We consider that definitional templates can be an invaluable aid when writing complete and coherent definitions, that these definitions would contain an explicit semantic structure, and that they would be understandable to both humans and computers.

We hypothesised that the terms belonging to the same conceptual category can be defined following the same definitional template so that the differences between terms become more visible. This definitional template would contain the relevant characteristics for defining a set of terms. Definitional templates ensure that the information in the definition is complete, the structure is consistent with the system of definitions, and that the definitional components are presented in an explicit and segmented manner according to their role within the definition.

We have followed the method for systematic concept analysis suggested by Meyer, Eck and Skuce (1997: 110), who considered characteristics as entities made up of two components: name and value.

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2.1 Method to Establish Definitional Templates for the field 'Ceramics'

The main source of terminological information in our project has been the TXTCeram Corpus, compiled in a previous project (Alcina et al. 2005, Alcina et al. 2007). In the following sections we describe the steps followed in our study to determine the definitional template for ceramic terms.

1. Selection of terms

Conceptual groups have to be homogeneous enough to be able to identify a relevant set of features for all of them. For example, we have analysed the processes that occur in industry, such as firing, glazing or drying, or the defects that may occur. These ceramic defects that can appear in a ceramic product are described using terms such as *teardrop*, *bloating* or *cracking*.

2. Collection of conceptual information

The second step was to compile knowledge-rich contexts about these terms, as they offer relevant information about the concept. Our objective was to extract a minimum of two contexts for each term.

We have used linguistic patterns that have been identified in previous studies for the extraction of definitions from texts. Some examples are verbal patterns such as *caracteriz*, consist*, describ*, llam*, denomin*, conoc**, proposed by Sierra et al. (2008).

In cases when these patterns were not productive, and so automatic extraction was not possible, we have read the fragments of the manuals that explain the given concept.

The figure 1 shows the concordances of the term *defect* with linguistic patterns in order to extract definitions.

FIG. 1 – Concordances of the term defect *with definitional verbal patterns*

3. Analysis of conceptual features

Next we analysed the contexts in order to obtain a set of features that are commonly used in the descriptions of the concepts of each conceptual group.

This conceptual analysis was carried out by segmenting the information and by assigning a label or code (the name of the characteristic), which describes the type of information that each fragment represents, as seen in Figure 1. In order to carry out this analysis, we used the qualitative analysis program called Atlas.ti, as explained in Valero and Alcina (2010).

For example, the feature PHYSICAL NATURE (NATURALEZA FÍSICA) describes the appearance that a defect has on a tile, such as ‘increase in the dimensions or bulk of the volume’ or ‘consisting of drops’ The feature CAUSE (CAUSA) describes the problem that produces a defect, for example ‘due to incorrect application, either through using a pointed brush instead of a flat brush or because of a fault in the airbrush nozzle if glazing was applied by spraying’ or ‘caused by a reaction to water or water vapour.

The figure 2 shows this analysis for the defect ‘bloating’ (hinchamiento) in the original text.

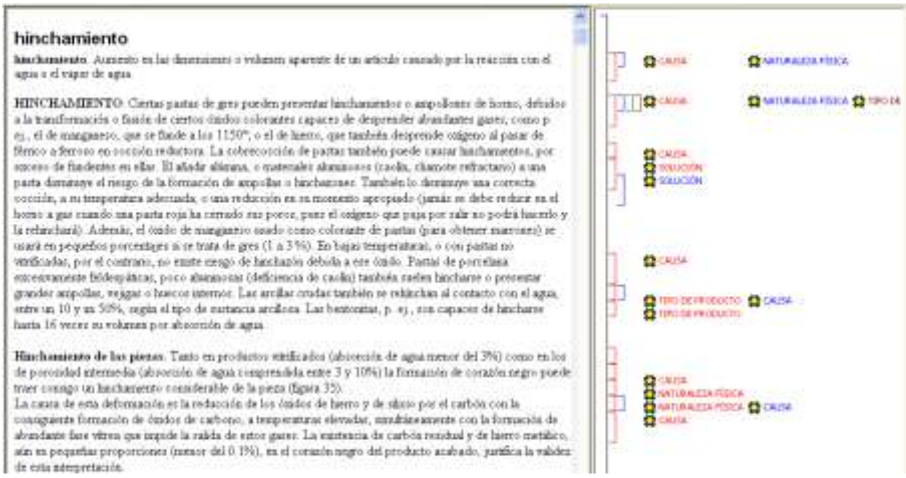

FIG. 2 – Analysis for the defect ‘bloating’ (hinchamiento)

4. Elaboration of the definitional template

After having identified the recurrent features used in the contexts to describe the concepts of that group, we established the definitional template, which contains the potentially relevant features for the definition of a concept.

Many authors, such as Seppälä (2004), believe that a given feature can be considered relevant or not relevant, depending on the user. That is why we have included in the template all the characteristics that were recurrent in the descriptions of the concepts written by specialised authors.

An example of this template is that shown below applied to the concept of one of the ceramic defects known as *black core* (Table 1).

	BLACK CORE
DESCRIPTOR	defect
PHYSICAL NATURE	dark spot
ZONE AFFECTED	surface
CAUSE	presence of carbon and reduced iron oxides
PHASE	firing
METHOD	all methods
TYPE OF PRODUCT	all products
CONSEQUENCE	reduction in the quality and properties of the final product. swellings and pyroplastic deformations
FREQUENCY	frequent
LEVEL OF SEVERITY	severe
SOLUTION	none

TAB. 1 – Definitional template for the ceramic defects applied to the term black core

In the first stage of our project we stored this information in a relational database. Although management was simple, the structure was too rigid. An ontology would be a more suitable way to represent the concept information.

3. Implementation of the terminological definition in the ontology editor Protégé

In order to represent the concept and its terminological definition, we take as our starting point the conceptual analysis carried out in section 2, grounded on the principles highlighted in Meyer et al. (1997) and Bowker (1997) on ontology-based terminology, as well as other publications that have followed similar developments (Faber 1999, 2002a, Madsen and Thomsen 2009a, b, Moreno Ortiz 2002, Roche et al. 2009, Temmerman and Kerremans 2003). Ontologies organise knowledge by describing the concepts of the domain and the relationships among those concepts.

The implementation of these ontologies may vary depending on the representation paradigm that is used (frames, descriptive logic, logic) and the language used for the implementation. In general, the implementation of an ontology consists of classes, properties and individuals. *Classes* are organised in a superclass-subclass hierarchy to form a taxonomy. Between superclass and subclass, where there is a relationship of subsumption, if we consider the class Cat to be a subclass of Animal, then 'Being a Cat implies that you are an Animal'. *Properties* are binary relationships that allow us to formally describe the requirements that must be met in order to be a member of a *class*. Thus, a class called Pizza is described as a set of things that have some kind of dough as a base and which is covered with a series of ingredients. In the ontology, each property is formalised as a pair with a characteristic name and its value with respect to the class that is described. In the figure 3 we can see how the class Pizza relates to the classes PizzaTopping and PizzaBase by means of the 'hasTopping' and 'hasBase' relationships, respectively.

FIG. 3 - Representation of Pizza properties

In previous work, we have already used this ontology editor to represent different aspects related to terminology, conceptual relationships and characteristics, in addition to exploiting possibilities of inference and the automatic classification of the reasoner (Estellés 2006, Maroto and Alcina 2009) with the aim of creating more flexible and useful electronic dictionaries for translators (Pastor and Alcina 2010).

We chose the ontology editor Protégé because it is a free-based editor with a large number of users worldwide, which allows for collaborative work, together with the fact that its architecture is open, thus allowing it to be extended through plug-ins (Musen 2015). For the implementation of definitions in this study, we have used Protégé version 5. This version, based on the ontology language OWL, makes it possible to create OWL-DL ontologies. It uses Description Logic Reasoner to check the consistency of the ontology and to automatically compute the ontology class hierarchy (Horridge 2009, 7).

In the previous section we have seen how to formalise a terminological definition by distinguishing the genus from the concept, and separating the different characteristics that make up the conceptual description. This structure could be implemented in the form of tables in a computer program such as a word processor, in rows and columns in a spreadsheet or as entries and fields in a terminology database. By using these systems, we would obtain an orderly visual representation that allows us to compare, for example, the different values that each field takes in a set of concepts.

Implementing an ontology editor adds a series of advantages over representation in more traditional formats in terms of its computation because it offers the possibility of reasoning about the concepts and the relationships among them.

3.1 Configuration of the elements of the definition in an ontological structure

From the ontology-based conceptual analysis explained in the previous section, we obtained the formal description of the set of subordinate concepts of 'ceramic defect'. The description of these concepts contains the concept Defect as the genus and a set of ten characteristics. The names of characteristics are repeated, that is, they are the same, for this set of concepts, while their value varies in each case.

The conceptual relationship that links the concept with the genus of its definition is of the hierarchical generic-specific type, whereas the relationships that the concept establishes with other concepts through the characteristics are of an associative nature. Figure 4 attempts to represent this different relationship. This has consequences in terms of how to implement these elements in an ontology.

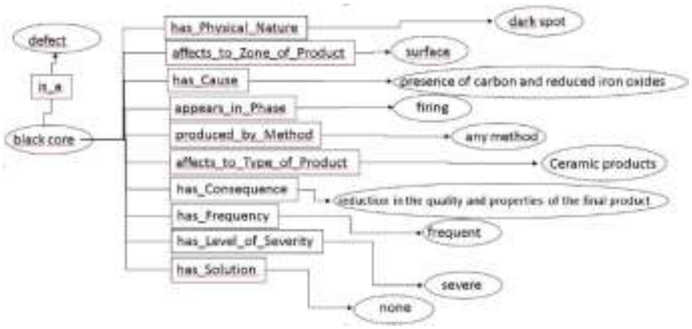

FIG. 4 – Ontology structure for the concept black core

In the ontology editor we have implemented each of these types of relationship in a different way: hierarchical generic-specific, on the one hand, and associative, on the other.

3.2 Implementation of the genus of the definition

The hierarchical generic-specific relationship that exists between the genus of the definition and the defined concept has been represented in the panel of the hierarchy of classes of the editor Protégé. Both classes are introduced as classes, and the specific one is made dependent upon its superordinate in the hierarchy. Figure 5 shows the representation of the concept BLACK CORE as a subclass that is dependent upon the class DEFECT in the hierarchy of classes.

FIG. 5 – Representation of the concept BLACK CORE *as a class/subclass*

Introducing these concepts in this way automatically results in the updating of the description panel of the subordinate concept, which shows information about its subordinate concept (see Figure 6).

FIG. 6 – Representation of the concept BLACK CORE *and their description*

3.3 Implementation of the characteristics of the definition

In the formalisation phase, we divide the characteristic into two parts: the name of the characteristic, which is common to the subordinate concepts of ‘defect’, and the value it takes for each of the subordinates, which will generally be different in each of them.

In the phase involving the implementation in the editor, we assume that the name of the characteristic acts as a link, an associative relationship, between the concept that we are describing and another concept from the domain.

For example, in the definition of ceramic defects, one of the essential characteristics for all of them is the description of their physical appearance, which refers to how the defect in the product is perceived (visually, to the touch, etc.). In the case of the defect *wedging*, the physical appearance that the piece presents is a ‘difference in thickness between two opposite parts of the tile’. In the case of the defect *foliated*, the physical appearance looks like ‘laminar stratifications of the material’ and in the case of the defect *black core* it presents a ‘dark spot’.

This example is shown graphically in Figure 7. Concepts are shown within an ellipse, while the name of the characteristic or relationship appears within a rectangle. The arrows indicate the direction in which the relationship is to be read, for example ‘wedging – has physical appearance – difference in thickness between two opposite parts of the tile’ (‘acuñado – presenta aspecto físico – diferencia de espesor entre dos partes opuestas de la baldosa’).

FIG. 7 – Concepts linked by the 'has physical appearance' (presenta aspecto físico) property

In the implementation phase, the name of the characteristic has been implemented in the editor as Object Property. The values of the characteristics, which we have analysed as concepts of the domain, have been implemented as classes in the class hierarchy panel. These data can be introduced into the editor in at least two ways. The first is by accessing the tab Classes, selecting the concept to be described and clicking on the section Subclass Of on the description panel of that concept. This opens a window that allows us to create the new property (or select it if it has already been created) and enter the corresponding value (or select it if it already exists). In Figure 8, we can see that the property 'hasPhysicalNature' and the filler DARK SPOT has been created and selected. After accepting this operation, the new characteristic will appear in the description of the concept BLACK CORE (see Figure 9).

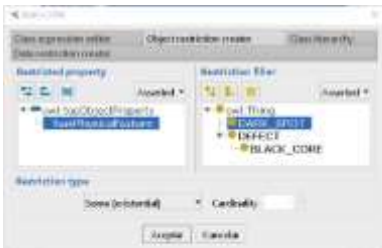

FIG. 8 – Object restriction creator view

FIG. 9 – Description of the concept black core with property

The classes and properties, once created in the ontology, remain available to be used again. Thus, when we need to describe another subclass of the concept Defect, the property 'hasPhysicalNature' or the class DARK SPOT will be available for use.

We can see the list of all the characteristics created in the ontology by accessing the Object Properties panel, where it is also possible to create and manage the characteristics (see Figure 10).

FIG. 10 – Object properties panel view

After filling in the different characteristics for each defect, we obtain the full description of each concept, which will look like the image shown in Figure 11, for the case of the concept BLACK CORE.

FIG. 11 – Description of the concept BLACK CORE *with properties*

Lastly, the values of the characteristics, which have been entered as classes, can also be grouped together under a common class that represents the type of value they introduce. For example, one aspect that all the values associated with the property 'is of a physical nature' have in common is that they describe the physical appearance. To facilitate the management of these concepts, we have converted them into a subclass of the class PHYSICAL NATURE (NATURALEZA FÍSICA), which we have created for this purpose (see Figure 12).

FIG. 12 – Subclasses for the N*ATURALEZA* F*ÍSICA class view*

4. Advantages and disadvantages of the implementation

There are currently no tools to facilitate the creation of definitions and, more particularly, to allow management of the definitions in terms of their content. We therefore found that the facilities offered by the ontology editor have many advantages for the terminographer.

Specifically, some of these **advantages** that we would like to highlight include the following:

1) Unicity and reuse of data. Once any concept has been entered into the ontology, we can use it again as many times as we need to simply by selecting it. In addition to saving us from having to rewrite the data, we also obtain two other advantages. First, it makes it easier for us to maintain consistency in the use of words and expressions throughout the whole database. The second one is that it offers a natural representation of the link that exists between different concepts or properties, without having to manually add cross-references or use other reference mechanisms between identical terms, as is usually the case in dictionaries and databases.

2) Comparison and testing of essential characteristics. Having all the concepts coordinated together, grouped under their superordinate concept, makes it easier to compare the use of the same essential and distinctive characteristics in all of them.

3) Grouping and comparison of the values of characteristics. The grouping of the values assigned to the same characteristic facilitates the comparison of the expressions used in order to homogenise them, as requested by the principles of lexicography. In this way, we will use the same expressions for the same ideas or descriptions.

4) Direct navigable access to all the elements of the definition. Each item of data, each element in the ontology, whether a class or a property, constitutes a node in a

network of internal relationships among all the elements, and can be used to navigate from one to another because each node is in turn a link.

The use of the ontology editor also presents several **drawbacks**. It is a tool that, despite offering different highly effective functionalities for conceptual analysis, is not intended for use by lexicographers or terminologists. What we have presented in this paper is a methodology that allows us to adapt the tool to these purposes. To enable lexicographers and terminologists to take advantage of the tool, it would be necessary to carry out further work on (1) adapting the methodology to the purposes of the development of definitions, or (2) adapting the tool itself, for example, its interface, in order to make it more transparent for use in lexicography and terminography.

5. Conclusion

In conclusion, we have taken another step forward in the use of ontologies in terminology, since, in addition to representing the hierarchical relationships among concepts, we also address the formalisation of other relationships so that they can be described and as an aid in the creation of terminological definitions.

Finally, we would like to point out that the functions explained in this paper are only a small sample of the possibilities offered by the ontology editor, and in future work we intend to continue to further explore its use in order to improve its application. We believe that this type of development not only makes the task of creating terminologies easier but also facilitates the dissemination of these terminologies in digital format to be consulted by human users and for use in natural language processing.

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Résumé

Les éditeurs d'ontologies sont des outils développés pour la classification et la description d'objets sur une base de données où ces dernières sont lisibles par un programme informatique, à des fins diverses. Puisque cet outil permet de regrouper et de classifier des éléments, nous nous proposons de l'utiliser pour la gestion de concepts terminologiques moyennant des caractéristiques et des valeurs, de manière à ce qu'elles puissent correspondre au format des ontologies.

Dans cet article nous démontrons comment nous avons complété l'information conceptuelle sur l'éditeur d'ontologies Protégé, et plus concrètement comment y représenter des concepts, des descriptions conceptuelles et la définition terminologique. Nous aborderons également l'analyse des avantages et des inconvénients du travail que nous sommes en train de développer en rapport avec cette façon de représentation conceptuelle, ainsi que sa continuité ou travail futur à réaliser.