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Ontology design patterns for annotation: The ORG ontology localization use case

Guadalupe Aguado de Cea [a], Olga Ximena Giraldo [a], Asunción Gómez-Pérez [a], Elena Montiel-Ponsoda [a], and María Poveda-Villalón [a]

[a] *Ontology Engineering Group, Escuela Técnica Superior de Ingenieros Informáticos, Universidad Politécnica de Madrid, Spain*

E-mail: {lupe,ogiraldo,asun,emontiel,mpoveda}@fi.upm.es

Abstract. Although ontologies were originally conceived as abstract knowledge representations understandable by computers, there is an ever increasing need of providing this knowledge to the user in a more friendly way. One method to facilitate this process is ontology localization, which has acquired great importance in research, in that it tries to present the ontology information in the user's language. However, localizing ontologies is not a trivial task. In this paper we propose some ontology design patterns that can guide users in the process of assigning labels or identifiers to ontology entities. Based on our experience on localizing ontologies, we have developed some good practices as patterns following the Ontology Design Patterns initiative.

Keywords: ontology, ontology design pattern, ontology annotation, ontology localization

1. Introduction

Ontologies are used to capture knowledge about some domain of interest and are recognised as important components of information systems and information processing. An ontology describes the concepts in the domain and also the relationships among these concepts. These entities (concepts and relationships) generally are represented using machine-readable languages such as RDF Schema and OWL.

A manner to facilitate the understanding and manipulation of ontologies by humans is associating natural language descriptions to ontology entities. Traditionally, linguistic information in ontologies has been represented by means of labels. Therefore, the use of meaningful labels will undoubtedly help users to understand the real context of the entities belonging to a particular ontology. In this sense, the use of meaningful labels in multilingual ontologies could contribute to draw these knowledge representations to the end user by adapting an ontology to a particular language and culture (i.e. ontology localization).

However, localizing ontologies is not a trivial task. In the multilingual ontologies we have analyzed, including the Organization ontology (ORG ontology), we have observed that ontology elements (concepts, relations, individuals, etc.), are represented by labels in the source natural language that do not take into account the localization process as they reflect the English language features but sometimes are quite far from other language ones.

The patterns that we propose in this contribution have a twofold goal: firstly to guide users in assigning labels or identifiers and descriptions to ontology entities. By labels we mean the properties or metadata that some ontology languages foresee for the purpose of describing the logical constructs in natural language (`rdfs:label`, `skos:prefLabel`, `lemon:LexicalEntry`, etc.), and by description we refer to natural language definitions that are represented with `rdfs:comments` or `dc:description` among others. Secondly, to help developers in the process of ontology localization by providing them with coherent, user-friendly examples of how to apply the above mentioned patterns.

In this sense we try to adopt previous efforts carried out by [8] and [7] and extend them by, first, adapting the proposed guidelines to the Ontology Design Pat-

terns (ODP from now on) initiative,[1] and second, by applying them to the ontology localization activity.

The structure of the paper is the following. Section 2 presents the main motivations to develop this work. Section 3 introduces and describes the seven proposed ontology annotation patterns and their relation with previous works. In Section 4 we analyze a use case of how to apply the proposed ontology annotation patterns during the ontology localization activity while Section 5 provides some general guidelines for helping in such activity. Finally, Section 6 expounds the related research efforts and Section 7 presents some concluding remarks, the lessons learnt and the future lines of work.

2. Motivation

There are plenty of initiatives to familiarize the user with the technologies in their own languages, and so, following this idea there is also a need for ontology localization. For this reason, our first goal was to provide a set of good practices for ontology localization in the form of patterns whenever possible.

With the experience gained when localizing ontologies, we realized that in some cases, the annotations provided for the ontology elements were ambiguous or lacked clarity both in the meaning of terms or the directionality of properties. All these facts led us to propose some patterns as ontology annotation patterns that could help in both processes, ontology development and ontology localization, following the model proposed by the Ontology Design Patterns initiative.

In Section 3, we present the annotation patterns to be used during ontology development and in Section 4, we describe the ontology localization use case. The correspondences between prefixes and namespaces used in those sections are shown in Table 1.

Table 1

Prefixes and namespaces relation.

Prefix	Namespace
rdf	http://www.w3.org/1999/02/22-rdf-syntax-ns#
rdfs	http://www.w3.org/2000/01/rdf-schema#
owl	http://www.w3.org/2002/07/owl#
org	http://www.w3.org/ns/org#
dc	http://purl.org/dc/terms/
skos	http://www.w3.org/2004/02/skos/core#

[1] http://ontologydesignpatterns.org/

3. Annotation ontology design patterns

This section presents seven ontology design patterns for ontology annotation extending the ontology design patterns classification proposed at [9]. More precisely, the “Annotation ODPs” category has been extended in order to represent “Linguistic realization ODPs”. According to the Oxford Dictionary[2] realization is used in linguistics to refer to the way in which a particular linguistic feature is used in speech or writing on a particular occasion. We extend this meaning to denote the way an ontological concept adopts when expressed in natural language by using different morpho-syntactic structures available in all natural languages. Taking this into account, the new category of ODPs is defined as follows:

Linguistic realization pattern: A linguistic realization patterns is a structure or guide that can be used in order to maintain coherence in expressing linguistically labels, properties and definitions, and to help users in naming the different elements of an ontology, both in the creation and the localization process.

As shown in Figure 1 six of the proposed patterns belong to the new category “Linguistic realization ODPs", which are at the same time by inheritance “Annotation ODPs”, while the other pattern belongs directly to the “Annotation ODPs” category. In such figure, the ODPs categories are shown in the upper box and are represented by rectangles while the proposed ODPs are represented by ellipses in the middle box. The new category proposed is shown in a darker (green if it is printed in color) rectangle and bold letter.

The seven proposed patterns are described following the template shown in Table 2. Such template follows the initiative started in [11] for describing logical patterns, architectural patterns and content patterns. In [9] a template for lexico-syntactic patterns is also provided. However, to the best of our knowledge there is no template proposed for annotation patterns.

In this particular case, as the addressed problem does not involve neither the structure of ontology elements nor modeling issues we do not provide a diagram for the patterns. For the sake of axiomatization, we can not provide logical axioms as these patterns deal with the understandability of the ontology

[2] http://www.oxforddictionaries.com/definition/english/realization

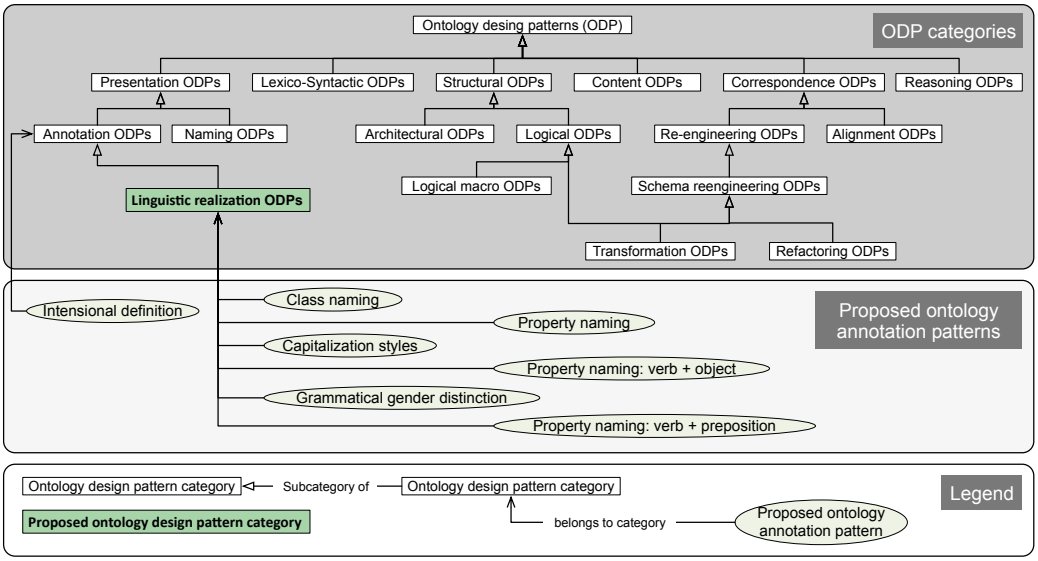

Fig. 1. Extension of the ontology design patterns classification and proposed annotation patterns. Derived from [9].

rather than its modelling issues. Nevertheless, we provide some serialization of the presented examples using `rdfs:label` for naming and `rdfs:comment` for descriptions, although other predicates such as `lemon:LexicalEntry`, `skos:prefLabel` or `skos:altLabel` for naming and `dc:description` for descriptions among others could have been used. Such serializations are provided by RDF[3] statements in turtle syntax.[4]

The patterns that apply only to the classes defined in the ontology are described in Table 3 "Intensional definition" and Table 4 "Class naming", whereas those that apply to the classes, properties and individuals are described in Table 5 "Capitalization styles" and Table 6 "Grammatical gender distinction". Finally, the patterns that apply only to the properties defined in the ontology are presented in Table 7 "Property naming", Table 8 "Property naming: verb + direct object" and Table 9 "Property naming: past participle + preposition".[5]

4. Applying the annotation ODPs to ontology localization

This section presents examples (Tables 11 to 17), following the recommendations suggested in the seven patterns shown in Section 3. These examples are described following the template in Table 10 and are the result of a manual localization of the annotations `rdfs:label` and `rdfs:comment` describing the classes and properties of the ORG ontology into Spanish.

5. Lessons learned/learnt from ontology localization process

This section presents a set of recommendations or best practices that could facilitate the ontology localization process. These recommendations are the result of localizing the ORG ontology into Spanish. Our best practices are organized as follows: i) general aspects, ii) recommendations about understanding the context of the ontology and, iii) recommendations addressed to the process of localization of ontology entities.

5.1. General aspects in ontology localization

– An ontology localization process is a task that requires linguistic, cultural and technological competences on the translator's part. This idea has been supported by both national[6] and interna-

[3] `http://www.w3.org/TR/rdf-primer/`

[4] `http://www.w3.org/TR/turtle/`

[5] If you consider that tables in this and next section can distract, we can put them as annexes for the sake of readability.

[6] UNE-EN 15038:2006 Servicios de traducción. Requisitos para la prestación del servicio, AENOR Ediciones

Table 2
Template for describing ontology annotation patterns

Name	**Name identifying the proposed pattern**
Description	
The description and rationale for the proposed pattern.	
Example	Title for the given example(s).
The description of the example(s) including RDF statements in turtle syntax.	
References	
References to previous work related to the given pattern. This field is optional.	
Applies to	classes and/or properties and/or individuals

Table 3
Intensional definition pattern

Name	**Intensional definition**
Description	
All definitions (comments, usage notes) should follow the same format. In the case of Spanish, the format followed is the one proposed by the UNE ISO 1087-1, following ISO 1087-1 and ISO 1087-2 in which an intensional definition states the superordinate concept and the delimiting characteristics. This means that definitions should not start with a verb as was the case for the English version of the ORG ontology. In this sense, we believe that we should use the accepted format or conventions of the target language.	
Example	Adding a description for a new class

In this use case we show how a class definition should have been created according to the presented pattern, it could also be applied to improve the current definition. The class `http://www.w3.org/ns/org#Organization` is defined in the ORG ontology as follows (due to readability and space issues we only include an excerpt of the definitions) :
`org:Organization a owl:Class, rdfs:Class;`
`rdfs:comment "Represents a collection of people organized together into a community or other social, commercial or political structure...Alternative names: _Collective_ _Body_ _Org_ _Group_"@en;`
According to the pattern presented, the description added would have been the following:
`org:Organization a owl:Class, rdfs:Class;`
`rdfs:comment "Collection of people organized together into a community or other social, commercial or political structure... Alternative names: _Collective_ _Body_ _Org_ _Group_"@en;`	

References	
UNE ISO 1087-1 Trabajos terminológicos. Vocabulario. Parte I: teoria y aplicación. AENOR. 2008. ISO 1087-1 Terminology work - Vocabulary - Part 1: Theory and application. 2000. ISO 1087-2 Terminology work - Vocabulary - Part 2: Computer applications. 2000.	
Applies to	classes

tional standards.[7] Following these lines, we recommend that the translation task should be performed by a team of translators with the collaboration of the ontology author/s, if possible, or ontology engineers and/or users of the ontology as possible users of the final application.

– The translators should have the adequate training and needed expertise in intercultural communication so as to fully render the content in the source language into the target language complying with the linguistic, textual and locale features of both languages. So, a background on Linguistics/Translation and Terminology would be highly desirable. Before presenting the final product, the translated ontology should be revised by an editor and/or an ontology engineer.

5.2. *Understanding the context of the ontology*

– All the documentation related to the ontology needs to be read thoroughly in order to understand the use and purpose of the ontology in general, as well as the "meaning" of the classes and proper-

[7] ISO/CD17100, 2010, "Translation services: Requirements for translation services"

Table 4
Class naming pattern

Name	**Class naming**
Description	
Labels attached to classes should be as short as possible, self-contained, meaningful, and concise (in the sense that they capture or summarize in a concise manner the meaning of the class). As for the form, labels for classes should be in the singular. Moreover, it should be advisable to choose a label that accepts suffixes, so as to relate morphologically certain derived terms in the ontology.	
Example 1	providing concise and precise names/labels for classes

There are cases where the concepts can be labelled by means of compact, concise and precise single terms or multi-words terms as for the case of the class `http://www.w3.org/ns/org#Membership` that could be named as follows:
`org:Membership a owl:Class, rdfs:Class;`
`rdfs:label "membership"@en;`
Note: In the original ORG ontology the term provided is "Membership" with capital letters, note that we have applied here the pattern "Capitalization styles" presented along this work.	

Example 2	providing descriptive and precise names/labels for classes

There are cases where a tradeoff between conciseness and precision within the naming is needed. For example, the class `http://www.w3.org/ns/org#ChangeEvent` that could be named as:
`org:ChangeEvent a owl:Class, rdfs:Class;`
`rdfs:label "change event"@en;`
Note: in the original ORG ontology it is provided as "Change Event", note that we have applied here the pattern "Capitalization styles" presented along this work.	

References	
Ontology development 101: A guide to creating your first ontology [8] Style guidelines for naming and labeling ontologies in the multilingual web [7]	
Applies to	classes

Table 5
Capitalization styles pattern

Name	**Capitalization styles**
Description	
Terms proposed as labels for ontology elements should follow the specific conventions of term formation accepted for each language.	
Example	adding a label to a given class

In this use case we show how a label attached to a class should have been created according to the presented pattern. It could also be applied to improve the current label. For example, for the case of the class `http://www.w3.org/ns/org#FormalOrganization` in the ORG ontology the label attached to it is:
`org:FormalOrganization rdfs:label "Formal Organization"@en ;`
According to the pattern presented the label should have been created in the following way:
`org:FormalOrganization rdfs:label "formal organization"@en ;`	

References	
RAE, 1999/2010. Ortografía de la lengua española, Madrid, for Spanish. Editorial: Espasa-Calpe. ISBN 10: 8423992500. ISBN 13: 9788423992508 W3C public-vocabs@w3.org mailing list `http://lists.w3.org/Archives/Public/public-vocabs/2014Feb/0069.html`	
Applies to	classes, properties and individuals

ties that make up the ontology. By documentation we refer to the ontology specification document (in the case of the ORG ontology, see[8]).

– In order to understand and correctly interpret the meaning of the ontology entities, we need to rely on natural language descriptions of those entities, be it in the form of comments, glosses, definitions or usage notes. Without those descriptions we

[8] `http://www.w3.org/TR/vocab-org/`

Table 6
Grammatical gender distinction pattern

Name	**Grammatical gender distinction**
Description	
According to the language in which the ontology is being expressed, the labels for classes, properties and individuals should include the masculine and feminine forms. This grammatical gender pattern applies, for example, to Indo-European languages including Spanish, German, Hindi and Russian.	
Example	creating different labels for gender distinction for a given entity

For example, in the role ontology (`http://bioportal.bioontology.org/ontologies/ROLEO`) there is a class to represent both actors and actresses (`http://purl.obolibrary.org/obo/RoleO_0000039`) as follows:
`http://purl.obolibrary.org/obo/RoleO_0000039 a owl:Class, rdfs:label "actor/actress";`
In order to create this concept according to the presented pattern the following statements should be established instead:
`http://purl.obolibrary.org/obo/RoleO_0000039 a owl:Class, rdfs:label "actor"@en ; rdfs:label "actress"@en ;`	

References	
RAE, 1999/2010. Ortografía de la lengua española, Madrid, for Spanish. Editorial: Espasa-Calpe. ISBN 10: 8423992500. ISBN 13: 9788423992508 Esbozo de una nueva gramática de la lengua española: Real Academia Española (http://www.rae.es/sites/default/files/Sala_prensa_Dosier_Gramatica_2009.pdf)	
Applies to	classes, properties, individuals

Table 7
Property naming pattern

Name	**Property naming**
Description	
In the case of labels for properties, we propose they consist of a verb or verbal phrase forming a syntagmatic pattern, i.e., a syntactic unit composed of at least one verb and the syntagmatic unit(s) that accompany that verb, usually the object representing the nearest argument of the verb.	
Example	providing names/labels for properties

For the case of the property `http://www.w3.org/ns/org#member` from the ORG ontology is is neither clear nor intuitive the directionality of the property just from the label attached to it, that is:
`org:member a owl:ObjectProperty, rdf:Property, owl:FunctionalProperty; rdfs:label "member"@en;`
A verbal phrase indicating the information about the directionality of the property could have been included by providing the following name to the property:
`org:member rdfs:label "is about member"@en;`	

References	
Ontology development 101: A guide to creating your first ontology [8] Style guidelines for naming and labeling ontologies in the multilingual web [7] Esbozo de una nueva gramática de la lengua española: Real Academia Española (http://www.rae.es/sites/default/files/Sala_prensa_Dosier_Gramatica_2009.pdf)	
Applies to	properties

may interpret the meaning and usage of classes and properties wrongly and produce a guide that misleads people to create data which uses the ontology differently.

– In case ontology entities are not accompanied by natural language descriptions, a description should be written and checked by the authors and users of the ontology before translating the labels of classes and properties. Then these descriptions should be analyzed to see if they fit the purpose and use of entities.

Table 8
Property naming: verb + direct object pattern

Name	**Property naming: verb + direct object**
Description	
In some cases of labels for properties, we propose the verbal phrase to form a syntagmatic pattern composed of a verb plus a direct object that usually represents the nearest argument. In that case, such object could represent the range of the given property.	
Example	providing names/labels for properties in the form of "verb + object"

In the case of the property `http://www.w3.org/ns/org#location` the ORG ontology provides a noun as label and does not include any verb form:
`org:location a owl:ObjectProperty, rdf:Property;`
`rdfs:label "location"@en;`
A verbal phrase indicating the action in present perfect form and the object to which it applies could have been provided according to the presented pattern. For example, the property could have been named as follows:
`org:location rdfs:label "has location"@en;`	

Applies to	properties

Table 9
Property naming: past participle + preposition pattern

Name	**Property naming: past participle + preposition**
Description	
In some cases of labels for properties, we propose the verbal phrase to form a syntagmatic pattern composed of a verb in past participle plus a preposition that usually indicates relation of time, place, direction, agent, instrument, etc. between the range of the property and the action the property represents.	
Example	providing names/labels for properties in the form of "past participle + preposition"

In the case of the property `http://www.w3.org/ns/org#location` the ORG ontology provides a noun as label and does not not include any verb form:
`org:location a owl:ObjectProperty, rdf:Property;`
`rdfs:label "location"@en;`
A verbal phrase indicating the action in the form of past participle and the place where the action takes place could have been provided according to the presented pattern. For example, the property could have been named as follows:
`org:location rdfs:label "is located at"@en;`	

Applies to	properties

Table 10
Template for representing ontology annotation patterns applied during ontology localization

Pattern applied	Name identifying the pattern applied
Example	Title for the given example
Description of the example	

5.3. Localization process of ontology entities

– We should make sure to have the most updated version and latest recommendation of the ontology specification. If there is a schema available, we should check it is aligned with the specification document.
– It is also advisable to look for "normative" translations of the ontology. They may also help in the translation process, especially when translating languages that belong to the same family. For example, suppose you want translate a multilingual ontology into Spanish; it is advisable to check if the ontology was previously translated into other languages that come from Latin, such as French and Italian.
– Before proposing a label for an ontology entity, we should translate the descriptions (comments, usage notes, or any other information available). This will help us find a better term to propose as label, since it is more natural and easy to translate a sentence or a body of text than to provide

Table 11
Example of applying the "intensional definition" pattern for ontology localization

Pattern applied	Intensional definition
Example	translating a description for a given class

This use case shows how independently of the style of the definition found in the original ontology the translation is made according to the proposed pattern. In this case, the class `http://www.w3.org/ns/org#Organization` is defined in the org ontology as follows (due to readability and space issues we only include an excerpt of the definitions):

```
org:Organization a owl:Class, rdfs:Class;
rdfs:comment "Represents a collection of people organized together into a
community or other social, commercial or political structure...Alternative names:
_Collective_ _Body_ _Org_ _Group_"@en;
```

In order to translate it into Spanish the following statement have been added to the org ontology:

```
org:Organization;
rdfs:comment "Grupo de personas que se organiza en una comunidad u otro tipo de
estructura social, comercial o política. Dicho grupo tiene un objetivo o motivo
común para su existencia ...Denominaciones alternativas: _colectivo_ _corporación_
_grupo_"@es.
```

Table 12
Example of applying the "class naming" for ontology localization

Pattern applied	Class naming
Example 1	providing concise and precise translations for class labels

There are cases where the translation from English to Spanish is straight forward and the concept in the original and target languages are compact and concise single terms or multi-word terms as for the case of the class `http://www.w3.org/ns/org#Membership` that is named as follows in the ORG ontology:

```
org:Membership a owl:Class, rdfs:Class;
rdfs:label "Membership"@en;
```

This class has been translated into Spanish by adding the following statement:

```
org:Membership rdfs:label "membresía"@es;
```

Example 2	providing descriptive and precise translation for classes labels

There are cases where a tradeoff between conciseness and precision within the description is needed. For example, when translating the class `http://www.w3.org/ns/org#OrganizationalCollaboration` it has been needed to create a more explicative name in order to add precision and context to the above mentioned term description. This class is defined in the ORG ontology in the following way:

```
org:OrganizationalCollaboration a owl:Class, rdfs:Class;
rdfs:label "Endeavour"@en;
```

The translation into Spanish added the following statement to such concept:

```
org:OrganizationalCollaboration rdfs:label "proyecto de cooperación
empresarial"@es;
```

Table 13
Example of applying the "capitalization styles" pattern for ontology localization

Pattern applied	Capitalization styles
Example	translating a label for a given class

This use case shows how independent of the capitalization style provided for elements in the original ontology, the translation into Spanish is made according to specific conventions of term formation accepted for Spanish language. In this case, the class `http://www.w3.org/ns/org#FormalOrganization` is labelled in the ORG ontology as follow:

```
org:FormalOrganization rdfs:label "Formal Organization"@en;
```

In order to translate it into Spanish the following statement has been added to the ORG ontology:

```
org:FormalOrganization rdfs:label "organización formal"@es;
```

Table 14
Example of applying the "Grammatical gender distinction" pattern for ontology localization

Pattern applied	Grammatical gender distinction
Example	providing different labels for gender distinction when translating a given entity

For the case of the `http://www.w3.org/ns/org#location` property the following label is provided in the ORG ontology:
`org:location a owl:ObjectProperty, rdf:Property;`
`rdfs:label "location"@en;`
In order to translate it into Spanish the following statements have been added to the ORG ontology:
`org:location rdfs:label "está ubicado en"@es;`
`rdfs:label "está ubicada en"@es`
This property is translated into Spanish using both the label "está ubicado en" as it can refer to "business" which is masculine in Spanish and the label "está ubicada en" as it can refer to "organization" that is feminine in Spanish.	

Table 15
Example of applying the "Property naming" pattern for ontology localization

Pattern applied	Property naming
Example	providing naming translations for properties

For example, the ORG ontology provides the following label for the property `http://www.w3.org/ns/org#classification`:
`org:classification a owl:ObjectProperty, rdf:Property;`
`rdfs:label "classification"@en;`
In order to clarify the directionality and meaning of the property we have included the following information as result of the translation into Spanish of such property:
`org:classification rdfs:label "pertenece a la clasificación"@es;`	

Table 16
Example of applying the "Property naming: verb + direct object" pattern for ontology localization

Pattern applied	Property naming: verb + direct object
Example	providing naming translations for properties in the form of "verb + object"

For example, the ORG ontology provides the following label for the property `http://www.w3.org/ns/org#organization`:
`rdf:label "organization"@en; a owl:ObjectProperty, rdf:Property;`
`rdfs:label "organization"@en;`
In order to clarifying the directionality and meaning of the property we have included the following information as result of the translation into Spanish of such property:
`org:organization rdfs:label "es condición de miembro sobre organización"@es ;`	

Table 17
Example of applying the "Property naming: past participle + preposition" pattern for ontology localization

Pattern applied	Property naming: past participle + preposition
Example	providing naming translations for properties in the form of "past participle + preposition"

For example, the ORG ontology provides the following label for the property `http://www.w3.org/ns/org#remuneration`:
`rdf:label "remuneration"@en; a owl:ObjectProperty, rdf:Property;`
`rdfs:label "remuneration"@en;`
In order to clarifying the directionality and meaning of the property we have included the following information as result of the translation into Spanish of such property:
`org:remuneration rdfs:label "recibe remuneración"@es;`	

an appropriate label that captures (summarizes) the meaning of that body of text in one word/term or multi-word expression. For some recommendations on the format and the formulations used in labels definitions, see the intensional definition pattern in Table 3.
– Once the description has been translated, one can propose a label for the ontology class or property. For some recommendations on the format and the formulations used in labels, see class naming pattern in table 4 and property naming pattern in Table 7. Depending on the language of origin and the language you are translating into, you will be able to use labels that are closer to the original language (this is typical in the case of languages with a Latin root, for example). However, the essential part should be that the labels you propose better reflect the meaning of the ontology entity.

6. Related work

As mentioned before, there have been several attempts to propose recommendations in these fields. As for the localization process, in Espinoza et al. [2], high level guidelines were proposed for both manual and automatic localization processes inspired by the human translation process. Basically, the ontology localization activity was divided into 5 tasks that try to cover general aspects, such as using suitable linguistic resources, and more specific ones, such as obtaining the correct translations. Despite the validity of these guidelines, they are only broad recommendations that rightly identify the tasks involved in the translation process and the order in which those tasks should be performed. However, the guidelines described in this contribution focus on more specific questions related to the rendering of the labels from a translation viewpoint, the selection of the most appropriate labels according to the conceptualization in question, and the format to be given to those labels according to the language conventions determined by the language into which the ontology is being translated. It could be said that the guidelines and patterns that we present in this contribution expand task 3 of the guidelines by Espinoza et al., and are rather intended for human translators.

Regarding the annotation patterns proposed here, it is inevitable to resort to the recommendations given in literature for "naming" ontology entities, although annotation properties allow greater leeway and flexibility from a linguistic viewpoint. We claim that some of the recommendations given for "entity naming" may also be valid for our purposes, whereas others will have to be adapted or rethought for "entity labelling".

In this sense, some of the first recommendations for naming classes in ontologies are given by Noy and McGuiness "Ontology Development 101: A Guide to Creating Your First Ontology" [8]. Here the authors provide some guidelines that are bound to modeling decisions and the functionalities provided by ontology editors. Basically, they make users aware of the fact that some systems do not allow the same name space (local name) for classes and properties. In this sense, a difference is made by the use of lower case for naming properties and upper case for naming classes

In the framework of the Open Biomedical Ontologies (OBO) Foundry initiative we find some conventions intended to solve the problem of ontology integration proposed by Shober et al. [10]. The authors offer a comprehensive set of naming conventions that can be classified into two types: conventions on content and conventions on format. Regarding the first ones, the authors discourage the use of univocal names, homonyms and conjunctions, but advise the use of positive names and the recycling of strings instead of using synonyms. As for those conventions that focus on format, the following are of interest to us: a) use explicit and concise names ("wall of esophagus" instead of "the wall of the esophagus"); b) prefer singular nominal forms; c) use space as word separators or underscores as default; d) expand abbreviations and acronyms; e) prefer lower case beginnings for class and property names "as they would appear in normal English written text"; f) use plain ASCII format and avoid accents. Although these recommendations are intended for URI's local names, some of them may also make sense for the labels that describe ontology elements, namely, a), b), and c). However, others are only relevant to the English language and would not work for other languages or would need to be adapted according to the specific language conventions of each language, specifically, e) and f).

Fliedl et al. [3] also propose general style guidelines for naming OWL classes and properties based on a analysis of the ontologies contained in the DAML Ontology Library.[9] Though using the term OWL labels, they are not referring to the annotation property `rdfs:label`, but to the labels given to URIs' local

[9] `http://www.daml.org/ontologies/`

names. The motivation behind this work is the verbalization or rendering of ontologies in natural language taking as input URIs' local names. The sort of recommendations that they make mainly refer to the format to be followed by local names. For example, they suggest the use of the CamelCase notation to format class names or the use of lower case for properties. In fact, the formatting proposed in this work is in line with the guidelines endorsed by the Semantic Web community. In this regard, Ishida[10]) focuses on the multilingualism in URIs and the "Best Practices for Publishing Linked Data" working group[11] in URIs for Linked Data, but despite the efforts this problem is still not satisfactorily solved .

There has been (and still is) a lot of discussion and work on defining guidelines for the effective use of URIs, starting with Tim Berners-Lee's article Cool URIs don't change.[12] In this respect, we find some valuable guidelines presented at Common HTTP Implementation problems, a W3C Note in the context of the Technical Architecture Group,[13] which summarizes, paraphrases and extends many of the ideas from Berners-Lee's article. Among the twelve proposed guidelines, the "Choose URIs wisely" one seems to be a perfect fit when thinking about naming ontology elements for the Web. In this guideline the authors state the following: (1) Use short URIs as much as possible, (2) Choose a case policy, (3) Avoid URIs in mixed case, and (4) As a case policy choose either "all lowercase" or "first letter uppercase".

More recently, in the context of the Linked Data initiative, we find the work by Labra Gayo et al. on Multilingual Linked Open Data Patterns [4]. From the patterns provided in this catalog, we would be interested in those for naming and those for labelling resources. As for the first ones, the authors offer interesting discussions on the use of descriptive URIs, opaque URIs, full URIs or International Local Names. As for the labeling patterns, the authors recommend that labels should be provided for all ontology entities, and the language of those labels should be given by means of language tags. However, no further recommendations are given on the format that those labels should follow. This catalog has also been taken as input in the WC3 Community Group "Best Practices in Multilingual Linked Open Data",[14] which aims at deepening on the annotation issue.

Also referring to entity naming and proposed in the form of design patterns, we find the work by Svátek and Sváb-Zamazal [12]. These authors provide ontology naming patterns that aim to specify or "systematically populate" the category of Naming Ontology Design Patterns suggested in the OntologyDesignPatterns.org portal. The authors distinguish among generic naming conventions, single-entity patterns related to different entity types (classes, object properties, data properties and instances), and cross-entity patterns related to constructs such as class-subclass pairs or pairs of mutually inverse properties. This work is also in line with the previous reviewed literature on patterns for naming ontology entities. For instance, the authors encourage the use of nouns in the singular form for classes, the inclusion of the noun instead of only the specifying adjective for classes lower in a hierarchy, or the use of concise names to avoid verbosity.

As previously said, we have taken into account the recommendations or patterns in the state-of-the-art as long as they can also be applied to entity labeling. In this regard, and to the best of our knowledge, we only find some very preliminary guidelines for entity labeling in Montiel-Ponsoda et al. (2011) [7]:

1. Use the singular form for nouns that describe classes.
2. Use verbal phrases and the predicate or range in object properties for disambiguation purposes.
3. Use spaces as word delimiters, since it supports readability.
4. Use upper or lower case according to the language conventions of each language.
5. Include as many labels as needed to describe ontology entities.

As the authors already point out, such guidelines have to be reviewed for each language. Though being formulated in a simple way, we agree with the main idea behind these guidelines, namely, enriching ontologies with descriptions in natural language to better capture the meaning of classes and properties, thus trying to reflect the real meaning of the conceptualization. All that involves the use of descriptors as they would be used by experts in professional communication (not only terms but also definitions), and also accounts for variation (synonyms). The latter may also require to

[10] http://www.w3.org/International/articles/idn-and-iri/

[11] http://www.w3.org/TR/ld-bp/

[12] http://www.w3.org/Provider/Style/URI.html

[13] http://www.w3.org/TR/chips/

[14] http://www.w3.org/community/bpmlod/

rely on more complex models of linguistic and lexical information that allow to account for richer descriptions. In this sense we refer the interested reader to McCrae et al. 2011 [5], Montiel-Ponsoda et al. 2010 [6] or Cimiano et al. 2010 [1] for literature on such models.

7. Conclusions and future work

Producing a good drafting document for the natural language annotations of an ontology avoids possible ambiguity problems in the original language and makes the task of localization easier. In addition, it provides better text comprehensibility, as well as more coherence to ontologies.

We found that most ontologies analyzed do not use meaningful labels for named entities. When they do use labels, these labels are ambiguous or not accurate, hindering understanding of the knowledge represented in the ontologies.

Here we propose a set of good practices (or patterns) for creating meaningful labels in the design ontology process. Also, we demonstrated (through examples extracted from the ORG ontology) the suitability of these patterns in ontology localization cases. We justify our proposal using real examples extracted from our own experiences in the translation of ontologies. We believe that today the Multilingual Web is a reality, and guidelines are needed to take into account the linguistic background of developers.

We have learnt that the combination of an interdisciplinary team, composed both by experts in linguistics and ontology developers, and ideally completed also with domain experts, brings better solutions to different activities of ontology annotation and localization.

As future work we foresee that a detailed analysis of a representative number of languages and alphabets will help to develop more general, detailed guidelines that cover all different cases it could appear. For example, for alphabets that do not have distinction between lower case and capital letters, as kanji for Japanese, or languages where there is no distinction for gender or number, like Indonesian.

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