eClassOWL: A Fully-Fledged Products and Services Ontology in OWL

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Abstract

A major obstacle towards e-Commerce applications based on Semantic Web technology is the lack of industry-strength ontologies for products and services. Besides simple, script-based transformations of the UNSPSC[1] taxonomy, there are currently no serious ontologies for products and services. We show that there exist several pitfalls when reusing industrial products and services taxonomies, namely UNSPSC and eCl@ss[2], for eCommerce ontologies, and present eClassOWL, an industry-strength OWL ontology for products and services based on eCl@ss.

1 Introduction

Numerous researchers have pointed out the enormous potential of ontologies for e-business scenarios, for example [Fensel, 2001; Fensel *et al.*, 2001a; Fensel *et al.*, 2001b; Gupta and Qasem, 2002; Obrst *et al.*, 2001; Omelayenko, 2000; Omelayenko, 2001; Zhao, 2003], and many sub-problems of making this a reality have been addressed, e.g. the challenges associated with mapping among e-business ontologies [Obrst *et al.*, 2001]. However, there is a lack of serious ontology engineering efforts in the products and services domain that go beyond academic prototypes. Industrial taxonomies are an extremely valuable basis for ontology engineering, because they include a large number of consensual concept definitions plus a hierarchy. In our analysis we show that the interpretation and consequent representation of the semantics of the original taxonomic relationship of UNSPSC and eCl@ss is an important modeling decision, which eventually affects the usefulness of the resulting ontology.

2 Ontology Engineering Challenges

When taking the categories found in a taxonomy as the basis for the creation of an ontology, we face a fundamental problem: Unless there is a formal definition of the semantics of the taxonomic relationship, the intensions of the category concepts (e.g. the product classes) *are tangled with the interpretation of the taxonomic relationship.* In other words: If we lack a formal definition of either the hierarchical relationships or the category concepts, then *how we understand the taxonomic relationship determines the shape of the category concepts* and vice versa. For example, the hierarchies of both UNSPSC and eCl@ss were created on the basis of practical aspects of procurement, treating those commodities that "somehow" belong to a specific category as descendents of this closest category. This makes "ice" a subclass of "non-alcoholic beverages" in UNSPSC and "docking stations" a subcategory of "computers" in eCl@ss. The fatal consequence of a naïve interpretation of the taxonomic relationship as being equivalent to rdfs:subClassOf is obvious: We can no longer use the resulting classes for buying processes, because a search for all instances of "computers" will also return docking stations, and ordering the cheapest available instance of non-alcoholic beverages will very likely return just ice cubes.

Basically there are the three known approaches of transforming a given products taxonomy into an OWL ontology:

1. Create one class for each taxonomy category and assume that the meaning of the taxonomic relationship is equivalent to rdfs:subClassOf.
2. Create one class for each taxonomy category and represent the taxonomic relationship using an annotation property taxonomySubClassOf.
3. Treat the category concepts as instances instead of classes and connect them using a transitive object property taxonomySubClassOf.

Approach 1 is chosen by both available transformations of UNSPSC [Klein, 2002; McGuinness, 2001] into products and services ontologies. While the underlying approach is not necessarily incorrect, it does not yield a products and services ontology, but a set of cost accounting and purchasing management categories. Quite clearly, we want to make the resulting products and services ontology be useful for many different application areas, including the search for products and services, and not limit the usage to spend analysis. Solution 2, represented in OWL Lite and OWL DL, lacks the support for transitivity of the taxonomic relationship, since a property that connects classes with classes can only be an annotation property, which is non-transitive. The downside of solution 3 is that it requires OWL Lite or OWL DL reasoning support in order to process the transitive nature of the property. For scalability reasons, we wanted to find a solution that does not require reasoning capabilities beyond rdfs:subClassOf.

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[1] http://www.unspsc.org/
[2] http://www.eclass-online.com/

For a detailed discussion see [Hepp, 2005a] and [Hepp, 2005b].

In addition to the classes and the hierarchy, the set of properties in product standards contribute a lot to machine readable product description in the Semantic Web, for they provide a standardized representation for concepts as generic as "weight" or as specific as "pump capacity", and should thus also be reused.

3 eClassOWL: A Real Products and Services Ontology in OWL

In this section, we outline how eCl@ss can be transformed into a fully-fledged products and services ontology in OWL. Our approach is as follows (see Figure 1):

1. We create *two* separate concepts for (1) the *generic* product or service category and (2) the respective *taxonomy* category.
2. We arrange the *taxonomy* concepts in a strict rdfs:subClassOf hierarchy, but not the generic concepts. This allows for capturing the hierarchy of taxonomy concepts without linking the generic concepts to incorrect superordinate classes.
3. In order to ease annotation, we create one annotation class for each taxonomy node which becomes an rdfs:subClassOf of *both* the respective generic and the respective taxonomy concept. With this construct, a single rdf:type statement is sufficient to make a product an instance of both the generic and the taxonomy concept.

This yields exactly the distinction we want: When searching for a TV maintenance service, we look for instances of the *generic* class, and when looking for all items that belong to the taxonomy category, we use the taxonomy concept. For example, a store manager might want to find all products in the TV set segment. In this case, he or she also wants to find TV set cabling and maintenance, so the query will be based on the taxonomy concept.
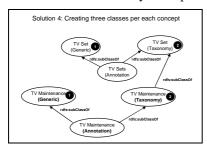

Figure 1: Separating the generic from the taxonomic concept

4 Status of the Project

We have finished the transformation of eCl@ss 5.1 into a products and services ontology. Currently, we are preparing the legal framework and documentation for an official release. The final version will be available at http://www.heppnetz.de/eclassowl.

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