What Makes a Good Ontology?  
A Case-Study in Fine-Grained Knowledge Reuse

Miriam Fernández, Chwynnny Overbeeke, Marta Sabou, and Enrico Motta

Knowledge Media Institute,  
The Open University, Milton Keynes, United Kingdom  
{M.Fernandez, C.Overbeeke, R.M.Sabou, E.Motta}@open.ac.uk

Abstract. Understanding which ontology characteristics can predict a “good” quality ontology, is a core and ongoing task in the Semantic Web. In this paper, we provide our findings on which structural ontology characteristics are usually observed in high-quality ontologies. We obtain these findings through a task-based evaluation, where the task is the assessment of the correctness of semantic relations. This task is of increasing importance for a set of novel Semantic Web tools, which perform fine-grained knowledge reuse (i.e., they reuse only appropriate parts of a given ontology instead of the entire ontology). We conclude that, while structural ontology characteristics do not provide statistically significant information to ensure that an ontology is reliable (“good”), in general, richly populated ontologies, with higher depth and breadth variance are more likely to provide reliable semantic content.

Keywords: semantic relations, knowledge reuse, Semantic Web.

1 Introduction

Ontologies are fundamental Semantic Web (SW) technologies, and as such, the problem of their evaluation has received much attention from areas such as ontology ranking [8], selection [16][21], evaluation [11] and reuse [22]. Various approaches have been proposed in these fields, ranging from manual evaluation to (semi-)automatic evaluation of a single ontology to benchmark evaluation of the entire Semantic Web, and, finally, to task-based evaluations of a single ontology or a collection of ontologies. These studies have explored a variety of ontology characteristics that could predict ontology quality, including characteristics such as the modeling style of the ontologies, their vocabulary, structure, or performance within a given task. In this paper we continue the investigation of what makes a “good” ontology by using a task-based approach to evaluate the collection of ontologies available on the SW in terms of measures relating to their structure.

The context of our work is that of fine-grained knowledge reuse, i.e., the reuse of ontology parts rather than the ontology as a whole. This kind of knowledge reuse is increasingly frequent, particularly for the new family of applications that take advantage of the large scale of the Semantic Web and the set of mature technologies.
for accessing its content\(^1\) in order to reuse online knowledge. In the case of these applications, knowledge reuse happens at run-time, and therefore it primarily focuses on the reuse of small parts of ontologies, typically at the level of a semantic relation [17]. This is why it is essential to automatically detect the quality of such relations.

The task we focus on in this paper is the evaluation of a single semantic relation (and not that of an entire ontology). We have built an algorithm that explores online ontologies in order to perform this task [18]. The performance of the task depends on the selection of these ontologies. We experiment with a set of structure-based ontology characteristics to select appropriate ontologies and decide which characteristics are more important by measuring their influence on the performance achieved when predicting the quality of relations. The correlation between structure-based ontology characteristics and ontology correctness arises from our own experience in previous works [10][18], and other ontology evaluation studies where this distinction seems to be natural, useful and recurrent (see e.g. [15]).

Our findings show that while structural ontology characteristics do not provide statistically significant information to identify a correct ontology, some of them point to valuable information that can help enhance ontology selection techniques. In particular, we conclude that richly populated ontologies with a high breadth and depth variance are more likely to be correct, and should be ranked higher by ontology selection algorithms.

The contribution of our paper is two-fold. On the one hand, we further advance work on automatic relation evaluation by providing our findings on the ontology characteristics which could predict which ontologies are most likely to provide correct relations. On the other hand, a side-effect of this work is a large-scale investigation of what are the core structural characteristics that can predict a good-quality ontology.

The rest of the paper is structured as follows. We present related work in Section 2 and describe some motivating scenarios in the context of fine-grained knowledge reuse in Section 3. Section 4 introduces the task we focus on, the evaluation of a single semantic relation, and its implementation. We present the evaluation setup in Section 5 and detail experimental results in Section 6. We conclude in Section 7.

## 2 Related Work

As the number of ontologies on the Web increases, the need arises to determine which ontologies are of the highest quality or are the most appropriate for a certain task. There are several conceptions of what makes a “good” ontology, which will be discussed in this section.

Significant work has been done in the area of ontology quality assessment [6][14]. Most of these attempts try to define a generic quality evaluation framework. As a result, specific applications of ontologies are not taken into account, and the ontology is considered as a whole during its quality evaluation.

Existing evaluation methods rely on rather simple ways of specifying an information need, such as (sets of) keywords or a corpus from which sets of keywords are abstracted and output their results as a ranked list of ontologies [21].

\(^1\) [http://esw.w3.org/topic/TaskForces/CommunityProjects/LinkingOpenData/SemanticWebSearchEngines](http://esw.w3.org/topic/TaskForces/CommunityProjects/LinkingOpenData/SemanticWebSearchEngines)