ABSTRACT
This paper outlines an ongoing research focused on the quality analysis of semantic annotation towards better Web Services management. Considering the properties of the annotation process and result, we provide an overview of the main issues related to the semantic annotation of Web Services and our first clues to tackle this relevant issue.

Categories and Subject Descriptors
H.3.5 [Information Storage and Retrieval]: Online Information Services – Web-based services

General Terms
Management, Performance, Reliability, Verification.

Keywords

1. INTRODUCTION
Nowadays, the Semantic Web enables newest technological infrastructures to interpret, discover, combine and exploit data on the Web. The main basis of Semantic Web is computer-understandable descriptions of Web resources (i.e. documents, web pages and services…) built by annotating with metadata and facilitating the comparison and retrieval.

Web Services are traditionally described by the WSDL language, which has been enhanced with semantic annotations by means of different languages like SAWSDL. With this language richer information about the behavior of the Web Service can be provided and simplify their management.

We are particularly interested in the quality of the Semantic Web services (SWS) annotations. In order to be useful, semantic annotations for Web services (WS) must be trustworthy descriptions of the service component for which they have been created. At the same time, semantic annotation is time consuming and demands deep domain knowledge even for an expert annotator. More and more methods try to improve such annotations and propose automatic or semi-automatic annotation techniques [4]. This kind of methods is founded on different techniques such as ontologies, syntactic matching, machine learning, etc. The diversity of such methods unfortunately leads also into heterogeneous WS annotations that are often incompatible, incomplete, or imprecise. Defects or conflicts on annotations may drive to several ambiguities and errors that required to be detected. Indeed, as several works underline [1,2,3], the quality of annotations affects the quality of knowledge. More specifically, analyzing and improving the quality of semantic annotations, we enable a better understanding of Web resources and promote initial guidelines to better manage Web services’ descriptions. We argue that improving the quality of semantic annotations is a first step to improve Semantic Web Service (SWS) discovery.

Considering this research context, interesting questions arise, like: Which criteria have to be considered to annotate a Web Service (WS)? Under which conditions an annotation is considered useful, consistent, or reliable? What is the impact of poor quality annotations on WS discovery? How can we improve semantic annotations for WS?

The focus of this paper is not to provide answers to all these questions. Our goal is to discuss our first clues (Section 3) concerning these inquiries and provide a general overview of our ongoing work and perspectives.

2. SEMANTIC WEB SERVICE ANNOTATIONS
In our study, we are specially interested in the semantic annotations that include machine-readable descriptions (semantics) [4,5] and are based on ontological annotation techniques for WS. These kinds of annotation have been proposed as a solution for providing richer information about the behavior of Web services and simplify their management through partial automation of tasks like discovery, composition or invocation.

Figure 1. Semantic Annotation with SAWSDL
In a semantic Web context, an annotation is the mapping between the reference ontology and the elements of the schema. The SAWSDL language2 defines three attribute extensions for semantic annotations (see Figure 1) where modelReference is used to annotate XML Schema type definitions, element and attribute declarations, as well as WSDL interfaces, operations and faults. It

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11 http://www.w3.org/2002/ws/sawSDL/spec/

2 http://www.w3.org/2002/ws/sawSDL/spec/examples/
points to one or more models expressed in semantic representation languages, e.g. ontology. In figure 2, we illustrate a generic semantic annotation process which is the core of several Web services annotations tools [3].

![Semantic Annotation Process](image)

**Figure 2. Semantic Annotation Process**

Such a process includes different phases: **XSD elements Identification** which extracts the elements to annotate (input, output, complex types, etc), the **Concept matching** which achieves the mapping between the schema elements and the ontological concepts, and finally the **Annotation** which adds relevant annotation(s) to the elements.

### 3. TOWARDS A QUALITY EVALUATION FRAMEWORK

The level of freedom provided by the current languages for SWS description unfortunately leads to several inconsistencies, for instance: meaningless or unreliable annotations coming from non-experts, irrelevant annotations regarding the annotation goal and the Web service description, etc.

Next, we summarize the main identified issues when semantically annotating Web services. We distinguished the following issues according to the each phase of the annotation process and verified their impact on the annotation result:

- **Annotation goals**: annotation should facilitate reuse and integration.
- **Input**: determine which elements are required to be annotated.
- **Annotation description**: annotation syntax (conformity to W3C standard), inconsistencies resulting from a non-expert annotator.
- **Methods** (syntactic and semantic): algorithms are used to match elements with ontological concepts.
- **Annotation association** (1:1, 1:n, n:1): When one element owns different annotations: which annotation is the most relevant?
- **Ontology**: domain appropriateness, possible structural and semantic invalidation after update, unreliable ontology.

In order to estimate the impact of these issues, we have adopted a quality-based approach, referring quality in terms of integrity and consistency of the annotation process and result. To describe and quantify such aspects, we propose the following criteria (Table 1).

Considering these criteria, we look now at the design of an evaluation framework in order to assess the annotation process and results under the same conditions.

<table>
<thead>
<tr>
<th>Annotation description</th>
<th>Methods</th>
<th>Association Type</th>
<th>Ontology Conformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completeness</td>
<td>Precision</td>
<td>Semantic relevance</td>
<td>Ontology currency</td>
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<td>Expressiveness</td>
<td>Recall</td>
<td>Appropriateness</td>
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<td>Semantic validity</td>
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<td>- Annotator reputation</td>
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**Table 1. Quality criteria for semantic annotation**

Compared with other approaches\(^1\) [2,6], our proposal is to track the annotation process, validate it and then analyze the result. For this, we consider the following main aspects: first, evaluate the matching process responsible for finding the relations between the concepts and the elements to be annotated. Then, validate the ontology conformity, this means take into consideration the genealogy, evolution, description and domain of the ontology; and determine and validate the annotation type intended to be performed. We argue that supervising the annotation process according to the quality criteria better annotation results can be obtained.

### 4. CONCLUSION AND FUTURE WORK

In this paper we have introduce our ongoing research work concerning the quality of semantic annotation in the WS domain. The first clues highlighted in this position paper provide the core of elements to analyze the consistency and integrity of semantic annotations for WS. Furthermore, our work foregrounds the need for integrating a quality evaluation framework which sets a solid basis for WS discovery and composition issues.

Besides these important manners, we agree that more specific problems exist and can be further discussed. For example, how to optimize the ontology and an annotated model? How to solve the inconsistency or conflicts during the mapping? etc. We expect that such issues will be addressed in the near future.

### 5. REFERENCES


\(^1\) http://img.cs.man.ac.uk/quasar/