Change Discovery in Ontology-Based Knowledge Management Systems

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Abstract: In this paper, we present a novel approach for the change discovery in ontology-based knowledge management systems. It extends our previous work in the ontology evolution by taking into account the usage of an ontology in the knowledge management system. The approach is mainly based on the analysis of the user’s interaction with the system in providing annotations for knowledge resources, as well as in the process of accessing the knowledge by querying the knowledge repository. We defined several assessment criteria to estimate the quality of annotations and the user’s needs from the point of view of the knowledge management. These criteria result in the recommendations for the continual system improvement. Two evaluation studies illustrate the benefits of our approach.

1 Introduction

Knowledge management systems in general are not developed to remain stable, but are subjects to continual change, which is caused by several factors:

- The environment in which KM systems operate can change unpredictably, thereby invalidating the assumptions that were made when the system was built. For example, acquiring a new subsidiary in an enterprise adds new business areas as well as functionalities to the existing system.
- Users’ requirements often change after the system is already built, warranting system’s adaptation. For example, hiring new employees may lead to new competencies and greater diversity within the enterprise, which need to be reflected in the system.
- Some changes in the domain are implicit and can be discovered only through the analysis of user’s interaction with the system. For example, if many users are interested in two topics in conjunction (e.g. debug and java), and there is no knowledge resource matching this criterion, then an efficient knowledge management system should signal that a knowledge resource about the combination of these topics is needed (e.g. a document on how to perform debugging of java code).
Ad hoc management of the changes in knowledge management systems may work in the short-term, but to avoid unnecessary complexity and failures in the long run, the management has to be interpreted at the conceptual level. In ontology-based knowledge management systems ontologies are used as a conceptual backbone for providing information about knowledge resources and for accessing to the knowledge resources [1]. Therefore, in ontology-based knowledge management systems the changes caused by above-mentioned factors should be applied to the ontology.

The changes can be defined explicitly by the knowledge officer or by the end user. These changes cover business strategy evolution, modification in the application domain, additional functionality, etc. and they are captured in a variety of ways: direct discussion or interviews, customer specifications, surveys, observations. However, some changes may be discovered by analysing log-files tracking user’s interaction with the system. The application of these changes enables the continual improvement of the knowledge management systems according to the changes in the users’ needs. Although this facility enhances the efficiency of the system, as known to the authors there are no methods and tools that take into account change discovery.

In this paper we present an approach that supports discovery of the changes in ontology-based knowledge management systems. Change discovery is the first phase in the ontology evolution process [2] that enables the timely adaptation of an ontology, as well as the consistent management/propagation of the ontology changes to dependent elements. More details about ontology evolution can be found in [3].

Our primary goal is to suggest the knowledge engineer how to adapt the underlying ontology or annotation in order to enhance the whole system. In that sense we do not only discover the changes, but also estimate their effects on the functionality of the system and choose the most useful one.

The paper is organized as follows: In the second section we discuss the methods to discover changes in ontology-based knowledge management system. Moreover we introduce several assessment criteria to estimate the quality of annotations and the user’s needs from the point of view of knowledge management. Section 3 contains two evaluation studies. After a discussion of related work in the section 4, concluding remarks summarize the importance of the presented approach.

2 Change Discovery in Ontology-Based KM Systems

Change discovery can be defined as a process of inducing the changes from existing data. In the ontology-based knowledge management system it should consider (i) the ontology as a domain model that underpins that system, (ii) the annotations\(^1\) that are results of the knowledge providing phase and (iii) the user’s activities in the knowledge management system. Consequently, we have identified the following ways of discovering changes [2]:

- **Structure-driven change discovery** identifies the set of heuristics to improve an ontology based on the analysis of the ontology structure. Based on our experience in the ontology development [1], the most frequently used heuristics are:

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\(^1\) An annotation consists of a set of ontology instances. We use term metadata as a synonym for an ontology instance.