

Chapter 8

Ontology Evolution: State of the Art and Future Directions

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ABSTRACT

Ontologies evolve continuously throughout their lifecycle to respond to different change requirements. Several problems emanate from ontology evolution: capturing change requirements, change representation, change impact analysis and resolution, change validation, change traceability, change propagation to dependant artifacts, versioning, etc. The purpose of this chapter is to gather research and current developments to manage ontology evolution. The authors highlight ontology evolution issues and present a state-of-the-art of ontology evolution approach by describing issues raised and the ontology model considered (ontology representation language), and also the ontology engineering tools supporting ontology evolution and maintenance. Furthermore, they sum up the state-of-the-art review by a comparative study based on general characteristics, evolution functionalities supported, and specificities of the existing ontology evolution approaches. At the end of the chapter, the authors discuss future and emerging trends.

INTRODUCTION

Today, ontologies are finding their way into a wide variety of applications. In addition to the Semantic Web, they are also applied to knowledge management, content and document management, information and model integration, etc. They offer rich and explicit semantic conceptualizations and reasoning

capabilities and facilitate query exploitation and system interoperability. However, ontological knowledge cannot be considered as being fixed and static. Just like any structure holding knowledge, it needs to be updated as well. Ontology development is a dynamic process starting with an initial rough ontology, which is later revised, refined and filled in with the details (Noy & McGuinness, 2001). Even during the usage of the ontology, the knowledge of the modeled domain can change

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and develop. To remain useful, the ontology has to cope with frequent changes in the application environment.

The purpose of this chapter is to gather research and current developments to manage ontology evolution and to discuss future direction. The chapter is composed of three main parts. In the first part, we outline ontology evolution requirements, we present a comparative study of ontology, database schema, and knowledge-based system evolution; and we detail ontology change management issues.

In the second part, devoted to a state-of-the-art review, we present an overview of existing ontology evolution approaches and highlight the functionalities supported by their process. The study also takes into account the ontology representation language and its consistency constraints. We also describe ontology engineering tools supporting a part of/or a complete ontology evolution process. At the end of this part, we sum up the review by a comparative study based on general characteristics, evolution functionalities supported, and specificities of the existing ontology evolution approaches.

The third part focuses on future research directions by gathering the latest research in progress on ontology evolution and giving perspectives on open issues.

ONTOLOGY EVOLUTION ISSUES

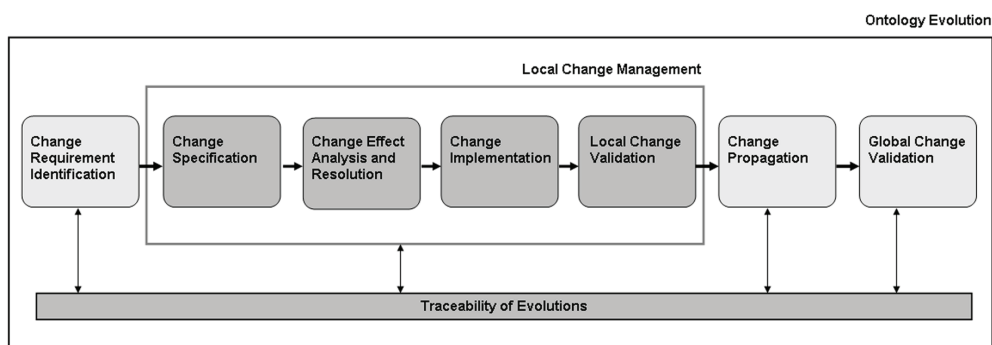
In this section, we try to give a better understanding of the ontology evolution problem by analyzing the context of the problem, comparing it with problems and solutions in related areas and outlining its issues.

The increasing number of ontologies in use and their costly adaptation to change requirements make ontology evolution very important. Ontology evolution regards the capability of managing the modification of an ontology in a consistent way. It is defined as being “the timely adaptation of an ontology and consistent propagation of changes to dependent artifacts” (Maedche, Motik, & Stojanovic, 2003, pp.287).

Ontology Evolution Requirements

Ontology evolution requirements have been discussed in (Blundell & Pettifer, 2004; Noy & Klein, 2004; Stojanovic & Motik, 2002; Stojanovic, 2004; Klein, 2004). Ontology evolution is a complex problem (figure 1): Besides identifying change requirements from several sources (modeled domain, usage environment, internal conceptualization, etc.), the management of a change –from a request to the final validation and application– needs to formally specify the required change, to analyze and resolve change effects on ontology, to implement the change, and

Figure 1. Ontology evolution requirements



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