Chapter 2.29
Engineering Conceptual Data Models from Domain Ontologies:
A Critical Evaluation

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ABSTRACT

This article studies the differences and similarities between domain ontologies and conceptual data models and the role that ontologies can play in establishing conceptual data models during the process of developing information systems. A mapping algorithm has been proposed and embedded in a special purpose transformation engine to generate a conceptual data model from a given domain ontology. Both quantitative and qualitative methods have been adopted to critically evaluate this new approach. In addition, this article focuses on evaluating the quality of the generated conceptual data model elements using Bunge-Wand-Weber and OntoClean ontologies. The results of this evaluation indicate that the generated conceptual data model provides a high degree of accuracy in identifying the substantial domain entities, along with their relationships being derived from the consensual semantics of domain knowledge. The results are encouraging and support the potential role that this approach can take part in the process of information system development.

INTRODUCTION

In the last decade, ontologies have been considered as essential components in most knowledge-based application development. As these models are increasingly becoming common, their applicability has ranged from the artificial intelligence domain, such as knowledge engineering/representation and natural language processing, to different fields like information integration and retrieval systems, the semantic Web, and the requirements analysis phase of the software development process. Therefore, the importance of using ontologies in building conceptual data models (CDMS) (CDMs) has already been recognized by different researchers. In our approach, we claim that the differences and similarities between ontologies and CDMs play an important role in the development of CDMs during the information system development process. We indicate that CDMs can be enriched by modeling the consensual knowledge of a certain domain, which, in turn, minimizes the semantic heterogeneities between the different data models (El-Ghalayini, Odeh, McClatchey, & Solomonides, 2005). We chose to study ontologies represented by the Web ontology language (OWL), since it is the most recent Web ontology language released by the World Wide Web Consortium in February 2004 (W3C-World Wide Web Consortium, 2005), and its formal semantics are based on description logics (DL).

The remainder of this article is structured as follows. The next section provides relevant information related to ontologies, CDMs, and the so-called transformation engine (TE). Then the following section discusses the process of evaluating the TE and its parameters, in general, and the qualitative dimension in evaluating the quality of the generated CDM elements, using ontological rules. This evaluation is demonstrated by a real-life case study related to the transparent access

Figure 1. General architecture of the proposed approach
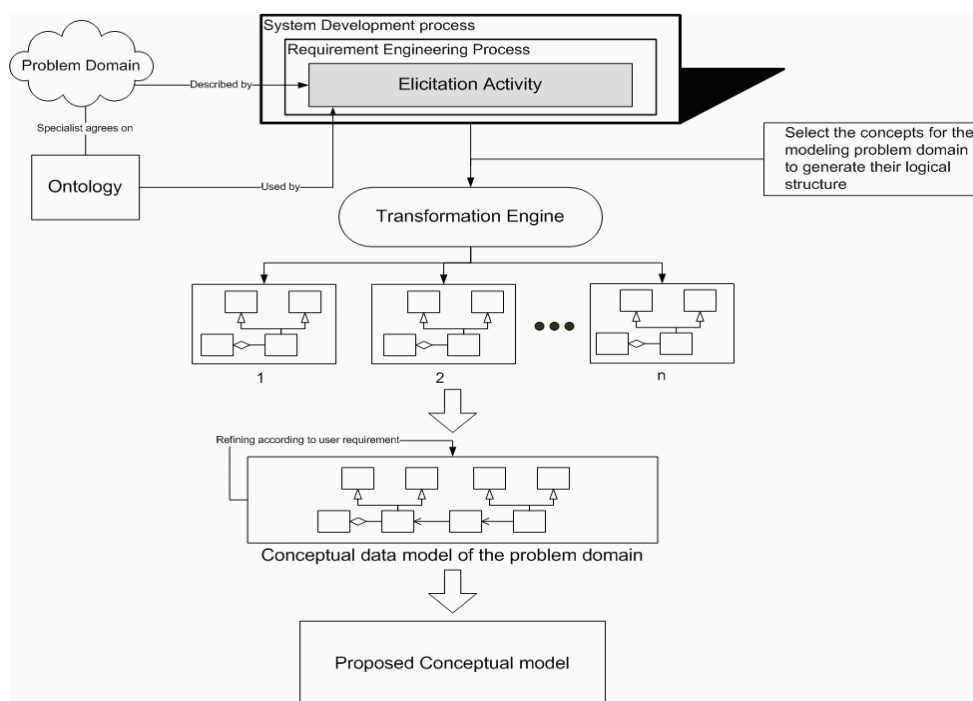
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