

Chapter 16

Knowledge-Based Systems for Data Modelling: Review and Challenges

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ABSTRACT

Data modelling is a complex process that depends on the knowledge and experience of the designers who carry it out. The lack of designers' expertise in that process negatively affects the quality of created models which has a significant impact on the quality of successive phases of information systems development. This chapter provides an overview of data modelling, especially the entity relationship method, main actors in the modelling process, and highlights the main problems and challenges in this field. Knowledge based system for data modelling support has a potential to minimize and prevent most of the problems that occur in modelling process. Therefore, a systematic review of the existing KB systems, methods, and tools for the data modelling process is made. By summarizing their main characteristics, some important desirable features of the new KB system for data modelling support are identified. With this in mind, a new KB system for data modelling support is proposed, which applies formal language theory (particularly translation) during the process of conceptual modelling.

INTRODUCTION

The information systems development process consists of the following phases: strategic planning, analysis, design, implementation, maintenance, and evaluation. As part of the information system design and implementation, the database structure has been developed. It serves to satisfy the information needs of information system users. This includes conceptual and logical database design (based on collected and analysed requirements), physical database design and database implementation (Elmasri & Navathe, 2011). This chapter is focused on the conceptual and logical database design in data modelling process that occurs in the design phase of information systems development.

Conceptual and logical database design (conceptual data modelling or data modelling) is an activity that is performed in the early stages of information systems development. Based on the user requirements, the process of the data modelling identifies the fundamental concepts and relationships of the observed reality and represents them in the conceptual schema form (Batini, Ceri & Navathe, 1992).

One of the main data modelling problems is the creation of a complete, easy-to-use, understandable and semantically correct conceptual schema. This process is knowledge intensive, complex and difficult (Teorey, 1999). Data modelling is critical in the development of information systems and errors committed in this stage are reflected in the poor quality of the database and incorrect query results Batini, Ceri, & Navathe, 1992; Martin & Leben, 1995).

Various Knowledge Based (KB) systems are developed to support data modelling in the development of the information system. KB system is a computer system that uses the methods and techniques of artificial intelligence to solve problems. The general structure of the KB system includes: knowledge base inference engine, self-learning, explanation and reasoning and user interface (Sajja & Akerkar, 2010).

KB system for data modelling can help users to develop better data models (Batini, Ceri, & Navathe, 1992). It can intervene, propose design choice, identify errors in the data model, and advise users to correct the model. The information system design process itself is appropriate for a problem domain for the KB system approach, because it is a non-algorithmic, non-trivial, and not completely deterministic problem (Lo & Choobineh, 2002).

The final goal of the authors' main research is the development of a KB system for the data modelling process using finite state transducers from formal language theory (i.e. translation). A conceptual proposal of that system is given in fifth section of the chapter. The other chapters' sections are organized in the following manner: the second section presents the data modelling process including its main actors and the entity relationship method, the third section deals with problems and challenges in the data modelling process, while a review of existing KB systems, tools and methods is given in the fourth section. The chapter ends with a conclusion, showing further directions of the author's research.

DATA MODELLING

During the analysis phase of information systems development user requirements are specified. The analysis identifies the need of a business organization for information. After the analysis phase, follows the design phase – the process that (based on user requirements specified in the analysis phase) results in a set of basic components of the information system, and formal representation of their relations which are independent of information systems implementation. The design phase consists of data relationship identification and design, database design and architectural design of the software product. The first two

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