Chapter XI

Using Semantic Technologies for the Support of Engineering Design Processes

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Abstract

The design and development processes of complex technical systems are of crucial importance to the competitiveness of a technology-oriented enterprise. These processes are characterized by high creativity and strong non-deterministic dynamics. Established information science methods, however, are intended for more deterministic work processes. They cannot be effectively applied to support creative activities like conceptual synthesis, analysis, and decision-making. Therefore, methods of experience management need to be exploited here. This chapter presents a new integrated approach to such design process guidance based on capturing the process traces in a Process Data Warehouse (PDW). Both the products to be designed and
the process steps that correspond, are structured and stored as extended method traces. This trace capture facilitates the processing and subsequent reuse of the information through a process-integrated development environment. The concept of the PDW has been evaluated in several engineering design case studies. One of those, which focuses on the conceptual design of a chemical production plant, will be described in more detail.

Introduction

Knowledge about engineering design processes constitutes one of the most valuable assets of modern technology-oriented enterprises. This is especially true for creative and non-deterministic design processes, as treated in this publication. Those processes are only marginally supported by established product lifecycle management (PLM) systems and similar approaches. Information items from the early phases of the product lifecycle are only weakly structured and usually not integrated. The knowledge of these design processes is normally only known implicitly to the participating designers and teams, relying heavily on the personal experience background of each designer. To fully exploit this important intellectual capital, it must be made explicit and shared among designers and across an enterprise. A comprehensive and consistent knowledge management framework needs to be established, to capture and integrate the individual knowledge items emerging in the course of an engineering design project, and thus to drive experience reuse processes.

Typically, a vast amount of design information is manipulated by legacy tools and stored in highly heterogeneous sources, such as electronic documents, files, and databases. Thus, any knowledge management system (KMS) needs to provide a comprehensive representation of the contents of these sources, thereby correlating the scattered knowledge items and providing a single point of access to design knowledge. As such, a comprehensive representation cannot be complete (for practical reasons); the KMS should employ mechanisms to easily locate the original knowledge sources, where more detailed information can be retrieved. To this aim, (meta) information about the sources (e.g., type, structure, version history, storage location) has to be combined with information about their contents.

To support the direct reuse of the knowledge applied in design processes, the traces of these processes need to be captured. These traces can then be searched and reused as some kind of experience knowledge in similar situations. In addition to capturing the products of the design processes, that is, the documents, diagrams and other resources created and modified during the work processes, it is necessary to capture these processes themselves. This allows providing information about the circumstances in which the individual knowledge items have been created. In particular,