Interoperability of Knowledge Based Engineering Software

Uwe Kaufman
Fraunhofer IPK
and
Russell W. Claus
NASA Glenn Research Center

Abstract

The design process of manufacturing goods like vehicles, airplanes, and spaceships is increasingly being driven by conflicting requirements. There is a need to shorten the product development time while performing more rigorous multidisciplinary analysis of increasingly complex systems. There is a need to involve a larger group of design partners while retaining core competencies within the design group. Knowledge Based Engineering software has been used to ameliorate these challenges, but market acceptance of the software has been growing only slowly due to their weak integration into the overall product development process.

Knowledge Based Engineering software provides a systematic approach to capture design knowledge so that it can be used in future applications (such as redesign or product lifecycle support). It supports linking requirements to design artifacts and captures constraints and relationships in a manner that allows integration with Computer Aided Design (CAD) software. Product Data Management (PDM) today is widely accepted as a means to store design data, especially CAD models and metadata. The new challenges of the most developed manufacturing enterprises is the implementation of a Product Lifecycle Management system, which often is referred to being an extension of PDM, but actually represents a process for the capturing of all data that concerns the whole product lifecycle, including the knowledge that lead to the specific design solution.

A past National Institute for Standard and Technology (NIST) workshop highlighted the lack of interoperability as a key reason for slow market acceptance of KBE software. Current international standards efforts have not yet closed this gap. One previous effort that attempted to address this challenge was the Methodology for Knowledge Based Engineering Applications (MOKA) project. MOKA was a European-sponsored research effort to develop a methodology for KBE that would, first, find ways to represent the product and process knowledge for design and, second, build a software tool to enable the methodology. MOKA used the Unified Modeling Language (UML) as one tool to represent product knowledge and followed a systematic, Object-Oriented approach to capture product and process knowledge.

Going beyond MOKA in terms of the development of KBE tools, a Function Oriented Design (FOD) system was developed in the framework of the German national project iViP (Integrated Virtual Product Creation). FOD is a conceptual design tool that allows the functional decomposition of a product, which is an abstract representation of a virtual product. This abstraction is needed to capture design knowledge independently of the

CAD system and to allow an easy way to reuse existing design solutions. To ease the adoption of FOD systems, standard interfaces to access and store design information were chosen, such as OMG's PDM Enablers and CAD Services. At the same time it reveled the absence of higher level interfaces to store and retrieve knowledge related information.

The Object Management Group (***OMG***) is an international standards organization supporting the development of software standards through a Model Driven Architecture (***MDA***) approach. The wide-scale industry adoption of OMG's MDA provides application developers and users with the means to build interoperable software systems distributed across all major hardware, operating system, and programming language environments. One of these industry wide efforts is under the umbrella of the Manufacturing Technology and Industrial Systems (ManTIS) Domain Task Force.

The ManTIS's mission is to foster the emergence of cost effective, timely, commercially available and interoperable manufacturing domain software components through MDA standards. Its goals include:

- Recommend technology for adoption that enables the interoperability and modularity of manufacturing domain software components.
- Encourage the development and use of MDA manufacturing domain software components, thereby growing the object technology market.
- Leverage existing OMG specifications. Recommend liaison with other appropriate organizations in support of the preceding goals.

In this framework a number of industry relevant specifications have been submitted and adopted, like Product Data Management (PDM) Enablers, Computer Aided Design (CAD) Services, Data Acquisition from Industrial Systems (DAIS & HDAIS), Product Lifecycle Management (PLM) Services, Utility Management Systems (UMS) Data Access Facility, and Distributed Simulation Systems.

The work on an interface model specification for Knowledge Based Engineering (KBE) software has recently begun. This specification should enable the interoperability of design knowledge between various KBE systems and related software. Based on industry feedback, a Request for Proposal (RFP) has been drafted that calls for the specification of a standard interoperable KBE interface model that enables the interoperability stated above. The principal motivation is to achieve functional interoperability and exchange of data and knowledge without loss of information, tolerance or robustness in Computer-Aided Engineering (CAE) applications, in general, and Knowledge Based Engineering (KBE) applications, in particular. It is anticipated that this activity will increase user acceptance; enable long-term design knowledge capture and retrieval of engineering information; add formalism to an informal process, thus improving the design process; provide a vehicle for university research that could lead to improved knowledge representations; provide vendors with increased market acceptance; and possibly promote the development of a user group that could solve user problems without vendor expense.