Integration Approaches for CIM

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Background

In response to pressures to reduce product lead times, manufacturing companies are increasingly aware of the need for some form of integration along the whole product chain. Engineering tasks must be coordinated and data exchanged between the various specialised tools. An enterprise has two main tracks of information flow, namely technical and managerial, and product data management spans both tracks. On the technical track, applications are highly specialised supporting tasks such as product design (CAD) and the programming of numerically controlled machines (CAM). Generally, the various application systems on the technical track are referred to as CAx systems. CAx systems may not only differ in terms of functionality but also in terms of the amount and type of data managed, the run-time environment and performance characteristics.

For complete support of Computer Integrated Manufacturing (CIM), we must be able to integrate existing technical and administrative component application systems. These component systems vary in their data management support and many CAx systems store their data directly in files rather than in a database system. The issues are how to describe the dependencies between these component systems and ensure system-wide data consistency. A particularly difficult problem is that of how to interface existing application systems in such a way that their operation can be monitored and controlled and a global transaction scheme provided.

Integration must be achieved in a way that supports system evolution in terms of the introduction and replacement of application systems. This is particularly important given the trend towards the notions of the extended enterprise and virtual factories in which a particular product chain may span several enterprises. Further, emerging legal statutes (especially in relation to environmental factors) are resulting in changes to the requirements for product data management. Enterprise integration must be both flexible and dynamic. The best way of achieving this is to integrate component systems by mans of a control layer which coordinates tasks based on explicit inter-system dependencies amenable to both direct view and update.

Product Data Management systems (also known as Engineering Databases) have been developed for the integration of CAx systems by managing product data centrally. One problem with a centralised system controlling access to data is that its availability is critical to the operation of all component systems. In an effort to overcome this, systems are being developed which replicate the metadata and data required for coordination.

Alternatively, coordination approaches have been proposed which aim to maximise component subsystem autonomy and increase CIM system flexibility. These systems place less emphasis on data sharing and more emphasis on task coordination. The integration effort is minimised and only that information strictly essential to coordination is managed centrally.

Tutorial

In this tutorial, we review the requirements of CIM in terms of general product data management. Based on these requirements, we provide a comparison of different integration approaches for the exchange and consistency of product data across CIM component systems. In particular, we present the main features of current Product Data Management systems and compare these to the various forms of multidatabase approaches proposed by the database community.

The CIM integration effort is based on a number of emerging standards. The standard STEP/EXPRESS for the exchange of product data is intended to replace all the currently used exchange formats. While such standards do not ensure data consistency across CIM component systems, they provide an important part of the infrastructure necessary for global product data management. A brief overview of the EXPRESS data model and a discussion of its merits and limitations in terms of its use as a global data model, and specifically as model for coordination, are presented.