Chapter 5.11
An Ontology Approach to Collaborative Engineering for Producibility

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ABSTRACT

With today's high product variety and shorter life cycles in automobile manufacturing, every new car design must be adapted to existing production facilities so that these facilities can be used for the manufacturing of several car models. In order to ensure this, collaboration between engineering design and production engineering has to be supported. Sharing information is at the core of collaborative engineering. By implementing an ontology approach, work within domains requirement management, engineering design, and production engineering can be integrated. An ontology approach, based on an information model implemented in a computer tool, supports work in the different domains and their collaboration. The main objectives of the proposed approach are supporting the formation of requirement specifications for products and processes, improved and simplified information retrieval for designers and process planners, forward traceability from changes in product systems to manufacturing systems, backward traceability from changes in manufacturing systems to product systems, and the elimination of redundant or multiple versions of requirement specifications by simplifying the updating and maintenance of the information.

INTRODUCTION

Ten years ago, product life cycles in the motorcar industry were such that the development of a new car model usually meant setting up a new assembly line, or even a new manufacturing plant, for the model. This production facility could then be adapted to the requirements of the new model. With today's high product variety and shorter life cycles, this is no longer possible. Instead, new car designs must be adapted to existing production facilities so that they can be used for several car models, often run simultaneously and in an arbitrary, order-driven sequence on the same line operated by the same personnel. This change of manufacturing paradigm is illustrated in Figure 1.

This entirely new production paradigm relies on production constraints being well defined, understood, and applied by the car designers. Project planning and working practices with frequent interchange of information between production and design departments are a necessity. However, manufacturing data and their interrelationships are complex, and there is no universally accepted meaning for terms used in manufacturing (Schlenoff, Ivester, Libes, Denno, & Szykman, 1999). As a result, the communication of manufacturing data in a company is afflicted with ambiguous interpretations.

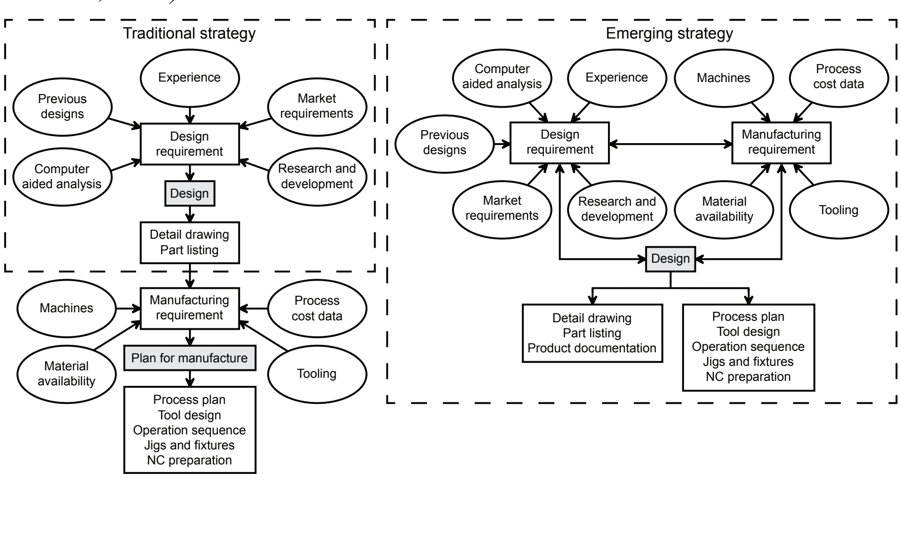
There is also a strong need for a more formalised definition of manufacturing constraints. A natural way is to represent these constraints as manufacturing requirements analogous to the functional requirements defined by the department for product planning. The designer thus receives a design task together with a requirements list covering both customer specifications and the specifications that certify producibility in existing plants and lines.

Purpose and Objectives

The purpose of this work is to explore ontology-based solutions to handling growing production-related information sources so that relevant information can always be retrieved in a flexible manner for the variety of needs that exist among designers and production engineers. It is important to choose dynamic solutions that allow the guidelines to change frequently. Such change will occur naturally as products, processes, and experiences evolve over time.

The objective is to enable a systematic approach to handling manufacturing requirements. Sharing information is at the core of collaborative engineering. With an ontology approach, work within domains requirement management, pro-

Figure 1. Change of manufacturing paradigm results in a need for new methods and tools in the product—production interface. Traditional strategy. A new manufacturing system for every new product. Emerging strategy Adapt the new products to the manufacturing system that evolves in small steps (Adapted figure from Hannam, 1997).



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