

Chapter XII

Collaborative Engineering for Enhanced Producibility by Ontology-Based Integration of Design and Production

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ABSTRACT

Many companies base their business strategy on customized products with a high level of variety and continuous functional improvements. For companies to be able to provide affordable products in a short time and be at the competitive edge, every new design must be adapted to existing production facilities. In order to ensure this, collaboration between engineering design and production engineering has to be supported. With the dispersed organisations of today combined with the increasing amount of information that has to be shared and managed, this collaboration is a critical issue for many companies. In this article, an approach for sharing and managing product and production information is introduced. The results are based on the experiences from a case study at a car manufacturer. By ontology-based integration, work within domains engineering design, production engineering and requirement management at the company was integrated. The main objectives with the integration were: support the formation of requirement specifications for products and processes, improve and simplify the information retrieval for designers and process planners, ensure traceability from changes in product systems to manufacturing systems and vice versa, and finally, eliminate redundant or multiple versions of requirement specifications.

INTRODUCTION

Ten years ago, product life cycles in the motor-car 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. But manufacturing data and its interrelationships are

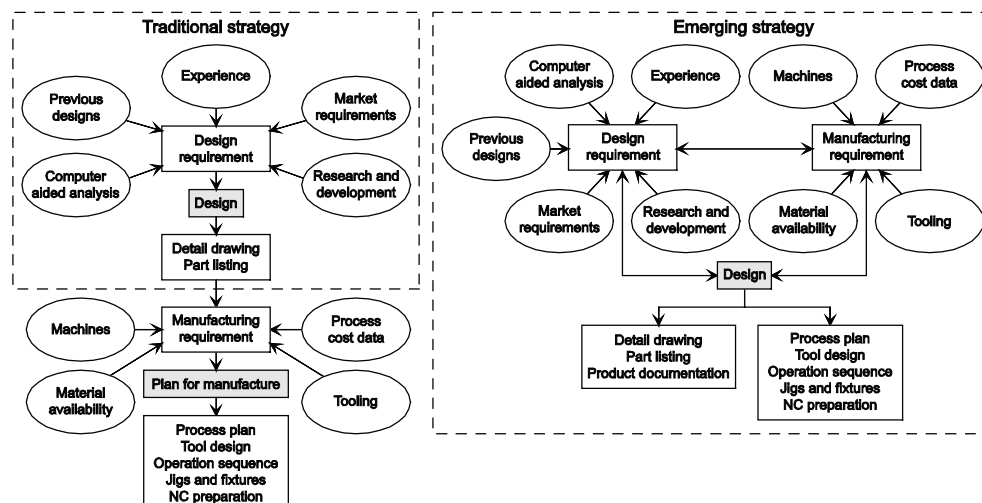
complex, and there is no universally accepted meaning for terms used in manufacturing (Schlenhoff, Ivester, Libes, Denno, & Szykman, 1999). As a result, communication of manufacturing data in a company is afflicted with ambiguous interpretations.

There is also a strong need for a more formalised definition of the 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 was 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

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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