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Chapter XII

Analytical Customer Requirement Analysis Based on Data Mining

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Abstract

This chapter applies data-mining techniques to help manufacturing companies analyze their customers' requirements. Customer requirement analysis has been well recognized as one of the principal factors in product development for achieving success in the marketplace. Due to the difficulties inherent in the customer requirement analysis process, reusing knowledge from historical data suggests itself as a natural technique to facilitate the handling of requirement information and the tradeoffs among many customers, marketing and engineering concerns. This chapter proposes to apply data-mining techniques to infer the latent information from historical data and thereby improve the customer requirement analysis process.

Introduction

Over the years, the philosophy has developed that the customer is the key to the success of product development. The ability to address customer wants and needs by rapidly bringing new and different high quality products to market has been viewed as a major source of competitive advantage for the business organizations in the global market over the past decade (Womack, Jones, & Roos, 1990). For example, the ability to analyze customers' requirements has made Toyota a world-class exemplar among the global automotive producers.

One of the key tasks for a business organization is the production operation. The main challenge facing a business organization is how to provide the right products to meet the consumers' requirements. As shown in Figure 1, the product development process involves information processing in four distinct domains according to the domain framework in axiomatic design (Suh, 2001). Product development in general encompasses three consecutive stages: (1) product definition — mapping of customer needs (CNs) in the customer domain to functional requirements (FRs) in the functional domain; (2) product design — mapping of FRs in the functional domain to design parameters (DPs) in the physical domain; and (3) process design — mapping of DPs in the physical domain to process variables (PVs) in the process domain. Within the context of mass customization, product design and process design are embodied in the respective product and process platforms. Customer requirement analysis is embodied in the product definition phase, characterized by mapping the customer requirements to product functional specifications, which in turn becomes the input to the downstream design activities, and is propagated to product and process platforms in a coherent fashion. The practice of translating customer requirements into products by simultaneously designing the product and manufacturing processes is a notable characteristic of companies that seek a competitive edge (Clark & Fujimoto, 1991). Thus, subjective customer requirements are translated into objective specifications from which engineers can start to design products. Timely, complete and accurate information is important for business organizations to meet diverse customer requirements in today's competitive global market (Pugh, 1991).

Consistent with the product development process, customer requirement analysis involves a tedious elaboration process conducted among customers, marketing practitioners, and designers. First, the customer requirements are normally qualitative and tend to be imprecise and ambiguous due to their linguistic origins. Second, the interrelationships (i.e., mapping) between CNs and FRs are often unclear in the early stage of design. Third, the specification of requirements results from not only the transformation of customer requirements from potential end-users, but also consideration of many engineering concerns, involving internal customers, downstream of the design team along the product realization process (Du, Jiao, & Tseng, 2003). In practice, product development teams must keep track of a myriad of requirement information derived from different perspectives of the product life-cycle, such as product technologies, manufacturability, reliability, maintainability, and environmental safety, to name but a few (Prudhomme, Zwolinski, & Brissaud, 2003).

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