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The role of product safety and liability in concurrent engineering

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Abstract

This paper explores the role of product safety and liability in the early stages of product design in a concurrent engineering environment. The paper presents an overview of literature pertaining to the significance of product liability for manufacturers. Further, the paper presents a system approach to product safety, a conceptual framework for design for safety and liability, and a product safety program, which covers the three safety techniques of Preliminary Hazard Analysis, Fault Tree Analysis, and Failure Mode and Effect Analysis. The focus of the paper, in terms of incorporating safety in the product, is on design, manufacturing, and providing warnings. The example of a disc braking system is presented and discussed in order to explain, test, and validate the model and methodology. The developmental aspects of product safety are considered and a Knowledge Based Management System (KBMS) is developed. The KBMS is capable of integrating data bases and knowledge bases into a system that generates form design features. These design features also contain product safety attributes. Finally, the paper presents conclusions and an assessment of the results and provides additional perspectives.

Keywords: Product design; Concurrent engineering; Product safety; Product liability; Preliminary hazard analysis; Fault tree analysis; Failure mode and effect analysis; Knowledge based management system; Disc braking system

1. Introduction

Product liability is a legal term used whenever the performance and integrity of a product is challenged legally. Product liability can be viewed as a vehicle for transferring funds from product manufacturers to injured victims. The lawsuits associated with product liability have been pivotal in forcing manufacturers to consider the financial impact of producing unsafe products. The courts have shown

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little mercy for manufacturers who neglect safety and who produce products that later prove to be unsafe. Product liability losses cost industries millions of dollars annually. This loss has forced even well managed firms to the verge of bankruptcy. One example is Cessna, an airplane manufacturer, which was nearly on the brink of ceasing all operations owing to the high cost of product liability (Kister, 1998).

Some manufacturers have been forced to stifle the rate of product innovation due to the fear of liability lawsuits. Major business acquisitions have been averted due to the uncertainties of product liability problems with prospective partners. Some products have been recalled or discontinued because of liability concerns; and, on occasion, no substitute is introduced to replace the withdrawn product. Some firms even voluntarily restrict multiple offerings of their product in order to elude potential and unexpected liability problems.

Incorporating more safety devices, as well as testing the product to ensure safety, could potentially result in more expensive products. This may lead to fewer new products entering the market. Industries most affected by product liability include those producing asbestos insulation, chemicals, rubber, various types of machinery, fabricated metal products, and electrical and industrial apparatus (Mergenbagen, 1995).

1.1. Objectives, scope, and organization of the paper

The objectives of this paper are twofold. (1) To develop a methodology and a conceptual framework by which safer, less liable, and minimal-risk products can be produced. (2) To address the implementation aspects of product safety and liability by proposing a knowledge-based management system. The scope of the paper is limited to safety and liability issues for mechanical products. The scope could include components, subsystems, and end products.

The significance and statistical overview of product liability is presented in the remainder of Section 1. A system approach to product liability, the conceptual framework, and the product safety program, which covers the safety techniques, are presented in Section 2. By using the conceptual framework and product safety techniques, an example of a braking system is presented and discussed in Section 3. The developmental aspects and computer requirements of product safety are considered by proposing a knowledge-based management system in Section 4. Finally, the conclusions and an assessment are presented in Section 5.

1.2. Significance and statistical overview of product liability issues

The following literature represents statistical and anecdotal evidence in order to signify the importance, implications, and costs associated with product liability. These are classified into three broad categories.

First, a literature review pertaining to litigation and product liability studies is presented:

- Moller (1996) conducted a comprehensive study of trends in jury verdicts in 15 jurisdictions. The author included the following trends with results noted in parentheses: the number of verdicts (trial rates were flat or decreasing); case types (automobile and landowner liability cases dominated the caseload, followed by medical malpractice, business, and product liability); the percentage of cases in which the plaintiff was successful (the success rate was 66% in automobile personal injury and business cases, 33% in the medical malpractice and 44% for product liability case); award amounts