Quality function deployment implementation based on Fuzzy Kano model: An application in PLM system

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Abstract

Product lifecycle management (PLM), a strategic business system allows more effective communication among different groups at dispersed locations to share ideas and access information needed for developing new products and executing innovative processes. The main function of PLM is to develop an attractive system which ensures customer satisfaction. Therefore, one of the important topics of the PLM system developments is to take customer requirements into consideration. Quality function deployment (QFD) has been widely used for numerous years; it is one of the structured methodologies that are used to translate customer needs into specific quality development. However, in the traditional QFD approach, each element's interdependence and customer requirements are usually not systematically treated. Additionally, the Kano model can effectively classify customer demand attributes, but to make Kano model more objective in the course of weighing, we have also included Fuzzy mode in our discussion. This study presents an integrative approach by incorporating the Kano model with Fuzzy mode into the matrix of QFD and adjusting customer requirement weights. This approach can fulfill two objectives, First, through the Kano model with the Fuzzy mode, it will not only discriminate out options for the required attributes in much more breadth but also simultaneously render the discretions on the linguistic implications much more accurate with the aid of the ambiguous questionnaire response method. Second, combining the Kano model and QFD, can not only provide a new way to optimize the product design but can also enhance customer satisfaction and loyalty, and minimize dissatisfaction. The proposed methods can be useful to both practitioners and researchers. To illustrate our findings, we have incorporated an example which suggests that the proposed approach can contribute to the creation of attractive PLM attributes and PLM innovation.
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Keywords: Product lifecycle management; Quality function deployment; Kano model; Fuzzy mode

1. Introduction

Product lifecycle management (PLM), a strategic business system, helps enterprises to achieve business goals of reducing costs, improving quality, and shortening time to market, while innovating their products,

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services, and business operations. The competition among various types of PLM system developments will only intensify. Under these circumstances, new PLM system development technologies are being employed to develop attractive PLM systems that will provide more satisfaction to customers.

However, for companies which design the PLM systems, customer requirements are generally not treated systematically. Even if customer requirements are collected before the design phase, they tend to be disregarded and finally vanish during the construction phase. Because of the lack of attention paid to customer requirements collection at these stages, problems in terms of design ability, delays due to incomplete designs, misunderstandings of customer expectations, rework, etc. are observed. Consequently, how to improve functions and modules, and creating them during the PLM system development stages with customer requirements are necessary and indispensable.

To clearly specify customer wants and needs, Quality Function Deployment (QFD) framework that is commonly discussed in the quality management literature can be used as a proactive approach to encounter quality issues instead of taking the passive approach of lunching customer complaints (Akao, 1990). The basic concept of QFD is to translate the desires of customer or voice of customer (VOC), into product technical requirements or engineering characteristics, and subsequently into parts characteristics, process plans and production requirements by using a chart called House of Quality (HOQ).

As competition for new markets and customers increases, level of customer satisfaction also became a key factor for long-term business success. Satisfied customers are loyal customers and ensure a lasting cash flow in the future. According to Reichfeld and Sasser (1990), a 5% increase in customer loyalty can increase the profit of a business by 100% due to the fact that satisfied customers purchase the products more often and in greater quantities. Generally, satisfied customers are less price-sensitive and more inclined to spend more on products they have tried and tested. The Kano model of customer satisfaction can determine ''attractive'' or ''must-be'' requirements which can be used in the QFD matrix to assure that most critical needs are translated into the next phases of product development (Tan & Shen, 2000). However, the selection of weights is very subjective. As a consequence, this study will use the Fuzzy mode to improve subjective linguistic scale in Kano's two-dimensional quality element. The use of Fuzzy mode is for respondents to express themselves about the extent of correct attribution by membership and any numeric value.

The reminder of this paper is organized as follows. Section 2 discusses the PLM system and its benefits. Section 3 then describes the traditional QFD framework as discussed in the literature. Subsequently, Section 4 discusses the formulation in more detail. Section 5 provides an illustrative example of the application of the PLM system during the development procedure. Finally, Section 6 provides concluding remarks.

This study presents a novel approach for determining customer requirements and PLM elements. First, the requirements in discussion are considered as attributes which are categorized as attractive, must-be or one-dimensional by using the Kano model method to make the requirements more objective when weighing the requirements by Fuzzy mode. Second, we design the product by integrating a decision-making technique to incorporate the dependencies inherent in the QFD process.

2. PLM system and its major benefits

Product lifecycle management (PLM) is a strategic business approach that helps enterprises to achieve their business goals of reducing costs, improving quality, and shortening time to market, while innovating their products, services, and business operations (Grieves, 2005). The core concept of PLM provides a definition of a completed product including all information and processes required to plan, develop, manufacture and support the product from concept through the end of its life integrating people, processes, business systems, and information. PLM allows effective communication among different groups at dispersed locations to share ideas and access information needed for developing new products and executing innovative processes. PLM is also a strategic business approach that forms the product-information backbone for a company and its extended company (Saaksvuori & Immonen, 2003). PLM can help enterprises to quickly develop and deliver products that drive enterprises' business. With PLM, enterprises gain the following benefits: