

An Integrated Product Design and Selection Approach Using Grey QFD and Grey TOPSIS Methods

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Abstract

Quality function deployment (QFD) is a successful product design tool for analyzing customer demands. Recently, researchers have combined QFD and grey system theory for solving small size, uncertain and incomplete data problems. However, some problems, such as single grey values, competitive analysis and prototype product selections, require further investigation. To resolve these issues, this study integrates interval grey numbers, QFD and TOPSIS techniques to develop a grey product design and selection (GPDS) method. GPDS can help product developers identify important engineering characteristics, perform a competitive analysis and select the best prototype product(s) under a small size and uncertain data environment. A real-world case study (paper facial mask) is offered to explain the research process of the GPDS method. The case results indicate that GPDS helps the case company identify important engineering characteristics, understand the intended market position of a product and select the best prototype product.

Keywords: Product design, prototype product selection, grey QFD, interval grey number, grey TOPSIS.

1. Introduction

In order to satisfy various customer needs and shorten a product life cycle, an enterprise should concentrate on accumulating market research data in the product design stage. The major challenge for an enterprise is how to obtain useful customer requirement information and then effectively convert it into engineering characteristics or quality factors for designing a new product. Currently, there are several successful product design methods which have different design principles and approaches, such as the product life cycle method, Taguchi method, value engineering and computer-aided design and manufacturing (CAD/CAM). All these methods have been extensively applied in various product design domains. However, their focus is usually on product requirement functions, while the diverse needs of customers are ignored [9, 24, 25]. In contrast, quality function deployment (QFD) considers both consumer needs and product functions in the product design and manufacturing stages. Chen et al. [4], Delice et al. [8] and Leon [11]