

Criteria Assessment in Design Evaluation for Product Development using Integrated Fuzzy-TOPSIS

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Abstract

The instability in today's market and the ever increasing and emerging demands for mass customized and hybrid products by customers, are driving companies and decision makers to seek for cost effective and time efficient improvements in their product development process. Design concept evaluation which is the end of conceptual design is one of the most critical decision points in product development. It relates to the final success of product development, because poor criteria assessment in design concept evaluation can rarely be compensated at the later stages. This has led to real pressure for the adaptation of new developmental architecture and operational parameters to remain competitive in the market. In this paper, a new integrated design concept evaluation based on fuzzy-technique for order preference by similarity to ideal solution (Fuzzy-TOPSIS) is presented. Prior to Fuzzy-TOPSIS, a new scale of "Weighting criteria" for survey process is developed to ease the rating process of evaluation criteria. Case example from industry is presented to demonstrate the efficacy of the proposed methodology. The result of the example shows that the new integrated method provides an alternative to existing methods of design concept evaluation.

Keywords:

Criteria assessment, Design evaluation, product development, Fuzzy-TOPSIS

1 INTRODUCTION

In today's industries, product design has become the main focus in a highly competitive environment and fast-growing global market [1]. The benchmarks used to determine the competitive advantage of a manufacturing company are customer satisfaction, shorter product development time, higher quality and lower product cost [2]. To meet this challenge, new and novel design methodologies that facilitate the acquisition of design knowledge and creative ideas for later reuse are much sought after. In the same context, Liu & Boyle [3] highlighted that the challenges currently faced by the engineering design industry are the need to attract and retain customers, the need to maintain and increase market share and profitability and the need to meet the requirements of diverse communities.

Concept selection or criteria assessment which is made in the early phases of design process is among the most important activities in new product development, as the consequences of a poor choice may be disastrous at worst [4]. Tools, techniques and methods are being developed that can support engineering design with an emphasis on the customer, the designer and the community [5]. Thus, a good design process should take into account the aforementioned criteria as early as possible in order to ensure the success of a product [6].

Fig. 1 outlines the phase of product life cycle from development until decline. In most researches the introduction, growth, maturity and decline stage are commonly developed. A lot of methods have been introduced and well

known. On the other hand, the development stage still has room to improve, i.e. to compromise with conceptual design.

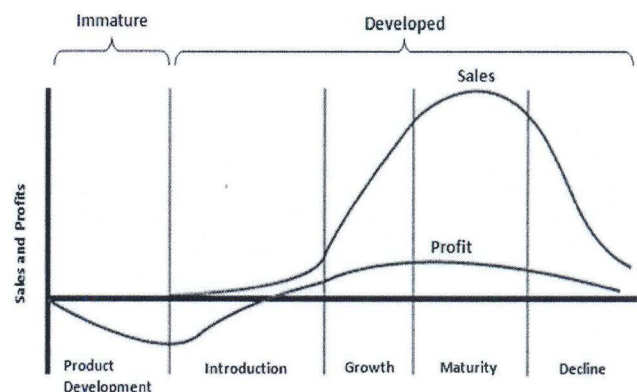


Fig. 1: Phases of product life cycle [7]

One important step in designing new products is generating conceptual designs [6]. The conceptual design process includes a set of technical activities, which are the refinement of customer requirements into design functions, new concept development and the embodiment engineering of a new product [8]. A study by Ullman [9] indicates that as much as 75% of the cost of a product is being committed during the design phase. Geng et al. [10] point out that