

PRODUCT CONCEPT SELECTION USING A FUZZY ANALYTIC HIERARCHY PROCESS

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Abstract

In today's fast-paced competitive market, each manufacturing company strives to launch a new product better and quicker. Launching a new product that will be successful in the market requires a series of right decisions early at the design stage. One of decisions that need to be correctly made during the design stage is selecting the best product concept that is worth developing. Product concept selection, by nature, belongs to multi criteria decision-making (MCDM) problems in which a decision maker has to pick the best concept among a set of alternatives or product concepts based on a set of criteria or attributes. Comparing product concepts to one another and ranking them are the pivotal roles in making the decision in such cases. Product concept selection during product development process is an iterative process that narrows the number of concepts quickly and selects the best concept. Several concept selection methods have been proposed. In ranking the product concepts, it is commonly assumed that decision makers can assign the relative weight of decision criteria and evaluate each alternative with respect to each selection criterion. However, during product development process, decision makers often deal with objects that are difficult to describe. Therefore, a new approach is required to perform product concept selection in product development process. The new approach should be robust enough for handling impreciseness of the product concept at the preliminary design. In the absence of complete and precise information, the fuzzy set theory becomes an effective tool for modeling complex systems. On the other hand, the analytic hierarchy process (AHP) becomes extensively used in dealing with MCDM problems. An important advantage of using AHP is its ability to help decision makers detect inadvertent misjudgments in pairwise comparisons. The objective of this paper is to present a Fuzzy Analytic Hierarchy Process with a Reference (FUZAR), a new approach that integrates the fuzzy set theory and the analytic hierarchy process using a reference in selecting the best product concept. In FUZAR, the fuzzy set theory is employed in performing "pairwise comparison" between competing alternatives and a "reference" on each of the criteria. The comparisons are also used to obtain the relative importance of criteria with respect to the overall objective. The use of a reference is due to the difficulty in consistently comparing concepts to one another. Once pairwise comparisons are completed, vector aggregates are computed through use of an original AHP method and fuzzy arithmetic operations. The results obtained from the proposed approach are consistent with those obtained from the original Analytical Hierarchy Process with a reference. The major contributions of the proposed approach include: (1) it accommodates the impreciseness of product concept at the preliminary design stage, (2) it maintains consistency in pairwise comparison, (3) it provides the results in terms of fuzziness, which resembles natural human thinking when comparing alternatives.

