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A New Fuzzy Model for Market Validation of Device Recycling Motor Oils

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Abstract

The market validation of any devices presents one of the most waste important tasks. There are many factors have a critical effect on market validation. These factors are defined by reverse logistic management team. In this paper, a new model for market validation of device for recycling is proposed which includes both quantitative and qualitative factors. In this paper, fuzzy pair-wise comparison matrix of the relative importance of factors is performed by reverse logistic team which use linguistic expressions. The factor weights are given by fuzzy AHP. The values of factor can be crisps and described by pre-defined linguistic expressions. All linguistic terms are modeled by triangular fuzzy numbers. The proposed model is verified through an illustrative example. The obtained results represent an input for future research which should include a good benchmark base for tested different devices which use in reverse logistic chains and their continuous improvement.

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1.0 Introduction

Increasing global competition forces companies to constantly increase the profit and better competitive positioning. These objectives can be achieved by reducing the time-to-market of their products, the using of the recycled raw materials, etc. Nowadays, manufacturing enterprises are expanding simulation models to obtain both

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quality of products, and to enable the validation of the products. It is realized into two phases. In the first phase, the measurement items for each product are generated and tentative indicators are provided. In the second phase, the confirmatory analysis is performed by using the different methods. The validation is vital to reduce process faults and facilitate efficient and effective engineering changes (Maropoulos and Ceglarek, 2010). On the other hand, the validation of new physical products are of primary importance for customer perception. In the literature, there are many definitions of the validation term. According to Babuska and Oden (2004) and Plant and Gamble (2003) validation is method that is used for confirming that a product meets its respective specifications and fulfils its intended purpose. The definition given by ISO 9000 validation is focused on fulfilling an intended use or application.

There are many methods that are used for the market validation of products in the early stages of product projects. These methods can be based on the market analyses, benchmarking tool, mathematical statistics, etc. In (Trentin et al, 2013) it is shown that sales configuration capabilities are applications designed to support potential customers in choosing within a company of product offer, the product solution that best fits their needs. The Analytic Hierarchical Process (AHP) is applied to help the company determine where to invest the development resources to achieve maximum payoff (Ramanathan and Yunfeng, 2009). A fuzzy group decision making approach to better align customer needs with objectives of product development is proposed by Büyüközkan *et al* (2004).

In this paper, author's attention is focused on the device for recycling of motor oils. The imortant of treated problem can be illustrated by the following facts: (1) there are a few producers of the considered device in the world market, (2) there are many types of devices for recycling of motor oils and (3) the unit price of device for recycling motor oils is high. In other world, the producers of the device type have monopol at the world market.

The uncertainties in: (1) the relative importance of factors (2) the some sub-factor values and (3) the customer satisfaction levels are described by management team. They use linguistic expressions is close to the human way of thinking. Modelling of linguistic terms is based on the fuzzy sets theory (Klir and Folger, 1988; Zimmeramnn, 2001). Fuzzy set theory resembles human reasoning in its use of approximate information and uncertainty to generate decisions (Kahraman, 2006) so that by applying the fuzzy approach all uncertainties and imprecision which emerged due to lack of good evidence are eliminated. In this paper, all uncertainties are modelled by triangular fuzzy sets.

The relative importance of each pair of factors is stated as fuzzy group decision making problem (Sadi-Nezhad and Damghani, 2009; Kelemensis and Askounis, 2010; Aleksic *et al*, 2014). By using fuzzy agreging method, the consensus of decision makers' opinions can be achieved. The benefits of using fuzzy Analytic Hierarchical Process (FAHP) are: (1) by using FAHP modeling of decision problem is performed in a holistic manner, (2) FAHP is an efficient tool for handling the fuzziness of the data involved in deciding the preferences or assessment of different decision variables. Handling of FAHP is performed by an approach which is introduced by Chang (1996). This approach does not involve cumbersome mathematical operation, and it has the ability to capture the vagueness of human thinking style. In the literature, this approach is most widely used (Seçme *et al.*, 2009; Torfi *et al.*, 2010; Kaya and Kahraman, 2011; Tadić *et al.*, 2013).

The paper is organized in the following way. The section 2 describes the evaluation framework. The modelling of uncertainties is presented in Section 3. A new fuzzy model for determining the market validation of recycling device for motor oils is proposed in Section 4. In Section 5, a proposed model is illustrated by an example with real-life data. Conclusions are presented in Section 6.

2.0 Evaluation framework

Results of good practice show that market validation of each recycling device should be performed. According to experience of experts in reverse logistic domain some of them have the strong influence on the economies of countries and environmental protection. It can be mentioned that each recycling device is specific in its way. Assessment of market validation each recycling need to be observed as a separate and unique problem. The proposed evaluation procedure is shown.