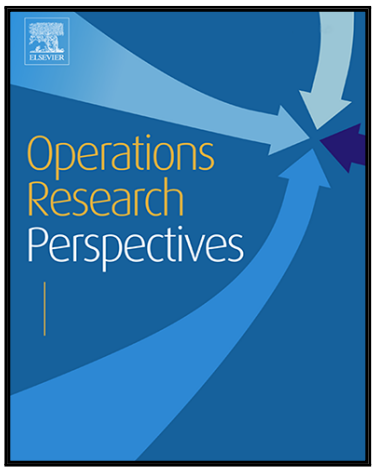

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A Novel Multi-Attribute Decision Making Approach for Selection of Appropriate Product Conforming Ergonomic Considerations

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Abstract

Ergonomic design of a product considers design, cognitive and behavioral information during the design stage with a view to improve the comfort level of the user and aesthetic look of the product. However, a large number of products are available in the market place possessing a wide range of features to address the ergonomic considerations. Many times, the features may be redundant and hardly enhance interaction between the user and the product leading to user dissatisfaction. But few important features focusing its functionality and physical comfort can possibly address the usability of product and improve satisfaction level of the user. This paper proposes a fuzzy multi-attribute decision making (MADM) approach integrating both subjective and objective weights for each criterion so that superior ergonomically designed product can be evaluated. The methodology is explained with the help of an example of selection of an office chair. Three popular approaches have been considered to compare the ranking of alternatives.

Keywords: Multi-attribute decision making (MADM); TOPSIS (Techniques for Order Preference by Similarity to Identical Solution);VIKOR (VIseKriterijumska Optimizacija I Kompromisno Resenjea); PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations)

1. Introduction

Competition in the market place demands high workload in an office environment resulting in prolonged sitting. Prolonged sitting may cause health risk like muscular disorders (Hales and Bernard, 1996). Therefore, ergonomically designed office chair possessing capability of maintaining compatibility between the user and product may lead to reduce fatigue. While designing or procuring an office chair, the psychological needs must be fulfilled in addition to physical needs to improve user satisfaction. Selection of an office chair with salient features satisfying ergonomic needs (both physical and psychological needs) becomes a complex decision making process. Keeping in view of complexity of the problem, multi-attribute decision making (MADM) approach can be considered during product design focusing on the requirements of user in terms of conflicting criteria in order to solve the task of selection of an ergonomically designed product. In a decision making process, it is unlikely that decision makers can express their preferences using crisp rating for attributes (Jee and Kang, 2000; Shanian and Savadogo, 2006; Jahan et al., 2010). As experts are not able to exactly specify to their preferences, linguistic variables using a fuzzy scale is used to conveniently deal with impreciseness and ambiguity in judgement (Chen, 2000; Chen et al., 2006; Girubha and Vinodh, 2012). Still the decision making becomes inconsistent because most of the approaches consider either objective or subjective attributes (Rao, 2012; Maniya and Bhatt, 2010). The attributes need to be properly evaluated for estimating attribute weights integrating both objective and subjective criteria (Rao and Patel, 2010). The subjective attributes can be dealt using eigen method (Saaty, 1977) or Delphi method (Hwang and Lin, 1987) whereas the objective attributes can be effectively managed by entropy method (Hwang and Yoon, 1981) for weight estimation. To address this issue, a novel decision making technique is proposed in this work considering both subjective and objective weights for attributes in order to facilitate the decision maker to deal with objective information regarding the product as well as the uncertainty of human judgement. The attribute ratings obtained from multiple experts are aggregated for effective decision making.

Three different popular MADM methods such as TOPSIS (Techniques for Order Preference by Similarity to Identical Solution), VIKOR (VIseKriterijumska Optimizacija I Kompromisno Resenjea) and PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations) are used to solve the selection problem of choosing the best