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Page count: 7
Word count: 4,106
Character count: 21,853
Submission date: 24-Oct-2023 03:11PM (UTC-0600)
Submission ID: 2206180480

(Abbreviation) Journal Name
Vol. XXX, No. XXX, 2013

New AHP Improvement using COMET Method Characteristic to Eliminate Rank Reversal Phenomenon

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Abstract— Rank Reversal in Multi-Criteria Decision Making (MCDM) is a phenomenon that occurs when an alternative is added or deleted because of a change in the order in which the result is ranked. The evaluation of the weight of criteria, which are established based on whether or not a decision maker considers them important, has an impact on the alternative ranking result in MCDM. Changes in decision result ranking called rank reversal is something that cannot be acceptable. Many researchers have done lots of research and created new methods for eliminating rank reversal, but until now there is still research that denies these new methods are free from rank reversal. The Analytical Hierarchy Process Method (AHP) as the oldest Decision support Method has an advantage in the decision according to the Decision Maker's (DM's) preference but is vulnerable of the rank reversal phenomenon. While Characteristic Object Method (COMET) is a method claimed to be free of rank reversal phenomenon. This paper will discuss how the integration of COMET to AHP especially in the phase of generating characteristic value and characteristic objects is added to the AHP phase, which will have an impact on digital marketing strategy decision-making for private Universities in Indonesia, especially the city of Palembang. The combination of COMET and AHP in this paper is tested with several testing tools, they are case study testing, accuracy testing and sensitivity analysis testing. The result of the combination of COMET and AHP will be named C-AHP. A consideration of DM's preference to the criteria weight, and the generation of alternative comparison based on criteria or any other attributes makes AHP free from rank reversal.

Keywords— Rank reversal, elimination, C-AHP, AHP, COMET, combination

1. INTRODUCTION

Multi-Criteria Decision Making (MCDM) Alternative ranking is affected by the weight given by the DMs to the criteria. The main methods of MCDM such as TOPSIS, ELECTRE, PROMETHEE, AHP, and their combination, have been criticized in accordance to the occurrence of a problem called Rank Reversal Phenomenon (RRP) [1]. Rank reversal is a phenomenon where the alternative's order of preference is altered when a new alternative is added, or an existing alternative is deleted from a decision problem. A rank reversal occurs when a new alternative has been added or an old alternative eliminated from decisions, and the order of preference for other options is changed. In 1980 Belton and Gear first observed a change in ranking in the AHP. [2]. One of the most important criteria for selecting the MCDM method is the phenomenon of rank reversal. There has been no answer to the question of a shift in rank as far as MCDM is concerned. Therefore, to obtain genuine results, a DM using MCD methods must know the problems that arise as a result of rank reversal. The rank reversal issue has not been solved yet in the MCDM context. Consequently, to obtain a valid result, DM using MCDM methods should be familiar with rank reversal phenomenon challenges. Although a lot of researchers declare that RRP is a natural feature of the decision-making process, RRP is undesirable and unwanted because it indicates unreliability in the MCDM approach, in the research about sustainable material selection, the research result showed that there was no way to confirm whether the number of options and criteria had any effect on rank reversal [3].

There have been many studies regarding RRP, which tried to eliminate rank reversal using various methods for the past 10 years. In 2014, a framework for the experiments to determine the cause of rank reversal in an MCDM Method was done, the result is a modification of a method with a robust combination in [4]. In addition to the RRP research carried out in 2017 with a reciprocal fuzzy preference relationship based on additive consistency for addressing RRP, there were also new methods that use proximity-indexed values and have demonstrated their accuracy compared to existing MCDM methods [1] [2]. An RRP investigation into potential causes of rank reversal was carried out in 2018, which indicates that preference followed by ranking score aggregation is the primary cause of RRP as a result of a lack of information in other research papers. A method for aggregation of scores has been proposed in some research to describe and illustrate the phenomenon of rank reversal using numerical examples. Compared to other tested methods, the results are better. According to the literature on decision-making, several methods suffer from this phenomenon, and one of them is AHP [5]. From 2020 era until 2023 the RRP research focused on the new method and/or the enhancement of the old method in MCDM with the additional Fuzzy to eliminate RRP such as AHP and TOPSIS method [6] [7] [8].

Analytical Hierarchy Process (AHP) as the method that applied for the last 25 years in many MCDM decision-making, has been used in lots of decisions in various fields. The pairwise

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