APPLICATION OF AHP-WASPAS METHOD IN SOLVING LAPTOP SELECTION PROBLEM

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1. Introduction

Choosing the best alternatives while considering multiple conflicting criteria is a complex decision-making process. The hybridisation of Analytic Hierarchy Process (AHP) method and Weighted Aggregated Sum Product Assessment (WASPAS) known as AHP-WASPAS method are among the methods that can be used to ease the process. In this study, real-life data about the laptop selection for the administrative offices of a supermarket (Aytaç Adalı & Tuş Işık, 2017) was applied to implement the method. The objectives of the study are to solve the laptop selection problem and to determine the ranking of the alternatives by using AHP-WASPAS method.

The WASPAS method is an integration method of Weight Sum Model (WSM) and Weight Product Model (WPM). By combining both WSM and WPM methods, the WASPAS method is said to be more beneficial as the accuracy of WASPAS method increases the ranking accuracy of the alternatives (Hashemkhani Zolfani et al., 2013). AHP method is used to compute the weight for criteria since it has consistency in providing weight to its parameter while WSM, WPM and WASPAS methods have no consistency (Hadikurniawati et al., 2018). In conclusion, the AHP-WASPAS method is applied to solve the problem because it is relatively simple based on its mathematical principles (Utami et al., 2019).

2. Methodology

AHP is a theory of measurement based on pairwise comparisons that use expert judgment to generate priority scales. The comparisons are made on an absolute scale, which indicates how

much one variable outnumbers another based on a particular attribute. The steps listed below show the procedures of AHP method in evaluating the importance of criteria (Saaty, 2008).

Step 1. Construct a pairwise comparison matrix, A and find the normalised pairwise comparison matrix, A_n. To normalise the matrix, all the elements in the column of matrix A must be divided by the sum of its column. Each column of the matrix A_n must add up to one.

Step 2. Calculate the weightage of each criterion by averaging across its row of matrix A_n. Let the relative weight be $W = W_1, W_2, \ldots, W_n$.

Step 3. Calculate consistency ratio, *CR* using $CR = \frac{CI}{RI}$ where $CI = \frac{\lambda_{max} - n}{n-1}$ with RI value in Table 1 and *n* is the size of the matrix. If CR<0.1, the pairwise comparison matrix is consistent.

Table 1. RI value

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

The weight for criteria is further used in the WASPAS method to solve the selection problem. The steps listed below show the procedure of WASPAS method (Zavadskas et al., 2012).

Step 1. Develop a decision matrix and normalise the decision matrix using equation (1) and (2) for beneficial criteria and non-beneficial criteria, respectively.

$$\bar{x}_{ij} = \frac{x_{ij}}{\max_i x_{ij}} \tag{1}$$

$$\bar{x}_{ij} = \frac{\min_i x_{ij}}{x_{ij}} \tag{2}$$

where $\bar{x}_{ij}$ is normalisation of x_{ij}.

Step 2. Calculate the relative importance based on the WSM method. The total relative importance of i^{th} alternative, denoted as $Q_i^{(1)}$ is

$$Q_i^{(1)} = \sum_{j=1}^{n} \bar{x}_{ij} w_j \tag{3}$$

where w_j is the weight (relative importance) of j^{th} criterion.

Step 3. Calculate the relative importance based on the WPM method. The total relative importance of i^{th} alternative, denoted as $Q_i^{(2)}$ is calculated as follows:

$$Q_i^{(2)} = \prod_{j=1}^{n} (\bar{x}_{ij})^{w_j} \tag{4}$$

Step 4. Calculate the relative importance for WASPAS method, Q_i using:

$$Q_i = 0.5Q_i^{(1)} + 0.5Q_i^{(2)} \tag{5}$$

3. Results and Discussions

By using AHP method, the criteria ranking was Processor speed > Cost > Memory (RAM) > Screen size > Display card memory > Screen resolution > Storage > Cache memory > Weight > Brand reliability. The most important criterion that the supermarket management looked for choosing the best laptop was the processor speed. The speed of a laptop processor dictated how fast the central processing unit (CPU) could retrieve and interpret instructions. This showed that the supermarket management chose the best laptop with the highest processor speed to manage their company. The least important criterion was brand reliability. Even though the brand created a perception of quality, safety, consistency and trust, the brand was not an important criterion in solving the laptop problem in this case study. The ranking order for the laptop alternatives was given by $A_2 > A_4 > 4_7 > A_6 > A_5 > A_1 > A_3$ using TOPSIS method. A_2 was the most preferred laptop and A_3 was the least preferred laptop.

4. Conclusion

In this study, sensitivity analysis was conducted to investigate the effect of adjusting the weight of criterion on the ranking of laptops and how the sensitivity might affect the decisions. In conclusion, the AHP-WASPAS method was considered as an appropriate tool for ranking or selecting the best alternative from a set of alternatives. Thus, the purposes of this study have been achieved.

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