

Inventory management via TOPSIS-AHP method embedded with Economic Order Quantity (EOQ)

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ABSTRACT – The choice of suppliers and their performance assessment are becoming major challenges. Evaluating suppliers and selecting one of them are complicated tasks because various criteria or objectives must be considered in the decision-making process.[1] In this study, we proposed a supplier selection analysis model considering both the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method. The objective is to determine and select the best combination of material and supplier of inventory using the TOPSIS analytical hierarchy process (AHP) method.

1. INTRODUCTION

The supplier selection process requires evaluating various criteria and different supplier features.[2] This process can be considered as a multi-criterion decision-making problem (MCDM) that includes both quantitative and qualitative factors. [3] This case study focuses on identifying the current process and problem in the compounding department of a rubber manufacturing company. Therefore, it aims to select the best combination of material and supplier of inventory using the technique for order preference by similarity to ideal solution (TOPSIS) analytical hierarchy process (AHP) method embedded with economic order quantity (EOQ).

2. METHODOLOGY

Establish the hierarchy a multi-criteria analysis model that combines the AHP (Analytic Hierarchy Process) and the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) methods was proposed. AHP method and determines the weights for the selected sets of criteria. The TOPSIS method was used to obtain the final ranking and the technology's hierarchy. [5] TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method for solving multiple criteria decision making (MCDM) problems based upon the concept that the chosen alternative should have the shortest distance to the positive ideal solution (A*) and the longest distance from the negative ideal solution (A-).[6]

For instance, the positive ideal solution maximizes the functionality and minimizes the cost, whereas the

negative ideal solution maximizes the cost and minimizes the functionality.[7]

3. RESULTS AND DISCUSSION

In this study, the main criteria and sub-criteria were pairwise compared. The main criteria comparisons are changeable, and each user saves their comparisons according to their preferences and priorities. In this study, five criteria are used as follows. Quality (C1), Cost (C2), Delivery Time (C3), Productivity (C4), and Quantity (C5).

Pair-wise comparisons of these criteria are shown in Table 3 and Overall priority ranking by AHP is shown in Table 4.

Table 3 Comparison matrix for main criteria

	C1	C2	C3	C4	C5
C1	1	3	3	5	7
C2	1/3	1	3	3	2
C3	1/3	1/3	1	2	3
C4	1/5	1/3	1/2	1	3
C5	1/7	1/2	1/3	1/3	1

Table 4 Overall priority ranking by AHP

Alternatives	PV
Supplier A	0.297
Supplier B	0.179
Supplier C	0.223
Supplier D	0.147
Supplier E	0.154

The final result of Selective closeness to an ideal solution was summaries as Table 5 below.

Table 5 Selective closeness to the ideal solution

Selective Closeness to Ideal Solution				
Supplier A	Supplier C	Supplier B	Supplier D	Supplier E
0.61233	0.52476	0.36804	0.35967	0.32206
1	2	3	4	5

Based on the results obtained from the Traditional AHP

and TOPSIS method methods, supplier A is selected to be optimized using EOQ. From industry data collection, annual demand (D) for the sulphur used in the compounding department was calculated based on daily consumption. Daily consumption of sulphur was average 225kg per kg.

Based on this quantity, the value of annual demand (D) is:

$$D = 225 \times 30 \times 12 \\ = 81,000 \text{ kg per year.}$$

Cost of ordering for an order (B) at RM 928.00.

The cost of carrying the unit for one year (C) is evaluated at 2% of the material price throughout the year.

Therefore:

$$C = 0.02 \times \text{RM } 928.00 \\ = \text{RM } 18.56$$

All the variables D, B, and C are with values, EOQ can be calculated.

$$EOQ = \sqrt{\frac{(2 \times 81000 \times 928)}{18.56}} \\ = 2846.05$$

Since the ordering of units cannot be in a decimal number, the numbers are rounded up to 2847 kg. Therefore, for the selected supplier A, the EOQ is 2847 kg.

4. CONCLUSIONS

From the results calculated from the AHP method, all the value of CR is less than 0.1, the judgments are acceptable because $CR < 0.1$. Table 6 below shows the summary of the highest-ranking weightage calculated by the two methodologies, Traditional AHP and TOPSIS method. The alternatives with the highest weightage for all the methods are consistent, with supplier A as the most suitable solution.

Table 6. Overall Rankings.

No	AHP		TOPSIS	
1	Supplier A	0.297	Supplier A	0.61233
2	Supplier C	0.223	Supplier C	0.52476
3	Supplier B	0.179	Supplier B	0.36804
4	Supplier E	0.154	Supplier D	0.35967
5	Supplier D	0.147	Supplier E	0.32206

From the AHP method, the result shows Supplier A that has a higher value (0.297 or 29.7%) among the other supplier. Supplier A also the best supplier TOPSIS-AHP method because supplier A had the highest selective closeness to the ideal solution, which is 0.61233. Therefore, for this analysis, it is concluded that supplier A, with the material from supplier A, is the best solution to meet the criteria of the manufacturing case study. The consistency of the two methods shows that the methodology is sufficient to select supplier A as

the ultimate priority for the best supplier.

The data obtained from the previous analysis in AHP and TOPSIS method was input as parameter use of economic order quantity calculation. EOQ is then simulated from this result. The economic order quantity (EOQ) to order upon purchasing of new inventory is 2847 kg.

In this study, we used the AHP-TOPSIS method to prevent difficulties and wastage of time in the e-content producing process. The AHP-TOPSIS combined method, developed in this paper, is more reliable. Drawbacks of the AHP method are eliminated by the help of TOPSIS. Obtained results demonstrate the importance of the method.

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