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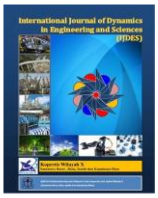

DETERMINING THE FEASIBILITY OF COCONUT COIR SUPPLIERS USING A COMBINATION OF DECISION SUPPORT SYSTEM METHODS

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Abstract

The process of procuring goods/services is an important supporting activity among business functions, where this activity has the potential to achieve a competitive advantage. Identifying suppliers is a strategic activity. Moreover, suppliers will provide goods that are very important and will be used for a long time. The method used in this research is normative juridical research by making observations, field notes, and interviews with related parties at the research location. The results of this study will benefit PT Maligai Citra Kelapa in selecting coconut coir suppliers. The analysis in this problem also uses two decision support system methods, namely Simple Additive Weighting (SAW) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS).

Keywords: **SPK, Supplier, SAW, TOPSIS**.

INTRODUCTION

The process of procuring goods or services is an important supporting activity among business functions, where this activity has the potential to achieve a competitive advantage. Procurement is usually not the main activity within an organization but as a distinct support function. Underscores the importance of procurement by recommending to organizations to describe the procurement process as a strategy, not as an operational function [1].

Identifying suppliers is a strategic activity. Moreover, suppliers will provide goods that are very important and will be used for a long time. The supplier is one of the business partners who play a role in ensuring the availability of supplies needed by the company [2]. PT Maligai Citra Kelapa is one of the companies that have problems in selecting coconut coir suppliers

RESEARCH METHODS

The simple additive weighting (SAW) method is a weighted sum method used to solve multiple attribute decision-making problems [3]. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes [4]. It can use the following formula:

$$r_{ij} = \begin{cases} \frac{x_{ij}}{Max\, x_{ij}} \; Jika\ j\ adalah\ atribut\ benefit \\ \frac{Min\, x_{ij}}{x_{ij}} \; Jika\ j\ adalaha\ atribut\ cost \end{cases} \quad \text{.... (1)}$$

Where :
Rij = Normalized performance rating
Maxij = The maximum value of each row and column
Minij = The minimum value of each row and column
Xij = The rows and columns of the matrix with Rij are the normalized performance ratings of the alternative Ai on the attributes Cj; i =1,2,…m and j= 1,2,…,n.

$$V_i = \sum_{j=1}^{n} W_j R_{ij} \text{ .... (2)}$$

A larger value of Vi indicates that alternative Ai is more preferred [5].
Where :
Vi = The final value of the alternatives

Wi = Predetermined weight
Rij = Matrix normalization

TOPSIS

TOPSIS is a multiple-criteria method for identifying solutions from a limited set of alternatives [6]. In general, the TOPSIS method has procedures in the process stages, which are as follows [7]:

a. Create a normalized decision matrix. With equality. [8]

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad \ldots\ldots\ldots\ldots\ldots..(3)$$

Where :
i = 1,2,3..m and j = 1,2,3…n
Rij = normalized matrix.
Xij = decision matrix.

b. Create a weighted normalized decision matrix.

c. Determine the positive and negative ideal solution matrices.
With equality [9] :

$$A^+ = y_1^+, y_2^+, \ldots \ldots y_n^+ \quad \ldots\ldots\ldots\ldots\ldots(4)$$
$$A^- = y_1^-, y_2^-, \ldots \ldots y_n^- \quad \ldots\ldots\ldots\ldots\ldots(5)$$

d. Determine the distance between positive and negative ideal solutions.
With equality [10] :

$$D_i^+ = \sqrt{\sum_{j=1}^{n}\left(y_i^+ - y_{ij}\right)^2} \quad \ldots\ldots\ldots\ldots(6)$$
$$D_i^- = \sqrt{\sum_{j=1}^{n}\left(y_{ij} - y_i^-\right)^2} \quad \ldots\ldots\ldots\ldots(7)$$

Where :
D_i^- = Negative ideal solution distance.
D_i^+ = Positive ideal solution distance
Yij = Value multiplied by weighting.
y_i^- = Negative ideal solution
y_i^+ = Positive ideal solution.
J = column of data

e. Defines a preferential value
With equality [10]

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad \ldots\ldots\ldots\ldots...(8)$$

RESULT

The following are the calculation steps using the SAW TOPSIS combination method

1. Make decision matrix for normalization of SAW method.

Alternative	C1	C2	C3	C4	C5
A1	4	4	5	4	5
A2	5	4	4	4	5
A3	5	5	4	5	5
A4	3	3	5	4	4
A5	5	5	4	3	4

Table 1. SAW Decision Matrix

Based on the table above, the next step is to find the normalization value using the equation (1).
Example of SAW normalization calculation

$$R_{1,1} = \frac{4}{\max(4,5,5,3,5)}$$
$$R_{1,1} = \frac{4}{5} = 0.8$$
$$R_{2,1} = \frac{5}{\max(4,5,5,3,5)}$$
$$R_{2,1} = \frac{5}{5} = 1$$

Based on the calculations that have been done, the normalization results are obtained which can be seen in the table below

Alternative	C1	C2	C3	C4	C5
A1	0.8	0.8	1	0.8	1
A2	1	0.8	0.8	0.8	1
A3	1	1	0.8	1	1
A4	0.6	0.6	1	0.8	0.8
A5	1	1	0.8	0.6	0.8

Table 2. Normalization of SAW

2. Looking for normalization of the TOPSIS method.
Based on the data in table 2 above, the next step is to find the normalization value of the TOPSIS method using the equation (3)

$$R_{1,1} = \frac{0.8}{\sqrt{0.8^2 + 1^2 + 1^2 + 0.6^2 + 1^2}}$$
$$R_{1,1} = \frac{0.8}{2} = 0.4$$
$$R_{2,1} = \frac{1}{\sqrt{0.8^2 + 1^2 + 1^2 + 0.6^2 + 1^2}}$$

$$R_{2,1} = \frac{1}{2} = 0.5$$

Based on the calculations that have been done, the normalization results are obtained which can be seen in the table below

Alternative	C1	C2	C3	C4	C5
A1	0.40	0.42	0.51	0.44	0.48
A2	0.50	0.42	0.40	0.44	0.48
A3	0.50	0.52	0.40	0.55	0.48
A4	0.30	0.31	0.51	0.44	0.39
A5	0.50	0.52	0.40	0.33	0.39

Table 3. TOPSIS Normalization

3. Performs weighted multiplication.

Criteria	C1	C2	C3	C4	C5
Weight	0.25	0.25	0.20	0.15	0.15

Table 4. Criteria Weight

The following are the steps to find the weighted multiplication value.

$$Y_{1,1} = 0.4 \; x \; 0.25 = 0.1$$
$$Y_{3,1} = 0.51 \; x \; 0.2 = 0.1$$

Based on the calculations that have been done, the weighted multiplication results are obtained which can be seen in the table below

Alternative	C1	C2	C3	C4	C5
A1	0.10	0.10	0.10	0.07	0.07
A2	0.13	0.10	0.08	0.07	0.07
A3	0.13	0.13	0.08	0.08	0.07
A4	0.08	0.08	0.10	0.07	0.06
A5	0.13	0.13	0.08	0.05	0.06

Table 5. Matrix Multiplication with Weights

4. Calculates positive and negative ideal solution values.

Based on the data in table 5, then look for positive ideal solution values using equation (4) and negative ideal solutions using equations (5)

$$Y_1^+ = max\{0.1; 0.13; 0.13; 0.08; 0.13\} = 0.13$$

$$Y_1^- = max\{0.1; 0.13; 0.13; 0.08; 0.13\} = 0.08$$

Based on the calculations that have been done, the results can be seen in the table below

Ideal	C1	C2	C3	C4	C5
Negative	0.08	0.08	0.08	0.05	0.06
Positive	0.13	0.13	0.10	0.08	0.07

Table 6. Value of Negative and Positive Ideal Solutions

5. Calculates the distance between positive and negative ideal solutions.

The following is an example of calculating the distance for a positive ideal solution using equation (6) and a negative ideal distance using equation (7)

$$D_1^- = \sqrt{\begin{matrix}(0.1-0.08)^2+(0.1-0.08)^2+(0.1-0.08)^2\\+(0.07-0.05)^2+(0.07-0.06)^2\end{matrix}}$$
$$D_1^- = 0.05$$

$$D_1^+ = \sqrt{\begin{matrix}(0.1-0.13)^2+(0.1-0.13)^2+(0.1-0.1)^2\\+(0.07-0.08)^2+(0.07-0.07)^2\end{matrix}}$$
$$D_1^+ = 0.04$$

Based on the calculations that have been done, the results can be seen in the table below

Alternative	D-	D+
A1	0.05	0.04
A2	0.06	0.04
A3	0.08	0.02
A4	0.03	0.08
A5	0.07	0.04

Table 7. Distance between Negative and Positive Ideal Solutions

6. Perform calculations of preference values and rankings.

$$V_1 = \frac{0.05}{0.05 + 0.04} = 0.54$$

$$V_2 = \frac{0.06}{0.06 + 0.04} = 0.62$$

Based on the calculations made above using equation (8), the results are as shown in the table below

Alternative	Preference	Rangking
A1	0.54	4
A2	0.62	3
A3	0.80	1
A4	0.26	5
A5	0.64	2

Table 8. Preference and Ranking Results

CONCLUSION

1. The combination of SPK methods such as the SAW and TOPSIS methods can be used to make decisions in selecting the eligibility of suppliers.
2. Using the combination of the SAW and TOPSIS methods it can be said that this method is quite efficient because it uses simpler mathematical equations and the results are quite efficient in determining the right alternative.

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