APPLICATION OF CALCULATION METHODS MULTI ATTRIBUTE UTILITY THEORY (MAUT) IN SELECTION OF YARN SUPPLIER

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Abstract— *The yarn supplier selection process is to determine suppliers who have efficiency in meeting the company's needs consistently and minimize risks related to the procurement of yarn and components needed. In solving problems in supplier selection using the Multi-Attribute Utility Theory (MAUT) method which consists of calculating matrix normalization and attribute normalization. The results obtained in this study are knowing the best supplier from other suppliers, namely GSM suppliers with a value of 0.87, so it can be said that the MAUT method can be used in the selection of yarn suppliers by involving price, quality, and delivery criteria.*

Keywords: *Application of Calculation, Multi-Attribute Utility Theory (MAUT), Yarn Supplier.*

Abstrak — Proses pemilihan supplier benang adalah untuk menentukan supplier yang memiliki efisiensi dalam memenuhi kebutuhan perusahaan secara konsisten dan meminimasi resiko yang berkaitan dengan pengadaan benang maupun komponen yang dibutuhkan. Dalam menyelesaikan permasalahan pada pemilihan supplier dengan menggunakan metode Multi Atribute Utility Theory (MAUT) yang terdiri dari perhitungan normalisasi matriks dan normalisasi attribute. Hasil yang didapatkan dalam penelitian ini adalah mengetahui supplier yang terbaik dari supplier yang lainnya adalah supplier GSM dengan nilai 0.87, sehingga dapat dikatakan bahwa metode MAUT dapat digunakan dalam pemilihan supplier benang dengan melibatkan kriteria harga, kualitas dan pengiriman.

Kata Kunci: *Penerapan Perhitungan, Multi Atribute Utility Theory (MAUT), Supplier Benang.*

INTRODUCTION

The selection of suppliers who are competent and able to provide quality raw materials is the first step to maintaining product quality. To meet the company's needs consistently and with quality, supplier selection needs to be done to obtain appropriate criteria for the company (Pratiwi et al., 2018). Supplier selection is one of the important things (Azwir & Pasaribu, 2017) in purchasing activities for companies, because the selection of suppliers is very influential on price or cost, quality, delivery (Rimantho et al., 2017), and the availability of a product. product. Therefore, every company needs to assess suppliers carefully and selectively (Trimulia et al., 2018).

Determining suppliers is a strategic activity, especially if the supplier will supply items that are important and will be used in the long term (Wardani et al., 2018). In meeting the needs of companies sometimes have more than one supplier which can cause some losses (Siregar et al., 2017) in the selection of suppliers who can collaborate with the company on an ongoing basis (Lukmandono et al., 2019). The purpose of the study is to assist in the supplier selection process to be more selective (Aprilia et al., 2019) in procuring the required yarn by looking at the supplier side who has efficiency in terms of relative and competitive prices, good yarn quality in the sense of by the product to be produced and the delivery side is good in the sense that it does not miss the scheduled time or can minimize delivery delays (Noviandri et al., 2015). Table. 1 below is the GAP analysis in this study:

Table. 1 GAP Analysis

Criteria	Company	Supplier	Gap
Cost	The costs incurred are minimal in the use of company funds to be efficient	Fees are adjusted to the offer submitted by the company	Bargaining occurs in terms of determining competitive prices offered by suppliers with the company's financial condition
Quality	Good quality selection based on supplier's offer	Quality adjustment to the cost conditions offered by the company	Negotiations for good quality must be directly proportional to the value of a competitive price
Delivery	Determination of the supplier with the fastest and best delivery by minimizing delays	Trying to meet the company's criteria by looking at the existing conditions	Strong desire on the part of the company and suppliers in the timely delivery process by minimizing delays

Source: (Susliansyah et al., 2021)

MATERIALS AND METHODS

In DSS some methods can be used to help solve problems, one of which is the MAUT method. The MAUT method is a part of the Multi-Criteria Decision Making method in DSS (Putra et al., 2020). In recent years, the MAUT method of decision analysis has been applied by a leader to help analyze the decisions made.

The Multi-Attribute Utility Theory (MAUT) method was introduced by Keeney and Raiffa in 1976. Simplicity in Death is one of the advantages of this technique, and it gives decision-makers abundant freedom of action to make the results more accurate and realistic (Fitriani, 2020).

Metode Multi-Attribute Utility Theory (MAUT) is a scheme in which the final evaluation, v(x) of an object x is defined as the weight added to a value that is relevant to its dimension value (Apriani, 2019) (Situmorang et al., 2018). The expression commonly used to refer to it is utility value (Safitri et al., 2021).

MAUT is used to convert from multiple importance into a numeric value on a scale of 0-1 with 0 representing the worst choice and 1 being the best. This allows direct comparisons of various sizes (Aldo et al., 2019). The result is a ranking order of evaluations that describes the choices of decision-makers. The entire evaluation value can be defined by the equation (Ramadiani & Rahmah, 2019) (Widodo & Nastoto, 2018).

The steps in the MAUT process are as follows (Situmorang et al., 2018) :

1. Create a decision framework, by defining the problem.
2. Generate alternatives that might solve the problem.
3. List all aspects that influence the decision.
4. Give weight to each aspect. The weights should reflect how important these aspects are to the problem.
5. Also, give weight to the alternatives. For each alternative, determine how satisfactory the alternative is concerning each aspect.
6. The process of evaluating each alternative on the existing aspects to get a decision.

The calculation of the MAUT method can be formulated as follows (Imandasari et al., 2019):

$$U_{(x)} = \frac{X - X_i^-}{X_i^+ - X_i^-} \quad \text{.....(1)}$$

Description:
x = Criteria Weight
X_i^- = Worst Criteria Weight
X_i^+ = Highest Criteria Weight

$$V_{(x)} = \sum_{i=1}^{n} w_j \; x_{ij} \quad \text{.....(2)}$$

Description:
Vi = The overall value of the alternative choices of a sub-criteria
W = TPV (priority weight) sub-criteria
Xij = Alternative value of a sub-criteria choice
i = Alternative choice j = Subcriteria

RESULTS AND DISCUSSION

The steps in this research are as follows:

1. Determining the Assessment Indicator

Furthermore, in this study, values based on indicators will be used which can be seen in Table 2 below:

Table. 2 Rating Indicator

Indicator	Value
Very good	5
Good	4
Enough	3
Bad	2
Very bad	1

Source: (Susliansyah et al., 2021)

2. Determining the Criteria Value

There are 3 criteria used in this study, namely price criteria (K1), quality criteria (K2), and delivery criteria (K3). The explanation can be seen in Table 2 below:

Table 2. Criteria Value

No	Criteria Name	Initial Criteria
1	Price	K1
2	Quality	K2
3	Delivery	K3

Source: (Susliansyah et al., 2021)

The value of each criterion is based on the following indicators:

a. Value Criteria Price

The value of the price criteria can be seen in Table 3 below:

Table.3 Value Criteria Price

Price Value	Indicator	Value
81 - 100	Very good	5
61 - 80	Good	4
41 - 60	Enough	3
21 - 40	Bad	2
0 - 20	Very bad	1

Source: (Susliansyah et al., 2021)

b. Value Criteria Quality

The value of the quality criteria can be seen in Table 4 below:

Table.4 Value Criteria Quality

Quality Value	Indicator	Value
81 - 100	Very good	5
61 - 80	Good	4
41 - 60	Enough	3
21 - 40	Bad	2
0 - 20	Very bad	1

Source: (Susliansyah et al., 2021)

c. Value Criteria Delivery

The value of the delivery criteria can be seen in Table 5 below:

Table.5 Value Criteria Delivery

Nilai Harga	Indikator	Nilai
81 - 100	Very good	5
61 - 80	Good	4
41 - 60	Enough	3
21 - 40	Bad	2
0 - 20	Very bad	1

Source: (Susliansyah et al., 2021)

3. Determining Criteria Weight

The weighting of these criteria is obtained from the company. The value of the price criterion is 50%, the quality criterion is 30% and the delivery criterion is 20%, so the total number of criteria is 100%. The explanation can be seen in Table 6 below:

Table 6. Criteria Weight

No	Initial Criteria	Weight Value
1	K1	0,5
2	K2	0,3
3	K3	0,2

Source: (Susliansyah et al., 2021)

4. Determine Research Data (Alternative Data)

The data used in this study are suppliers from PT. Mayer Indah Indonesia is a yarn supplier, totaling 5 suppliers. The explanation can be seen in table 7 and 8 below:

Table 7. The Value of Alternative Data in Companies

Supplier Code	Yarn Supplier Name	Price Criteria	Quality Criteria	Shipping Criteria
S1	Asia Garment's Accessories	80	60	80
S2	Benang Indah	75	40	60
S3	GMS	95	80	60
S4	Indachi Prima	80	60	85
S5	Indonesia Toray Synthetics (ITS)	75	15	40

Source: (PT Mayer Indah Indonesia, 2021)

Table 7 is an alternative value obtained by research from the company under study.

Table 8. Alternative Data Values Based on Indicator Values

Supplier Code	Yarn Supplier Name	Price Criteria	Quality Criteria	Shipping Criteria
S1	Asia Garment's Accessories	4	3	4
S2	Benang Indah	3	2	3
S3	GMS	5	4	3
S4	Indachi Prima	4	3	5
S5	Indonesia Toray Synthetics (ITS)	4	1	2

Source: (Susliansyah et al., 2021)

Table. 8 is the value obtained by the research based on the indicator value

5. Define the Normalization Matrix

In determining the normalization matrix by multiplying the normalization matrix from the data in Table 3, the formula used is formula 1. The examples of calculations for normalization are as follows: S1 supplier calculation K11=0,5. Based on the above calculations, the normal values of the decision matrix can be obtained as follows. The explanation can be seen in Table 9 below:

Table 9. Moral Value Matrix

Supplier Code	Yarn Supplier Name	K1	K2	K3
S1	Asia Garment's Accessories	0.5	0.67	0.67
S2	Benang Indah	0	0.33	0.33
S3	GMS	1	1	0.33
S4	Indachi Prima	0.5	0.67	1
S5	Indonesia Toray Synthetics (ITS)	0.5	0	0

Source: (Susliansyah et al., 2021)

The next stage will be multiplication of the normalized matrix with preference weights. The calculations are as follows:

S1 = (0,5 * 0,5)+(0,3*0,67)+(0,2*0,67)
= 0,59

Based on the above calculations, the results of the normalization matrix multiplication will be obtained which are shown in the table as follows. The explanation can be seen in Table 10 below:

Table 10. Multiplication results of normalized matrix

No	Supplier Name	$V_{(x)}$
1	S1	0.59
2	S2	0.17
3	S3	0.87
4	S4	0.65
5	S5	0.25

Source: (Susliansyah et al., 2021)

Table 11 is in order from the largest to the smallest value.

Table.11 Largest Value to Smallest Value

No	Supplier Name	$V_{(x)}$
1	S3	0.87
2	S4	0.65
3	S1	0.59
4	S5	0.25
5	S2	0.17

Source: (Susliansyah et al., 2021)

In this study, due to a large number of suppliers, the supplier procurement team must be more selective in making selections based on criteria that are by the company, taking into account aspects of price, quality, and delivery. With these criteria, a method is needed to help speed up and make it easier for companies to make decisions.

CONCLUSION

The MAUT method can process supplier data by producing decisions in the form of suppliers who have good or bad prices, quality, and delivery. This research can contribute to the company by providing information about supplier value data. The results obtained in this study by showing that

there is one supplier that has a good price, quality, and delivery is the GSM supplier Indachi with a value of 0.87.

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