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Selection of Quality Textile Materials to Support Supply Chain Management using the Weighted Product Method

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Abstract

Decision making is something that is very influential in the process of facing the chosen alternative. At this time, making decisions is no longer just based on human reason. Human limitations in thinking to solve a problem can now be helped by computerization. The use of computers has developed from simply processing data or presenting information, to being able to provide options to support decision makers. The development of information technology has enabled decision makers to be made more quickly and carefully. The research aims to apply the weighted product method to reduce errors in selecting quality textile materials. This research aims to make it easier to select quality textile materials. This research aims to be a good solution for Khatialo shops in selecting quality textile materials. The weighted product (WP) method is one of the methods used to complete a decision making system by considering criteria and weights . This is then continued with the ranking process which will select the best alternative from a number of alternatives, in this case the alternative in question is selecting quality textile materials based on specified criteria. The results obtained by the highest rating value were achieved by the 4th alternative called Semi Sutra with the Alternative code TK04.

Keywords :. Supply Chain Management, Textile Selection, Weighted Products, Weights, Alternatives.

1. Introduction

Decision making is something that is very influential in the process of facing the chosen alternative. At this time, making decisions is no longer just based on human reason. Human limitations in thinking to solve a problem can now be helped by computerization. The use of computers has developed from simply processing data or presenting information, to being able to provide options to support decision makers. The development of information technology has enabled decision makers to be made more quickly and carefully [1]

Decision Support Systems (DSS) are part of computer-based information systems, including knowledge-based systems (knowledge management) which are used to support decision making in an organization or company. Decision Support Systems are designed to support all stages of decision making starting from identifying problems, selecting relevant data, and determining the approach used in decision making, to evaluating alternative selection [2].

S PK is a system designed to be used as a tool to assist decision making in determining decisions, but this system is not to replace a person's capacity in making decisions, but is only used to provide considerations [3]

Supply Chain Management (SCM/Supply Chain Management) is an approach to produce and distribute in the right quantity, right location and right time in order to minimize costs and increase service satisfaction [4]. The SCM (Supply Chain Management) concept focuses on the main warehouse logistics section, namely product inventory sent to branch warehouses and small warehouses that are still experiencing product out-stock [5].

The weighted product (WP) method is often also known as the weighted addition method which is included in Multi Criteria Decision Making (MCDM) problem solving, where to achieve the goal of this method uses optimal alternatives from a number of alternatives with certain criteria. This is then continued with the ranking process which will select the best alternative from a number of alternatives, in this case the alternative in question is the selection of quality textile materials based on specified criteria [6].

The Weighted Product (WP) method is one of the methods used to complete a decision making system by considering criteria and weights [7]. The WP method is also called dimensionless analysis because its mathematical structure eliminates units of measurement. The WP method is a finite set of decision alternatives that are described in terms of several decision criteria [8].

Previous research on the comparison of decision support systems using the SAW and WP methods in granting loans found that the suitability level of the SAW method was 97.274% and the WP method was

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99.800006%, thus the WP method is the most relevant method for solving loan granting problems [9].

Previous research on the decision support system for determining the new location of the shoe laundry business at BECKS using the WP (Weighted Product) method found that the decision support system designed according to the needs of the shoe laundry at BECKS was not an absolute decision, the assessment was also returned by the parties. The calculation results obtained from determining the new location of the laundry business at BECKS which were ranked first were Jl. Madio Santoso No.102, Karakatau with a value of 0.0994 [10].

2. Research methodology

This research approach adopts quantitative methods, which is structured research that focuses on measuring and quantifying data for generalization purposes. The WP method algorithm is understood through a series of stages described in Figure 1 below:

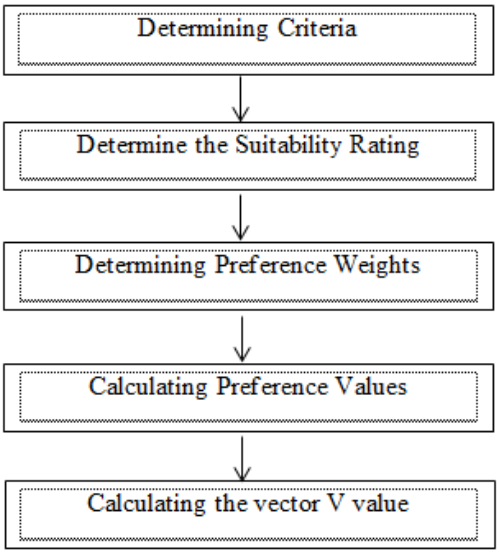

Figure 1. Research Framework

The Weighted Product method is a method for completing Multi Attribute Decision Making (MADM). The technique used in Weighted Product performs multiplication to connect attribute ratings, where the rating of each attribute must first be raised to the power of the weight attribute in question . The calculation process using the Weighted Product method consists of several steps or stages. The first step is to determine the weight value of each criterion (W). In this calculation, the W value will be in the range from 0 to 1. Where the total W value is 1. To get the normalized value of Wj by multiplying the beneficial attributes by 1, while the cost attributes are multiplied by - 1.

The Weighted Product method process is by multiplying each attribute against each alternative to connect the attribute rating, where the rating on the attribute is required to be raised to the appropriate attribute weight. This is part of what is called the normalization process

The following formula for alternative Ai is given as follows:

$$S_i = \prod_{j-i}^{n} X_{ij}^{W_j}; \text{dengan i} = 1,2 \ldots . \text{dst}$$

Where $\sum W_j = 1. W_j$is the rank that has a positive value for attributes that have a profit value and a negative value for cost attributes. The relative preferences of each alternative are given as follows

$$V_i = \frac{\prod_{j-i}^{n} X_{ij}^{W_j}}{\prod_{j-i}^{n} (X_j)^{W_j}} ; \text{dengan } 1 = 1,2 \ldots . . \text{dst}$$

3. Results and Discussion

3.1 Weighted Products

This research uses laptop specification and price data at the Khatialo Shop, Bukittinggi City, which was updated in June 2022. The first thing that must be done in applying the Weighted Product method is to determine the criteria. There are five criteria that are used as a reference in decision making, which can be seen in Table 1 below:

Table 1. Criteria Terms

Criteria	Criteria Terms
C1	Price
C2	Quality
C3	Material
C4	Motive
C5	Color

Based on the criteria and suitability rating for each alternative that has been determined, a value/weight will then be given to each alternative for each predetermined criterion.

1. Price Criteria (C1)

The following are the conversion values for the price criteria, there are 5 conversion values, which can be seen in Table 2 below:

Table 2. Price Value Conversion

C1	Mark
0 to 10,000	1
>10,000 to 20,000	2
>20,000 to 30,000	3
>30,000 to 40,000	4
>40,000	5

2. Quality Criteria (C2)

The following are the conversion values for the Quality criteria, there are 5 conversion values of very good, good, fair, bad and very bad, which can be seen in Table 3 below:

Table 3. Quality Value Conversion

C2	Mark
Very bad	1
Bad	2
Enough	3
Good	4
Very good	5

3. Material Criteria (C3)

The following are the conversion values for the material criteria, there are 5 conversion values, which can be seen in Table 4 below:

Table 4. Conversion of Material Values

C3	Mark
Very rough	1
Rough	2
Currently	3
Gentle	4
Very soft	5

4. Motive Criteria (C4)

The following are the conversion values for the motif criteria, there are 2 conversion values, which can be seen in Table 5 below:

Table 5. Motifs

C4	Mark
Plain	1
Motive	2

5. Color Criteria (C5)

The following are the conversion values for the color criteria, there are 3 conversion values for light, medium and dark, which can be seen in Table 6 below:

Table 6 . Color

C2	Mark
Dark	1
Currently	2
Bright	3

The value of each sub-criterion is the result of inputting alternative textile product data which has been converted based on the predetermined criteria weights. The alternative codes for the products obtained can be seen in table 7.

Table 7. Alternative Code

No	Alternative	Textile Names
1	TK01	Baloteli
2	TK02	Elena
3	TK03	Wolfis
4	TK04	Semi Silk
5	TK05	Roberto Kapali
6	TK06	Roselle
7	TK07	Tapeta
8	TK08	Toyobo
9	TK09	Yima
10	TK10	Diamonds

The alternative list relates to the type or name of the textile used in a context or analysis. Each alternative is assigned a unique code to briefly and clearly identify it in a particular analysis or selection. The table above is used to refer or identify the types of textiles that will be evaluated or compared in a particular calculation or research. Data on specification weights and textile prices based on sub-criteria assessments can be seen in Table 8.

Table 8. Alternative Weights

Alternative	Criteria				
	C1	C2	C3	C4	C5
TK01	3	4	3	1	3
TK02	2	5	4	1	2
TK03	3	5	4	1	2
TK04	4	5	5	2	3
TK05	3	4	4	1	2
TK06	5	5	5	1	3
TK07	3	4	2	1	3
TK08	4	5	4	1	3
TK09	4	5	5	1	3
TK10	3	5	5	1	2

The specified criteria require priority weights to determine how important the criteria are in order to obtain appropriate decision results. The priority levels can be seen in Table 9 below:

Table 9 : Weight Priority Level

Priority Level	Weight
Very important	5
Important	4
Quite important	3
Not important	2
Very unimportant	1

The initial weighting and categories for each criterion in this research are actually determined, so the following is the determination of the criteria weights as an example of textile selection which can be seen in Table 10 below:

Table 10: Criteria Weight Assessment

Criteria	Criteria Terms	Category	Weight
C1	Price	Cost	5
C2	Quality	Benefits	5
C3	Material	Benefits	5
C4	Motive	Benefits	2
C5	Color	Benefits	3

In the weight improvement process, it is first determined which criteria are worth the benefits and costs.

$$W_1 = \frac{5}{5+5+5+2+3} = \frac{5}{20} = 0{,}25$$
$$W_2 = \frac{5}{5+5+5+2+3} = \frac{5}{20} = 0{,}25$$
$$W_3 = \frac{5}{5+5+5+2+3} = \frac{5}{20} = 0{,}25$$
$$W_4 = \frac{2}{5+5+5+2+3} = \frac{2}{20} = 0{,}10$$
$$W_5 = \frac{3}{5+5+5+2+3} = \frac{3}{20} = 0{,}15$$

$$\sum W = 0{,}25 + 0{,}25 + 0{,}25 + 0{,}10 + 0{,}15 = 1$$

So after determining the w value for each criterion, then correct the weights as follows:

Table 11 : Weight Improvements

Criteria	Information	Weight	Weight Improvement
C1	Price	5	-0.25
C2	Quality	5	0.25
C3	Material	5	0.25
C4	Motive	2	0.10
C5	Color	3	0.15

The next step is to carry out calculations to determine the value of vector S as follows:

$S_1 = (3^{-0,25}) * (4^{0,25}) * (3^{0,25}) * (1^{0,10}) * (3^{0,15}) = 1.6675$

$S_2 = (2^{-0,25}) * (5^{0,25}) * (4^{0,25}) * (1^{0,10}) * (2^{0,15}) = 1.9731$

$S_3 = (3^{-0,25}) * (5^{0,25}) * (4^{0,25}) * (1^{0,10}) * (2^{0,15}) = 1.7829$

$S_4 = (4^{-0,25}) * (5^{0,25}) * (5^{0,25}) * (2^{0,10}) * (3^{0,15}) = 1.9982$

$S_5 = (3^{-0,25}) * (4^{0,25}) * (4^{0,25}) * (1^{0,10}) * (2^{0,15}) = 1.6861$

$S_6 = (5^{-0,25}) * (5^{0,25}) * (5^{0,25}) * (1^{0,10}) * (3^{0,15}) = 1.7632$

$S_7 = (3^{-0,25}) * (4^{0,25}) * (2^{0,25}) * (1^{0,10}) * (3^{0,15}) = 1.5068$

$S_8 = (4^{-0,25}) * (5^{0,25}) * (3^{0,25}) * (1^{0,10}) * (3^{0,15}) = 1.6408$

$S_9 = (4^{-0,25}) * (5^{0,25}) * (5^{0,25}) * (1^{0,10}) * (3^{0,15}) = 1.8643$

$S_{10} = (3^{-0,25}) * (5^{0,25}) * (5^{0,25}) * (1^{0,10}) * (2^{0,15}) = 1.8852$

After getting the vector value (S), the next step is to determine the vector value (V). After calculating the vector (V), the final value is produced for each alternative and the ranking from highest to lowest can be seen in Table 12 below:

Table 12 : Ranking Results

Vector (V)	Results	Textile Names	Alternative Code
V4	0.1124	Semi Silk	TK04
V2	0.1110	Elena	TK02
V10	0.1061	Diamonds	TK10
V9	0.1049	Yima	TK09
V3	0.1003	Wolfis	TK03
V6	0.0992	Roselle	TK06
V5	0.0948	Roberto Kapali	TK05
V1	0.0938	Baloteli	TK01
V8	0.0923	Toyobo	TK08
V7	0.0848	Tapeta	TK07

Based on the table above, it can be explained that the highest rating value was achieved by the 4th alternative called Semi Sutra with the Alternative code TK04, so it can be concluded that this textile is the best product in the Khatialo Shop by calculating using the Weighted Product (WP) method.

3.1 System Testing

The following displays the program that has been built, including a login page which is the initial display when the website is accessed. Figure 2 follows.

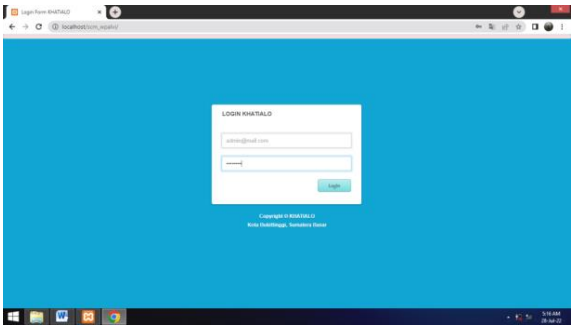

Figure 2 . Login Page

The following page is the calculation page for the Weighted Product method by *admin* .

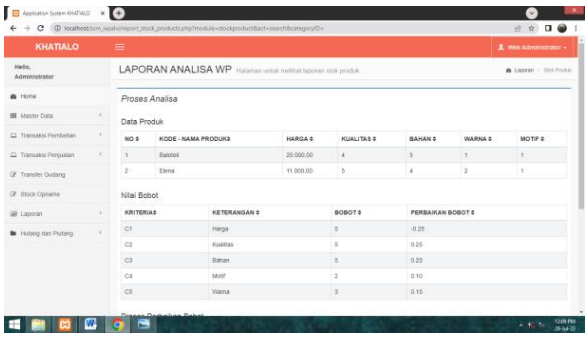

Figure **3.** WP Count Pages

4. Conclusion

By using the *Weighted Product method* in determining quality textile materials, errors can be minimized in selecting quality textile materials and the product supply chain system becomes computerized or an online sales system. The highest rating value was achieved by the 4th alternative called Semi Sutra with Alternative code TK04, so it can be concluded that this textile is the best product in the Khatialo Shop by calculating using the Weighted Product (WP) method.

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