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Comparative Analysis of Moora and Waspas Methods for Selecting the Best Supplier

Sartika Lina Mulani Sitio [a,1,*]

[a] *Informatics Engineering Study Program, Faculty of Computer Science, Pamulang University*
[1] *dosen00847@unpam.ac.id**
*Corresponding author

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ABSTRACT

Selecting the right supplier is an important element in the K-24 Pharmacy supply chain, as it directly impacts the availability and quality of drugs provided to customers. However, the supplier selection process is often faced with the complexity of various criteria that must be considered simultaneously. This creates problems in decision making that are often subjective and less than optimal. To overcome this problem, this study proposes a solution in the form of implementing the MOORA (Multi-Objective Optimization by Ratio Analysis) and WASPAS (Weighted Aggregated Sum Product Assessment) methods to support the best supplier selection process at K-24 Pharmacy. The purpose of this study is to develop a system that can provide objective and measurable supplier recommendations, based on various relevant criteria. This study uses data from several potential suppliers considered by K-24 Pharmacy. Relevant criteria are weighted based on their level of importance through interviews with pharmacy management. The criteria used in this research are delivery speed, discounts, service, warranty, authenticity of goods, payment terms and return of goods. Furthermore, the MOORA method is used to conduct multi-objective ratio analysis, while the WASPAS method combines the weighted sum and weighted product approaches to evaluate the overall performance of each supplier. The results of the study indicate that both methods are effective in providing consistent recommendations for selecting the best supplier. However, the WASPAS method is superior in providing more accurate and comprehensive results because of its ability to combine various aspects of evaluation. The implementation of the MOORA and WASPAS methods is expected to help the management of Apotek K-24 in making more appropriate decisions and reducing the risks associated with supplier selection.

I. Introduction

In an increasingly competitive business world, the ability to make the right decisions in choosing suppliers is one of the strategic aspects that determine the success of a company [1] Suppliers not only act as providers of raw materials or products, but also become partners that have a great influence on the company's operations and reputation. In the context of the pharmaceutical industry, especially in the K-24 Pharmacy, the selection of the right supplier is increasingly crucial because it is directly related to the quality of pharmaceutical products provided to the community. As one of the leading pharmacy chains in Indonesia, Apotek K-24 must ensure that the supply of medicines received always meets strict quality standards, is consistently available, and is affordable for consumers. K-24 Pharmacy prioritizes supply reliability to avoid stock shortages that can harm consumers, as well as ensure that the drugs sold are competitively priced. Therefore, the decision in choosing a supplier should not be made arbitrarily and must consider various important aspects [2]

However, the process of selecting suppliers is often not simple because it involves various criteria that must be considered simultaneously. For example, the price offered by suppliers must be evaluated against the quality of the products they provide. On the other hand, the punctuality of delivery, discounts, quality of goods and others are also factors that are no less important. The combination of these various factors creates its own

challenges for management in making optimal decisions. K-24 pharmacies must ensure that the selected supplier is able to meet all of these criteria to support the overall operation of the pharmacy.

Various approaches have been proposed in the literature to solve the problem of supplier selection, including the application of a multi-criteria method. One of the relevant studies is a study conducted which uses the Analytic Hierarchy Process (AHP) method to evaluate supplier performance based on several main criteria [2] Another study uses the AHP method and the TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) method for supplier selection in the manufacturing industry. This study was conducted to determine the best bolt supplier based on the criteria of price, quality, delivery, and service [3] And research conducted . In this study, the SAW method is used for the selection of the best supplier. And the results of the assessment that have been carried out will be calculated, then compared with each supplier that has been assessed so that a ranking can be obtained that can be used as a decision support [4] The three studies highlight the importance of selecting the right supplier but do not discuss in depth the application of the MOORA and WASPAS methods that have been proven effective in a more complex multi-criteria context.

A Decision Support System (SCI) is a computer-based system that assists decision-making by processing relevant data and information into an analysis that can be used by managers or decision-makers [5] SPK does not replace the role of decision-makers, but acts as a tool that provides various alternative solutions based on predetermined criteria [6] In the context of supplier selection, SPK allows management to conduct more structured, accurate, and efficient evaluations by considering various factors that affect the quality of decisions. In the research on the selection of the best supplier in Pharmacy K-24, the MOORA (Multi-Objective Optimization by Ratio Analysis) and WASPAS (Weighted Aggregated Sum Product Assessment) methods were chosen because they are both effective multi-criteria methods to solve complex decision-making problems. These two methods have advantages in processing and analyzing data with various criteria that must be considered simultaneously, such as price, product quality, delivery time, warranty, payment tempo, and others.

This research aims to develop a system that can be used by the management of K-24 Pharmacy in determining the best suppliers by considering various relevant criteria. By integrating the MOORA and WASPAS methods into the supplier selection process, it is hoped that it can minimize the risk of subjective decisions and ensure that the selected supplier is truly in accordance with the desired needs and quality standards. The methodology used in this study involves collecting data from various suppliers working with K-24 Pharmacy, determining the weight of criteria based on the level of importance, and applying the MOORA and WASPAS methods to analyze the performance of each supplier. The results of this study are expected not only to make a practical contribution to the management of K-24 Pharmacy, but also to add insight into the application of the multi-criteria method in selecting suppliers in the health sector.

II. Method

A. Data Collection

Primary data was collected through interviews and surveys conducted on the management of the K-24 Pharmacy. This data includes information about criteria that are considered important in selecting suppliers, such as delivery speed, discounts, service, warranty, authenticity of goods, payment tempo and return of goods. In addition, secondary data was collected from the internal documents of the K-24 Pharmacy as well as relevant literature to support this research.

B. Data Calculation

At this stage, calculations are carried out using the moora method and the waspas method.

1. Moora Method

   The MOORA (Multi-Objective Optimization by Ratio Analysis) method is one of the methods in multi-criteria decision-making that is used to optimize several goals or criteria simultaneously[7]. MOORA is used to evaluate various alternatives based on several predetermined criteria. This method is popular for its simplicity, flexibility, and ability to provide objective results. The following are the stages in the application of the MOORA method [8]:

   - Compile a decision matrix consisting of alternatives to be evaluated.
   - Normalization of matrix

     Normalization is carried out by dividing each element in the matrix by the Euclidean norm of the criterion.
   - Optimizing Atributes

Calculate the MOORA score for each alternative by adding the normalized value multiplied by the criterion weight. In MOORA, there are two types of criteria, namely criteria Benefits and cost criteria

$$X_{ij} = \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1n} \\ X_{21} & X_{22} & \cdots & X_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ X_{m1} & X_{m2} & \cdots & X_{mn} \end{bmatrix}$$

- Yi Value Ranking
  The Yi value in the MOORA method can be both positive and negative, depending on the comparison between the maximum and minimum values in the decision matrix. The ranking order based on Yi's value indicates the most optimal alternative. Thus, the best alternative is the one with the highest Yi value, while the worst alternative is the one with the lowest Yi value.

2. Waspas Method
   The WASPAS method is a multi-criteria method used to assist in decision-making by considering various criteria [9]. The WASPAS method combines the Weighted Sum Model (WSM) and Weighted Product Model (WPM) approaches to provide a more comprehensive evaluation of available alternatives. The stages of the WASPAS method are as follows [10]:
   - Constructing a decision matrix

     $$\text{Yi} = \sum_{j=1}^{m} - \sum_{j=g+1}^{n} X_{ij}^{*}$$

   - Decision matrix normalization

     Benefit: $R_{ij} = \frac{X_{ij}}{MaX_{ixij}}$

     Cost: $R_{ij} = \frac{MaX_{ij}X_{ij}}{Xij}$

   - Perform Qi value calculations

     $Qi = 0.5 \sum_{j=1}^{n} r_{ij}w_j + 0.5 \prod_{j=1}^{n} (r_{ij})^{wj}$

     The best alternative is the one that has the highest Qi value.

III. Results and Discussion

This section explains the application of the MOORA method and the WASPAS method in selecting the best supplier at the K-24 Pharmacy. The data used in this study includes various relevant assessment criteria for the selection of the best suppliers. The WASPAS method is used for multi-criteria assessment by considering the weight of each criterion and higher results indicate better performance in the context of the criteria assessed. While the MOORA Method is used for multi-criteria assessment, but focuses more on the ratio between criteria. From the results obtained, WASPAS with a value of 0.95 is superior to MOORA which has a value of 0.94. This shows that based on the criteria assessed, the performance produced by the WASPAS method is better than that of MOORA.

A. Data Analysis

From the results of the data collection, it is used to determine the criteria in determining decision supporters in selecting the best supplier. The criteria and weights of the results of the interview with the management of the K-24 Pharmacy are as follows:

Table 1. Criteria and Percentage Weights

Criterion Code	Criterion	Type	Weight
C1	Shipping Speed	Benefit	20
C2	Discount	Benefit	15
C3	Service	Benefit	15
C4	Warranty	Cost	10
C5	Authenticity of Goods	Cost	20
C6	Payment Tempo	Cost	10
C7	Return of Goods	Benefit	10

Based on the results of the interview, 5 permanent suppliers were obtained at the K-24 Pharmacy. Filling in supplier data is obtained from the management of K-24 Pharmacy which is arranged as shown in the table below:

Table 2. Data Supplier

Supplier	C1 (days)	C2 (%)	C3 (1-5)	C4 (month)	C5 (%)	C6 (days)	C7
Supplier A	3	10	4	12	100	30	Already
Supplier B	5	15	3	6	95	45	No
Supplier C	2	12	5	12	98	30	Already
Supplier D	4	8	4	3	100	60	No
Supplier E	6	20	2	6	90	90	Already
Supplier F	4	18	3	12	97	45	Already

For C7 (return goods), if Yes it will be given a value of 1, but if it is not it will be given a value of 0.

B. Analysis of The Calculation of the Moora Method

The calculation process of the MOORA method for the selection of the best supplier at the K-24 Pharmacy is as follows:

- Create a decision matrix obtained from table 2 data.

$$X_{ij} = \begin{bmatrix} 3 & 10 & 4 & 12 & 100 & 30 & 1 \\ 5 & 15 & 3 & 6 & 95 & 45 & 0 \\ 2 & 12 & 5 & 12 & 98 & 30 & 1 \\ 4 & 8 & 4 & 3 & 100 & 60 & 0 \\ 6 & 20 & 2 & 6 & 90 & 90 & 1 \\ 4 & 18 & 3 & 12 & 97 & 45 & 1 \end{bmatrix}$$

- Then normalize the matrix Xij. The result of the matrix normalization are as follows:

$$X_{ij} = \begin{bmatrix} 0.75 & 0.5 & 0.8 & 1 & 1 & 1 & 1 \\ 0.25 & 0.75 & 0.6 & 0.5 & 0.95 & 0.75 & 0 \\ 1 & 0.6 & 1 & 1 & 0.98 & 1 & 1 \\ 0.5 & 0.4 & 0.8 & 0.25 & 1 & 0.5 & 0 \\ 0 & 1 & 0.4 & 0.5 & 0.9 & 0 & 1 \\ 0.5 & 0.9 & 0.6 & 1 & 0.97 & 0.75 & 1 \end{bmatrix}$$

- Calculate preference values

Y_1^* = (0.2*0.75) + (0.15*0.5) + (0.15*0.8) + (0.1*1) + (0.2*1) + (0.1*1) + (0.1*1)
= 0.8465

Y_2^* = (0.2*0.25) + (0.15*0.75) + (0.15*0.6) + (0.1*0.5) + (0.2*0.95) + (0.1*0.75) + (0.1*0)
= 0.5775

Y_3^* = (0.2*1) + (0.15*0.6) + (0.15*1) + (0.1*1) + (0.2*0.98) + (0.1*1) + (0.1*1)
= 0.955

Y_4^* = (0.2*0.5) + (0.15*0.4) + (0.15*0.8) + (0.1*0.25) + (0.2*1) + (0.1*0.5) + (0.1*0)
= 0.565

Y_5^* = (0.2*0) + (0.15*1) + (0.15*0.4) + (0.1*0.5) + (0.2*0.9) + (0.1*0) + (0.1*1)
= 0.635

Y_6^* = (0.2*0.5) + (0.15*0.9) + (0.15*0.6) + (0.1*1) + (0.2*0.97) + (0.1*0.75) + (0.1*1)
= 0.8045

After the calculation is done using the MOORA method, it results in a ranking for supplier selection as follows:

Table 3. Assess Preferences

Supplier	Assess Preferences	Rangking
Supplier A	0.8465	2
Supplier B	0.5775	5
Supplier C	0.955	1
Supplier D	0.565	6
Supplier E	0.635	4
Supplier F	0.8045	3

Based on the results of the calculation of the MOORA method in selecting the best supplier at the K-24 Pharmacy, Supllier C was obtained as the best choice with the highest preference value of 0.955.

C. Analysis of Waspas Method Calculations

The following are the stages of calculating the WASPAS method for selecting the best supplier at Pharmacy K – 24:

- WSM (Weighted Sum Model) Calculation
  For each supplier, that is, multiply each value of each criterion by its weight and then add up the results.
  WSM = $\sum_{j=1}^{n} w_j \, x \, X_{ij}$

The calculation results from WSM can be seen in the table below:

Table 4. Calculation WSM

Supplier	C1 (day)	C2 (%)	C3 (1-5)	C4 (mounth)	C5 (%)	C6 (day)	C7	WSM
Supplier A	0.15	0.07	0.12	0.10	0.20	0.10	0.1	0.79
Supplier B	0.05	0.11	0.09	0.05	0.19	0.07	0	0.58
Supplier C	0.20	0.09	0.15	0.10	0.196	0.10	0.1	0.96
Supplier D	0.10	0.06	0.12	0.03	0.20	0.05	0	0.57
Supplier E	0	0.15	0.06	0.05	0.18	0	0.1	0.63
Supplier F	0.10	0.13	0.09	0.10	0.194	0.07	0.1	0.80

- WPM (Weighted Product Model) Calculation
  For the calculation of WPM, it is to multiply the value of each criterion that has been weighted. The calculation table from WPM is as follows:

Table 5. Calculation WPM

Supplier	C1 (day)	C2 (%)	C3 (1-5)	C4 (mounth)	C5 (%)	C6 (day)	C7	WPM
Supplier A	0.9	0.91	0.94	1	1	1	1	0.86
Supplier B	0.66	0.95	0.88	0.93	0.99	0.97	0	0.3
Supplier C	1	0.92	1	1	0.996	1	1	0.94
Supplier D	0.84	0.88	0.94	0.86	1	0.93	0	0.28
Supplier E	0	1	0.81	0.93	0.98	0	1	0
Supplier F	0.84	0.97	0.88	1	0.995	0.97	1	0.75

After the above steps, then combine the results of WSM with WPM using the average of the two as shown in the table below:

Table 6. Calculation of Waspas Values

Supplier	WSM	WPM	Value WASPAS
Supplier A	0.79	0.86	0.825
Supplier B	0.58	0.3	0.44
Supplier C	0.96	0.92	0.95
Supplier D	0.57	0.28	0.425
Supplier E	0.63	0	0.315
Supplier F	0.80	0.75	0.775

Based on the results of the calculation above using the WASPAS method, the best value was obtained at 0.94 for supplier C. So that supplier C can be said to be the best supplier for research conducted at the K-24 Pharmacy.

IV. Conclusion

Based on the research that has been conducted, the results of the analysis show that both methods, MOORA and WASPAS, produce consistent ratings, with Supplier C with a value of 0.95 which is selected as the best in both methods. MOORA provides quick and efficient results, while WASPAS provides a more comprehensive analysis by considering the interaction between criteria. Both of these methods have proven to be effective and reliable in the selection of suppliers at K-24 Pharmacy, with results showing consistency in the identification of the best suppliers.

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