Prediction System of Facility Maintenance using Weight Product (WP) Algorithm

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Abstract. This study aims to create a decision support system in determining the priority of facilities maintenance work. The current priority system of maintenance work is based on various criteria with uncertainties that often results in work that is not completed or requires a long time to work on it. It happens because the scheduling of maintenance priorities is wrong. Therefore, it needs a method of selecting priority maintenance in order to get a more accurate decision. This decision system design uses the WP method to consider the maintenance department to determine the priority selection of facility maintenance. The basic concept of the WP method is the method of solving using multiplication to link the attribute rating, where the rating must be raised first with the weight of the attribute in question. This process is the same as the normalization process. Based on this study, the results were obtained in the form of a priority level of maintenance work quickly and precisely on target from the results of the assessment and calculation of the priority level of maintenance work. Thus, using this method can increase the accuracy by 80% in determining the priority of the facility maintenance that will be conducted.

1. Introduction

Maintenance is a process of repair or preservation that is often carried out by a company of its facilities. This maintenance process is fundamental to do to preserve the facility so that it can function for an extended period. UPI YPTK Padang in the field of education also always carries out maintenance of its facilities. Nevertheless, often in the process of scheduling and determining the priority of the maintenance process, there usually has problems, so 60% of the maintenance work takes a long time, and some maintenance often does not finish with the specified time. From the previous maintenance studies such as "Maintenance Strategies and Their Combined Impacts on Manufacturing Performance" [9], "Maintenance Management Models: A Study of the Published Literature to Identify Empirical Evidence" [5], "Impact of Maintenance Strategies on the Performance of Industrial Facilities in Selected Industrial Estates in Lagos State, Nigeria" [6], "Maintenance Management Decision Model for Preventive Maintenance Strategy on Production Equipment" [1], the researchers obtained the criteria for this research, namely: processing time, cost, number of workers, level of requirement, and level of difficulty.

The basic concept of the Weight Product (WP) method is a method of solving using multiplication to link the attribute rating, where the rating must be raised first with the weight of the attribute concerned. This process is the same as the normalization process [4]. Based on the results of previous studies that the WP method can be done in a decision support system in determining damage and loss of housing after natural disasters [3], determining the best type of banana with the best pisang (banana) kepok results
for the production of banana chips [7], determining the assessment of employee performance in order to improve employee work processes [2].

Based on the results of this study, it can be concluded that the priority ranking systems of maintenance work are from the results of the assessment and calculation of the priority level of maintenance work. Thus, by using this method, the level of accuracy is 80% in determining the priority of facility maintenance that will be conducted.

2. Methodology

The research method used to conduct this research is a quantitative approach, where the data obtained in the form of numbers derived from direct observation in the field, interviews, and documentation obtained from field interviews. Therefore this study uses a quantitative method by comparing the compatibility between reality in the area with descriptive method theory.

The descriptive method can explain in stages what is happening. This study aims to describe a condition that occurs at this time with scientific procedures to solve problems scientifically [12]. The methods used for the study are:

2.1 Methods of Data Collection

Data collection is a technique used by researchers to collect data or information [11]. The method used for this data collection process is by using purposive sampling. Purposive sampling is a sampling technique by determining respondents who were selected by researchers based on the specifications of the sample data [8].

a. The observation method was done with direct observation of the field by preparing a list of data needs and data sources.
b. The interview method was conducted in a face-to-face manner and talked directly to the interviewees according to the list of questions prepared.
c. The documentation method was by which researchers received documents and data provided by UPI YPTK Padang.

2.2 Flowchart Research

This study uses a waterfall system development model, which is a system development process with a systematic and sequential approach by system development [10].

![Flowchart Research](image-url)
2.1 Weight Product (WP) Method

Weight product method calculation is the steps taken to find the best alternative estimation through several diverse factors. The steps of the weight product method include:

The initial stage in applying the weight product method calculation is determining the criteria. In this study, the criteria used in the selection process are seen in the following table:

| No. | Criteria             | Attribute | Weight Value |
|-----|----------------------|-----------|--------------|
| 1.  | Processing Time      | Cost      | 4            |
| 2.  | Cost                 | Cost      | 4            |
| 3.  | Number of Workers    | Cost      | 3            |
| 4.  | Level of Requirement | Benefit   | 4            |
| 5.  | Level of Difficulty  | Benefit   | 5            |

The scale value of importance level for each criterion from Table 1 can be seen in Table 2 as follows:

| Level of Importance | Description |
|---------------------|-------------|
| 1                   | Very Poor   |
| 2                   | Poor        |
| 3                   | Fair        |
| 4                   | Good        |
| 5                   | Very Good   |

3. Analysis and Result

3.1. Decision Matrix

In the decision matrix, the matrix column shows the attributes existing, namely criteria, while the row indicates the alternatives, namely the facilities to be maintained. The decision matrix refers to \( m \) alternative evaluated based on \( n \) criteria, and it can be seen in Table 3 below:

| \( A_1 \) | \( X_{11} \) | \( X_{12} \) | \( X_{13} \) | \( X_{14} \) | \( X_{15} \) |
|-----------|-------------|-------------|-------------|-------------|-------------|
| \( A_2 \) | \( X_{21} \) | \( X_{22} \) | \( X_{23} \) | \( X_{24} \) | \( X_{25} \) |
| \( A_3 \) | \( X_{31} \) | \( X_{32} \) | \( X_{33} \) | \( X_{34} \) | \( X_{35} \) |
| \( A_4 \) | \( X_{41} \) | \( X_{42} \) | \( X_{43} \) | \( X_{44} \) | \( X_{45} \) |
| \( A_5 \) | \( X_{51} \) | \( X_{52} \) | \( X_{53} \) | \( X_{54} \) | \( X_{55} \) |
| \( A_6 \) | \( X_{61} \) | \( X_{62} \) | \( X_{63} \) | \( X_{64} \) | \( X_{65} \) |
| \( A_7 \) | \( X_{71} \) | \( X_{72} \) | \( X_{73} \) | \( X_{74} \) | \( X_{75} \) |
| \( A_8 \) | \( X_{81} \) | \( X_{82} \) | \( X_{83} \) | \( X_{84} \) | \( X_{85} \) |
| \( A_9 \) | \( X_{91} \) | \( X_{92} \) | \( X_{93} \) | \( X_{94} \) | \( X_{95} \) |
| \( A_{10} \)| \( X_{101} \) | \( X_{102} \) | \( X_{103} \) | \( X_{104} \) | \( X_{105} \) |

The decision matrix data formed from the initial data table for each alternative with values can be seen in the following table 4:

| \( K_1 \) | \( K_2 \) | \( K_3 \) | \( K_4 \) | \( K_5 \) |
|-----------|-----------|-----------|-----------|-----------|
| \( A_1 \) | 3         | 2         | 3         | 4         | 4         |
| \( A_2 \) | 1         | 1         | 2         | 3         | 2         |
| \( A_3 \) | 5         | 3         | 4         | 5         | 5         |
| \( A_4 \) | 1         | 1         | 1         | 2         | 1         |
| \( A_5 \) | 1         | 1         | 1         | 2         | 2         |
3.2. Weight Repair

In the process of completion, after the decision matrix was obtained, the next step is to improve the weights for each criterion. In supporting the decision results of the facility maintenance used, there are five criteria with weights.

The following formula obtains the repair of the weight:

\[
W_f = \frac{W_f}{\sum W_f} \quad (1)
\]

Table 6. Weight Repair

| No. | Criteria                  | Weight Score | Weight Repair |
|-----|---------------------------|--------------|---------------|
| 1.  | Processing Time           | 4            | 4/20 = 0.2    |
| 2.  | Cost                      | 4            | 4/20 = 0.2    |
| 3.  | Number of Workers         | 3            | 3/20 = 0.15   |
| 4.  | Level of Requirement      | 4            | 4/20 = 0.2    |
| 5.  | Level of Difficulty       | 5            | 5/20 = 0.25   |

![Figure 2. Diagram of Weight Repair](image)

3.3. S Vector Value

After the decision matrix and the repair of criteria weights were obtained, the next step is to find the s vector value, using a formula as follows:

\[
S_i = \prod_{j=1}^{n} \frac{X_{ij} W_j}{\prod_{j=1}^{n} W_j} \quad (2)
\]

Calculation of Si value can be seen at the following completion:

\[
\begin{align*}
S_1 &= (5 \cdot 0.2)(3 \cdot 0.2)(4 \cdot 0.15)(5 \cdot 0.2)(5 \cdot 0.25) = 0.9750 \\
S_2 &= (1 \cdot 0.2)(1 \cdot 0.2)(1 \cdot 0.15)(2 \cdot 0.2)(1 \cdot 0.25) = 1.1487 \\
S_3 &= (1 \cdot 0.2)(1 \cdot 0.2)(1 \cdot 0.15)(2 \cdot 0.2)(2 \cdot 0.25) = 1.3660 \\
S_4 &= (1 \cdot 0.2)(2 \cdot 0.2)(2 \cdot 0.15)(4 \cdot 0.2)(3 \cdot 0.25) = 1.3625 \\
S_5 &= (1 \cdot 0.2)(2 \cdot 0.2)(2 \cdot 0.15)(5 \cdot 0.2)(2 \cdot 0.25) = 1.4788 \\
S_6 &= (1 \cdot 0.2)(1 \cdot 0.2)(1 \cdot 0.15)(1 \cdot 0.2)(2 \cdot 0.25) = 1.1892 \\
S_7 &= (2 \cdot 0.2)(3 \cdot 0.2)(2 \cdot 0.15)(5 \cdot 0.2)(3 \cdot 0.25) = 1.0762 \\
S_8 &= (1 \cdot 0.2)(1 \cdot 0.2)(2 \cdot 0.15)(3 \cdot 0.2)(2 \cdot 0.25) = 1.1436
\end{align*}
\]
3.4. Vi Vector Value

Calculating the Vi vector or the relative preference of each alternative. For a ranking uses this formula:

\[
V_i = \frac{\prod_{j=1}^{n} \frac{x_{ij}}{w_j}}{\prod_{j=1}^{n} (x_{ij} w_j)} \ldots \ldots (3)
\]

The simple form as following:

\[
i = V_i = \frac{s_i}{s_1 + s_2 + \ldots + s_n}
\]

To get the results of the calculation of the solution can be seen in the following calculations:

\[
V_1 = \frac{s_1}{s_1 + s_2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 + s_{10}} = 0.0800
\]

\[
V_1 = \frac{s_1}{s_1 + s_2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 + s_{10}} = 0.0800
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V_1 = \frac{s_1}{s_1 + s_2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 + s_{10}} = 0.0800
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\]

\[
V_1 = \frac{s_1}{s_1 + s_2 + s_3 + s_4 + s_5 + s_6 + s_7 + s_8 + s_9 + s_{10}} = 0.0800
\]
4. Conclusion

Based on the calculation of the decision support system using the Weight Product (WP) method, the Vi value matrix calculation is obtained after the count. The value of the overall data is found. For the alternative results, Vi value, which has the highest value, is the "Andalusia Library" building.

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