Application of Computer-assisted Analytic Hierarchy Process Method to Evaluate Employee Performance

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Abstract. Human resources have a very important role in a company. The quality of human resources is one of the factors to improve the productivity of company performance. Therefore, companies need to assess the performance of employees to find out success or failure in carrying out their duties. The problem that occurs at PT XYZ is that the assessment process carried out still uses a manual method so that the employee performance evaluation process becomes slow and inaccurate. In evaluating employee performance, it is still very subjective. The absence of methods used to support decisions in determining employee performance appraisal. The purpose of this study is to make a decision in selecting employees who have good performance values using the Analytic Hierarchy Process (AHP) method. The criteria used for employee assessment are performance, work attitude, potential, ability, and personality. From the results of the study it was found that the AHP method can already be used to select good employee performance based on predetermined criteria. Compared with previous research, the method is only used to choose the criteria for evaluation, it has not been used to select employees.

1. Introduction

Human resources are company assets that must be managed properly. With good human resource management, it will add value to the company [1][2]. Employee assessment is an effort to make an assessment of one's achievements which aims to increase employee productivity which ultimately increases company productivity [3][4]. At present, the performance appraisal of employees at PT XYZ is still subjective therefore the results are still not optimal. The method that can be used for employee selection is the AHP Method. AHP method is a comprehensive and structured decision-making method [5]. This method includes a performance appraisal process that starts from determining the weight of each criterion to determine the importance of each indicator. This value will produce alternative weights to find out the highest alternative value.

Based on previous research, there are several references used by the authors, namely the first study discusses integrated fuzzy multi-attribute decision making models for employee performance assessment [6] and the second study discusses the application of several criteria for performance evaluation using the AHP Method [7]. From the two studies, decision support methods are only used to find out what criteria will be used as performance appraisal, and is not used to select employees who have good performance values based on predetermined criteria. The research that will be conducted is selecting employees who have parameters that determined based on good performance. Another study used as a source of research is about employee performance appraisal systems using the TOPSIS method.
[8], the employee scoring system uses fuzzy methods [9]. From the two studies, the Topsis method and the Fuzzy method were used to assess the performance of employees, the difference from the research to be carried out was the parameters used to assess employees.

From the problems at PT XYZ and references from previous research, a decision support system is needed to assess the performance of employees at PT XYZ. The purpose of this system is to facilitate PT XYZ in selecting employees who have good performance values, using the AHP method.

2. Methods
The method used to determine employees who have good performance values is the AHP method. In the AHP method the value of comparison is between 1 and 9, the table of comparison values can be seen in Table 1.

| Grade | Explanation                          |
|-------|--------------------------------------|
| 1     | equally important                    |
| 2     | approaching a little more important  |
| 3     | a little more important              |
| 4     | approaching more important than      |
| 5     | more important than                  |
| 6     | approaching very important from      |
| 7     | very important from                  |
| 8     | close to absolute from               |
| 9     | absolutely very important from       |

The steps to using the AHP method are [10][11]:
1. Define the problem and determine the solution desired, then set the hierarchy of the problem at hand.
2. Determine priority elements by determining priorities element is to create a pair comparison matrix that will compare the paired elements according to the given criteria. after that, the matrix is filled using numbers to present the relative importance of an element to another element.
3. Synthesize
   Considerations for pairwise comparisons are synthesized to get overall priority. The things done in this step are:
   a. Add values from each column in the matrix.
   b. Divide each value from the column with the appropriate column to get the normalization of the matrix.
   c. Add the value of each line and divide by the number of elements to get the average value.
4. Measuring consistency
   In making a decision, it's important to know how good consistency is, because we don't want a decision based on considerations with low consistency. The things done in this step are:
   a. multiply each value in the first column with relative priority first element, the value in the second column with the relative priority of the second element, and so on
   b. Add up each row.
   c. The result of the number of rows divided by the relative priority elements concerned.
   d. Add the quotient above with the number of elements, the result is called \( \lambda_{\text{max}} \).
5. Calculate the Consistency Index (CI) with the formula:
   \[ \text{CI} = (\lambda_{\text{max}} - n) / n, \]
   where: \( n = \text{Number element} \)
6. Calculate Consistency Ratio / Consistency Ratio (CR) with the formula:
   \[ \text{CR} = \text{CI} / \text{RC}, \]
   where:
   \[ \text{CR} = \text{Consistency Ratio} \]
CI = Consistency Index  
IR = Random Consistency Index

7. Check the consistency of hierarchies. If the value is more than 10%, the assessment must be corrected. But if the consistency ratio (CI / IR) is less or equal to 0.1, then the calculation results can be stated correctly. List of Random Consistency Index (IR) can be seen in Table 2.

| Matrix Size | Value of IR |
|-------------|-------------|
| 1,2         | 0.0         |
| 3           | 0.58        |
| 4           | 0.90        |
| 5           | 1.12        |
| 6           | 1.24        |
| 7           | 1.32        |
| 8           | 1.41        |
| 9           | 1.45        |
| 10          | 1.49        |
| 11          | 1.51        |
| 12          | 1.48        |
| 13          | 1.56        |
| 14          | 1.57        |
| 15          | 1.59        |

Data used for employee selection is taken from data at PT. XYZ. this data is obtained from the results of interviews with the staffing section of the company. The data used in this study are alternative criteria and data. Based on the interview with the employee section of the company, the criteria data consisted of performance, work attitude, potential, ability, and personality. while alternative data is data about employees who will be given an assessment.

3. Results and Discussion
Criteria data along with sub criteria used in this study can be seen in Table 3.

| Code | Name of Criteria       | Sub criteria                                      | Code    |
|------|------------------------|--------------------------------------------------|---------|
|      |                        | Name of Sub criteria                             |         |
| C01  | Performance            | very good (assessment by the leadership)         | VG      |
|      |                        | well (assessment by the leadership)              | WL      |
|      |                        | less (assessment by the leadership)              | LS      |
|      |                        | High (90 – 100)                                  | H       |
| C02  | Work attitude          | Normal (75 – 89)                                 | N       |
|      |                        | Low (60 – 74)                                    | L       |
|      |                        | High (90 – 100)                                  | H       |
| C03  | Potential and ability  | Normal (75 – 89)                                 | N       |
|      |                        | Low (60 – 74)                                    | L       |
|      |                        | very good (assessment by the leadership)         | VG      |
| C04  | Self-personality       | well (assessment by the leadership)              | WL      |
|      |                        | less (assessment by the leadership)              | LS      |
The process of selecting employees using the AHP method is as follows:

a. General criteria calculation
In this calculation the pairwise comparison matrix will be determined then look for the criteria value matrix, the sum of each row matrix, the concentration ratio matrix and look for consistency ratio information. From the criteria data used, the pairwise comparison matrix can be seen in Table 4.

| Code | C01 | C02 | C03 | C04 |
|------|-----|-----|-----|-----|
| C01  | 1.00| 3.00| 5.00| 5.00|
| C02  | 0.33| 1.00| 5.00| 3.00|
| C03  | 0.20| 0.20| 1.00| 3.00|
| C04  | 0.20| 0.33| 0.33| 1.00|
| **Total** | **1.73** | **4.53** | **11.33** | **12.00** |

From the pairwise comparison matrix data, the criteria value matrix can be seen in Table 5. The value of each element in table 4 is obtained from the results of the comparison area and the number of rows in Table 5.

| Code | C01 | C02 | C03 | C04 | Priority Weight |
|------|-----|-----|-----|-----|-----------------|
| C01  | 0.58| 0.66| 0.44| 0.42| 0.52            |
| C02  | 0.19| 0.22| 0.44| 0.25| 0.28            |
| C03  | 0.12| 0.04| 0.09| 0.25| 0.12            |
| C04  | 0.12| 0.07| 0.03| 0.08| 0.08            |

The value of the concentration ratio matrix for general criteria data can be seen in Table 6.

| Code | Sum | Priority | The Result |
|------|-----|----------|------------|
| C01  | 6.85| 0.52     | 7.38       |
| C02  | 3.24| 0.28     | 3.52       |
| C03  | 0.87| 0.12     | 0.99       |
| C04  | 0.14| 0.08     | 0.22       |

From the calculation results obtained the concentration ratio value is -0.27, so this criterion is suitable for use in decision support systems.

b. Calculation of sub criteria
For this calculation, the calculation steps are the same as the calculation of criteria data. Calculations are carried out for 4 criteria, namely C01, C02, C03, and C04. When getting the value of the criterion matrix, the value of the sub priority will be obtained. For example, the criteria value matrix from sub criteria C01 can be seen in Table 7.
The sub-priority value is obtained from the priority value divided by the largest value in the priority column. The example of the biggest priority value is 0.63, so the sub-priority value of the Good sub-criteria is 0.26 / 0.63 = 0.41. The concentration ratio value for each sub-criterion is smaller than 0.1 so that all sub-criteria are appropriate for use in decision support systems.

c. Taking the priority results of each criteria
After each calculation of criteria and sub criteria is carried out, the results can be taken as a guide for selecting employees who have good performance values based on criteria and sub criteria. Table of results of priority values criteria and sub criteria can be seen in Table 8.

d. Selection of employees who have good performance values
This step is the last step for selecting employees. For example, in this voting 7 employees will be selected. The value of each employee for each criterion can be seen in Table 9.
Table 9. Values criteria for each employee

| Employee | C01 | C02 | C03 | C04 |
|----------|-----|-----|-----|-----|
| A01      | WL  | N   | R   | B   |
| A02      | WL  | T   | T   | SB  |
| A03      | WL  | T   | T   | SB  |
| A04      | LS  | N   | T   | SB  |
| A05      | VG  | R   | N   | B   |
| A06      | VG  | R   | N   | K   |
| A07      | WL  | T   | R   | B   |

Alternative values for criteria data from each employee can be seen in Table 10. This value is obtained by matching the priority values of each criterion.

Table 10. Alternative Values

| Employee | C01 | C02 | C03 | C04 |
|----------|-----|-----|-----|-----|
| A01      | 0.41| 0.41| 0.17| 0.41|
| A02      | 0.41| 1   | 1   | 1   |
| A03      | 0.41| 0.41| 0.41| 0.41|
| A04      | 0.17| 0.41| 1   | 1   |
| A05      | 1   | 0.17| 0.41| 0.41|
| A06      | 1   | 0.17| 0.41| 0.17|
| A07      | 0.41| 1   | 0.17| 0.41|

Each value (cell) in Table 10 is multiplied by the priority value of each criterion, so that the ranking results are obtained. Ranking data can be seen in Table 11.

Table 11. Ranking results

| Employee | C01 | C02 | C03 | C04 | Total |
|----------|-----|-----|-----|-----|-------|
| A01      | 0.24| 0.09| 0.02| 0.03| 0.38  |
| A02      | 0.24| 0.22| 0.09| 0.08| 0.63  |
| A03      | 0.24| 0.09| 0.04| 0.03| 0.40  |
| A04      | 0.10| 0.09| 0.09| 0.08| 0.36  |
| A05      | 0.58| 0.04| 0.04| 0.03| 0.68  |
| A06      | 0.58| 0.04| 0.04| 0.01| 0.66  |
| A07      | 0.24| 0.22| 0.02| 0.03| 0.51  |

From Table 11 it can be concluded that the value of 0.68 is the highest value in the column number, and that value is the value of the employee A05, so employee A05 is the employee who have a the most performance value in the first rank.

From the results of the study it was found that the AHP method can already be used to select good employee performance based on predetermined criteria. Compared with previous research, the method is only used to choose the criteria for evaluation, it has not been used to select employees.
4. Conclusion
From the results obtained, the AHP method can help PT XYZ in selecting employees who have good performance values. This selection is based on criteria data are performance, work attitude, potential, ability, and personality.

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