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Implementation of the Topsis and AHP Methods in the Decision Support System for Determining the Best Employees

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Abstract

Every company or agency needs Human Resources (HR) in the form of employees who have competence and good performance. Employees are one of the most important assets owned by a company. The West Sumatra Province Transportation Service is the organizer of government affairs in the field of transportation or transportation policy for the West Sumatra Province region where the selection of the best employees is still not optimal using Microsoft Excel. The aim of designing a new system at the Provincial Transportation Service is to create optimization in the assessment of each employee to facilitate the recapitulation of employee data. The data is analyzed and processed according to the research framework, namely using a Decision Support System, especially the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) and Analytic Hierarchy Process (AHP) methods. In this research, 10 alternative employees were taken to be assessed. Based on formula calculations using the AHP method, it is used to determine the weighted value of each existing criterion, then the resulting values from the weighting are used to carry out rankings using the TOPSIS method. After carrying out calculations using these 2 methods, the result was that the best employee was alternative 9 in the name of Rusdi with a value of 0.9995. So with this calculation the results can show which employees have the right to be the best employees in that agency.

Keywords: Selection of the Best Employees, Decision Support Systems, Topsis, AHP , Criteria .

1. Introduction

Every company or agency needs Human Resources (HR) in the form of employees who have competence and good performance. Employees are one of the most important assets owned by a company in its efforts to maintain survival, development, the ability to compete and earn profits [1]. In order to improve the quality and discipline of employee work, it is necessary to carry out an assessment of each employee with the aim of determining the best employee in the West Sumatra Province Transportation Service. For employees who are selected as the best employees, there needs to be rewards/awards as a reward for what they have achieved in their work, so that this can stimulate/motivate the enthusiasm of other employees in optimizing their performance. The best employees are employees who display behavior that is in line with the company's vision, mission, goals, culture and values [2].

A Decision Support System (DSS) is a system for assembling and integrating every individual's intellectual resources with computer capabilities to improve the quality of the resulting decisions [3][4][5]. Understanding DSS and its use as a system that supports and supports decisions is carried out through a relative review of the roles of humans and computers in order to understand their respective areas of function, their strengths and weaknesses [6]. The aim of forming an effective SPK is to utilize the advantages of both elements, namely humans and electronic devices[7][8].

A decision support system can be defined as a system intended to support managerial decision makers in semistructured situations. Decision support systems are indicated for decisions that require judgment or for decisions that cannot be supported at all by algorithms [9].

Method Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is based on the concept where the best selected alternative not only has the shortest distance from the positive ideal solution, but also has the longest distance from the negative ideal solution. This concept is widely used in the MCDM concept to solve practical decision problems, this is because the concept is simple and easy to understand, it is computationally efficient, and has the ability to measure relative performance from decision alternatives in simple mathematical form [10][11].

The TOPSIS method is one of the methods used to solve MADM problems. The TOPSIS method is based on the concept where the best selected alternative not only has the shortest distance from the positive ideal solution, but also has the shortest distance from the negative ideal solution [12][13].

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Analytic Hierarchy Process (AHP) can solve complex multi-criteria problems into a hierarchy. A complex problem can be interpreted as having too many criteria for a problem, more than one person making decisions, and inaccurate data available [14].

Previous research by Shylvia Nurul Amida and Titin Kristiana on Decision Support Systems for Employee Performance Assessment Using the Topsis Method. Conducted observations at the Maju Baru Village government office to help solve the problem of selecting the best employees and obtained the results of calculations using the Topsis method. The highest score was obtained with a value of 1 from an employee named Budi from data from 10 employees studied [15]

Iin Mutmainah and Yunita regarding the application of the Topsis method in selecting expedition services, using the Topsis method in selecting expedition services at PT Tachimita Hoka Utama to minimize errors in selecting expedition service partners by taking 6 sample criteria. Where the analysis results obtained using this method contained 3 highest preference values, namely Sentral Cargo (0.8887) , Indah Logistic Cargo (0.5856), and Ezra Cargo (0.5444). The highest rank was obtained by Sentral Cargo [16].

Currently, there are still many agencies or companies where there is an imbalance in assessing employee performance in making decisions based on existing subjective judgments, thus affecting the decline in employee quality. For this reason, it is necessary to find a solution to solve the problem of this speculation

Due to the large number of employees in the West Sumatra Province Transportation Agency, it is difficult for agencies to assess the performance of each employee, for this reason it is necessary to create a computerized system to make it easier to make decisions on selecting the best employees or what can also be called a Decision Support System (SPK). To support solving this problem, the author uses the AHP (Analytical Hierarchy Process) and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) methods. The advantage of the AHP method in making a decision is that it compares each criterion that a problem has so that a weighted value for each existing criterion is obtained [18]. Meanwhile, the TOPSIS method is based on the concept of the best alternative choice which has the shortest or farthest distance from the solution obtained [19][20].

2. Research methodology

The research framework is the concept or stages that will be carried out in the research. So that the steps taken by the author in this design do not deviate from the main discussion and are easier to understand, the sequence of research steps will be made systematically so that it can be used as a clear and easy guide for solving existing problems. The steps for the AHP method are as follows:

1. Determine the level of importance between criteria
2. Create a pairwise comparison matrix
3. Perform normalization on each pairwise matrix value
4. Determine the average value of the criteria matrix
5. Find the maximum Lamda (ƛ) value

After carrying out the steps above, the next step is to measure consistency with the following steps:

1. Calculating the CI Index Consistency using the formula:

$$CI = \frac{\lambda_{max} - n}{n} \qquad (1)$$

Where n is the number of elements

2. Calculating the Consistency Ratio (CR) using the formula:

$$CR = \frac{\text{CI}}{RI} \qquad (2)$$

Where CR is Consistent Ratio and CI is Consistent Index.

The steps for the TOPSIS method are as follows:

1. Creating alternative data and its criteria
2. Making a normalized decision matrix, using the following formula:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{m} x_{ij^2}}} (i = 1,2 \dots n; j = 1,2, \dots, m)$$

Where $x_{ij}$is the performance rating of the Ith alternative against the jth attribute and $r_{ij}$is an element of the normalized decision matrix.

3. Create a weighted normalized matrix

$$\text{y=} \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1j} \\ y_{21} & y_{22} & \cdots & y_{2j} \\ \cdots & \cdots & \cdots & \cdots \\ y_{i1} & y_{i2} & \cdots & y_{ij} \end{bmatrix} \text{for} y_{ij} = w_j r_{ij}$$

Where $\boldsymbol{w_j}$is the weight of the j-criterion and$\boldsymbol{y_{ij}}$ is an element of a normalized decision matrix.

4. Determine the positive ideal solution matrix (A+) and the negative ideal solution matrix (A-)

$$A^+ = (y_1^+, y_2^+, \dots, y_j^+)$$
$$A^- = (y_1^-, y_2^-, \dots, y_j^-)$$

With

$$y_j^+ = \begin{cases} i_{max} \ y_{ij,jika\ j=keuntungan} \\ i_{min} \ y_{ij,jika\ j=biaya} \end{cases}$$

$$y_j^- = \begin{cases} i_{max} \ y_{ij,jika\ j=keuntungan} \\ i_{min} \ y_{ij,jika\ j=biaya} \end{cases}$$

6. Determine the distance of alternative values from the positive ideal solution matrix (di+) and the negative ideal solution matrix (di-), the distance of the positive ideal solution (di+)

$$d_i^+ = \sqrt{\sum_{j=1}^{m} \left(y_{ij} - y_j^+\right)^2}$$

$$d_i^- = \sqrt{\sum_{j=1}^{m} \left(y_{ij} - y_j^-\right)^2}$$

Where $y_j^+$is an element of the positive ideal solution matrix and $y_j^-$is an element of the negative ideal solution matrix.

7. Determine the preference value (ci) for each alternative. Preference value is the closeness of an alternative to the ideal solution

$$c_i = \frac{d_i^-}{d_i^- + d_i^+}$$

Where a $c_i$larger value indicates alternative priority.

3. Results and Discussion

In this research, the determination of criteria weights was carried out using the Analytic Hierarchy Process (AHP) method, while the TOPSIS method was used to carry out rankings by optimizing positive and negative ideal solutions to get the best employees. There are hybrid calculations from the AHP and TOPSIS methods as follows:

3.1 The weighting stages use the AHP method

1. Determine the level of importance between criteria

The first stage in calculating the AHP method is determining the level of importance between the criteria used to create the pairwise comparison matrix. The level of importance between the criteria in this research is:

Table 1 Assessment Criteria

Intensity of Interest	Definition
1	Equally important than the others
3	A little more important than the others
5	Quite important compared to the others
7	Very important compared to others
9	Extremes are more important than others
2,4,6,8	The middle value between two adjacent elements
Reciprocal	If element 1 has one of the numbers above compared to element j, then j has the opposite value when compared with i

After conducting interviews with the West Sumatra Province Transportation Service, the priorities for each criterion were obtained.

1. Knowledge (C4) is as important as ability (C5)
2. Attendance (C3) is as important as attitude (C2)
3. Knowledge (C4) and ability (C5) are quite important compared to absenteeism (C3) and attitude (C2)
4. Attendance (C3) and attitude (C2) are quite important compared to cooperation (C1)
5. Knowledge (C4) and ability (C5) are more important than Collaboration (C1)

2. Make pairwise comparison matrix

Creating a pairwise comparison matrix between criteria based on previously defined importance level values. The decision matrix for comparison of criteria is shown in Table 2

Table 2 Pairwise Criteria Comparison Matrix

	C1	C2	C3	C4	C5
C1	1	0.33	0.33	0.2	0.2
C2	3	1	1	0.6	0.6
C3	3	1	1	0.6	0.6
C4	5	1.66	1.66	1	1
C5	5	1.66	1.66	1	1
Total	**17**	**5.65**	**5.65**	**3,4**	**3,4**

3. Perform normalization on each pairwise matrix value

The way to normalize is by dividing each value in a column by the total value for each column. Normalization of pairwise matrix values in Table 2 was carried out to make the value range 1 to 0. The results of normalization of pairwise comparisons are shown in 3, namely as follows:

Table 3 Normalization Results of Pairwise Comparisons

	C1	C2	C3	C4	C5
C1	0.059	0.058	0.058	0.059	0.059
C2	0.176	0.177	0.177	0.176	0.176
C3	0.176	0.177	0.177	0.176	0.176
C4	0.294	0.294	0.294	0.294	0.294
C5	0.294	0.294	0.294	0.294	0.294
Total	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**

4. Determine the average value of the criteria matrix

The way to determine the average value is by adding up all the values per row and dividing by the number of existing criteria. The results are shown in Table 4 below

Table 4 Weight Results for Each Criteria

	C1	C2	C3	C4	C5
C1	0.059	0.058	0.058	0.059	0.059
C2	0.176	0.177	0.177	0.176	0.176
C3	0.176	0.177	0.177	0.176	0.176
C4	0.294	0.294	0.294	0.294	0.294
C5	0.294	0.294	0.294	0.294	0.294

The average values shown in Table 4 are used as weights for calculations using the Topsis method in creating weighted normalization. The weight values produced by the AHP method cannot be used directly, but must first be tested for consistency. The list of weights obtained from the AHP method is W = [0.059, 0.177, 0.177, 0.294, 0.294]

5. Find the maximum Lamda (λ) value

To get the max lambda (λ) value, it can be calculated using the concept of matrix multiplication between the pairwise comparison matrix in Table 4.4 and the transpose weight value. The results of the maximum lambda values are shown in Table 5

Table 5 Maximum Lambda (λ) value

	C1	C2	C3	C4	C5	W	Max (λ)
C1	0.059	0.058	0.058	0.059	0.059	0.059	0.997
C2	0.176	0.177	0.177	0.176	0.176	0.177	0.998
C3	0.176	0.177	0.177	0.176	0.176	0.177	0.998
C4	0.294	0.294	0.294	0.294	0.294	0.294	1,000
C5	0.294	0.294	0.294	0.294	0.294	0.294	1,000
Total	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**4,993**

6. Calculating Consistency Index (CI)

Here is how to calculate the Consistency Index (CI)

$$CI = \frac{4.993-5}{5-1} = -0.001803$$

7. Calculating Consistency Ratio

The consistency ratio value is calculated by dividing the CI value by the Random Index (RI) value. In this study, 5 criteria were used, so the RI value was 1.12 . As for the CI calculation process

$$\frac{C(-0.001803)}{1.12} = -0.00161$$

Based on the resulting CR value (-0.00161) < 0.1, the weight of each criterion can be said to be consistent. So the weights obtained using the AHP method can be used.

3.2 The ranking stages use the TOPSIS method

1. Creating alternative data and its criteria

The first stage is to create a decision matrix based on alternative data along with criteria for determining the best employees at the West Sumatra Province Transportation Service obtained from the public relations department.

Table 6 Alternative Data

Alternative	Code
Heri Noriardi, SE, MM	A1
Alfiandri, SS, MM	A2
Wanmaidi, SH	A3
Israwati	A4
Rita Susanti	A5
siti Khadijah	A6
Masjoni, SP, SH	A7
Idris, SH	A8
Rusdi	A9
Andrizal Yunaldi	A10

Table 4.7 Decision Matrix

Alternative	Criteria				
	C1	C2	C3	C4	C5
A1	85	90	90	95	90
A2	90	85	85	90	95
A3	85	90	85	90	90
A4	90	85	80	85	85
A5	85	80	85	80	85
A6	85	90	90	80	80
A7	85	85	85	90	90
A8	85	85	90	90	80
A9	95	90	80	85	85
A10	85	90	85	80	85

2. Creation of a normalized decision matrix

The results of the normalization of the decision matrix are shown in Table 8

Table 4.8 Normalized Decision Matrix

Distribution	[x1] 68660	[x2] 67790	[x3] 65215	[x4] 66145	[x5] 67015
Alternative	C1	C2	C3	C4	C5
A1	0.00124	0.00133	0.00138	0.00144	0.00134
A2	0.00131	0.00125	0.00133	0.00136	0.00142
A3	0.00124	0.00133	0.00133	0.00136	0.00134
A4	0.00131	0.00125	0.00123	0.00129	0.00127
A5	0.00124	0.00118	0.00133	0.00121	0.00127
A6	0.00124	0.00133	0.00138	0.00121	0.00119
A7	0.00124	0.00125	0.00133	0.00136	0.00134
A8	0.00124	0.00125	0.00138	0.00136	0.00119

A9	0.001 38	0.001 33	0.001 23	0.001 29	0.001 27
A10	0.001 24	0.001 33	0.001 3	0.001 21	0.001 27

3. Create a weighted normalized matrix using priority weights obtained using the AHP method. The weighted normalized matrix is calculated by multiplying the value of each alternative in the normalized decision matrix multiplied by the weight value resulting from the AHP method. The results of the normalized decision matrix are shown in table 4.9

Table 9 Results of the Weighted Normalized Decision Matrix

Alternative	Criteria				
	C1	C2	C3	C4	C5
A1	0.000073	0.000235	0.000244	0.000422	0.000395
A2	0.000077	0.000222	0.000231	0.000400	0.000417
A3	0.000073	0.000235	0.000231	0.000400	0.000395
A4	0.000077	0.000222	0.000217	0.000378	0.000373
A5	0.000073	0.000209	0.000231	0.000356	0.000373
A6	0.000073	0.000235	0.000244	0.000356	0.000351
A7	0.000073	0.000222	0.000231	0.000400	0.000395
A8	0.000073	0.000222	0.000244	0.000400	0.000351
A9	0.000082	0.000235	0.000217	0.000378	0.000373
A10	0.000073	0.000235	0.000231	0.000356	0.000373

4. Determine the positive and negative ideal solution matrices

ideal solution and negative ideal solution for each criterion are shown in Table 10

Table 10 Positive and Negative Ideal Solution Matrix

	C1	C2	C3	C4	C5
A+	0.000082	0.000235	0.000244	0.000422	0.000417
A-	0.000073	0.000209	0.000217	0.000356	0.000351

5. Determine the distance between positive and negative ideal solutions

Distance between positive and negative ideal solutions for each criterion. Shown in Table 11

Table 11 Results of Distance Values for Positive and Negative Ideal Solutions

Alternative	Ideal Solution Distance	
	D+	D-
A1	0.000008593548	0.000000007788
A2	0.000004297382	0.000004303194
A3	0.000008594227	0.000000004766
A4	0.000004301341	0.000004297679
A5	0.000008600303	0.000000000665
A6	0.000008601843	0.000000001418
A7	0.000008594397	0.000000004255
A8	0.000008598062	0.000000002883
A9	0.000000004637	0.000008594724
A10	0.000008599621	0.000000001347

6. Specifies the preference value

Below are the preference values for each alternative

Table 12 Preference Values

Alternative	The final result
A1	0.0009
A2	0.5003
A3	0.0006
A4	0.4998
A5	0.0001
A6	0.0002
A7	0.0005
A8	0.0003
A9	0.9995
A10	0.0002

7. Ranking

The final results obtained using the Topsis method are ranked based on the greatest value of each employee or alternative. The ranking results are shown in Table 13

Table 13 Ranking Results

Alternative	The final result	Ranking	Decision
A9	0.9995	1	Best 1
A2	0.5003	2	Best 2
A4	0.4998	3	Best 3
A1	0.0009	4	Best 4
A3	0.0006	5	Best 5
A7	0.0005	6	Best 6
A8	0.0002	7	Best 7
A6	0.0003	8	Best 8
A10	0.0002	9	Best 9
A5	0.0001	10	Best 10

4. Conclusion

Having this new system makes it very easy for the West Sumatra Provincial Transportation Service to determine the best employees in this agency because the system is more efficient. Calculation of value weighting based on criteria makes it easier to recapitulate employee activities. Of the 10 alternatives tested, the result that got the best score was alternative 9 with the name Rusdi with a value of 0.0995. The available database is based on criteria, making it easier for admins to store existing employee data. This system is very helpful for technological advancement in the agency.

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