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Decision Support System for New Employee Selection Using AHP and TOPSIS

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ABSTRACT

There are so many prospective workers with the same educational background, but not necessarily in accordance with the required company position and not necessarily they have the same expertise. To minimize the occurrence of errors, it can be done by making a decision-making system (DSS) to provide these recommendations. In this study, the Analytical Hierarchy Process (AHP) and the Technique For Order Preference by Similarity to Ideal Solution (TOPSIS) method were used to provide recommendations for prospective new employees. The steps taken are to compare the importance of each criterion weight with the AHP method. Then the ranking stage is carried out using the TOPSIS method to get recommendations for selected employees. The data used in this study is primary data in the form of 70 data on prospective employees from PT Hutama Jaya Perkasa. From the 70 data then selected to be 36 prospective employees based on the order of the highest ranking. Software testing is done by comparing the results of system calculations and the results of company calculations. Based on the test results obtained an accuracy value of 94.4%.

1. Introduction

DSS is an effective system in helping to make a complex decision. This system uses various decision rules, analysis models, comprehensive databases and knowledge from decision makers [11].

The method used to solve the problem of alternative selection the best is Multi Criteria Decision Making (MCDM). MCDM is a decision-making method for determining the best alternative from a number alternatives based on certain criteria [4]. MCDM consists from several types of methods such as Simple Additive Weighting (SAW), SMART, Weight Sum Model (WSM), Weight Product (WP), Analytical Hierarchy Process (AHP), Profile Matching, Technique For Order Preference by Similarity to Ideal Solution (TOPSIS), and others. Each method has characteristics and criteria different uses.

The method to be used in this study is the AHP and TOPSIS methods. The reason for using the AHP method is because in AHP there is an eigenvector concept, which is used to process the priority ranking of each criterion based on a pairwise comparison matrix [5]. The advantages of the TOPSIS method are that the concept is simple and easy to understand, computationally efficient, and has the ability to measure the relative performance of decision alternatives in a simple mathematical form [8].

In previous research on comparative analysis of the AHP and TOPSIS methods, the results of measuring the accuracy of the AHP method were 45%, while the TOPSIS method was 73% [7]. For this reason, researchers combined the two methods to try to get a better accuracy value. In other previous studies, the combination of AHP and TOPSIS has been well implemented. Decision makers use the AHP method to calculate the weight of the criteria and the recommendations are calculated using TOPSIS. This implementation produces good accuracy test results and greatly

influences the recommendation results [8].

This research will design and build a decision support system with a case study on the selection of new employees at PT Hutama Jaya Perkasa based on a website using AHP and TOPSIS.

2. Literature Study

a. Decision Support System

Michael S.Scott Morton, first revealed the DSS concept in the early 1970s with the term Management Decision System. DSS refers to a system that utilizes computer support in the decision making process. There are many expert opinions regarding the understanding of DSS. In the opinion of Man and Watson, DSS is a system that can help make decisions through the use of data and decision models to solve semi -structured or unstructured problems [2]. DSS is a system that can help decision makers in making decisions about a problem accurately and faster. DSS includes information from the data that has been processed relevant, but keep in mind that DSS is not a decision -making tool but a supporting system in the decision maker [1].

b. Recruitment

Recruitment is a process of searching for labor carried out by the company with the aim of finding, identifying and attracting prospective employees to be employed by the company. Employees are human resources that play a role in moving or managing other resources in the organization, so that organizations must be able to use existing human resources effectively and efficiently in accordance with the needs of the organization [6].

c. Analytic Hierarchy Process (AHP)

Thomas L. Saidy is the person who develops the AHP method, according to him this method is a framework for making decisions effectively about complex problems by simplifying and accelerating the decision making process by solving the problem into its parts, in a hierarchical arrangement [9]. AHP is one of the many methods that are very often used in DSS. AHP is a functional hierarchy with the main input is the perception of humans who are considered as experts to provide weighting each criterion [8].

The steps for the AHP method are as follows:

1) Identify the problem then create a hierarchical structure of the problem.
2) Compares elements in pairs according to the specified criteria.
3) The pairwise comparison matrix is filled with numbers that describe the relative importance of each element.
4) Add up the values of each column in the matrix.
5) Find the normalization matrix by dividing each value from the column by the total column.
6) Add up the values of each row then divide by the number of elements to obtain the average value.

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

1) Multiplies the value in the first column by the relative priority of the first element.
2) Add up each row.
3) Dividing the row sum result by the relative priority elements.
4) Add up the division results above with the number of elements present. The result is called (t).
5) Calculate Consistency Index (CI) using the formula:

$$CI = \frac{t-n}{n-1} \quad (1)$$

Information :

CI = Consistency Index
n = Number of criteria
t = Weight Vector

6) The random index (RIn) is the average CI value selected based on the Random Index table.

Table 1 . Pairwise Comparison Rating Scale (Skala *Saaty*)

N	1	2	3	4	5	6	7	8	9	10	11	12	13
RI	0	0	0.58	0.9	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,54	1,56

7) Calculate Consistency Ratio (CR) using the formula:

$$CR = \frac{CI}{RI_n} \quad (2)$$

- If CI = 0, then the hierarchy is consistent.
- If CR < 0.1, then the hierarchy is quite consistent.
- If CR > 0.1, then the hierarchies are highly inconsistent.

Information :

CR = Consistency Ratio
CI = Consistency Index
RIn = Random Index

d. Technique for Others Reference by Similarity to Ideal Solution (TOPSIS)

Yoon and Hwang introduced the TOPSIS method in 1981. TOPSIS used the euclidean distance from an alternative to calculate the closest distance from the positive ideal solution and the farthest of the negative ideal solution. Positive ideal solution is the amount of the maximum value that exists in each criterion. While the negative ideal solution is the worst values that exist in each criterion [9]. TOPSIS procedures follow the steps that start from creating a normalized decision matrix, making a normalized decision matrix, determining the matrix of positive ideal solutions and negative ideal solutions matrices, determining the distance between the values of each alternative and the matrix of the positive ideal solution and the matrix of the negative ideal solution up to Determine the preference value for each alternative [7].

TOPSIS requires a performance rating for each alternative Ai on each normalized Cj criterion, namely:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x^2_{ij}}} \quad (3)$$

Information :

r_{ij} = Performance Rating
x_{ij} = Matrix

With i=1,2...,m and j=1,2,...,n

The positive ideal solution (A^+) and the negative ideal solution (A^-) can be determined based on the normalized weight rating ($y$ij) as:

$$y_{ij} = w_i r_{ij} \quad (4)$$

Information :

y_{ij} = Normalization Weight Rating
r_{ij} = Performance Rating
w = weight

With i=1,2…,m and j=1,2,…,n.

$$A^+ = (y1+, y2+, \cdots, yn+) \quad (5)$$

Information :

A^+ = Positive distance
y = number of matrix element

$$A^- = (y1-, y2-, \cdots, yn-) \quad (6)$$

Information :

A^- = Positive distance
y = number of matrix element

With

$$y^+_{\mathbf{j}} = \begin{cases} max_i y_{ij} \rightarrow if\ \mathrm{j}\ is\ benefit\ attribute \\ min_i y_{ij} \rightarrow if\ \mathbf{j}\ is\ cost\ attribute \end{cases}$$

$$y^-_{\mathbf{j}} = \begin{cases} min_i y_{ij} \rightarrow if\ \mathrm{j}\ is\ benefit\ attribute \\ max_i y_{ij} \rightarrow if\ \mathrm{j}\ is\ cost\ attribute \end{cases}$$

The distance between alternative Ai and the positive distance (D_i^+) is formulated as:

$$D_i^+ = \sqrt{\sum_{j=i}^{n} (y_i^+ - y_{ij})^2} \rightarrow \mathrm{i} = 1,2, \ldots, \mathrm{m} \quad (7)$$

Information :

D_i^+ = Positive distance
y = number of matrix element

$$y^+_{\mathbf{j}} = \begin{cases} max_i y_{ij} \rightarrow if\ \mathrm{j}\ is\ benefit\ attribute \\ min_i y_{ij} \rightarrow if\ \mathbf{j}\ is\ cost\ attribute \end{cases}$$

The distance between alternative Ai and the negative distance (D_i^-) is formulated as:

$$D_{i^-} = \sqrt{\sum_{j=i}^{n}(y_{ij} - y_i^-)^2} \rightarrow i = 1,2, \dots, N \quad (8)$$

Information :

D_i^- = Negative distance
y = number of matrix element

$$y^-_j = \begin{cases} min_i y_{ij} \rightarrow if\ j\ is\ benefit\ attribute \\ max_i y_{ij} \rightarrow if\ j\ is\ cost\ attribute \end{cases}$$

The preference value for each alternative (Vi) is given as:

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} \quad (9)$$

Information :

Vi = Preference value
D_i^+ = Positive distance
D_i^- = Negative distance

e. Accuracy Calculation

Accuracy testing is calculated from the exact number divided by the amount of data.

$$\text{Level of accuracy} = \frac{True\ Test\ Data}{Total\ Test\ Data} \text{ x } 100\% \quad (10)$$

f. Relevance Research

DSS that uses the AHP method and TOPSIS produces an accuracy of 80%, this accuracy is obtained from survey comparison and system comparison. The sensitivity test results show that the combination of the AHP and TOPSIS methods, the average value of the five tests has a small sensitivity and is good for use in a recommendation system [8].

3. Methodology

a. Test Datasets

The data used for testing is a primary dataset obtained from PT Hutama Jaya Perkasa. Data consists of 70 prospective employees with 4 criteria, namely: Experience, Ability, Psychological Test and Interview.

Table 2. Test Data Employees Selection

No	Name	Experience	Ability	Psychological	Interview
1	A01	87	80	70	78
2	A02	90	75	70	74
3	A03	73	40	60	70
4	A04	75	75	80	78

...					
70	A70	74	75	75	76

b. Software Architecture

In carrying out system development, steps are needed in the form of a system framework with clear stages. The research framework can be seen in Fig. 1.

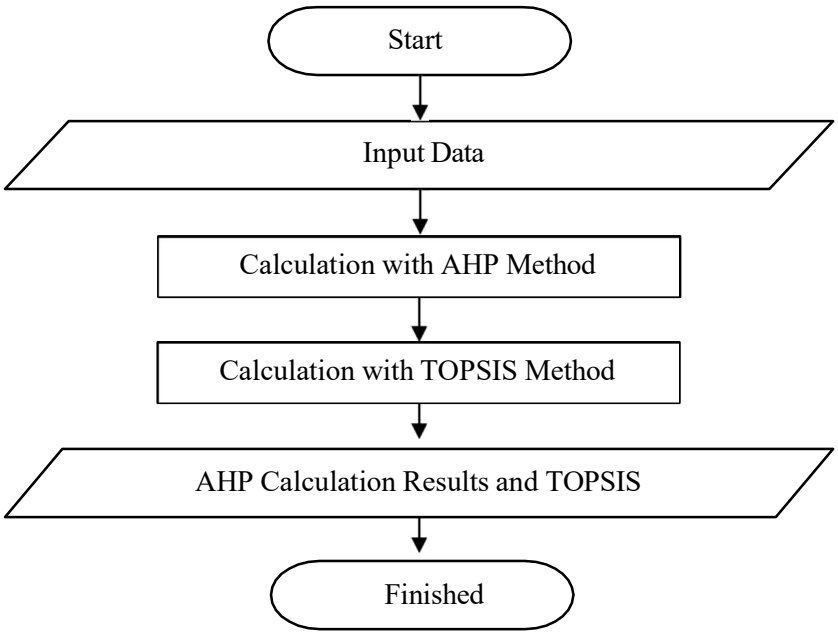

Fig. 1. System Framework

c. Test Criteria

Data is processed using the AHP with the same criterion weight score of 1, 2, 3 and criterion 4 weight which is slightly more important than the other criteria and TOPSIS methods so as to produce the best alternatives in the selection of new employee acceptance. The next step is to analyze and evaluate the results of the calculation of the AHP and TOPSIS method, by comparing the accuracy produced by the system with company data.

d. Tools Used in Research Implementation

The devices used in the testing process is a personal computers with the following hardware specifications Processor Intel(R) Core(TM) i3-6006U CPU @ 2.00GHz, RAM 8 GB DDR4, Storage 254 GB SSD and software specification operating sytem windows 10, 64 bit, teks editor visual studio code

4. Result and Discussion

The following is a comparison of the results of recommendations from decision support systems and the results of ranking prospective employees from companies with the same criterion weight score of 1, 2, 3 and criterion 4 weight which is slightly more important than the other criteria, as well as the value of confidence in the ranking.

Table 3. Ranking Comparison Results Between Systems and Companies

No.	Name	C1	C2	C3	C4	System Calculations	Company Calculations	Compatibility
1	A15	90	85	80	80	1	1	T
2	A12	95	80	80	78	2	2	T
3	A36	88	80	75	78	3	4	T
4	A24	85	80	80	78	4	3	T
5	A01	87	80	70	78	5	9	T
6	A23	90	70	80	80	6	5	T
7	A49	85	75	75	78	7	12	T
8	A69	84	80	75	76	8	10	T
9	A18	90	75	75	76	9	7	T
10	A22	90	80	75	74	10	6	T
11	A04	75	75	80	78	11	16	T
12	A27	90	75	70	76	12	13	T
13	A34	74	80	70	78	13	22	T
14	A57	76	75	80	76	14	19	T
15	A05	73	75	75	78	15	24	T
16	A47	83	75	70	76	16	21	T
17	A65	89	75	75	74	17	13	T
18	A59	86	80	70	74	18	14	T
19	A14	90	70	80	74	19	11	T
20	A70	74	75	75	76	20	27	T
21	A02	90	75	70	74	21	15	T
22	A40	89	75	70	74	22	17	T
23	A30	72	85	75	74	23	20	T
24	A61	89	75	80	72	24	8	T
25	A16	76	80	70	74	25	25	T
26	A33	75	75	75	74	26	28	T
27	A45	74	75	75	74	27	31	T
28	A35	88	70	70	74	28	23	T
29	A64	76	70	75	74	29	33	T
30	A66	72	70	70	76	30	39	F
31	A60	73	75	70	74	31	37	F
32	A26	87	70	60	76	32	35	F
33	A55	79	70	70	74	33	36	T
34	A52	90	60	70	76	34	32	F
35	A50	72	75	75	72	35	34	T
36	A06	86	70	70	72	36	29	T
37	A13	72	70	70	74	37	40	T
38	A32	84	65	70	72	38	38	T
39	A42	81	60	70	74	39	42	T
40	A41	88	70	70	70	40	30	T
41	A29	90	65	75	70	41	26	T
42	A58	77	70	60	72	42	44	T
43	A38	76	70	65	70	43	43	T
44	A43	81	55	65	74	44	47	T

45	A17	88	55	60	74	45	45	T
46	A20	85	60	70	70	46	41	T
47	A48	71	60	60	74	47	52	T
48	A62	76	65	65	70	48	46	T
49	A63	84	50	60	74	49	50	T
50	A10	81	65	50	72	50	49	T
51	A31	84	50	65	72	51	48	T
52	A19	76	60	55	72	52	53	T
53	A07	75	55	60	72	53	55	T
54	A21	73	55	65	70	54	54	T
55	A11	82	45	60	72	55	58	T
56	A28	73	50	65	70	56	59	T
57	A44	72	60	55	70	57	60	T
58	A46	72	65	55	68	58	56	T
59	A53	85	60	45	70	59	57	T
60	A08	72	55	55	70	60	60	T
61	A03	73	40	60	70	61	63	T
62	A54	90	50	60	66	62	51	T
63	A25	77	50	55	68	63	62	T
64	A67	73	50	45	70	64	66	T
65	A51	85	45	45	68	65	64	T
66	A56	78	45	45	68	66	68	T
67	A37	72	50	40	68	67	70	T
68	A39	72	55	45	66	68	65	T
69	A68	78	50	50	60	69	67	T
70	A09	72	50	50	60	70	69	T

From the table above, there are 66 true values and 4 false values. Of the 70 employees, 36 employees with the highest rank were selected. A comparison graph of the ranking of selected employees between the system and the company can be seen in Fig. 2.

Fig. 2. Selected employee test results

From Fig.2. It can be seen that the true value is 34, which is said to be true if the condition of the ranking of the system is the same as the ranking of the company, which means that the system

has succeeded in ranking and is in accordance with the results of the ranking carried out by the company. Meanwhile, the ranking which has a false value is 2, which means that the system is not successful in ranking so that the results of the ranking by the decision support system are wrong or not in accordance with the results of the company. With the number of correct test data of 34 out of a total of 36 selected employees, an accuracy value of 94.4% was obtained.

5. Conclusion and Recommendation

Based on the research process that has been carried out as well as the test results and the process of analyzing the test data, it can be concluded as follows Website of the decision support system for the selection of new employees can be built using the AHP and TOPSIS. AHP method used to compare the level of importance of each criterion and TOPSIS is used for ranking, this method has been implemented and has been used at PT Hutama Jaya Perkasa and the level of accuracy in the results of applying the AHP and TOPSIS methods in selection of new employee acceptance at PT Hutama Jaya Perkasa with using 70 data is 94.4%.

Improvements are still needed to obtain better results so the authors provide the following points for consideration in the development of further research, including decision support system for selecting the acceptance of this new employee candidate can be develop again, because in this system it can only be processing with 4 criteria and to solve multi-criteria problems, you can not only use the AHP and TOPSIS methods, compare them with other methods to support more effective decisions.

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