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Comparison of Multi-Criteria Decision Support Methods (AHP, TOPSIS, SAW & PROMENTHEE) for Employee Placement

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Abstract. The right decision in placing employees in an appropriate position in a company will support the quality of management and will have an impact on improving the quality of human resources of the company. Such decision-making can be assisted by an approach through the Decision Support System (DSS) to improve accuracy in the employee placement process. The purpose of this paper is to compare the four methods of Multi Criteria Decision Making (MCDM), ie Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW), Analytic Hierarchy Process (AHP) and Preference Ranking Organization Method for Enrichment Of Evaluations (PROMETHEE) for the application of employee placement in accordance with predetermined criteria. The ranking results and the accuracy level obtained from each method are different depending on the different scaling and weighting processes in each method.

1. Introduction

Placing Human Resources (HR) based on the competence that it has ensures for a company to get quality human resources [1]. The process of placing human resources in accordance with their qualifications is a complicated thing and can be a benchmark for good or bad management on the company because HR itself is one of the constituent elements in a management [2]. One of the reasons for the complexity of the HR placement process is the subjectivity of the management. The use of the Decision Support System (DSS) in assisting the admissions process, the DSS is used to provide recommendations when there are many applicants by ranking and recommending the most eligible candidates.

The method that can be used in placement is Multiple Criteria Decision Making (MCDM), MCDM is used to perform assessment or selection of several alternatives in limited quantities or it can be said to select the best alternative from a number of alternatives [3]. MCDM works on the basis of certain criteria that must be determined by the company to recruit prospective employees [1]. Some examples of MCDM are Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW), Analytic Hierarchy Process (AHP) and Preference Ranking Organization METHod for Enrichment of Evaluations (PROMETHEE) [4].

Sontakke [5] uses the Ideal Solution Technique (TOPSIS) in the process of evaluation air conditioner manufacture, the evaluation of vendor considering both quantitative and quality to examine their performance then make a ranking from it. It uses cost, quality, service as well as reliability attributes. The result from its process is used as future decision making. Afshari et al [7] uses MCDM for employee selection where the results prove that the use of MCDM in this case SAW which results can improve the process of selecting employees and measuring subjectivity.



In this study a comparison between the methods Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW), Analytic Hierarchy Process (AHP) and Preference Ranking Organization Method for Enrichment of Evaluations (PROMETHEE). To determine the accuracy of each method for employee placement.

2. Selection of Multi-Criteria Decision-Making (MCDM) Methods

MCDM methods that are compared in this paper are Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW), Analytic Hierarchy Process (AHP) and Preference Ranking Organization Method for Enrichment of Evaluations (PROMETHEE). Where the data used is employee placement data that has criteria that is knowledge, skill, ability, physical condition and attitude, where the weight of each criteria as shown in table 1.

TABLE I
WEIGHT VALUE OF EACH CRITERIA

Criteria	Weight
Knowledge	Medium
Skill	High
Ability	High
Physical	High
Attitude	Medium

2.1 Analytic Hierarchy Process (AHP)

This AHP method helps solve complex problems with the structure of a hierarchy of criteria, stakeholders, outcomes and by drawing considerations for developing weights or priorities. It also combines the strengths of feelings and logic concerned on various issues, then synthesizes diverse considerations into results that match our expectations intuitively. The structure of an AHP model is a model of an inverted tree. There is a single purpose at the top of the tree that represents the purpose of the problem of decision making. A hundred percent decision weight is at this point. Just below the goal is a leaf point indicating the criteria, both qualitative and quantitative. Goal Weight should be divided between rating points based on rating. [4]

2.2 Simple Additive Weighting (SAW)

Simple Additive Weighting (SAW) is a weighted sum method. The basic concept of the SAW method is to search for the weighted sums obtained from the performance ratings of each alternative on all criteria [8]. In the SAW method it is necessary to process the normalization of the decision matrix into a scale comparable to all alternatives. In SAW method there are 2 (two) attributes that are benefit and cost criteria. The steps are:

Determine the alternatives

Define the criteria that will be used as a reference in decision making.

Provides an alternative match rating rating on each criteria.

Determine the weight of the preferences or importance of each criterion.

Create a match rating table of each alternative on each criteria.

Create a decision matrix formed from the match rating table of each alternative on each criterion.

Perform normalized decision matrix by calculating the value of the performance of the normalized performance which will form a normalized matrix.

The end result of the preference value is derived from the sum of the matrix elements of the normalized matrix element with the corresponding preference weight of the matrix column. [6]

2.3 Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)

TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) is one of the multicriteria decision-making methods introduced by Hwang and Yoon. The principle used TOPSIS is the chosen alternative must have the closest distance from the ideal ideal solution and furthest from the ideal ideal solution from a geometric point of view using the Euclidean distance to determine the relative proximity of an alternative with the optimal solution. The positive ideal solution (A+) is defined as the sum of all the best attainable values for each attribute, while the ideal ideal solution (A-) consists of all the worst values achieved for each attribute [6].

TOPSIS considers both, the distance to the ideal ideal solution (S_i^+) and the distance to the ideal ideal solution (S_i^-) by taking the proximity relative to the positive ideal solution. Based on a comparison of the relative distance, an alternative priority arrangement (A_i) can be achieved. This method is used to solve practical decision-making problems. Because the concept is simple and easy to understand, computing is efficient, and has the ability to measure the relative performance of decision alternatives.

2.4 Preference Ranking Organization Method for Enrichment of Evaluations (PROMETHEE)

Promethee is one method of determining the order or priority in MCDM (Multi Criterion Decision Making). The alleged predominance of criteria used in promethees is the use of value in outranking relationships. The use of promethee is to determine and produce decisions from several alternatives. The key issues are simplicity, clarity and stability. Promethee serves to process data, both quantitative and qualitative data at once. Where all the data are combined into one with the weight of scores that have been obtained through the assessment or survey [8].

3. Result

In this research, data used as much as sixty data prospective new employee where the result of ranking which resulted from four method compared with result of recommendation from expert in this case management to get level of accuracy of each - each method. The results of comparison of AHP, SAW, TOPSIS and PROMENTHEE methods are shown in Table 2

TABLE II
A RANKING COMPARISON BETWEEN AHP, SAW, TOPSIS AND PROMENTHEE METHODS WITH EXPERTS

Ranking	AHP	SAW	TOPSIS	PROMENTHEE	EXPERT
1	X19	X19	X19	X19	X19
2	X49	X49	X49	X49	X49
3	X59 *	X53	X53	X53	X53
4	X42	X42	X42	X42	X42
5	X47	X47	X47	X47	X47
6	X45 *	X4	X4	X4	X4
7	X38 *	X59	X59	X59	X59
8	X53 *	X14	X14	X14	X14
9	X12	X38	X38	X38	X38
10	X24	X13 *	X57	X57	X57
11	X4	X27	X27	X27	X27
12	X25	X25	X13	X13	X13
13	X57	X45	X45	X45	X45
14	X14	X48	X50	X12	X50
15	X28	X12	X48	X50	X48
16	X27	X24	X12	X48	X12
17	X5	X57	X24	X24	X24
18	X13 *	X50 *	X25	X25	X25
19	X44 *	X3	X28	X28	X28
20	X15	X6	X6	X6	X6
21	X33	X33	X33	X33	X33
22	X48 *	X1	X1	X1	X1
23	X50 *	X34	X34	X34	X34
24	X35	X28 *	X35	X35	X35
25	X26 *	X16	X16	X16	X16
26	X32 *	X23 *	X26	X26	X26
27	X6 *	X5	X5	X5	X5
28	X23 *	X54	X54	X54	X54
29	X31 *	X15	X15	X15	X15
30	X2 *	X51	X51	X51	X51
31	X34 *	X21	X21	X21	X21
32	X16 *	X52 *	X3	X3	X3

33	X1 *	X32	X32	X32	X32
34	X54 *	X31	X31	X31	X31
35	X21 *	X35 *	X23	X23	X23
36	X3 *	X26 *	X40	X40	X40
37	X17	X17	X17	X17	X17
38	X51 *	X40 *	X44	X44	X44
39	X41	X41	X41	X41	X41
40	X40 *	X9 *	X52 *	X7 *	X52
41	X8 *	X2	X2	X2	X2
42	X46	X46	X46	X9 *	X46
43	X9 *	X8	X7 *	X8	X8
44	X7	X7	X8 *	X52 *	X7
45	X52 *	X44 *	X9	X46 *	X9
46	X56 *	X20	X20	X20	X20
47	X58	X58	X58	X58	X58
48	X37 *	X30	X30	X30	X30
49	X55	X55	X55	X55	X55
50	X20 *	X10 *	X10	X10	X10
51	X11	X11	X11	X11	X11
52	X39	X39	X39	X39	X39
53	X36	X56	X56	X56	X56
54	X10 *	X37	X37	X37	X37
55	X18	X18	X18	X18	X18
56	X30 *	X36	X36	X36	X36
57	X22	X22	X22	X22	X22
58	X43	X43	X43	X43	X43
59	X29	X29	X29	X29	X29
60	X60	X60	X60	60	X60

Based on the results shown by Table 2, the difference in rankings between the AHP, SAW, TOPSIS and PROMENTHEE methods with the ranking resulted by the expert. So by using the formula

$$\text{Prosentase} = \frac{\text{Jumlah Ketepatan}}{\text{Jumlah Data}} \times 100\% \dots \dots \dots [1]$$

The accuracy of the AHP method is obtained

$$\text{Prosentase} = \frac{30}{60} \times 100\% = 50\%$$

The accuracy of the SAW method is

$$\text{Prosentase} = \frac{49}{60} \times 100\% = 81.67\%$$

The level of accuracy of the TOPSIS method is

$$\text{Prosentase} = \frac{57}{60} \times 100\% = 95\%$$

The accuracy of the PROMENTHEE method is

$$\text{Prosentase} = \frac{56}{60} \times 100\% = 93.34\%$$

Based on experiments conducted on 60 datasets for employee placement with AHP, SAW, TOPSIS and PROMENTHEE methods, obtained different accuracy levels of each method in terms of ranking employees. In terms of accuracy, TOPSIS method has the highest accuracy of 95% followed by PROMENTHEE of 93.34% and TOPSIS 81.67% and last AHP of 50%. Regardless of the level of accuracy, the four methods show a not too different result on the ranking of 10 prospective employees to be accepted. TOPSIS and PROMENTHEE produce the same rank recommended by experts. SAW there is 1 difference, whereas in AHP there are 4 differences. In the case tested, AHP that widely used, but if there are many criteria will reduce its accuracy. While SAW has a slightly better accuracy than AHP, TOPSIS tends to be superior so it can be one of the best choices for cases with many criteria.

While PROMENTHEE can be an alternative to TOPSIS because of its accuracy and ability to handle cases with many criteria.

4. Conclusion

From ranking comparison experiments for employee placement with AHP, SAW, TOPSIS and PROMENTHEE methods, different accuracies for each method are obtained. TOPSIS method has the highest accuracy of 95% followed by PROMENTHEE of 93.34% and TOPSIS 81.67% and last AHP of 50%. Regardless of the different levels of accuracy the four methods show the results that are not too different in the ranking of the top 10 prospective employees to be received, TOPSIS and PROMENTHEE produce the same rank recommended by experts, SAW there is 1 difference whereas in the AHP there are 4 differences. In the case of AHP tested even though applied a lot but if too many criteria will reduce the level of AHP accuracy, while SAW has a slightly better accuracy than AHP. TOPSIS tends to be superior so it can be one of the right choices if there are many criteria. While PROMENTHEE can be alternative in addition to TOPSIS because of its accuracy and ability to handle many criteria.

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