

Decision Support Systems for Employee Performance Assessment

Darius Shyafary¹, Wahyuni Eka Sari², Dwi Cahyadi¹ and Rony H.¹

¹*Department of Design, Politeknik Negeri Samarinda, Samarinda, Indonesia*

²*Department of Information Technology, Politeknik Negeri Samarinda, Samarinda, Indonesia*

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Abstract: Quality employees are an essential resource in a company. Employees who have qualification standards that match the company's profile cause company productivity increased. PT. Pertamina (Persero) is one of the state companies that manage the oil and gas sector in Indonesia, which maintains the quality of its employees. PT. Pertamina always considers discipline, health, safety, and employee performance. Employee Performance Assessment is needed to maintain the quality and profile of the company. Employee performance assessment using the decision support systems method is Simple Additive Weighting (SAW) and Profile Matching (PM) can be suitable for assessing employees. It can reduce errors in determining the best employees and obtain a fair decision. In this study, a comparison between SAW and PM was built to find the best method. The SAW and PM methods were chosen because they are not complicated in calculations and are suitable for small data. The results showed that the accuracy of PM was 73% compared to SAW was 46%.

1 INTRODUCTION

Business industries are faced with changing dynamics to compete with technological advances. Creating organizational excellence in the company through employee development is one of the best steps to deal with today (Chiu et al., 2021) (Bezdrob & Šunje, 2021) (Lei et al., 2021). Employees who have standards following the company's qualifications, the company's productivity will indeed be maintained and increase. Employee performance assessment is one of the most efficient development, motivation, and evaluation methods in a company. A performance assessment system is used to measure the effectiveness and efficiency of employees (Islami et al., 2018).

PT Pertamina is one of the state companies with an important sector, managing oil and gas in Indonesia. Discipline, Health, safety, and Performance of employees are always be prioritized in PT. Pertamina. An employee performance assessment needs to upgrade and maintain the quality and profile of the company. In order to support this, it is necessary to evaluate the quality of employees by using a decision support system. Employee performance assessment is a human resource management activity in a company which is an essential point in terms of the sustainability of a company.

One of the leading values of PT. Pertamina is "Capable," which means it is managed by professional, skilled, and highly qualified leaders and workers and is committed to building research and development capabilities. Employees with these criteria can improve the quality of the company that must be appropriately managed. Human Resources management is a determining aspect of the company's success. Employee performance assessment is collected subjectively. The problem for companies in selecting the best employees is in the subjective and manual assessment. Companies are challenging to determine the employees with a good qualification in a measurable. So this problem can be solved by building a Decision Support System (Komsiyah et al., 2019).

The simple Additive Weighting (SAW) method and Profile Matching were used in this study. The SAW method was chosen because it is able to select the best alternative based on the specified criteria (Roszkowska & Kacprzak, 2016). Research using the SAW method includes determining the best ambulance location (Abdullah et al., 2018) and the best cornfield location (Sayedmohammadi et al., 2018). The Profile Matching method is the most appropriate method used in the process of comparing individual competencies into the competencies of a position so that differences in competencies can be known. The initial process is carried out by determining the aspects and sub-aspects, as well as

finding the weight value for each sub-aspect, looking for the gap between the profile and data from the employee (Rahim, 2017) (Atmanegara et al., 2017). Several studies with profile matching are for the position placement of employees (Dhammayanti et al., 2019), selection of new employees (Sunarti et al., 2017), and employee performance assessment (Safrizal et al., 2019)

2 THEORETICAL REVIEW

In this study, two methods are used. Simple Additive Weighting (SAW) and Profile Matching (PM). There are eight steps calculating for the SAW method and seven steps for the Profile Matching method.

2.1 Simple Additive Weighting (SAW)

The step by step SAW (Abdullah et al., 2018) method calculating are:

1. Determine alternatives.
2. Determine the criteria that will be used as a reference in making decisions.
3. Converting alternative values into the value of the match rating on each criterion.
4. Determine the weight of preference or level of importance (W) of each criterion $W=[W_1 W_2 W_3 \dots W_j]$
5. Make a decision matrix X which is formed from the suitability rating table of each alternative on each criterion.
6. Normalize the decision matrix by calculating the value of the normalized performance rating r_{ij} from alternative A_i on criteria C_j .

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\max_i(x_{ij})} & \text{if } j \text{ is benefit} \\ \frac{\min_i(x_{ij})}{x_{ij}} & \text{if } j \text{ is cost} \end{cases} \quad (1)$$

7. The results of the normalized performance rating form a normalized matrix (R)

$$R = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1j} \\ r_{i1} & r_{i2} & \dots & r_{ij} \end{bmatrix} \quad (2)$$

The final result of the preference value is obtained from the sum of the normalized matrix row elements (R) with the preference weights (W) corresponding to the matrix column elements (W). The results of the calculation if the Preference value of the larger alternative identifies that the alternative is the best alternative.

2.2 Profile Matching

Profile matching started with defining the minimum value for each assessment variable. The difference between each test data value against the minimum value of each variable is a gap. Then the gap is weighted. The weight of each variable will be calculated on average based on the Core Factor (CF) and Secondary Factor (SF) variable groups. The composition of CF plus SF is 100%, depending on the interests of the user of this method. The last stage of this method is accumulating CF and SF values based on the values of the testing data variables (Dhammayanti et al., 2019), (Tharo & Utama Siahaan, 2016). The smaller the gap produced by the weight of significant value, the greater opportunity for employees was occupying these positions (Sunarti et al., 2017). The competency assessment system will describe the achievements and potential of human resources by their work units. Employee achievement and competence can be a measure of employee success in completing work.

The weighting of the Profile Matching method is a definite value that is firm on a certain value because the existing values are members of the crisp set. In a crisp set, the membership of an element in the set is stated explicitly, whether the object is a member of the set or not, by using a characteristic function.

The steps for the profile matching method are:

1. Determine the required data variables.
2. Determine the aspects used for the assessment.
3. Gap profile mapping.

With the formula:

$$Gap = \text{Criteria aspect value} - \text{Target value} \quad (3)$$

4. After obtaining the Gap value, then the weight is given to each Gap value.
5. Calculation and grouping of Core Factor and Secondary Factor. After determining the weight of the gap value, then they are grouped into two groups, namely:
 - Core Factor, which is the most important or prominent or most needed criteria (competence) by an assessment that is expected to obtain optimal results.

$$NCF = \frac{\sum NC}{\sum IC} \quad (4)$$

Information:

NFC : Average core factor

NC : Total value of core factor

IC : Number of the items core factor

- Secondary Factors (Supporting Factors) are items other than aspects that exist in the

core factor. To calculate the secondary factor, the formula is used.

$$NSF = \frac{\sum NS}{\sum IS} \quad (5)$$

Information:

NFS : Average secondary factor

NS : Total value of secondary factor

IS : Number of secondary factor items

6. Calculation of Total Value. Total value is obtained from the percentage of core factors and secondary factors that are estimated to affect the results of each profile.

$$N = (x) \% NCF + (x) \% NSF \quad (6)$$

Information:

N : Total score of criteria

NFS : Average secondary factor

NFC : Average core factor

(x) % : Entered percent value

7. Calculation of ranking determination. The final result of the profile matching process is ranking. Determination of ranking refers to the results of certain calculations.

$$Ranking = (x) \% NMA + (x) \% NSA \quad (7)$$

Information:

NMA : Total score of Main Aspect criteria

NSA : Total score of Supporting Aspect criteria

(x) % : Entered percent value.

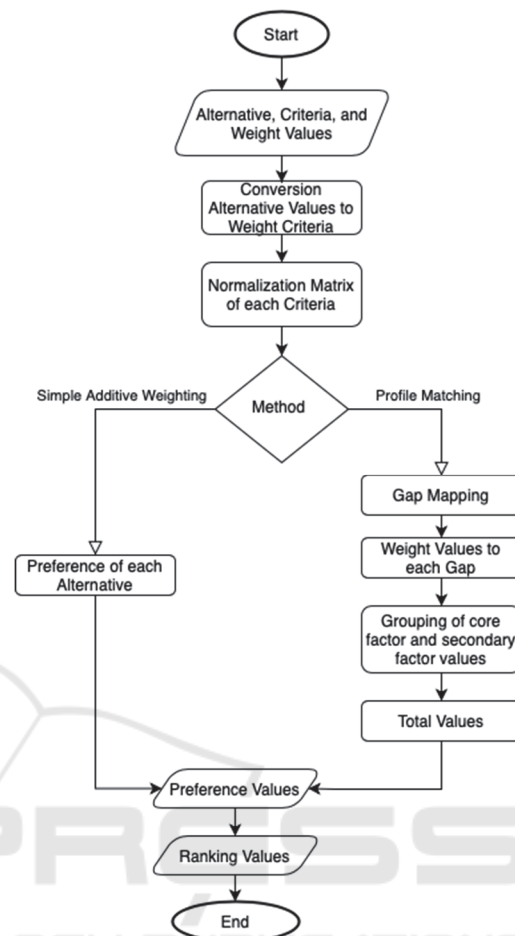


Figure 1: Design Method.

3 METHODOLOGY

Section 3 describes the design of the proposed method and the steps to be completed. There are 4 criteria that influence employee performance assessment. The alternatives used in the study were 15 employees.

3.1 Design Method

The study was designed to compare the output of the use of the SAW and PM methods. It is measured based on the results of alternative rankings. In the SAW and PM methods, the criteria, alternatives, and initial weights are prepared in advance, and then all are presented in the form of a normalized matrix. Furthermore, the normalized matrix can be processed using SAW and PM methods. The design method of this study is presented in Figure 1.

3.2 Criteria

In Table 1, the weight value of the criteria is based on guidelines from the HRD of PT. Pertamina. The greatest weight to the criteria of job security. The lowest value weight is for the active criteria. In Table 2, the assessment uses a Likert scale between 1 – 5 for each choice. Safety criteria are compliance in applying Safety operational standards during work. Performance criteria are the ability of employees to carry out their duties and awards achieved. Achievement can be measured from discipline, problem-solving ability, and the resulting product for the company. Health criteria are the health condition of employees for a certain period. Health conditions include regular medical check-ups. Participation criteria are the activeness of employees in responding to a problem. Participation includes roles in discussions, obeying orders from higher management, and cooperating with the team.

Table 1: Alternative.

No	Name	Department	Position	Safety	Performance	Health	Participation
1	SR	Equipment Overhaul	Section Head EO	Good	Poor	Good	Fair
2	IS	MA 3	Supervisor Instrument	Good	Fair	Poor	Fair
3	ABW	HSC	Shift Supervisor Distill	Good	Fair	Fair	Poor
4	AI	Workshop	Section Head Workshop	Fair	Good	Poor	Fair
5	NH	HC Business Partner	Officer II HC Business Partner	Fair	Good	Poor	Fair
6	BD	Marine Region VI	Assistance Manager Plan	Fair	Good	Poor	Good
7	LK	Marine Region VI	Officer PQC	Fair	Good	Fair	Poor
8	DW	Project Engineering	Sr Supervisor Cost. Eng	Good	Good	Fair	Poor
9	SH	Laboratory	Supervisor Quality', N'Eng	Fair	Poor	Fair	Fair
10	YM	Laboratory	Shift Supervisor CONAL Gas', N'Eng	Fair	Fair	Fair	Fair
11	KM	Laboratory	Shift Supervisor CONAL Gas	Fair	Good	Good	Fair
12	IS	Dis & Wax	Section Head Dis & Wax	Fair	Fair	Good	Good
13	DEP	General Maintenance	Supervisor Elect & Inst	Excellent	Good	Fair	Good
14	BK	Oil Movement	Shift Supervisor North Tank Farm	Fair	Good	Good	Good
15	AF	Dis & Wax	Sr Supervisor EWTP/DHP	Good	Good	Fair	Fair

Table 2: Criteria.

Criteria	Weight	Type	Scale	Values
Safety	0,3	Benefit	Excellent	5
			Good	4
			Fair	3
			Poor	2
			Very poor	1
Performance	0,25	Benefit	Excellent	5
			Good	4
			Fair	3
			Poor	2
			Very poor	1
Health	0,25	Benefit	Excellent	5
			Good	4
			Fair	3
			Poor	2
			Very poor	1
Participation	0,2	Benefit	Excellent	5
			Good	4
			Fair	3
			Poor	2
			Very poor	1

3.3 Alternative

The alternative used is permanent employees at PT Pertamina RU V Balikpapan. In this study, fifteen alternative data were used. Alternative data are presented in Table 2. Employee assessment is carried out on employees with a tenure of more than five years and a minimum position of Officer Head.

4 RESULT AND DISCUSSION

Section 4 contains the steps of the calculation Profile Matching, SAW, and data testing. The selected test is to calculate the accuracy of the method compared with the selection results manually.

4.1 Simple Additive Weighting

The criteria and alternative data have been defined based on Tables 1 and 2, so the next step is to normalize the matrix. The step is to calculate the value of the normalized performance rating r_{ij} from the alternative A_i on the criteria C_j . If it is a benefit criterion, then the value of x_{ij} is divided by the value of $\text{Max } x_{ij}$ from each column, while the criteria are

cost, the Min value of x_{ij} from each column is divided by the value of x_{ij} .

Table 3: Normalization Matrix.

Alt	Criteria			
	Safety	Performance	Health	Participation
SR	0.80	0.50	1.00	0.75
IS	0.80	0.75	0.50	0.75
ABW	0.80	0.75	0.75	0.50
AI	0.60	1.00	0.50	0.75
NH	0.60	1.00	0.50	0.75
BD	0.60	1.00	0.50	1.00
LK	0.60	1.00	0.75	0.50
DW	0.80	1.00	0.75	0.50
SH	0.60	0.50	0.75	0.75
YM	0.60	0.75	0.75	0.75
KM	0.60	1.00	0.50	0.75
IS	0.60	0.75	1.00	1.00
DEP	1.00	1.00	0.75	1.00
BK	0.60	1.00	1.00	1.00
AF	0.80	1.00	0.75	0.75

The normalized matrix based on Table 3 is multiplied by the weight criteria in Table 1 to get the preference value. Furthermore, the final result or the total preference value is obtained from the sum of the normalized matrix row elements (R) and the weights. The following Table 4 is the total preference value and the ranking order based on the largest preference value for each alternative.

Table 4: Preferences Value of Alternative.

No	Alternative	Preference Value	Rank
1	SR	0.770	6
2	IS	0.700	14
3	ABW	0.720	9
4	AI	0.712	12
5	NH	0.714	11
6	BD	0.760	7
7	LK	0.722	8
8	DW	0.780	5
9	SH	0.640	15
10	YM	0.710	13
11	KM	0.715	10
12	IS	0.820	4
13	DEP	0.940	1
14	BK	0.880	2
15	AF	0.830	3

In Table 4, preference values based on the calculation of the Simple Additive Weighting method shown that Alternative 13 is ranked 1 with a value of 0.94, Alternative 14 is ranked 2 with a value of 0.88, and Alternative 15 is ranked 3 with a value of 0.83, and the following ranking with the preference value of each employee.

4.2 Profile Matching

In the employee performance assessment calculation using the profile matching method, the assessment criteria are first defined. Assessment criteria contain information about each variable's weight and type of factor for each variable—the following Table 5 shows information about the criteria.

Table 5: Assessment Criteria.

Criteria	Weight	Type	
C1	Safety	30%	Core Factor
C2	Performance	45%	Core Factor
C3	Health	45%	Secondary Factor
C4	Participation	20%	Secondary Factor

There are two variables as core factors are Safety and Performance. Two other variables as secondary factors are Health and Participation. The weights for each criterion have been presented in Table 5. The Competency Standards used are 5 for Safety, 4 for Performance, 4 for Health, 4 for Participation. Aspects of the assessment criteria are defined as Very Good equal to 5, Good equal to 4, Neutral equal to 3, Poor equal to 2, Very Poor equal to 1. The following in Table 6 describes the aspects of employee assessment

Table 6: Aspects of Employee Assessment.

Alt	Safety (C1)	Performance (C2)	Health (C3)	Participation (C4)
SR	4	2	4	3
IS	4	3	2	3
ABW	4	3	3	2
AI	3	4	2	3
NH	3	4	2	3
BD	3	4	2	4
LK	3	4	3	2
DW	4	4	3	2
SH	3	2	3	3
YM	3	3	3	3
KM	3	4	2	3
IS	3	3	4	4
DEP	5	4	3	4
BK	3	4	4	4
AF	4	4	3	3

Based on the data on the aspect of the criterion value, it can be seen that the ideal criterion is the Gap value. The gap value is obtained from the standard competency value, subtracted from each value aspect, then the calculation of the gap value will be obtained as shown in Table 7. The step to calculate the GAP value is the standard competency value reduced by the value of each criterion. For example, the alternative SR has a GAP value of -1. This is because SR has a safety value of 4-5, so that a value of -1 is

obtained. GAP calculations were carried out for all alternatives against 4 criteria.

Table 7: Gap Value.

Alt	Safety (K1)	Performance (K2)	Health (k3)	Participation (K4)
SR	4	2	4	3
IS	4	3	2	3
ABW	4	3	3	2
AI	3	4	2	3
NH	3	4	2	3
BD	3	4	2	4
LK	3	4	3	2
DW	4	4	3	2
SH	3	2	3	3
YM	3	3	3	3
KM	3	4	2	3
IS	3	3	4	4
DEP	5	4	3	4
BK	3	4	4	4
AF	4	4	3	3
Competency Standard	5	4	4	4
SR	-1	-2	0	-1
IS	-1	-1	-2	-1
ABW	-1	-1	-1	-2
AI	-2	0	-2	-1
NH	-2	0	-2	-1
BD	-2	0	-2	0
LK	-2	0	-1	-2
DW	-1	0	-1	-2
SH	-2	-2	-1	-1
YM	-2	-1	-1	-1
KM	-2	0	-2	-1
IS	-2	-1	0	0
DEP	0	0	-1	0
BK	-2	0	0	0
AF	-1	0	-1	-1

After obtaining the Gap value for each criterion, each employee's profile is assigned a weight value by matching the Gap. The weight value based on PM Method as shown as in Table 8.

Table 8: Weight Value for Gap.

No	Gap	Weight
1	4	5
2	3	4,5
3	2	4
4	1	3,5
5	0	3
6	-1	2,5
7	-2	2
8	-3	1,5
9	-4	1

The weight value based on the gap has been obtained based on the guidelines from Table 8 (Dhammayanti et al., 2019). The next step is to

calculate the NCF and NSF values. NCF and NSF calculation steps are based on formulas 4 and 5. Gap values for all alternatives are based on Table 7. The results of NCF and NSF calculations can be seen in Table 9.

Table 9: NCF and NSF Value.

Alternative	NCF	NSF
SR	2,25	2,75
IS	2,5	2,25
ABW	2,5	2,25
AI	2,5	2,25
NH	2,5	2,25
BD	2,5	2,5
LK	2,5	2,25
DW	2,75	2,25
SH	2	2,5
YM	2,25	2,5
KM	2,5	2,25
IS	2,25	3
DEP	3	2,75
BK	2,5	3
AF	2,75	2,5

NCF and NSF values are obtained for each alternative. The next step is to calculate the total value. The results of calculating the total weight and ranking for the Profile Matching method are presented in Table 10. The formula to calculate the total value is based on Formula 6, and to get the ranking value is based on Formula 7.

Table 10: Total Value and Rank.

Alternative	Total	Rank
SR	2,4750	7
IS	2,3871	10
ABW	2,3873	9
AI	2,3870	11
NH	2,3869	12
BD	2,5000	6
LK	2,3866	13
DW	2,5250	5
SH	2,2250	15
YM	2,3625	14
KM	2,3875	8
IS	2,5875	4
DEP	2,8875	1
BK	2,7250	2
AF	2,6375	3

Based on the calculation of the Profile Matching method, it was found that Alternative 13 was ranked 1 with a total value is 2.8875, Alternative 14 was ranked 2 with a total value is 2.725, and Alternative 15 was ranked 3 with a total value is 2.6375, as well as other rankings with a value of each employee. The

highest-ranking is based on the most significant total value. All data can be seen in Table 10.

4.3 Discussion

The accuracy between the SAW and PM methods is influenced by many factors. It can be caused by the conversion of scale values which can affect the difference in the ranking results and the far accuracy results between the two methods. The completion stage in PM is more effectively used in terms of determining the best employees at PT Pertamina RU V Balikpapan, compared to SAW. This can be seen from the results of testing the method with data in the field. The accuracy value of the PM method is higher than the SAW method. In some conditions that require accuracy of results, it is necessary to focus on the final total score obtained, not only focus on ranking. In more significant cases, other methods or algorithms can be used so that the input value can match the real conditions.

Table 11: Results of SAW and PM Method.

Alt	Results		
	Manual	SAW	PM
SR	7	6	7
IS	10	14	10
ABW	9	9	9
AI	8	12	11
NH	13	11	12
BD	6	7	6
LK	12	8	13
DW	5	5	5
SH	15	15	15
YM	14	13	14
KM	11	10	8
IS	4	4	4
DEP	1	1	1
BK	2	2	2
AF	3	3	3

The accuracy is made by comparing the calculation of manual data with the proposed method. SAW method obtained conformity with the manual data is 7 data. In contrast to SAW, for the PM method, the similarity with the original data is 11 data. Based on the similarity of data, the accuracy of the SAW method is 46%, and PM is 73%. The test results are described in Table 11. The coloured line indicates that there is a discrepancy in the calculation results.

5 CONCLUSIONS

The decision support system was successfully designed to select the best employees at PT Pertamina RU V Balikpapan by applying the Simple Additive Weighting and Profile Matching methods. Based on the results of manual and system tests, the results show that the SAW ranking method provides an accuracy of 46% and the PM ranking method shows an accuracy of 73%. In the cases of the best employees at PT Pertamina RU V Balikpapan, the Profile Matching method is more effectively used because the method test provides a greater level of accuracy than the Simple Additive Weighting method. Providing criteria by combining methods and machine learning such as naive Bayes or fuzzy in the data analysis process so that the results obtained are more accurate. The decision support system is expected to be developed online so that employees can access the calculation results in a transparent assessment.

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