Determination of Exemplary Employees Using Simple Additive Weighting

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Abstract– A human resource is someone who is willing, and able to contribute to the business in order to achieve the goals of the organization or company. One of the most important factors of a company is human resources. The SAW (Simple Additive Weighting) method is also used to find the optimal alternative from a number of alternatives with certain criteria. The essence of SAW is to determine the weight value for each attribute, then proceed with a ranking process that will select the alternatives that have been given. The variables used in this study are attendance data, responsibility, social interaction, performance, personality, work discipline in each division where the employee works. The results obtained information that of the 24 employees who deserve to be exemplary employees are 23 employees with the highest score. So that the employee is declared worthy as an exemplary employee with a score of 75.

Keywords: Alternative, Employee, Performance, SAW, Exemplary

1. INTRODUCTION

A human resource is someone who is willing, and able to contribute to the business in order to achieve the goals of the organization or company. One of the most important factors of a company is human resources (HR). The director of human resources of a company greatly influences many aspects that determine the success of the company's work. If the human resources department can be well organized, it is expected that they can carry out all their business processes. This decision support system helps to rank individual employees, change criteria, and change weight values. The criteria in question are employee persistence, responsibility, social interaction, work discipline and employee personality. This is useful to help suggest decisions regarding the selection of exemplary employees each month[1]–[4].

In a decision support system there are goals that must be achieved, namely helping managers in making decisions to solve semi-structured problems, supporting managers' decisions instead of changing or replacing those decisions, and increasing manager effectiveness in decision making instead of increasing efficiency. The decision support system should include the three main components of the DBMS (database management system), MBMS (model base management system), and the user interface. The knowledge-based management subsystem is optional, but can provide many benefits due to the intelligence of the three main components. As in all management information systems, users can be considered as components of a decision support system [5]–[8].

The SAW method is one of the most frequently used methods of Multiple Attribute Decision Making (FMADM). This method is the basis of some FMADM methods such as AHP and PROMETHEE which calculate the final value of a given alternative. The SAW method is often also known as the weighted addition method [9]–[11]. Fuzzy Multiple Attribute Decision Making (FMADM) is a method used to find the optimal alternative from a number of alternatives with certain criteria. The essence of Multiple Attribute Decision Making (FMADM) is to determine the weight value for each attribute, then proceed with a ranking process that will select the alternatives that have been given[12]–[15].

The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all attributes. The basic concept of the Simple Additive Weighting (SAW) method is to find the weighted sum of the performance ratings for each alternative on all attributes. The Simple Additive Weighting (SAW) method requires the normalization process of the decision matrix (X) to a scale that can be compared with all existing alternative ratings. This method is the best known and most widely used method in dealing with Multiple Attribute Decision Making (MADM) situations[16]–[19]. MADM itself is a method used to find the optimal alternative from a number of alternatives with certain criteria. This Simple Additive Weighting (SAW) method requires the decision maker to determine the weight for each attribute. The total score for the alternatives is obtained by adding up all the multiplication results between ratings (which can be compared across attributes) and the weight of each attribute. The rating of each attribute must be dimension-free in the sense that it has passed the previous matrix normalization process [20]–[23].

The SAW (Simple Additive Weighting) method is also used to find the optimal alternative from a number of alternatives with certain criteria. The essence of SAW is to determine the weight value for each attribute, then proceed with a ranking process that will select the alternatives that have been given. Basically, there are 3 approaches to find the attribute weight value, namely the subjective approach, the objective approach and the integration approach between subjective & objective[24]–[26].

In determining the order of high-achieving exemplary employees, the subjectivity of decision makers often arises. To avoid this, the determination of exemplary employees can be done by using a model that can determine exemplary employees according to the criteria set by the organization or decision makers. One method that can be used is the SAW (Simple Additive Weighting) method. If the Simple Additive Weighting method is applied in determining exemplary employees, then this will be very helpful in recommending which employees are entitled to the title of exemplary employees. This study uses variables, namely attendance data, responsibility, social interaction, performance, personality, work discipline in each division where the employee works[27]–[30].

2. RESEARCH METHODS

2.1 Thinking Framework

Systems thinking framework is a main framework that can be used as an approach in solving a problem.

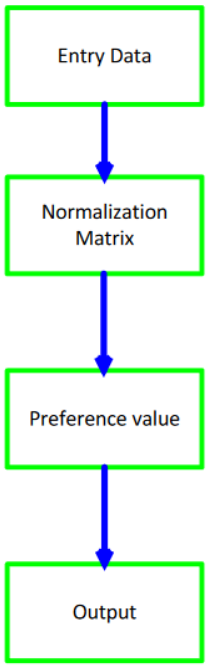

Figure 1. Thinking Framework

The framework for determining exemplary employees using simple additive weighting is as follows:

1. System users must enter the necessary data to run the exemplary employee determination system. These data are as follows:
   a. Criteria Data, Attributes, Weights
   b. Criteria Set Data, Value
   c. Employee data
2. The system then normalizes the matrix after the data is entered..
3. After that, the system makes a preference, which is multiplying the weight of the criteria by the matrix.
4. Then the preference value is obtained from the multiplication.
5. The output of the system is in the form of an achievement card that will be addressed to title holders as exemplary employees.

2.2 Simple Additive Weighting

The completion steps in using the SAW method are

1. Determine the alternative (candidate), namely Ai.

2. Determine the criteria that will be used as a reference in making decisions, namely Cj.
3. Provide a rating of the suitability of each alternative on each criterion.
4. Determine the weight of preference or level of importance (W) for each criterion. W = [W1, W2, W3, …. , Wj]
5. create a match rating table for each alternative on each criterion.
6. Make a decision matrix X which is formed from the suitability rating table of each alternative on each criterion. The x value of each alternative (Ai) on each criterion (Cj) that has been determined, where, i=1,2,…m andj=1,2,…n.

$$X=\begin{bmatrix} x11 & \cdots & xij \\ \vdots & \ddots & \vdots \\ xi1 & \dots & xij \end{bmatrix} \quad (1)$$

7. Normalize the decision matrix X by calculating the value of the normalized performance rating (rij) from alternative Ai on criteria Cj.

$$\mathbf{Rij} = \begin{cases} \dfrac{xij}{\text{Max i}(xij)} \\ jIf\ j\ is\ a\ benefit\ attribute(benefit) \\ \dfrac{\text{Min i}(xij)}{xij} \\ if\ j\ is\ a\ cost\ attribute\ (cost)) \end{cases} \quad (2)$$

8. The results of the normalized performance rating value (rij) form a normalized matrix (R)

$$R=\begin{bmatrix} x11 & \cdots & xij \\ \vdots & \ddots & \vdots \\ xi1 & \dots & xij \end{bmatrix} \quad (3)$$

9. The final result of the preference value (Vi) is obtained from the sum of the normalized matrix row elements (R) with the preference weights (W) corresponding to the matrix column elements (W)

$$Vi = \sum_{j=1}^{n} Wj\ Rij \quad (4)$$

10. The ranking is done by multiplying the SAW value by the Indication value and the final result of the value will be ranked according to the order of the results that have the largest value to the smallest

3. RESULTS AND DISCUSSIONS

The alternative given is the name of the employee, while the criteria in selecting employees are Attendance Attendance, Social Interaction, Performance, Personality, Discipline, Responsibilities which are taken into consideration.

3.1 Determination of Criteria Weight,

Determination of weight based on the size of the influence of the criteria on the decision alternatives. The greater the influence, the greater the weight and vice versa. The total weight for all criteria is one.

Table 1. Determination of Criteria and Weighted Data

Criteria	Information	Weight
W1	Attendance Attendance	5
W2	Social interactions	15
W3	Performance	30
W4	Personality	10
W5	Discipline	20
W6	Responsibility	20

3.2 Exemplary Employee Selection Test Data

The data processed in this study is employee data obtained from the company by taking a sample of 24 employees. The next employee assessment is as in table 1 below.

Table 2. Employee Data Assessment

ID	Name	Criteria					
		W1	W2	W3	W4	W5	W6
P001	Employee 1	1	2	3	4	3	1
P002	Employee 2	1	3	4	1	2	2
P003	Employee 3	0	4	2	2	3	3
P004	Employee 4	1	1	4	2	2	1
P005	Employee 5	1	2	3	1	3	4
P006	Employee 6	1	3	2	3	4	1
P007	Employee 7	0	2	4	2	2	3
P008	Employee 8	1	3	2	1	2	4
P009	Employee 9	0	3	4	2	1	3
P010	Employee 10	1	2	3	1	2	2
P011	Employee 11	0	2	1	2	3	3
P012	Employee 12	0	4	2	2	2	3
P013	Employee 13	1	2	1	3	3	3
P014	Employee 14	1	3	4	1	2	2
P015	Employee 15	0	3	3	3	2	4
P016	Employee 16	0	1	4	2	3	4
P017	Employee 17	1	2	2	2	4	2
P018	Employee 18	1	3	1	3	2	3
P019	Employee 19	1	1	2	3	2	2
P020	Employee 20	0	2	4	1	3	3
P021	Employee 21	1	3	2	3	1	2
P022	Employee 22	0	1	2	3	3	3
P023	Employee 23	1	2	4	1	2	4

3.3 Normalization Calculation

In the calculation using the SAW method, the initial step is to determine the criteria used in determining the best employees and the weight of each criterion. Next is to find the normalization value of the existing data.

Table 3. Normalization Calculation

R11	1	1
	MAX(1;1;0;1;1;1;0;1;0;1;0;0;1;1;0;0;1;1;1;0;1;0;1;1)	
R21	1	1
	MAX(1;1;0;1;1;1;0;1;0;1;0;0;1;1;0;0;1;1;1;0;1;0;1;1)	
R31	0	0
	MAX(1;1;0;1;1;1;0;1;0;1;0;0;1;1;0;0;1;1;1;0;1;0;1;1)	
R41	1	1
	MAX(1;1;0;1;1;1;0;1;0;1;0;0;1;1;0;0;1;1;1;0;1;0;1;1)	
R51	1	1
	MAX(1;1;0;1;1;1;0;1;0;1;0;0;1;1;0;0;1;1;1;0;1;0;1;1)	
R61	1	1
	MAX(1;1;0;1;1;1;0;1;0;1;0;0;1;1;0;0;1;1;1;0;1;0;1;1)	
R12	2	0.5
	MAX(2;3;4;1;2;3;2;3;3;2;2;4;2;3;3;1;2;3;1;2;3;1;2;4)	
R22	3	0.75
	MAX(2;3;4;1;2;3;2;3;3;2;2;4;2;3;3;1;2;3;1;2;3;1;2;4)	
R32	4	1

	MAX(2;3;4;1;2;3;2;3;3;2;2;4;2;3;3;1;2;3;1;2;3;1;2;4)	
R42	1	0.25
	MAX(2;3;4;1;2;3;2;3;3;2;2;4;2;3;3;1;2;3;1;2;3;1;2;4)	
R52	2	0.5
	MAX(2;3;4;1;2;3;2;3;3;2;2;4;2;3;3;1;2;3;1;2;3;1;2;4)	
R62	3	0.75
	MAX(2;3;4;1;2;3;2;3;3;2;2;4;2;3;3;1;2;3;1;2;3;1;2;4)	
R13	3	0.75
	MAX(3;4;2;4;3;2;4;2;4;3;1;2;1;4;3;4;2;1;2;4;2;2;4;1)	
R23	4	1
	MAX(3;4;2;4;3;2;4;2;4;3;1;2;1;4;3;4;2;1;2;4;2;2;4;1)	
R33	2	0.5
	MAX(3;4;2;4;3;2;4;2;4;3;1;2;1;4;3;4;2;1;2;4;2;2;4;1)	
R43	4	1
	MAX(3;4;2;4;3;2;4;2;4;3;1;2;1;4;3;4;2;1;2;4;2;2;4;1)	
R53	3	0.75
	MAX(3;4;2;4;3;2;4;2;4;3;1;2;1;4;3;4;2;1;2;4;2;2;4;1)	
R63	2	0.5
	MAX(3;4;2;4;3;2;4;2;4;3;1;2;1;4;3;4;2;1;2;4;2;2;4;1)	
R14	4	1
	MAX(4;1;2;2;1;3;2;1;2;1;2;2;3;1;3;2;2;3;3;1;3;3;1;2)	
R24	1	0.25
	MAX(4;1;2;2;1;3;2;1;2;1;2;2;3;1;3;2;2;3;3;1;3;3;1;2)	
R34	2	0.5
	MAX(4;1;2;2;1;3;2;1;2;1;2;2;3;1;3;2;2;3;3;1;3;3;1;2)	
R44	2	0.5
	MAX(4;1;2;2;1;3;2;1;2;1;2;2;3;1;3;2;2;3;3;1;3;3;1;2)	
R54	1	0.25
	MAX(4;1;2;2;1;3;2;1;2;1;2;2;3;1;3;2;2;3;3;1;3;3;1;2)	
R64	3	0.75
	MAX(4;1;2;2;1;3;2;1;2;1;2;2;3;1;3;2;2;3;3;1;3;3;1;2)	
R15	3	0.75
	MAX(3;2;3;2;3;4;2;2;1;2;3;2;3;2;2;3;4;2;2;3;1;3;2;3)	
R25	2	0.5
	MAX(3;2;3;2;3;4;2;2;1;2;3;2;3;2;2;3;4;2;2;3;1;3;2;3)	
R35	3	0.75
	MAX(3;2;3;2;3;4;2;2;1;2;3;2;3;2;2;3;4;2;2;3;1;3;2;3)	
R45	2	0.5
	MAX(3;2;3;2;3;4;2;2;1;2;3;2;3;2;2;3;4;2;2;3;1;3;2;3)	
R55	3	0.75
	MAX(3;2;3;2;3;4;2;2;1;2;3;2;3;2;2;3;4;2;2;3;1;3;2;3)	
R65	4	1

	MAX(3;2;3;2;3;4;2;2;1;2;3;2;3;2;2;3;4;2;2;3;1;3;2;3)	
R16	1	0.25
	MAX(1;2;3;1;4;1;3;4;3;2;3;3;3;2;4;4;2;3;2;3;2;3;4;3)	
R26	2	0.5
	MAX(1;2;3;1;4;1;3;4;3;2;3;3;3;2;4;4;2;3;2;3;2;3;4;3)	
R36	3	0.75
	MAX(1;2;3;1;4;1;3;4;3;2;3;3;3;2;4;4;2;3;2;3;2;3;4;3)	
R46	1	0.5
	MAX(1;2;3;1;4;1;3;4;3;2;3;3;3;2;4;4;2;3;2;3;2;3;4;3)	
R56	4	1
	MAX(1;2;3;1;4;1;3;4;3;2;3;3;3;2;4;4;2;3;2;3;2;3;4;3)	
R66	1	0.25
	MAX(1;2;3;1;4;1;3;4;3;2;3;3;3;2;4;4;2;3;2;3;2;3;4;3)	

From the normalization calculations above, the results/values for each criterion will be obtained which will then begin the ranking process to find the ranking results using the SAW (Simple Addictive Weighting) method, for the full normalization results above can be seen in table 4..

Table 4. Normalization of Employee SAW

ID	Nama	Kriteria					
		W1	W2	W3	W4	W5	W6
P001	Employee 1	1	0.5	0.75	1	0.75	0.25
P002	Employee 2	1	0.75	1	0.25	0.5	0.5
P003	Employee 3	0	1	0.5	0.5	0.75	0.75
P004	Employee 4	1	0.25	1	0.5	0.5	0.25
P005	Employee 5	1	0.5	0.75	0.25	0.75	1
P006	Employee 6	1	0.75	0.5	0.75	1	0.25
P007	Employee 7	0	0.5	1	0.5	0.5	0.75
P008	Employee 8	1	0.75	0.5	0.25	0.5	1
P009	Employee 9	0	0.75	1	0.5	0.25	0.75
P010	Employee 10	1	0.5	0.75	0.25	0.5	0.5
P011	Employee 11	0	0.5	0.25	0.5	0.75	0.75
P012	Employee 12	0	1	0.5	0.5	0.5	0.75
P013	Employee 13	1	0.5	0.25	0.75	0.75	0.75
P014	Employee 14	1	0.75	1	0.25	0.5	0.5
P015	Employee 15	0	0.75	0.75	0.75	0.5	1
P016	Employee 16	0	0.25	1	0.5	0.75	1
P017	Employee 17	1	0.5	0.5	0.5	1	0.5
P018	Employee 18	1	0.75	0.25	0.75	0.5	0.75
P019	Employee 19	1	0.25	0.5	0.75	0.5	0.5
P020	Employee 20	0	0.5	1	0.25	0.75	0.75
P021	Employee 21	1	0.75	0.5	0.75	0.25	0.5
P022	Employee 22	0	0.25	0.5	0.75	0.75	0.75
P023	Employee 23	1	0.5	1	0.25	0.5	1

Next, perform the ranking process with the weight of each criterion, by means of the normalized value results which are then multiplied by the respective weights of the predetermined criteria to get the results of exemplary employee scores..

Table 5. SAW Ranking of Employees

ID	Name	Total value
P001	Employee 1	65
P002	Employee 2	68
P003	Employee 3	50
P004	Employee 4	58
P005	Employee 5	72
P006	Employee 6	63
P007	Employee 7	67
P008	Employee 8	63
P009	Employee 9	66
P010	Employee 10	57
P011	Employee 11	50
P012	Employee 12	60
P013	Employee 13	57
P014	Employee 14	68
P015	Employee 15	71
P016	Employee 16	73
P017	Employee 17	62
P018	Employee 18	56
P019	Employee 19	51
P020	Employee 20	70
P021	Employee 21	52
P022	Employee 22	56
P023	Employee 23	75

Based on the simulation results through the SAW method, information is obtained that of the 24 employees above who deserve to be exemplary employees, 23 are the employees with the highest scores. So that the employee is declared worthy as an exemplary employee with a score of 75.

4. CONCLUSION

The results of the calculation of employee performance appraisal based on the Simple Additive Weighting (SAW) method to assist companies in processing employee performance appraisals. With the exemplary employee appraisal report, the leader will know which employees will be rewarded for their performance. Based on the results of the performance appraisal information system questionnaire distributed to 10 respondents, the percentage of respondents' assessment is 81.24%. The results of the respondent's calculation are in the 80% - 100% interval which is categorized as very good. The SAW method obtained information that of the 24 employees above who deserve to be exemplary employees are 23 employees with the highest score. So that the employee is declared worthy as an exemplary employee with a score of 75.

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