DECISION SUPPORT SYSTEM FOR DETERMINATION EXEMPLARY EMPLOYEES USING SIMPLE ADDITIVE WEIGHTING METHOD (CASE STUDY: BKN OFFICE YOGYAKARTA)

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ABSTRACT

The selection of exemplary employees is an annual event divided into three categories: civil servants, non-civil servants, and outsourced employees. Selection is based on four criteria: performance quality, discipline percentage, moral behavior, and leadership quality. The Assessment Team's assessment process for exemplary employees is carried out by recapitulating the assessment data for each work unit and determining exemplary employees from the recapitulation results using a manual form for evaluating employee performance within BKN Yogyakarta. Manual assessment requires quite a long time and has the risk of errors during the calculation process, so researchers see the need for a decision support system for selecting exemplary employees using the Simple Additive Weighting (SAW) method. This system helps the personnel department quickly and accurately rank exemplary employees. The system calculation results use the SAW method with 6 alternative employees with each score: Sudi 1, Heru 0.9, Vivid 0.82, Anjas 0.82, Tri 0.75, and Suwar 0.5. Sudi received the highest score and was designated as a model employee for this period.

Keywords: *Simple Additive Weighting, SAW, Decision Support System, Exemplary Employees*

1. INTRODUCTION

BKN Yogyakarta Regional Office I is a Yogyakarta regional civil service affairs office with duties and functions in fostering and administering State Civil Apparatus Management in its working area. The authority is still vested in the government in accordance with statutory provisions. In implementing bureaucratic reform, among other things, self-assessments are carried out, performance achievements are measured, work productivity is monitored, individual assessments are used performance-based instruments, and an organizational culture is created and developed oriented towards improving performance and rewarding employees are The selection of exemplary employees is an annual agenda divided into three categories, namely State Civil Apparatus (ASN), Non-Civil Servant Government Employees (PPNPN), and Outsourced Employees [1]. The selection is based on employee performance and discipline through suggestions from each section. Apart from that, to accommodate the participation of all employees, the process of selecting exemplary employees is carried out using an online media meter. The assessment process from the Assessment Team for exemplary employees is carried out by recapitulating the assessment data from each work unit and determining exemplary employees from the results of the recapitulation using a manual form for assessing employee performance within the Kanreg I BKN Yogyakarta.

Problems often arise when the manual assessment process for exemplary employees takes a long time, and sometimes calculation errors occur due to the large number of employees to be assessed, so there is a need for a decision support system using the SAW method. The basic concept of SAW is searching weighted summation of each performance alternative on all attributes requiring process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings, really simple and easy to understand and can implemented in the support system decisions made with attention weights and criteria so that the system is easier and efficient [2], [3]. Decision

support system is an implementation system used to help a leader in taking decision [4], [5]. Interactive computerized system which is used to make decisions using models and data to fix semi-problems structured and unstructured [6].

Similar research was conducted by Ohti Sohma 2022, to select the best employee performance in the company using the SAW method. This research used 9 the criteria that have been determined include ethics or personality, discipline, absenteeism, responsibility, cooperation, leadership ability, work speed, work accuracy and quality of work results.With this ranking method, the assessment will be more precise because it is based on predetermined criteria values and weights so that you will get more accurate results regarding who will receive awards from the company [7]. Budi Arifitama, 2022 conducted research using the SAW method for the scholarship selection process. The criteria used include GPA, competition participation, lecturer recommendations, and organizational participation, which are the criteria that will be taken into consideration in the selection process, and parents' income. The decision support system is used to minimize errors and reduce bias in the selection process of students who are entitled to receive scholarships. As a result, each student will receive an eligibility score that will influence the final decision [8]. Kikye, 2022. Conducting research at PT. Cindyani Tiwi Sustainable selection of the best employees using the SAW method. The research used several criteria needed to help decision makers, including: discipline, quality of work, cooperation and behavior. Based on the whole the criteria and alternatives in this research resulted in Darwansyah being the best employee at PT. Cindyani Tiwi Lestari with a total preference score of 2,875. The SAW method is an effective and practical method for calculating recommendations for the best employees at PT. Cindyani Tiwi Lestari so that decision makers can consider these recommendations according to the specified priorities [9].

This research uses 4 criteria according to the results of the 2020 decision meeting of the Head of Office and the Assessment Team of Kanreg I BKN, including: Quality of Performance, Percentage of Discipline, Moral Behavior and Leadership Quality. This decision support system is expected to make it easier for the personnel department to assess exemplary employees.

2. RESEARCH METHODOLOGY

2.1 Research Workflow

The initial stage involves conducting direct observations at BKN Yogyakarta, by interviewing related parties to find out what problems occurred during the process of determining exemplary employees. Next, conduct a literature review to increase insight and knowledge regarding the problems to be discussed and determine methods for solving the problems being faced. The literature review was carried out by searching the literature in the form of guidebooks and journals resulting from previous research. The third stage was collecting data obtained through direct observation and interviews. The fourth stage, designing an information system aims to analyze the results of the problems that occur, then provide design and creation of applications based on needs and provide an overview of the system to be built. At the data processing and analysis stage, determine the criteria for decision making called Ci. Next, determine the suitability rating for each alternative and each criterion and create a decision matrix based on the criteria. After that, normalize the matrix based on the adjusted equation so that the final result is a ranking obtained from a number of additions from matrix multiplications. Details of the research flow can be seen in the Figure 1.

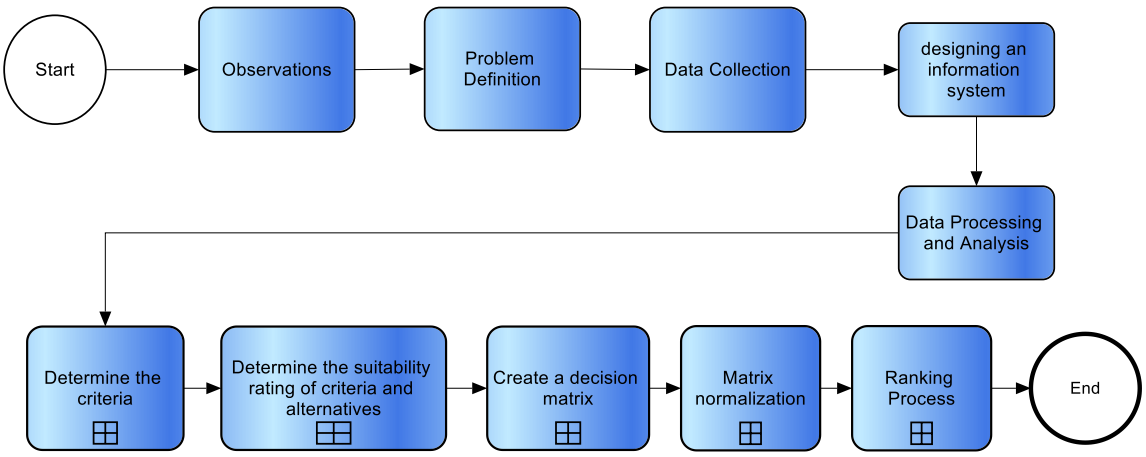

Figure 1. Research Workflow

2.2. Data Collection

The data collection stage is to collect supporting data in solving the problem that is the focus of the research. Data was obtained through direct observation and interviews. Criteria data is used as a reference in making decisions about exemplary employees. Based on the 2020 Head of Regional Office I BKN Regulations which were amended according to the results of the decision meeting of the Head of Office and the Assessment Team, the criteria data includes performance quality, discipline percentage, moral behavior, and leadership quality. Apart from that, the sub-criteria data, criteria weights and sub-criteria values have been agreed with the personnel department and leadership and have been arranged according to the agency's needs. The assessment of each alternative will be entered by the coordinator. The first step is calling the NIP and employee data will appear as an alternative, then the assessment of each alternative is selected according to the value of each sub-criteria. Next, the system will calculate the data that has been entered according to the SAW calculation and ranking method.

2.3. The Selection of Exemplary Employees

The selection of exemplary employees is an annual agenda, which is divided into three categories, namely Civil Servants (PNS), Non-Civil Servant Government Employees (PPNPN), and Outsourced Employees. The selection is based on employee performance and discipline through suggestions from each section. Employee performance is a key factor in achieving success and achieving organizational goals, so it is necessary to measure and evaluate employee performance periodically as a tool to gain insight into individual performance strengths and weaknesses [10]. Apart from that, to accommodate the participation of all employees, the process of selecting exemplary employees is carried out using online media meter. The exemplary employee award is a form of balance between reward and punishment given by the office. It is hoped that the reward for exemplary employees can encourage other employees to excel, be dedicated and work better for the sake of the homeland and the nation [11].

2.4. Simple Additive Weighting (SAW) Method

The SAW method is one of the methods used in the decision making process. The SAW method recognizes 2 (two) attributes, namely profit criteria and cost criteria. The fundamental difference between these two criteria is in the selection of criteria when making decisions [11]. The completion steps for using this method are as follows.

a. Determine the alternative, namely (Ai).
b. Determine the criteria used as a reference in decision making, namely (Cj).
c. Provides a suitability rating value for each criterion.
d. Determine the preference weight or level of importance (W) for each criterion:
   W = [W1,W2,W3…,WJ] (1)
e. Create a suitability rating table for each alternative for each criterion.
f. Create a decision matrix (X) which is formed from the suitability rating table for each alternative for each criterion. The X value of each alternative (Ai) for each criterion (Cj) has been determined where i=1,2,…m and j=1,2,…n.

$$X = \begin{matrix} a_1 \\ a_2 \\ a_3 \\ . \\ . \\ . \end{matrix} \begin{bmatrix} x_{11} & x_{12} & x_{13} & \cdot & \cdot & x_{1n} \\ x_{21} & x_{22} & x_{23} & \cdot & \cdot & x_{1n} \\ x_{31} & x_{32} & x_{33} & \cdot & \cdot & x_{1n} \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & x_{mn} \end{bmatrix} \quad (2)$$

g. Normalizing the decision matrix by calculating the normalized performance rating (rij) value of alternative Ai on criteria Cj, given the following equation.

$$r_{ij} = \begin{cases} \frac{Xij}{Maxi\ Xij} \\ \frac{Mini\ Xij}{Xij} \end{cases} \quad (3)$$

   If i is a benefit attribute, if j is the cost attribute (cost). The profit criterion is the value of the benefit for the decision maker, whereas the cost criterion is if it causes costs for the decision maker. If it is a profit criterion, the value is divided into each column, while for the cost criterion, the value of each column is divided by the value [12].
h. The results of the normalized performance rating (r_{ij}) form a normalized matrix (R).
i. Where rij is the normalized performance rating of alternative Ai on attribute Cj; i=1,2,…,m and j=1,2,…,n. The preference value for each alternative (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).

$$V_i = \sum_{j=1}^{n} W_j \; r_{ij} \quad (4)$$

The calculation results of a larger Vi value indicate that alternative Ai is the best alternative [13].

2.5. System Design Method

This initial planning stage begins with creating a use case model. The Use Case in this system planning involves 4 actors, namely Admin, HR, Coordinator, and Head. Admin is a person who can manage criteria data, sub-criteria, alternatives, weight values, user data, reports and monitoring dashboards. HR is a person who can manage data on criteria, alternatives and weight values. The coordinator is the person who can manage assessment data. The head is the person who can manage the system dashboard. The system use case design can be seen in the Figure 2.

Based on planning, there are several important elements that play a direct role in the user system. The user enters employee data, then the application processes the data according to SAW calculations, then the database stores and displays the data through the application. The architectural modeling of this system can be seen in the Figure 3.

Activity Diagrams are patterns used in modeling business processes and also to represent the sequence of activities or actions in a process in an information system [14]. Activity diagrams explain in detail what happens in a use case. Activity diagrams show how actors interact with the system.

The activity diagram in Figure 4 explains the process flow for users including admin, HR, coordinator and head to log in to the system. Users can start the login process by going to the application home page. The system will display a login page on the main or home page for the user and the user needs to enter a username and password. Then the data entered by the user is validated and will be validated. If the data entered is correct, the application will direct the user to the dashboard page. However, if the data entered is incorrect, the application will display an error message and take the user to correct the username and password.

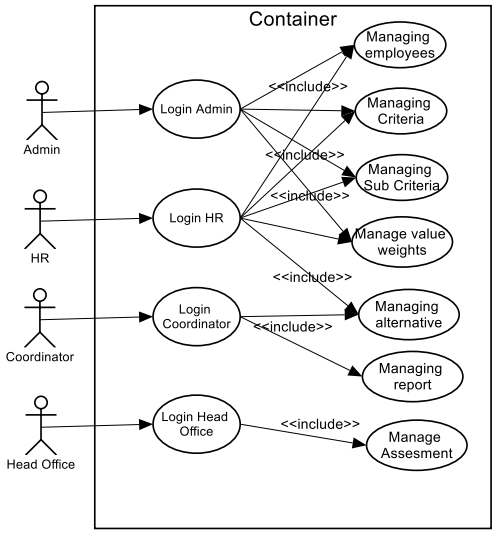

Figure 2. Use Case Decission Support System

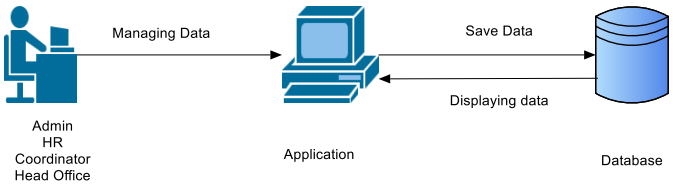

Figure 3. Application architectural model

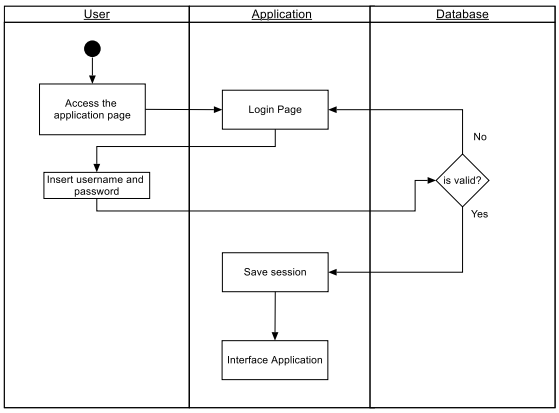

Figure 4. Activity Diagram Login

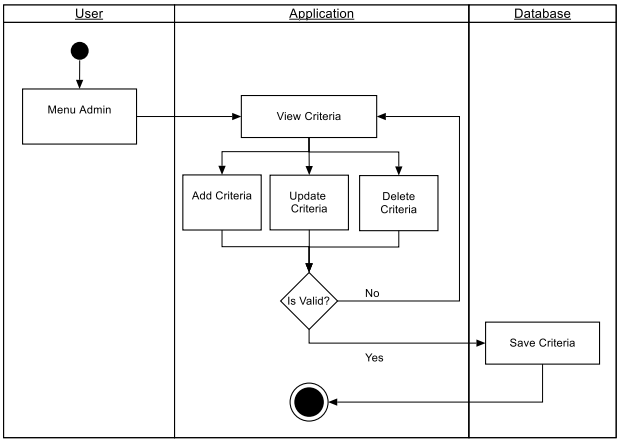

Figure 5. Activity Diagram Manage Criteria

The activity diagram in Figure 5 explains the process flow when the Admin manages criteria data in the exemplary employee decision support system. The admin becomes the actor and selects the criteria menu, displays the criteria data, adds criteria data, edits the criteria data and deletes the criteria data. The application will display a form to add data, edit data and confirm deleting data, then validate the application. If the data complies with the provisions, it will be saved into the database. If it is not appropriate, an error message will be displayed and it will return to the criteria form.

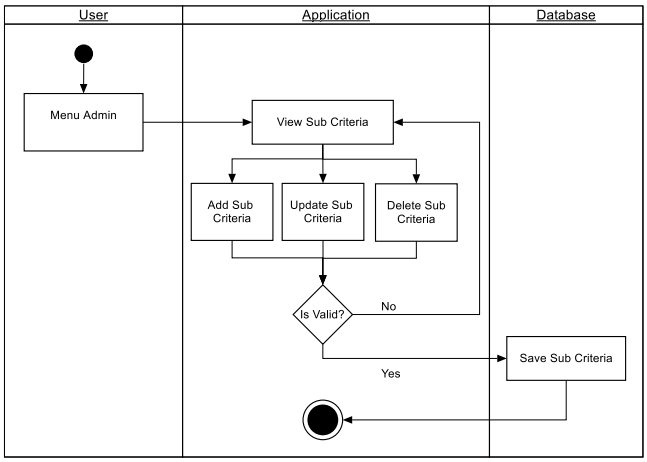

Figure 6. Activity Diagram Manage Sub Criteria

The activity diagram in Figure 6 explains the process flow when the Admin manages sub-criteria data in the exemplary employee decision support system. The admin becomes the actor and selects the sub-criteria menu, displays sub-criteria data, adds sub-criteria data, edits sub-criteria data and deletes sub-criteria data. The application will display a form to add data, edit data and confirm deleting data, then validate the application. If the data complies with the provisions, it will be saved into the database. If it is not appropriate, an error message will be displayed and will return to the sub-criteria form.

The activity diagram in Figure 7 explains the process flow when the Admin manages weight data for each criterion in the exemplary employee decision support system. The admin becomes an actor and selects the weight menu, displays the weight data for each criterion, adds weight data for each criterion, edits the weight data for each criterion and deletes the weight data for each criterion. The application will display a form to add data, edit data and confirm deleting data, then validate the application. If the data complies with the provisions, it will be saved into the database. If it is not appropriate, an error message will be displayed and it will return to the criteria value form.

The activity diagram in Figure 8 explains the process flow when the Coordinator manages assessment data for the alternative selected in the exemplary employee decision support system. The coordinator becomes an actor and selects the alternative menu, displays assessment data for each alternative, adds assessment data for the selected alternative, edits assessment data for the selected alternative and deletes assessment data for the selected alternative. The application will display a form to add data, edit data and confirm deleting data, then validate the application. If the data complies with the provisions, it will be saved into the database. If it is not appropriate it will display an error message and return to the assessment form for the selected alternative.

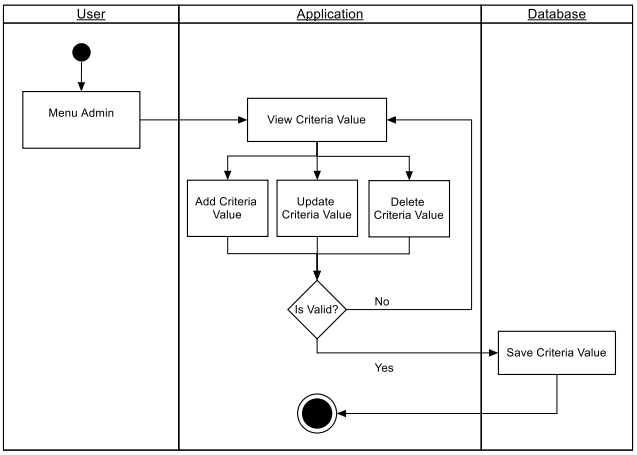

Figure 7. Activity Diagram Manage Criteria Value

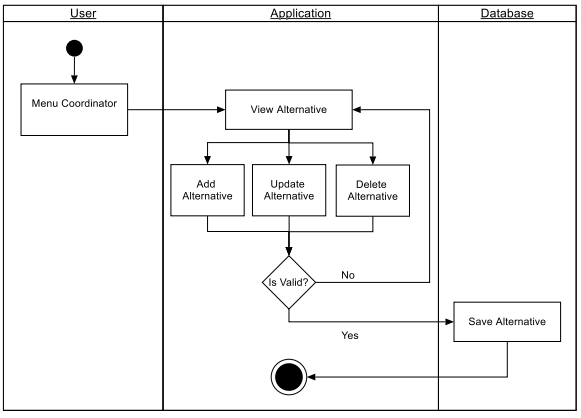

Figure 8. Activity Diagram Manage Alternative

Table 1. Criteria

Code	Criteria Name	Characteristic	Weight
K1	Employee Performance	Max (benefit)	30
K2	Employee Discipline	Max (benefit)	30
K3	Moral Behavior	Max (benefit)	30
K4	Leadership Qualities	Max (benefit)	10

Table 2. Sub Criteria

Code	Criteria Name	Sub Criteria	Value
K1	Employee Performance	Special	4
		Good	3
		Enough	2
		Not Enough	1
K2	Employee Discipline	91-100%	4
		81-90%	3
		71-80%	2
		<=70%	1
K3	Moral Behavior	Above Expectations	4
		According to Expectations	3
		Below Expectations	2
		Less Expectations	1
K4	Leadership Qualities	Very good	4
		Good	3
		Enough	2
		Not Enough	1

Table 3. Alternative

Code	Alternative	Criteria			
		K1	K2	K3	K4
A1	197906212000031001	4	3	3	3
A2	196312021991032001	3	4	3	3
A3	196302081991031001	4	4	3	3
A4	196210201985032001	2	2	2	2
A5	196209251983121001	3	3	3	3
A6	196112271991031001	4	4	4	4

3. RESULTS AND DISCUSSIONS

3.1 Results

In the process using the SAW method, several stages are carried out in making the decision to select exemplary employees at the BKN Yogyakarta Regional Office I. Table 1 determines the criteria for exemplary employees that will be used as a reference in decision making. Then determine the weight of the criteria for each criterion. Determine the suitability rating of each alternative for each criterion by determining the value range from 1 to 4 as in Table 2.

The next step is to determine the alternative choices, in this example there are 6 employees as prospective employee candidates who are filled in with their employee identification number (nip) as in Table 3. The next step is the process of creating a decision matrix. From the alternative table we create the matrix.

$$\mathbf{X}=\begin{Bmatrix} \mathbf{4} & \mathbf{3} & \mathbf{3} & \mathbf{3} \\ 3 & 4 & 3 & 3 \\ 4 & 4 & 3 & 3 \\ 2 & 2 & 2 & 2 \\ 3 & 3 & 3 & 3 \\ 4 & 4 & 4 & 4 \end{Bmatrix}$$

Normalization is carried out using the following formula.

$r_{ij}= \frac{Xij}{Max\ Xij}$, if j is the profit criterion

$r_{ij}= \frac{Min\ Xij}{Xij}$, if j is the cost criterion

Using the max(benefit) formula for all columns, it is calculated starting from row 1 column 1 divided by the maximum value of the column according to the criteria.

$$r_{11} = \frac{4}{\text{Max}\{4; 3; 4; 2; 3; 4\}} = 4/4 = 1;$$

$$r_{21} = \frac{3}{\text{Max}\{3; 3; 4; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{31} = \frac{4}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 4/4 = 1;$$

$$r_{41} = \frac{2}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 4/4 = 1;$$

$$r_{51} = \frac{3}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{61} = \frac{4}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 4/4 = 1;$$

$$r_{12} = \frac{3}{\text{Max}\{4; 3; 4; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{22} = \frac{4}{\text{Max}\{3; 3; 4; 2; 3; 4\}} = 4/4 = 1;$$

$$r_{32} = \frac{4}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 4/4 = 1;$$

$$r_{42} = \frac{2}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 2/4 = 0{,}5;$$

$$r_{52} = \frac{3}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{62} = \frac{4}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 4/4 = 1;$$

$$r_{13} = \frac{3}{\text{Max}\{4; 3; 4; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{23} = \frac{3}{\text{Max}\{3; 3; 4; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{33} = \frac{3}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{43} = \frac{3}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 2/4 = 0,\ 5;$$

$$r_{53} = \frac{3}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{63} = \frac{4}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 4/4 = 1;$$

$$r_{14} = \frac{3}{\text{Max}\{4; 3; 4; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{24} = \frac{3}{\text{Max}\{3; 3; 4; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{34} = \frac{3}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{44} = \frac{2}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 2/4 = 0{,}5;$$

$$r_{54} = \frac{3}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 3/4 = 0{,}75;$$

$$r_{64} = \frac{4}{\text{Max}\{3; 3; 3; 2; 3; 4\}} = 4/4 = 1;$$

R=

1	**0,75**	**0,75**	**0,75**
0,75	1	0,75	0,75
1	1	0,75	0,75
0,5	0,5	0,5	0,5
0,75	0,75	0,75	0,75
1	1	1	1

Determine the preference weight or level of importance (w) for each criterion. W = [30; 30; 30; 10] in percent, or W = [0.3; 0.3; 0.3; 0.1]. The final result of the preference value (Vi) is obtained from the sum of the normalized matrix row elements (R) with the normalized weights (W) corresponding to the matrix column elements (W).

$Vi = \sum n\, j{=}1\ wjrij.$

A1 = (0,3 x 1)+(0,3 x 0,75)+(0,3 x 0,75)+(0,1x0,75) = 0,825

A2 = (0,3 x 0,75)+(0,3 x 1)+(0,3 x 0,75)+(0,1x0,75) = 0,825

A3 = (0,3 x 1)+(0,3 x 1)+(0,3 x 0,75)+(0,1x0,75) = 0,9

A4 = (0,3 x 0,5)+(0,3 x 0,5)+(0,3 x 0,5)+(0,1x0,5) = 0,5

A5= (0,3 x 0,75)+(0,3 x 0,75)+(0,3 x 0,75)+(0,1x0,75) = 0,75

A6 = (0,3 x 1)+(0,3 x 1)+(0,3 x 1)+(0,1x1) = 1

Table 4. Score Result

Alternative	**Score**
A1 = 196209251983121001/Sudi	1
A2 = 196302081991031001/Heru	0,9
A3 = 197906212000031001/Vivid	0,825
A4 = 196312021991032001/Anjas	0,825
A5 = 196210051985031003/Tri	0,75
A6 = 196210201985032001/Suwar	0,5

3.2 Discussions

Based on the ranking score calculation that has been carried out for each alternative by utilizing the saw method in the calculation process, it was found that the employee who has the highest score among other employees with a value of 1 is sudi who can be recommended as an exemplary employee this year as in the Table 4. The results of system calculations using the SAW method with 6 employees who will get the title of exemplary employee are Sudi, Heru, Vivid, Anjas, Sudi, Tri and like Suwar.

4. CONCLUSION

Based on the ranking score calculation that has been carried out for each alternative by utilizing the SAW method in the calculation process, it was found that the employee who has the highest score among other employees with a value of 1 is Sudi who can be recommended as an exemplary employee this year. As for the other alternatives, each got a score of Heru 0.9, Vivid 0.82, Anjas 0.82, Tri 0.75, and Suwar 0.5. In future research, other methods such as multi-attribute utility theory can be combined so that the strengths and weaknesses of each method can be identified.

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