

DECISION SUPPORT SYSTEM FOR THE SELECTION OF THE BEST EMPLOYEES OF BMT NU GAPURA SUMENEP COOPERATIVE USING THE SIMPLE ADDITIVE WEIGHTING (SAW) METHOD

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ABSTRACT

Employees are the most important resource in a company to carry out the company's management targets and improve the company's performance quality in developing its business. Capable and quality resources that are in accordance with the company's targets are a priority for a company. To maintain this, employee performance evaluation is a major concern by conducting employee assessments. Employee assessments at the BMT NU Cooperative still experience several obstacles, namely that they are still based on the subjectivity of the Cooperative manager and tend to produce decisions that are not relevant to the employee's performance results. Thus, it creates professional discrimination against work. For the assessment of the best employees using the Simple Additive Weighting (SAW) method with several assessment weights for each criterion. Thus, providing accurate employee assessment results that are in accordance with the work done by employees. The SAW method is used by adding each weight to each criterion. The final result is obtained from the calculation process, namely the summation of the normalized matrix with the weight per criterion which shows the ranking of the selection of the best employees. Then, from these calculations, accurate information is obtained about the best employees at the BMT NU Cooperative, Gapura District, Sumenep Regency.

Keywords: *Best Employees, Simple Additive Weighting, Decision Support System*

INTRODUCTION

Good and quality employees are certainly the most important asset in a company, corporation or agency in any field. Apart from good and bad development of a company, apart from good company management, employee performance is also an important factor. If employees are able to carry out their duties well, then a company's targets will be achieved. Including the condition that the company's targets will be achieved, if employees are able to create a good impression on customers. Therefore, qualified resources are needed that have very high competence and loyalty.

To be able to generate resources as mentioned above, companies must make an effort, one of which is by selecting the best employees to increase enthusiasm and stimulate employees to improve their performance. Improving the quality of employee performance is an important point that can improve the company's overall performance. Therefore, efforts are needed in the form of assessing employee performance. With this assessment, the company can determine outstanding employees in each specified period.

By having quality human resources that are in line with company targets, a company will develop and improve, especially in its operations. However, there are several obstacles to the Nuansa Umat Supermarket, Kec. Gapura Kab. Sumenep which is a subsidiary of BMT NU East Java, namely in selecting the best employees. Determining the best employees still uses a cultural system which until now has become a tradition, so the element of subjectivity is very high, apart from that the number of employees at Swalayan Nuansa Umat is relatively large and the method for inputting grades still uses Microsoft Excel. Thus, it takes a relatively long time and the results of the assessment process are often not on target and do not match performance results employee. And the resulting policies tend to be less valid, inaccurate and irrelevant to the work being done. [1]

The problems that arise can be large or small scale which greatly influences the decision results. Nowadays humans are starting to develop systems that can help determine the best alternative in a problem, namely decision support systems (DSS). In a decision support system there are alternatives, criteria and weights used to determine a solution.[2]

Decision support systems can be used as a tool to evaluate employee performance, namely by using one of the methods in the decision support system [3]. Decision support systems make it easier for managers to determine assessments of employee performance [4]. To determine the best employee, this is done by adding up the weights of the performance ratings for each alternative for all attributes. The Simple Additive Weighting (SAW) method was chosen to assess and rank employee work performance. With ranking, it is hoped that the assessment process will be more precise because it is based on predetermined criteria values and weights so that more accurate results will be obtained in determining the best employees [5].

METHOD

Method of Collecting Data

The data collection method used to obtain information in this research is as follows:

A. Observation

Observations were carried out by directly observing the relevant sections, reviewing the system flow in the assessment process, and observing the performance evaluation process for BMT NU Gapura Supermarket employees.

B. Interview

This method involves the author asking questions to related parties to gather information about the performance evaluation process for BMT NU Gapura Supermarket employees.

C. Literature Review

Researchers collect the necessary data by searching and digging up information related to the problem being studied from books and the internet.

System Development Methods

This system was developed using the waterfall method which is well known in software engineering [6]. The waterfall model method is shown in Figure 1 below.

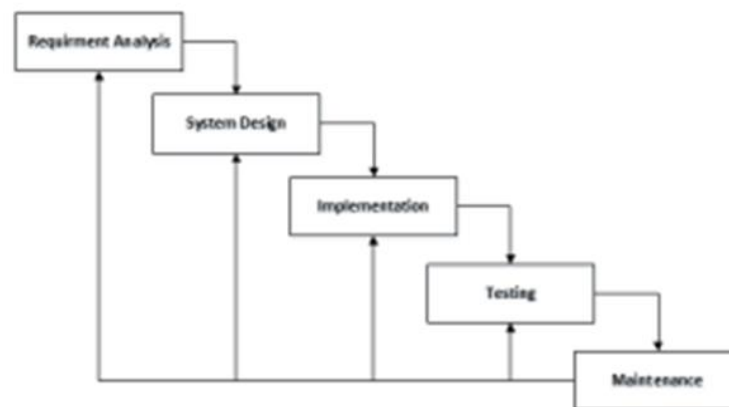


Figure 1. Waterfall Model

The stages in the waterfall method include:

A. System Analysis

Systems analysis involves breaking down system requirements into components to determine, evaluate, and propose solutions to problems, opportunities, obstacles, and expected needs.

B. System Design

System design utilizes data collected through data analysis to determine application development workflows. Including designing a database system using Context Diagrams, Data Flow Diagrams, and Entity Relationship Database (ERD).

C. Implementation.

Software designs are converted into complete programs or program units during implementation.

D. System Testing

After implementation, testing is carried out to identify errors in the system for correction.

E. Maintenance

The maintenance phase is carried out after the application is deployed and used by users, especially if the system encounters problems that were not detected during testing.

Simple Additive Weighting Method

In research conducted by researchers, the data used comes from company data. This data was collected by searching for data directly in the field and by conducting direct interviews with employees and managers of the BMT NU Supermarket, Gapura District, Sumenep Regency. The criteria that will be used are the alternatives that will be compared. There are 10 (ten) alternatives and 3 (three) criteria that will be used through weighting *fuzzy*, then the data is analyzed, so that it has quantitative properties.

There are various methods that can be used in decision support systems. One of them is the Simple Additive Weighting (SAW) method which is a weighted addition method. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all criteria [7]. The SAW method requires a process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings. The SAW method recognizes 2 (two) attributes, namely profit criteria and cost criteria. The basic difference between these two criteria is in the selection of criteria when making decisions.

The following is a flow diagram of the SAW method:

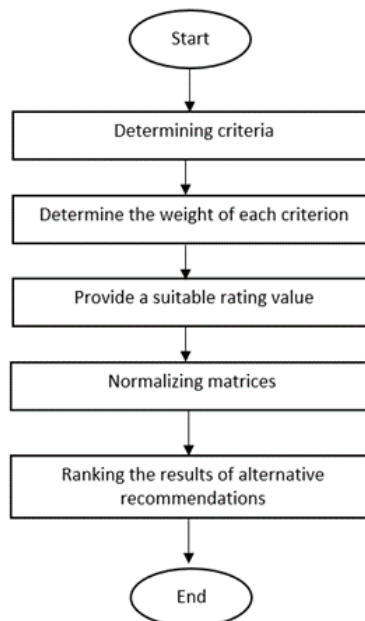


Figure 2. SAW Method Flow Diagram

The steps in using this method are [8]:

1. Determine the criteria that will be used as a reference in decision making, namely C_i .
2. Determine the suitability rating of each alternative for each criterion.
3. Create a decision matrix based on criteria (C_i), then normalize the matrix based on equations adjusted to the type of attribute (profit attribute or cost attribute) to obtain a normalized matrix R .
4. The final result is obtained from the ranking process, namely the sum of the multiplication of the normalized matrix R with the weight vector to obtain the largest value which is selected as the best alternative (A_i) as a solution.

The equation for carrying out this normalization is:

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\text{Max}_{ij}} \\ \frac{\text{Min}_{ij}}{x_{ij}} \end{cases}$$

Information:

r_{ij} = normalized performance rating

Max_{ij} = maximum value of each row and column

Min_{ij} = minimum value of each row and column

x_{ij} = rows and columns of the matrix

Where r_{ij} is the normalized performance rating of alternative A_i on attribute C_j ; $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$. The preference value for each alternative (V) is given by the equation:

$$V_i = \sum_{j=1}^n w_j r_{ij}$$

Information:

V_i = Final value of the alternative

w_j = Predetermined weight

r_{ij} = Matrix normalization

A larger V value indicates that alternative A_i is more selected.

This research was conducted by applying the multi attribute decision making (MADM) approach. This MADM approach is used to search for several alternatives that have certain criteria so that the optimal alternative can be found. This MADM approach can be carried out in two steps, namely:

1. Through the aggression of decision alternatives for each goal for each alternative.
2. Ranking these alternatives based on the aggregation of decisions.

This research takes 3 (three) criteria that are used as attributes in the data processing process, including presence, loyalty, performance and discipline. The results of this research will be information in the form of recommendations for the best employees which will be given to management as consideration in making decisions on selecting the best employees of BMT NU Gapura Sumenep Supermarket. These recommendations are given based on input provided by users which are then processed using the SAW method until obtained. list of best employee recommendations.

RESULTS AND DISCUSSION

System Modeling

Context Diagram, is a top level data flow diagram (*DFD Top Level*), which is the least detailed diagram of an information system that depicts data flows into and out of the system and into and out of external entities. Context Diagram describes the system in one circle and its relationships with external entities. The circle describes the entire process in the system [9].

The Context Diagram of the best employee selection decision support system is a form of depiction of the elements of the best employee selection decision support system at the BMT NU Gapura Supermarket which includes administrators and managers. This Context Diagram depiction is not explained in detail, because what is most emphasized is the interaction of the system with the environment that will access it. This is a general description of the processes in the decision support system for selecting the best employees. The Context Diagram of the best employee selection decision support system is as shown in Figure 3.

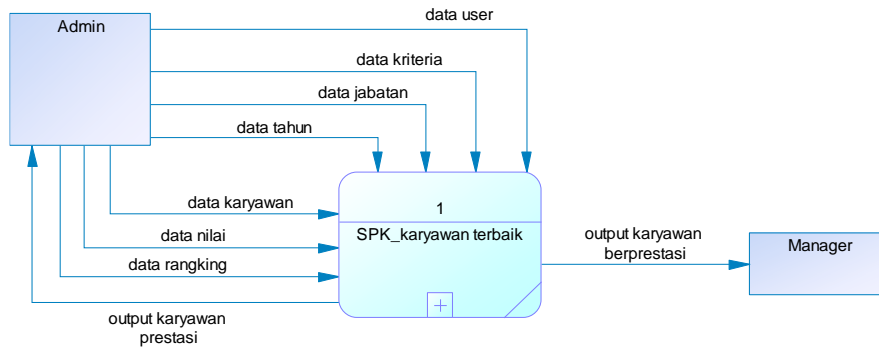


Figure 3. Context Diagram of SPK for Best Employees

Data flow diagram (DFD) is a diagram used to describe the flow or movement of data in a business or company system. DFD uses special symbols to describe how data flows from one process to another in the system. DFD helps in visualizing how data is processed and moves between entities, processes and data stores in a business system [10].

a. Level 1 Data Flow Diagram

This level 1 Data Flow Diagram (DFD) explains the entity's activities in detail after decomposing the Context Diagram in the decision support system for high achieving students. The Data Flow Diagram level 1 of the best employee decision support system is as shown in Figure 4.

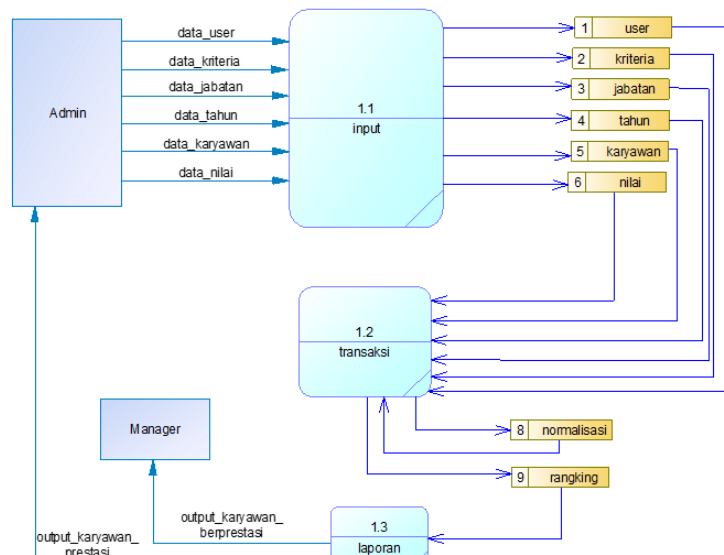


Figure 4. DFD SPK for Best Employees

b. Entity Relationship Diagram (ERD)

ERD is a simple and clear quality that probably explains much of the widespread use of ER models. ERD can express the entire logic of the database structure graphically [11].

1. Conceptual Data Model (CDM)

Conceptual Data Model (CDM) is a data model that has not been defined in a physical database. CDM is the overall logical structure of a database and is not related to any software or data storage structure. The following is the conceptual data model of the decision support system for high achieving students as in Figure 5 below.

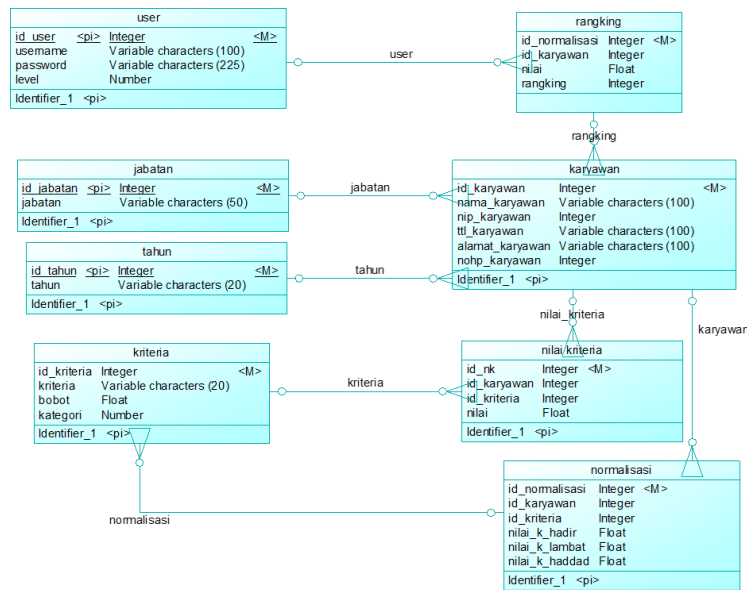


Figure 5. Conceptual Data Model

2. Physical Data Model (PDM)

Physical Data Model is a physical organization in a graphical format that produces a record of modifications in the database design that takes into account the software and data storage that generates CDM with extended attributes. The following is the physical data model of the decision support system for high achieving students as in Figure 6.

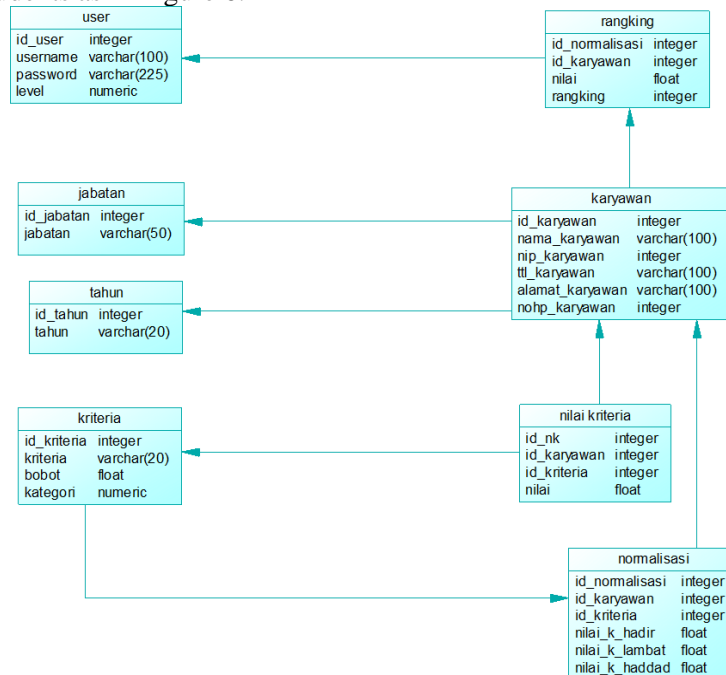


Figure 6. Physical Data Model

Determination of Criteria

Determining the best employees requires criteria and weights in the SAW method, but it is necessary to determine the criteria first. These criteria were obtained from observations in BMT NU Supermarket. Tables 1 and 2 below are the criteria and alternatives that have been obtained in determining the best employees, namely:

Tabel 1. Criteria

Code	Criteria	Attribute	Range (%)	Weight
C1	Presence	Benefit	50%	0,30
C2	Delay	Cost	30%	0,20
C3	Presence Haddad	Benefit	20%	0,20

Tabel 2. Alternative

No	Alternative Code	Name
1	A1	Rizqiyah
2	A2	Zaina
3	A3	And Salim
4	A4	Nur Fine
5	A5	Uhtul Istifada
6	A6	Ummul Khoiroh
7	A7	Anisa Nafisi
8	A8	Nur Maulinda
9	A9	khalilatur Rasyidah
10	A10	Achmad Muzammil

The criteria weight consists of 3 (three) numbers *Fuzzy* contained in the following table:

Tabel 3. Numbers Fuzzy

No	Information	Linguistic	Weight
1	Low	R	0,20
2	Currently	S	0,30
3	High	T	0,50

Provides a Suitability Rating Value

In determining the best employees, criteria and weights are needed in the SAW method. However, it is necessary to determine the criteria first and these criteria were obtained from the results of research at the BMT NU Gapura Supermarket, Sumenep.

There are two weightings used as preference weights (w) in this system, namely weighting the level of importance and weighting the level of suitability contained in each alternative. Match level weighting aims to make it easier to process data and each data is then converted into fuzzy form. In tables 4 to 6 below are the suitability ratings for all criteria.

a. Presence

The suitability rating for the attendance criteria is as follows:

Table 4. Ratings of Suitability for Attendance Criteria

Presence	Mark	Category
1-50	1	Construction
51-60	2	Warning
61-70	3	Warning
71-100	4	Safe

b. Delay

The suitability rating for the delay criteria is as follows in table 5:

Table 5. Delay Criteria Suitability Rating

Delay	Mark	Category
1-2	4	Safe
3-4	3	Warning
5-6	2	Warning
7-8	1	Construction

c. Haddad's presence

The suitability rating for Haddad's presence criteria is as shown in table 6 below:

Table 6. Delay Criteria Suitability Rating

Haddad's presence	Mark	Category
1-50	1	Construction
51-60	2	Warning
61-70	3	Warning
71-100	4	Safe

After all the criteria have been determined, the next stage is to match the value of each alternative based on the criteria. From these employees or alternatives, they will be selected to be the best alternative. The following are the values for the suitability rating taken from the sample values as in tables 7 and 8.

Table 7. Sample Values

Code Alternative	Name	Criteria		
		C1	C2	C3
A1	Rizqiyah	98	1	88
A2	Zaina	75	2	78
A3	And Salim	90	0	84

A4	Nur Fine	77	1	74
A5	Uhtul Istifada	65	8	75
A6	Ummul Khoiroh	67	4	66
A7	Anisa Nafisi	77	2	58
A8	Nurmaulinda	69	1	83
A9	Khalilatur Rashidah	78	2	73
A10	Achmad Muzammil	85	0	80

Table 8. Compatibility Rating Value

No	Name	Criteria		
		C1	C2	C3
1	Rizqiyah	Safe	Safe	Safe
2	Zaina	Safe	Safe	Safe
3	And Salim	Safe	Safe	Safe
4	Nur Fine	Safe	Safe	Safe
5	Uhtul Istifada	Warning	Construction	Safe
6	Ummul Khoiroh	Warning	Warning	Warning
7	Anisa Nafisi	Safe	Safe	Warning
8	Nurmaulinda	Warning	Safe	Safe
9	Khalilatur Rashidah	Safe	Safe	Safe
10	Ahmad Muzammil	Safe	Safe	Safe

Then, in table 9 below is the decision matrix x which was formed based on table 7 above and then converted into numbers *fuzzy*.

Table 9. Alternative Suitability Ratings on Criteria

No	Name	Criteria		
		C1	C2	C3
1	Rizqiyah	4	4	4

2	Zaina	4	4	4
3	And Salim	4	4	4
4	Nur Fine	4	4	4
5	Uhtul Istifada	3	1	4
6	Ummul Khoiroh	2	3	2
7	Anisa Nafisi	4	4	3
8	Nurmaulinda	3	4	4

Decision Matrix Based on Criteria

The values from the match table results are then created into a decision matrix as follows:

$$\begin{pmatrix} 4 & 4 & 4 \\ 4 & 4 & 4 \\ 4 & 4 & 4 \\ 3 & 1 & 4 \\ 2 & 3 & 2 \\ 4 & 4 & 3 \\ 3 & 4 & 4 \\ 4 & 4 & 4 \\ 4 & 4 & 4 \end{pmatrix}$$

Matrix Normalization

At the matrix normalization stage, the table used is table 4.6 which aims to obtain calculation results for each criterion. The matrix normalization is as follows:

1. Attendance Criteria

$$\begin{aligned} R_{11} &= 4/4 = 1 \\ R_{12} &= 4/4 = 1 \\ R_{13} &= 4/4 = 1 \\ R_{14} &= 4/4 = 1 \\ R_{15} &= 3/4 = 0.75 \\ R_{16} &= 2/4 = 0,5 \\ R_{17} &= 4/4 = 1 \\ R_{18} &= 3/4 = 0.75 \\ R_{19} &= 4/4 = 1 \\ R_{110} &= 4/4 = 1 \end{aligned}$$

2. Delay Criteria

$$\begin{aligned} R_{11} &= 1/4 = 0,25 \\ R_{12} &= 1/4 = 0,25 \\ R_{13} &= 1/4 = 0,25 \\ R_{14} &= 1/4 = 0.25 \\ R_{15} &= 1/1 = 1 \\ R_{16} &= 1/3 = 0,333 \\ R_{17} &= 1/4 = 0,25 \\ R_{18} &= 1/4 = 0.25 \\ R_{19} &= 1/4 = 0,25 \\ R_{110} &= 1/4 = 0.25 \end{aligned}$$

3. Haddad Attendance Criteria

$$R11 = 4/4 = 1$$

$$R12 = 4/4 = 1$$

$$R13 = 4/4 = 1$$

$$R14 = 4/4 = 1$$

$$R15 = 4/4 = 1$$

$$R16 = 2/4 = 0,5$$

$$R17 = 3/4 = 0,75$$

$$R18 = 4/4 = 1$$

$$R19 = 4/4 = 1$$

$$R110 = 4/4 = 1$$

$$\begin{pmatrix} 1 & 0,25 & 1 \\ 1 & 0,25 & 1 \\ 1 & 0,25 & 1 \\ 1 & 0,25 & 1 \\ 0,75 & 1 & 1 \\ 0,5 & 0,333 & 0,5 \\ 1 & 0,25 & 0,75 \\ 0,75 & 0,25 & 1 \\ 1 & 0,25 & 1 \\ 1 & 0,25 & 1 \end{pmatrix}$$

Ranking Process

To carry out the ranking, we first carry out calculations to determine the preference values V1 to V10 as follows:

$$V1 = (1*0.5) + (0.25*0.3) + (1*0.2) = 0.5 + 0.075 + 0.2 = 0,775$$

$$V2 = (1*0.5) + (0.25*0.3) + (1*0.2) = 0.5 + 0.075 + 0.2 = 0,775$$

$$V3 = (1*0.5) + (0.25*0.3) + (1*0.2) = 0.5 + 0.075 + 0.2 = 0,775$$

$$V4 = (1*0.5) + (0.25*0.3) + (1*0.2) = 0.5 + 0.075 + 0.2 = 0,775$$

$$V5 = (0,75*0,5) + (1*0,3) + (1*0,2) = 0,375 + 0,3 + 0,2 = 0,875$$

$$V6 = (0.5*0.5) + (0.333*0.3) + (0.5*0.2) = 0.25 + 0.0999 + 0.1 = 0,4499$$

$$V7 = (1*0.5) + (0.25*0.3) + (0.75*0.2) = 0.5 + 0.075 + 0.15 = 0,725$$

$$V8 = (0.75*0.5) + (0.25*0.3) + (1*0.2) = 0.375 + 0.075 + 0.2 = 0,65$$

$$V9 = (1*0.5) + (0.25*0.3) + (1*0.2) = 0.5 + 0.075 + 0.2 = 0,775$$

$$V10 = (1*0.5) + (0.25*0.3) + (1*0.2) = 0.5 + 0.075 + 0.2 = 0,775$$

From the results of calculating the Vi value of each employee who will be the best and worst employee, it can be seen in table 10, namely the employee ranking table below:

Tabel 10. Determination of Ranking

Code Alternative	No	Mark	Ranking
A1	Rizqiyah	0,775	2
A2	Zaina	0,775	2
A3	And Salim	0,775	2
A4	Nur Fine	0,775	2
A5	Uhtul Istifada	0,875	1
A6	Ummul Khoiroh	0,4499	10
A7	Anisa Nafisi	0,725	8
A8	Nurmaulinda	0,65	9
A9	Khalilatur Rashidah	0,775	2
A10	Achmad Muzammil	0,775	2
A3	And Salim	0,775	2

From the results of the employee performance ranking in the sample above using the Simple Additive Weighting (SAW) method, the employee with the highest score and the right to get the best employee title is the employee named Uhtul Istifadah with a SAW score of 0.875.

System Implementation

1. Log In

In order to be able to access the modules in the system based on the login type used, you must log in first by filling in the username and password on the login form that corresponds to the database. The log in display is as in Figure 7 below.



Figure 7. Log In Page

2. Add Employees

When adding data, you can select it from the available menu, such as when adding employee data which will be entered into the database as in Figure 8 below:



Figure 8. Add Employees

3. Rating Page

The assessment page is the display when the admin/secretary inputs the attendance, tardiness and haddad attendance values. The appearance of the assessment page is as shown in Figure 9 to Figure 11 below:

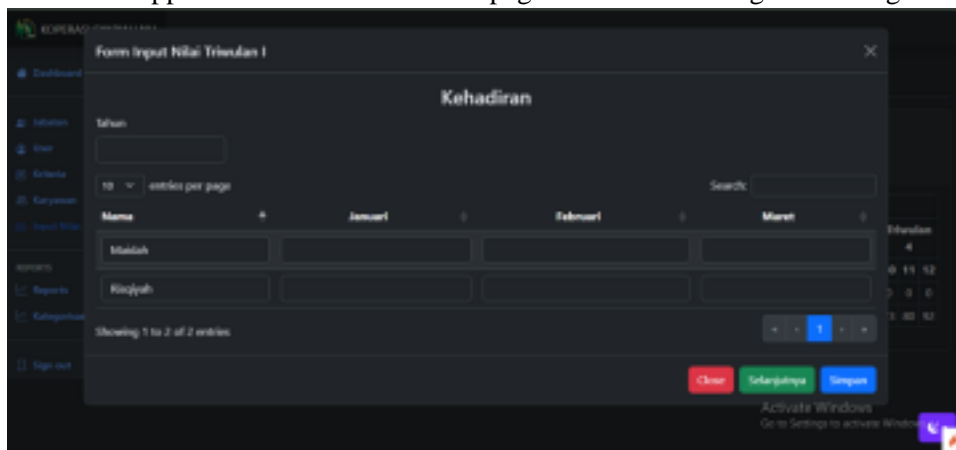


Figure 9. Attendance Assessment Page

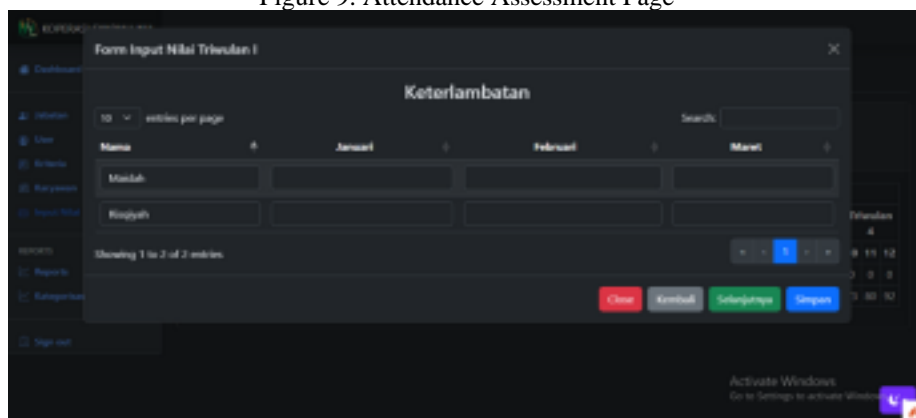


Figure 10. Delay Assessment Page

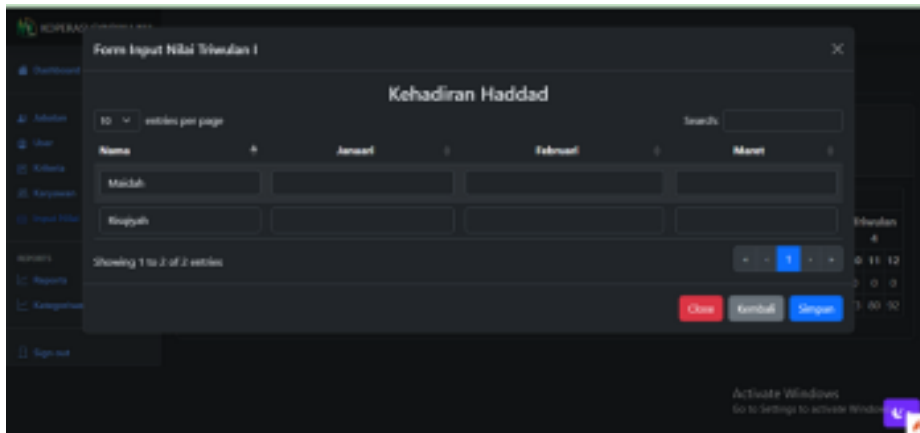


Figure 11. Haddad Attendance Assessment Page

4. Ranking Page

The ranking page is the main function for calculating the results of the criteria that have been input as in Figure 12 below:

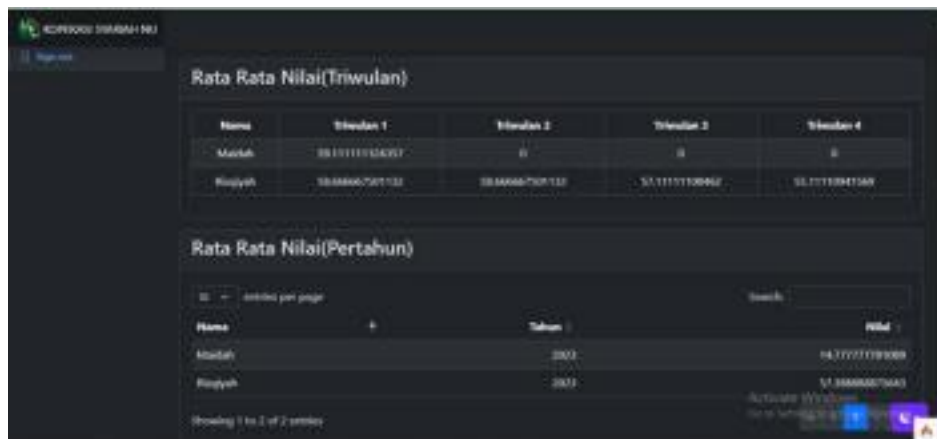


Figure 12. Page Ranking

5. Categorization Page

The categorization page is the result of inputting values as well as providing initial information to employees regarding performance carried out over a period of three months as in Figure 13 below.



Figure 13. Categorization Page

CONCLUSION

In decision support systems, the SAW method can be used to help select the best employees. The data contained in this research is dynamic, both criteria data and sub-criteria data, which means that the data can be changed at any time according to what is needed by the decision maker. The attendance orientation criterion is the criterion that has the greatest contribution in determining the best employees at the BMT NU Gapura Supermarket

Sumenep. Based on all the criteria and alternatives in this research, Uhtul Istifadah is the best employee at the BMT NU Gapura Sumenep Supermarket with a total score of 0.875. The SAW method is an effective and practical method for calculating recommendations for the best employees at the BMT NU Gapura Sumenep Supermarket, so that decision makers can consider these recommendations in accordance with the specified priorities.

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