Decision Support System For Determining The Best Employee Using The Visekriterijumsko Kompromisno Rangiranje Method (Case Study At Distribution Center Guardian)

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Abstract - The quality of human resources is one of the supporting factors to increase the performance productivity of a corporate agency. Highly competent human resources can support the level of performance, with performance appraisal, the achievements of each employee will be obtained. To obtain fast and accurate information on employee performance that meets the expected criteria. To find out this, with a multi-criteria decision-making method by solving complex and unstructured situations into parts and compiling them using the Visekriterijumsko Kompromisno Rangiranje (VIKOR) method on Decision Support Systems (SPK), the determination of the best employee can be calculated based on the calculation of the weight their respective criteria, so that they can quickly select the best employees in the company. From the final results of the VIKOR method, ranking 1 is Sukron, with a value of 0.

Keywords - Decision Support System, Best Employee, VIKOR

1. INTRODUCTION

Employees are one of the most important assets owned by a company in its efforts to survive, develop, compete and generate profits. Competition in the increasingly fierce business world has encouraged companies to work harder to improve the quality of their companies. One of the efforts is to improve the quality of human resources because good quality human resources can increase the productivity and performance of a company. In order to maintain and improve the quality of employees, companies need to evaluate employee performance in the form of selecting the best employees. Selection of the best employees is an aspect that is quite important in performance management [1].

The Distribution Center Guardian selects employees and rewards the best employees by evaluating their employees' performance every year. This is intended to produce productivity, healthy competition between employees with each other, increase employee

morale, minimize errors that occur at work, maintain quality, initiative in work, maintain company integrity, and good collaboration between employees with one another. as well as material for management considerations for the promotion process.

In making this application, the author uses the concept of a Decision Support System. The method used is the VIKOR method, which stands for the word (Visekriterijumsko Kompromisno Rangiranje). The VIKOR method is a ranking method and makes decisions based on the highest rank. The advantages of this method are easy to use and have good decisions for goals, objectives, and ratings [2].

Based on the background described above, the authors decided to conduct a study entitled "The Best Employee Maintenance Decision Support System Using the Visekkriterijumsko Kompromisno Rangiranje Method (Study Case Distribution Center Guardian)".

2. RESEARCH METHOD

According to M. Susilo, the waterfall model is the most widely used model for the development stage. This waterfall model is also known as the traditional model or classical model. The waterfall model is often also called the sequential linear model or the classic cycle. This waterfall model provides a sequential software lifeflow approach starting from analysis, design, coding, testing and support stages.

The stages of the waterfall method according to T.Nurhidayah:

1. Requirements

At this stage the developer must know all the information about software requirements such as the uses of the software desired by the user and also the limitations of the software being made. This information is usually taken from interviews, surveys or from discussions. The information is then processed and analyzed to obtain complete data

2. Design

The next stage is the design which is done before the coding process begins. It aims to provide a complete picture of what must be done and see how the desired system looks. Of course this helps to be more specific about hardware and system requirements and then also defines the system architecture that will be made as a whole.

3. Implementation

Then is the implementation stage such as implementing the code. Software development will be broken down into small modules which will be combined in the next stage. In this stage, a deeper examination will also be carried out, there are modules that have been made. As if it has fulfilled the desired function or not.

4. Verification or Integration Testing

The fourth stage is testing, which is carried out to test the system. At this stage, the modules that have been made at the implementation stage will be merged. System testing aims to determine whether the software is in accordance with the design and functionality of the application whether it is running well or not. So with the testing phase it can prevent errors, bugs, errors in the program before the deployment and production stages. There are also people who are responsible for conducting testing, namely quality assurance and quality control.

5. Maintenance

The last stage of the waterfall method is the maintenance application stage. After you have tested the system, you will enter the production stage and also use the software. At this stage the maintenance process is carried out, so the developer makes improvements to the errors found in the application after being used by the user.

3. RESULTS AND DISCUSSION

3.1 Theoretical basis

The results of the analysis of the system running on the proposed new system design, the authors carry out the implementation in this study. And the following is a sub-chapter regarding the results and discussion of the Distribution Center Guardian "Decision Support System For Determining The Best Employee Using The Visekriterijumsko Kompromisno Rangiranje Method", namely:

1. Make a decision-making system application for selecting the best employees.
2. Making the best employee selection decision-making application to help determine employees who deserve to be the best employees.

3.2 VIKOR Method Calculation

VIKOR is a method that was first developed and proposed by Opricovic & Tzeng in 1998[5]. VIKOR literally means optimization of multiple criteria into a compromise rating. VIKOR is used to determine the list of ranking solutions, compromise solutions, and the stability range of weights which are used as the basis for the stability of compromise solutions obtained from initial weights (initialization weights). The focus on the VIKOR method is to rank and select solutions from a series of alternatives in situations where the reference criteria conflict with each other (Opricovic, 1998). The ranking of alternative solutions is based on a measure of proximity to the ideal solution [6].

The following describes the steps carried out in the recommendations using the VIKOR method [7]:

1. Determine alternatives
2. Define criteria
3. Provide a weighted value for each alternative (Ai) for each (Ci) that has been determined
4. Arranging Alternatives and Criteria in the form of a Decision Matrix (F) Compiling criteria and alternatives in the form of a matrix. The data obtained is used as data for the Decision matrix (F). At this step, each criterion and alternative is arranged in the form of an F matrix; Aj states alternatives to i=1,2,3,...m; and Cxn states the criteria for j=1,2,3,... n.

$$F = \begin{array}{c} A_1 \\ A_2 \\ \vdots \\ A_m \end{array} \begin{bmatrix} C_{x1} & C_{x2} & \cdots & C_{xn} \\ x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

5. Determine the criteria weight (W)

Determine the weight of the criteria obtained from system users according to the needs or desired criteria. The general formula for the weight of the criteria is that the equation applies:

$$\sum_{j=1}^{n} W_{j=1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

6. Normalization Matrix (N)

Make a normalization matrix by determining positive values and negative values as the ideal solution for each criterion of the F matrix and then normalize it with the following equation:

$$N_{ij} = \frac{\left(f^+_{\,j} - f_{ij}\right)}{\left(f^+_{\,j} - f^-_{\,j}\right)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

7. Weight Normalization (F*)

Determine the weighted value of the normalized data for each alternative and criteria. Multiply between the normalized data values (N) and the specified criteria weight values (W), with the following calculations:

$$F^*{}_{ij} = w_j . N_{ij}$$ .... (4)

Information :

$F*_{ij}$: normalized data values that have been weighted for alternative i on criteria j

Wj : weight value on criteria j

N : normalized data values for alternative I on criteria ji: 1, 2, 3, …., m is the alternate sequence number

j   : 1, 2, 3, …, n is the attribute or criterion sequence number 20

8. Calculating Utility measures(S) and Regret Measures(R)

Utility measures (S) and Regret measures (R) of each alternative are calculated using the following formula:

$$S_i = \sum_{j=1}^{n} w_j \frac{(f_j^* - f_{ij})}{(f_j^* - f_j^-)}$$ (5)

$$R_i = \max_{j=1,2,...,n} \left[w_j \frac{(f_j^* - f_{ij})}{(f_j^* - f_j^-)} \right]$$ (6)

Si (maximum group utility) and Ri (minimum individual regret of the opponent), both of which state utility measures measured from the farthest and closest points from the ideal solution, while wj is the weight given to each jth criterion.

9. Calculating the value of Utility measures (S) and Regret measures (R)

Calculate the Utility Measure of each alternative. There are 2 Utility Measures that are calculated, namely the value of S and R.

10. Calculating the VIKOR index (Q)

Each alternative i is calculated for its VIKOR index using the following formula:

$$Q_i = v \left[\frac{(S_i - S^+)}{(S^+ - S^-)} \right] + (1 - v) \left[\frac{(R_i - R^+)}{(R^+ - R^-)} \right]$$ .... (7)

S- : $\min_i (Si)$

S+ : $\max_i (Si)$

R- : $\min_i (Ri)$

R+ : $\max_i (Ri)$

v   : v is a veto, namely the rule of the VIKOR method is used to calculate the VIKOR index with a value of 0.4 , 0.5 , or 0.6.

The smaller the VIKOR index (Qi), the better the alternative solution.

11. Alternative ranking

In the VIKOR method, alternative ranking is seen based on the VIKOR index value obtained and the alternative with the smallest VIKOR index with value is the most effective alternative and ranks first.

3.2.1 Alternative Data

n calculating using the VIKOR method, an alternative is needed as a comparison [12]. There are 4 alternative data taken to be taken into consideration in this study as follows:

Table 3.1 Alternative data

Alternative	Remark
A1	Sukron

A2	Syadan
A3	Ishaq
A4	Rafli

3.2.2 Criteria Data

In calculating the determination of the best employees, predetermined criteria are needed [13]. Here are 5 criteria used as material for consideration in selecting the best employees:

Table 3.2 Criteria Data

Criteria	Remark
C1	Honesty
C2	Discipline
C3	Diligent
C4	Responsible
C5	Communication

3.2.3 Sub Criteria Value Data

Table 3.3 Sub Criteria Value Data

Mark	Weight C1	Weight C2	Weight C3	Weight C4	Weight C5
Very Good	5	5	5	5	5
Good	4	4	4	4	4
Enough	3	3	3	3	3
Not Enough	2	2	2	2	2
Bad	1	1	1	1	1

3.2.4 Alternate Weight Value

Gives a weight value to each alternative (Ai) for each criterion (Ci) that has been determined.

Table 3.4 Alternative weight values

Alternative	Criteria				
	C1 (Honesty)	C2 (Discipline)	C3 (Diligent)	C4 (Responsible)	C5 (Communication)
A1 (Sukron)	5	4	5	4	3
A2 (Syadan)	4	3	4	5	5
A3 (Ishaq)	5	5	4	3	4
A4 (Rafli)	4	5	4	5	4
MAX	5	5	5	5	5
MIN	4	3	4	3	4

3.2.5 Decision Matrix

Arranging alternatives and criteria into the form of a decision matrix:

$$\begin{bmatrix} 5 & 4 & 5 & 4 & 3 \\ 4 & 3 & 4 & 5 & 5 \\ 5 & 5 & 4 & 3 & 4 \\ 4 & 5 & 4 & 5 & 4 \end{bmatrix}$$

3.2.6 Determining Criteria Weight

Based on the data given in table 3.5, the criteria weight data (W) is obtained as follows:

$$W = \begin{bmatrix} 25 & 20 & 25 & 15 & 15 \end{bmatrix}$$

3.2.7 Creating a Normalized Matrix (N)

The normalization matrix is calculated based on table 3.5, previously calculating the min and max values of each criterion. After the min and max values are obtained, then the normalization of the decision matrix N is calculated according to table 3.5, so that the following results are obtained:

$N_{1,1} \quad = \dfrac{(5-5)}{(5-4)} = 0$

$$N_{2,1} \quad = \quad \frac{(5-4)}{(5-4)} = 1$$

$$N_{3,1} \quad = \quad \frac{(5-5)}{(5-4)} = 0$$

$$N_{4,1} \quad = \quad \frac{(5-4)}{(5-4)} = 1$$

Likewise, the same method is carried out for all alternatives on the 2nd criterion to the 5th criterion and the results of normalization (N) are obtained as follows:

Table 3.5 Normalized matrix (N)

Alternative	Criteria				
	C1 (Honesty)	C2 (Discipline)	C3 (Diligent)	C4 (Responsible)	C5 (Communication)
A1 (Sukron)	0	0,5	0	0,5	1
A2 (Syadan)	1	1	1	0	0
A3 (Ishaq)	0	0	1	1	0,5
A4 (Rafli)	1	0	1	0	0,5

3.2.8 Weight Normalization(F*)

The decision matrix that has been normalized (N) is then multiplied by the weight of the criteria that have been determined, then the results are as follows:

$F^*_{1,1} = 0 \times 25 = 0$

$F^*_{2,1} = 1 \times 25 = 25$

$F^*_{3,1} = 0 \times 25 = 0$

$F^*_{4,1} = 1 \times 25 = 25$

Likewise, it is also carried out in the same way up to the 5th criterion and the weighted normalization matrix (F*) is obtained as follows:

Table 3.6 Weight normalization (F*)

Alternative	Criteria				
	C1 (Honesty)	C2 (Discipline)	C3 (Diligent)	C4 (Responsible)	C5 (Communication)
A1 (Sukron)	0	10	0	7,5	15
A2 (Syadan)	25	20	25	0	0
A3 (Ishaq)	0	0	25	15	7,5
A4 (Rafli)	25	0	25	0	7,5

3.2.9 Calculating Utility measures (S) and Regret measures (R)

Calculating Utility measures of each alternative. There are 2 Utility Measures that are calculated, namely the value of S and R. The calculation of the value of the Utility measures S according to 3.7 for each alternative is as follows:

$S_1 = F^*_{1,1} + F^*_{1,2} + F^*_{1,3} + F^*_{1,4} + F^*_{1,5}$
   $= 0 + 10 + 0 + 7,5 + 15$
   $= 32,5$

$S_2 = F^*_{2,1} + F^*_{2,2} + F^*_{2,3} + F^*_{2,4} + F^*_{2,5}$
   $= 25 + 20 + 25 + 0 + 0$
   $= 70$

$S_3 = F^*_{3,1} + F^*_{3,2} + F^*_{3,3} + F^*_{3,4} + F^*_{3,5}$
   $= 0 + 0 + 25 + 15 + 7,5$
   $= 47,5$

$S_4 = F^*_{4,1} + F^*_{4,2} + F^*_{4,3} + F^*_{4,4} + F^*_{4,5}$
   $= 25 + 0 + 25 + 0 + 7,5$
   $= 57,5$

Calculation of the value of Regret measures (R) according to table 3.7 for each alternative is as follows:

$R_1 = \max\{F^*_{1,1}; F^*_{1,2}; F^*_{1,3}; F^*_{1,4}; F^*_{1,5}\}$
$\quad = \max\{0;10;0;7,5;15)$
$\quad = 15$

$R_2 = \max\{F^*_{2,1}; F^*_{2,2}; F^*_{2,3}; F^*_{2,4}; F^*_{2,5}\}$
$\quad = \max\{25;20;25;0;0\}$
$\quad = 25$

$R_3 = \max\{F^*_{3,1}; F^*_{3,2}; F^*_{3,3}; F^*_{3,4}; F^*_{3,5}\}$
$\quad = \max\{0;0;25;15;7,5\}$
$\quad = 25$

$R_4 = \max\{F^*_{4,1}; F^*_{4,2}; F^*_{4,3}; F^*_{4,4}; F^*_{4,5}\}$
$\quad = \max\{25;0;25;0;7,5\}$
$\quad = 25$

3.2.10 Calculating Vikor Index

The next step before determining the vikor index value we first look for:

S- = $\min_i$ (Si); S+ = $\max_i$ (Si) ; R- = $\min_i$ (Ri); R+ = $\max_i$ (Ri)

S+ = obtained from the maximum value of S1 to S4

S- = obtained from the minimum value of S1 to S4

R+ = obtained from the maximum value of R1 to R4

R- = obtained from the minimum value of R1 to R4

Then the results are obtained as follows:

Table 3.7 Min and max values S1 to S4 & R1 to R4

Alternative	Mark S	Mark R
A1	32,5	15
A2	70	25
A3	47,5	25
A4	57,5	25
MIN	32,5	15
MAX	70	25

From these results we can calculate the vikor index value by:

$$Q_i = v \left[\frac{(S_i - S^+)}{(S^+ - S^-)}\right] + (1 - v)\left|\frac{(R_i - R^+)}{(R^+ - R^-)}\right]$$

Then obtained as follows:

Table 3.8 vikor index value

Alternative	With Veto = 0,5
A1 (Sukron)	0
A2 (Syadan)	1
A3 (Ishaq)	0,7
A4 (Rafli)	0,833

After getting the index value, we can rank it by looking at the value from the smallest to the largest value, where the smallest value is the best or most effective.

3.2.11 Alternative Ranking

Ranking alternatives by sorting starting from the smallest Q value:

Table 3.9 Alternative ranking

Employe Name	Index Value	Ranking
Sukron	0	1
Ishaq	1	2
Rafli	0,7	3
Syadan	0,833	4

From this ranking, we get that the most effective employee to be the best employee is Sukron.

3.3 Analysis

3.3.1 Running System

The system currently running at the Distribution Center Guardian still uses a manual method, namely using paper as an employee appraisal form, so that the information generated is sometimes inaccurate because calculations are done manually[9][10].
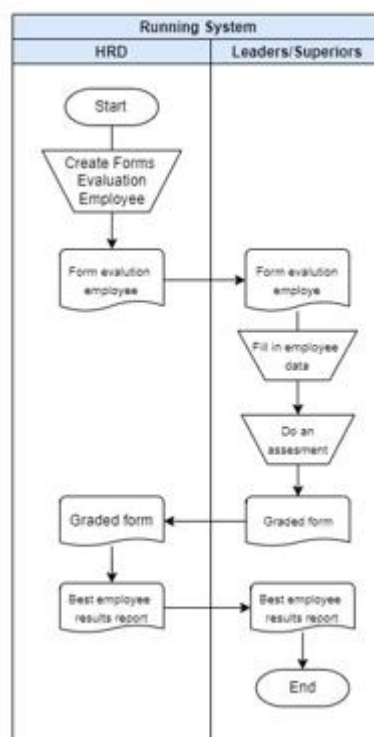

Figure 1. running system flowchart

3.3.2 Proposed System

The system that the author proposes for the process of determining the best employees at the Distribution Center Guardian is to create a website-based decision support system [11]. Leaders can evaluate employees quickly and accurately without calculating employee values manually.
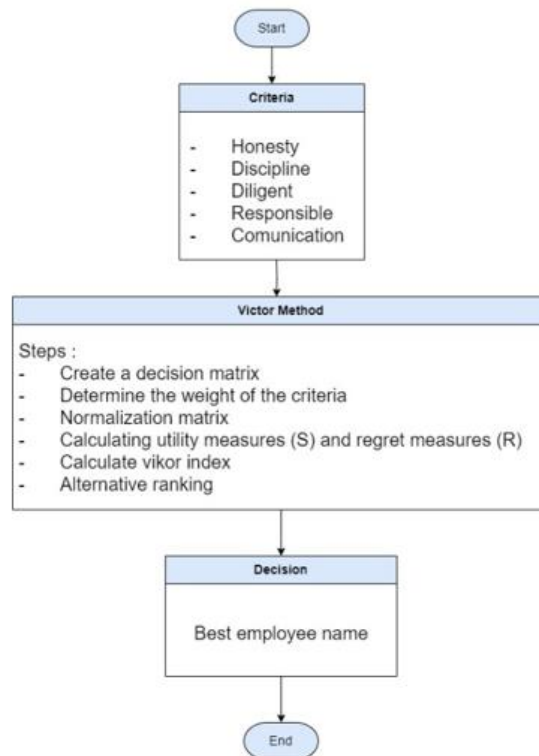
Figure 2. Flowchart proposal system

3.4 Design
3.4.1 Use Cases Diagram

This diagram describes the expected functionality of a system. The emphasized system is "there" which is done by the system and a use case represents an interaction between actors and the system.
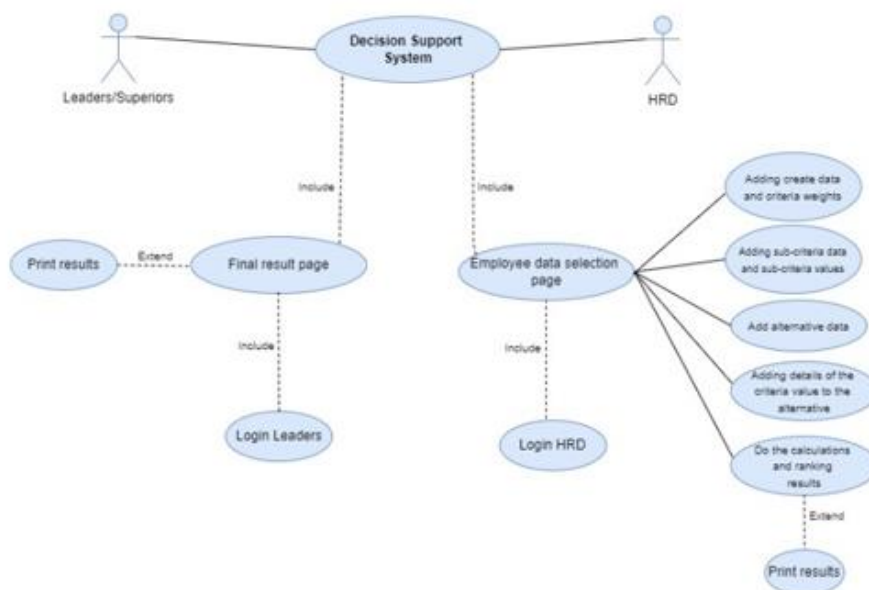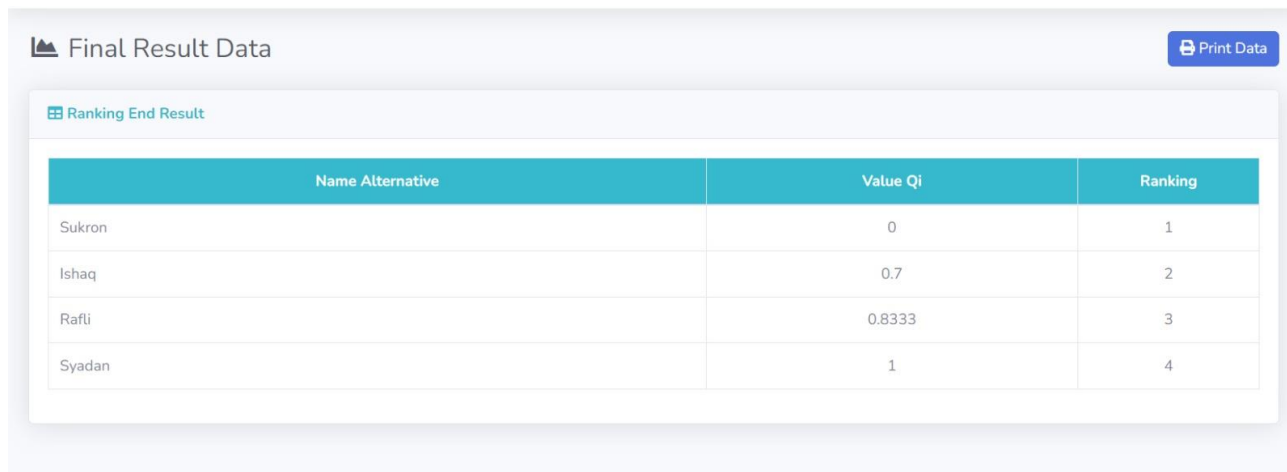

Figure 3. Use Case Diagrams

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3.5 System Implementation

The following is a system implementation or display of results from a decision support system application that has been made by the author [14][15]. On the final result data page, the admin can see the final result value and ranking from the vikor method calculation.

Figure 4. Final result data page

3.6 Black Box Testing

Blackbox is a way of testing is done by simply running or executing a unit or module and then observing whether the results of that unit are in accordance with the desired process. So Blackbox is user testing, usually software testing using the Blackbox method involves clients or customers who order the software, from here the client's wishes for the software can be seen, for example the client wants the appearance to be changed or the process of running the software to be more understandable.

No	Test Scenario	Expected Results	Test Result	Conclusion
1	Login to the system	The system displays the dasboard page	According to expectations	Valid
2	Click the criteria data menu	The system displays the criteria data	According to expectations	Valid
3	Click the sub criteria data menu	The system displays the sub criteria data	According to expectations	Valid
4	Click the alternative data menu	The system displays the alternative data	According to expectations	Valid
5	Click the assessment data menu	The system displays the assessment data	According to expectations	Valid
6	Click the calculation data menu	The system displays the calculation data	According to expectations	Valid
7	Click the final result data menu	The system displays the final result data	According to expectations	Valid
8	Click the logout menu	the system displays the login and logout pages from the dashboard page	According to expectations	Valid

4.CONCLUSION

From the results of the research and making of decision support systems that have been implemented, it can be concluded that:

1. From the final results of the VIKOR method, the 1st rank is Sukron, the 2nd rank is Ishaq, the 3rd rank is Rafli and the 4th rank is Syadan. It can be interpreted that the one who deserves to be the best employee is Sukron.

2. Decision support systems, making it easier for leaders to accurately filter or determine the best employees.

3. The best employee support decision support system has been successfully built using PHP programming and using a MySQL database to store input data.

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