BEST EMPLOYEE ASSESSMENT DECISION SUPPORT SYSTEM USING ANALYTICAL HIERARCHY PROCESS (AHP) AND ADDITIVE RATIO ASSESSMENT (ARAS) METHODS

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ARTICLE INFO

Article history
Received 10 Nov 2021
Revised 17 Nov 2021
Accepted 30 Nov 2021

Keywords
Decision Support System
Additive Ratio Assessment (ARAS)
Analytical Hierarchy Process (AHP)
Best Employees Rating

ABSTRACT

The purpose of this research is to make it easier to solve the problem of evaluating the best employees in the company PT. ASA KARYA MULTIGUNA, therefore a decision support system is needed. The Analytical Hierarchy Process (AHP) method is used for weighting criteria and the Additive Ratio Assessment (ARAS) method is used for ranking alternatives. From the results of the weighting of the criteria obtained weights for ability (0.31), initiative (0.04), discipline (0.08), performance (0.21), responsibility (0.13), attendance (0.08), communication (0.04), attitude (0.08). From the results of the alternative rankings, for the November 2020 period, the first place was Hendri Gustian, the second was Eka Wingsati Sartono, and the third was Eva Maya Fadila. In the December 2020 period, the first place was Hariyadi, the second was Hendri Gustian, and the third was Deden KuThe In the January 2021 period, the first rank was Deden Kurniawan, the second rank was Hilman Djuniarto, and the third rank was Nurhayati Natalia. The data for 3 periods from November 2020 to January 2021, which were tested managed to an average confidence level is 84.1%

1. Introduction

The development of technology and computers at this time is so fast and very influential in human life at this time. In technology and computer science, many systems can help humans work, one example is a decision support system [5]. The decision support system is an interactive system that helps in making decisions on a semi-structured or unstructured problem [8]. Deciding on a problem, both simple and complex, takes a lot of information and is accurate. Based on the information that has been collected, can be processed to support decision-making by offering alternatives.

In a company, one of the important elements is human resources or qualified and competent employees to help achieve the company's goals [6]. The company has an assessment for its employees with various predetermined criteria. Therefore the company appreciates the performance of its employees because one of the company's successes is determined by its employees. Many appreciations can be given to the best employees, such as promotions, additional salaries, bonuses, and facilities.

Employee appraisal will provide various benefits for the employee himself or the company such as providing motivation for employees to improve the quality of work, and for the company, it can have an impact on increasing productivity for the company itself [6]. However, the problem faced in evaluating the best employees is if there are many employees and many employees with the same

potential. Therefore, a decision support system is needed to solve the problem of evaluating the best employees in the company.

2. Literature Study / Hypotheses Development

A. Decision Support System

According to Agustini (2003), in research (Nugraha & Wirdayanti, 2016) the concept of a decision support system (DSS) or can be called a Decision Support System (DSS) was first revealed in the 1970s by Michael S. Scott Morton the term "Management Decision". System" regarding the definition of a decision support system is "a computer-based system whose purpose is to assist decision making in utilizing data and also certain models in solving various semi-structured and unstructured problems". Decision support systems are basically designed to support all stages of decision making starting from identifying problems, selecting data relating to previously identified problems, determining the approach used in the decision-making process, and up to evaluating alternative choices [7].

B. *Analytical Hierarchy Process* (AHP) Method

The AHP method was developed by Prof. Thomas Lorie Saaty from Wharton Business School in the early 1970s, which is used to find the order of priority or ranking of various criteria and alternatives in solving a problem. AHP is a method of measurement used to determine the ratio scale by performing pairwise comparisons of each factor. Pairwise comparisons can be determined by the intuition of actual measurement or relative measurement, degree of importance, intuition (feeling), experience, or one's facts, which is a basic scale that shows relative preferences [2].

Decision-making using the *Analytical Hierarchy Process* method generally consists of several steps, namely as follows [3]:

1. Defining the problem and determining the desired solution, then compiling a hierarchy of the problems encountered.
2. Specifies the priority of the element.
    a) Compare elements in pairs according to the given criteria to get a paired comparison.
    b) Represent the relative importance of an element to other elements by filling in a pairwise comparison matrix using numbers.
3. Synthesis

    The considerations for pairwise comparisons are synthesized to obtain the overall priority.
4. Measuring Consistency

    Knowing how good consistency is because it is important in decision-making.
5. Perform the calculation of the *Consistency Index* (CI) with the formula:

$$CI = \frac{(\lambda max - n)}{(n-1)} \quad \text{..... (1)}$$

    Where: n = number of elements
6. Perform the calculation of the *Consistency Ratio* (CR) with the formula:

$$CR = \frac{CI}{IR} \quad \text{..... (2)}$$

    where: CR = *Consistency Ratio,* CI = *Consistency Index*, IR = *Random Consistency index*

7. Check hierarchy consistency. If the value is more than 10%, then the judgment data assessment must be corrected. However, if the Consistency Ratio (CR) is less or equal to 0.1, then the calculation results can be declared correct.

C. *Additive Ratio Assessment* (ARAS) Method

Additive Ratio Assessment (ARAS) is a method used for ranking based on several existing criteria, using the *utility degree,* to compare the overall index value of each alternative to the overall index of the optimal alternative [1].

The stages in conducting the ranking process using the *Additive Ratio Assessment* method are as follows [4] :

1) Formation of Decision-Making Matrix

$$X = \begin{bmatrix} x_{01} & \dots & x_{0j} & \dots & x_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & \dots & x_{ij} & \dots & x_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{n1} & \dots & x_{mj} & \dots & x_{mn} \end{bmatrix} \quad i = \overline{0,m};\ j = \overline{1,n} \qquad \dots\dots (3)$$

Where: m = number of alternatives, n = number of criteria, x_{ij} = performance value of alternative i against criterion j, x_{0j} = optimum value of criterion j

2) Normalization of Decision-Making Matrix for all criteria

$$X = \begin{bmatrix} \overline{x}_{01} & \dots & \overline{x}_{0j} & \dots & \overline{x}_{0n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \overline{x}_{i1} & \dots & \overline{x}_{ij} & \dots & \overline{x}_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ \overline{x}_{n1} & \dots & \overline{x}_{mj} & \dots & \overline{x}_{mn} \end{bmatrix} \quad i = \overline{0,m};\ j = \overline{1,n} \qquad \dots\dots (4)$$

If the criteria used are maximum or benefit then the normalization is:

$$\overline{x}_{ij} = \frac{x_{ij}}{\sum_{n=0}^{m} x_{ij}} \qquad \dots\dots (5)$$

If the criteria used are minimum or cost, then the normalization process has 2 stages, namely:

$$x_{ij} = \frac{1}{x_{ij}^*};\ \overline{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}} \qquad \dots\dots (6)$$

Where: x_{ij} = normalized value

3) Determine the weight of the matrix that has been normalized in step 2

$$\sum_{j=1}^{n} w_j = 1 \qquad \dots\dots (7)$$

Where : W_j = criterion weight

4) Determine the value of the optimum function

$$S_i = \sum_{j=1}^{n} \hat{x}_{ij};\ i = \overline{0,m,} \qquad \dots\dots (8)$$

5) Determining the ranking level

$$K_i = \frac{S_i}{S_0};\ i = \overline{0,m,} \qquad \dots\dots (9)$$

Where : K_i = alternative ranking level value, S_i = optimum value for alternative i,

S_0 = optimum value for optimal alternative

D. Other Relevant Research

Previous research conducted by Shanka Shubhra Goswami and Soumpan Mitra (2020) with the title "Selecting The Best Mobile Model By II-26 Applying AHP-COPRAS And AHP-ARAS Decision Making Methodology". Many electronic gadgets provide benefits to people's lives. For example, like mobile phones, now mobile phones have become one of the important necessities in everyone's life. Various companies are launching new models of mobile phones all over the world with new features and better specs which leaves buyers confused. It is very difficult to choose a suitable mobile phone model among many mobile phone models. And besides that there are also many conflicting criteria. In this study, for analysis, 10 models of mobile phones or alternatives from various brands from various online shopping sites were selected that have different specifications and in terms of prices ranging from low budget to medium budget. The selection process is carried out based on 4 important criteria, namely price, internal storage, RAM, and brand. The weight of the criteria is calculated using the Analytical Hierarchy Process (AHP) and the weight of the criteria is then used in the Complex Proportional Assessment (COPRAS) and Additive Ratio Assessment (ARAS) methods. The methods of Complex Proportional Assessment (COPRAS) and Additive Ratio Assessment (ARAS) were applied to the selection of the best mobile phone and the order of preference ranking of models was also proposed by each process. The results that can be concluded from this study are that model 1, namely the Redmi 7a, is the best cellphone among the 10 models available in the market and followed by model 3, namely the Samsung J7 in the second position and model 2, namely the Samsung Galaxy A10 in the third position.

3. Methodology

The stages that will be carried out in this research are as follows:

a) Conduct literature studies by collecting information from various sources such as journals, final assignments, books, and other sources related to Decision Support Systems, especially the *Analytical Hierarchy Process* (AHP) and *Additive Ratio Assessment* (ARAS) methods.

b) Learned the concept of calculating the *Analytical Hierarchy Process* (AHP) and *Additive Ratio Assessment* (ARAS) methods.

c) Collecting data that will be used in research in the form of secondary and primary data from the company PT. ASA MULTI-PURPOSE WORKS. Collecting datasets in the form of employee assessment data from the company and conducting interviews with authorized people in the company to get a comparison value of criteria.

d) Perform software development using the *Rational Unified Process* (RUP) method.

e) Analyze the results of the tests performed.

   To get the level of suitability of the combination of *Analytical Hierarchy Process* (AHP) and *Additive Ratio Assessment* (ARAS) methods, parameters are needed to test whether the method used can solve problems in the assessment of the best employees in the company PT. ASA MULTI-PURPOSE WORKS. At this stage, the analysis of the test results is carried out by calculating the value of the level of suitability of the tests that have been carried out and the results of system testing.

f) Draw conclusions and suggestions for the software that has been built based on the results of test analysis as a result of research.

g) Make a report based on the results of the research.

There are steps of weighting criteria using the AHP method are as follows:

a) Compare each predetermined criterion in pairs.

b) Create a comparison matrix based on the results of the comparison of each criterion.

c) Make matrix normalization from the comparison matrix.

d) Add up each row of the normalized matrix and then divide by the number of criteria to get the weight.

e) Multiply the value of the first column in the comparison matrix with the first weight value, and so on, then add up each row.

f) The result of the sum of the rows is divided by the weight in question and then added up.

g) The result of the sum above is divided by the number of existing criteria, and the result is called λmax.

h) Calculate the Consistency Index (CI) with the formula CI = (λmax − n)/n.

i) Calculate the Consistency Ratio with the formula CR = CI/IR.

j) Check the results of hierarchical consistency. If the value is more than 10%, then the judge's data should be corrected. However, if the Consistency Ratio is less than 0.1, then the calculation results can be declared correct.

Alternative ranking steps are using the ARAS method are as follows:

a) Determine the optimum value of each criterion for the optimum alternative.

b) Make a matrix from the optimum alternative and the value of each criterion on the alternative.

c) Make a matrix normalization from the matrix above. If the criteria are minimum or cost then 1 is divided by the criterion value first.

d) Determine the matrix weight that has been normalized by multiplying the criterion value by the criterion weight in question.

e) Add up each row of matrix weights to get the optimum value.

f) Divide each optimum value by the optimum alternative optimum value to get the ranking level.

4. Result and Discussion

1. Implementation

The interface designs that have been made will be implemented into decision support system software using Hyper Text Mark Language (HTML), Cascading Style Sheets (CSS), and the Javascript programming language. The following displays the results of system implementation using the *Analytical Hierarchy Process* (AHP) and *Additive Ratio Assessment* (ARAS) methods:

Sriwijaya Journal of Informatic and Applications
Vol. 3, No. 1, January 2022, pp. 10-19
e-ISSN 2807-2391

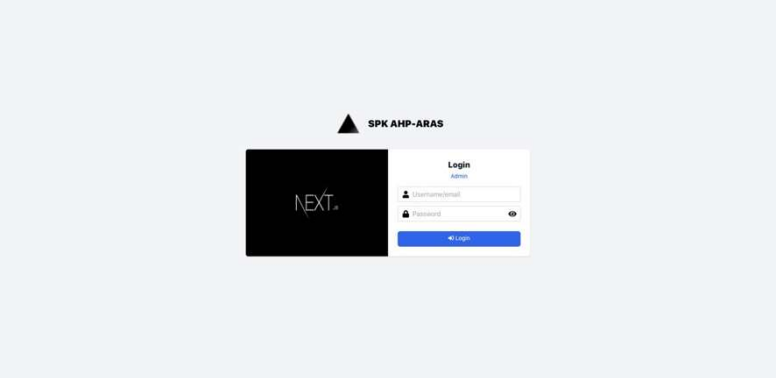

Figure 1. Admin Level User Login Page Interface

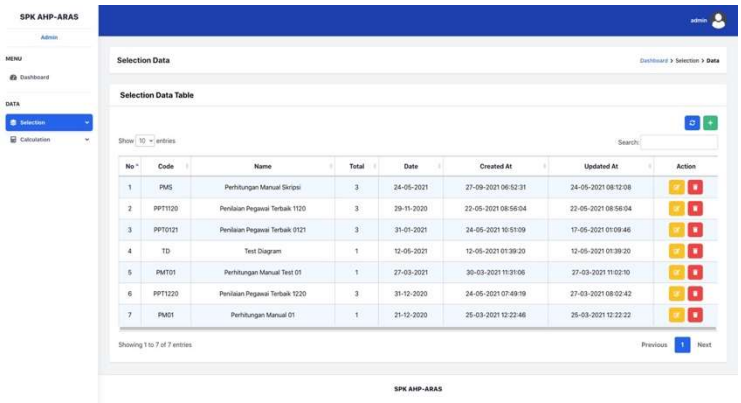

Figure 2. Selection Page Interface

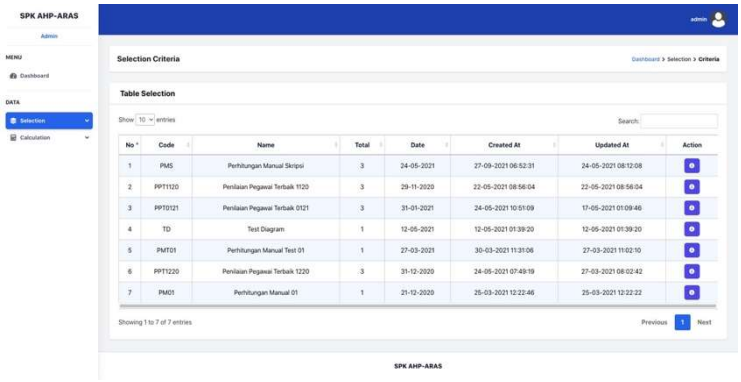

Figure 3. Criteria Selection Page Interface

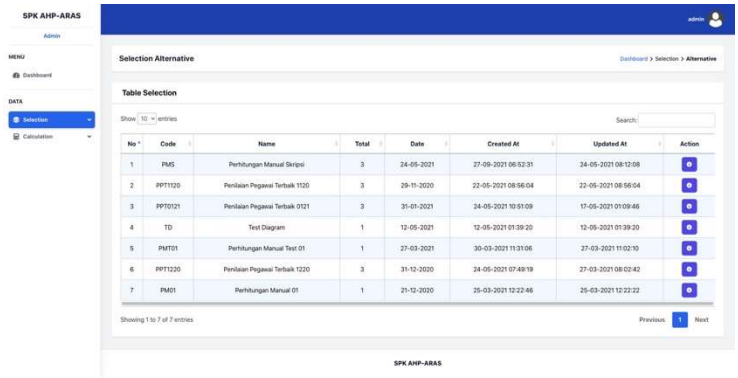

Figure 4. Alternative Selection Page Interface

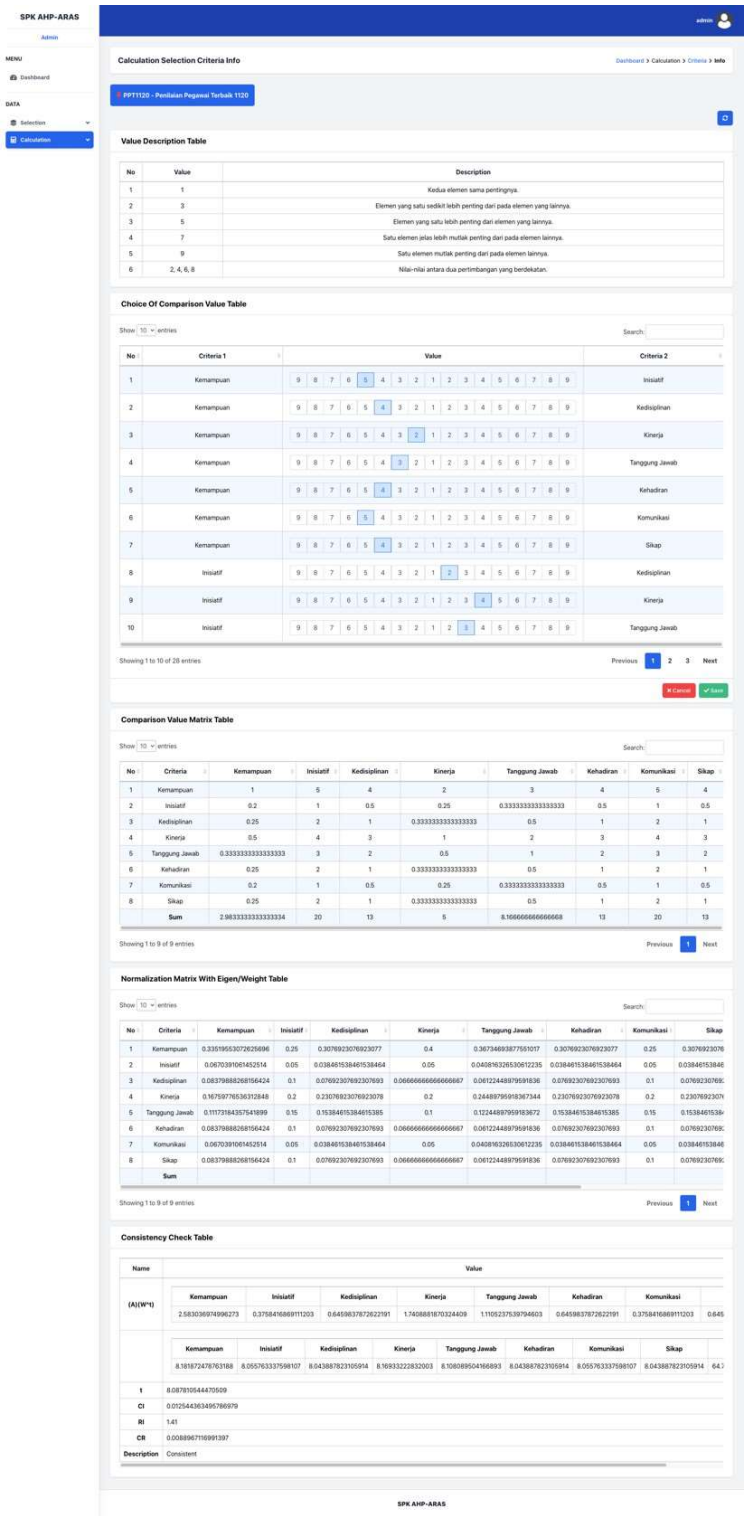

Figure 5. Interface Selection Info Page Calculation Criteria & Value Selection Form Comparison Criteria

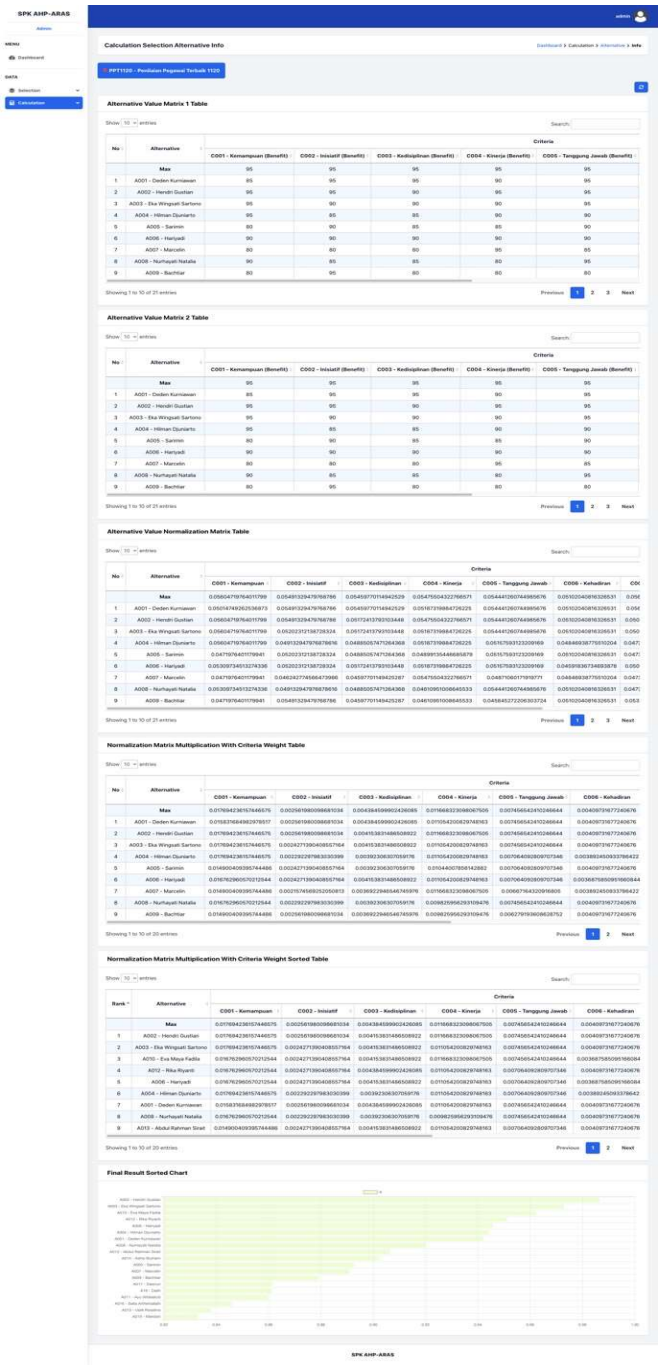

Figure 6. Calculation Alternative Selection Info Page Interface

Based on the results of tests that have been carried out on the suitability of software design and software implementation, it can be concluded that the units and interfaces built can run well. This is indicated by the conclusion that the results of the scenarios in the test cases all give the same conclusion, which is accepted.

2. Research Results and Analysis

At this stage, software testing is carried out using test data that has been obtained from the company PT. ASA KARYA MULTIGUNA has been entered into an excel file and then the data in the excel file is entered manually into the software. After getting the ranking results from the software, the compatibility level presentation will be calculated using the formula:

$$\text{Tingkat Kecocokan} = \frac{jumlah\ data\ benar}{jumlah\ data\ keseluruhan} \times 100\% \quad \text{..... (10)}$$

Table 1. Results of the Research Suitability Level Test

No	Month	Year	Number of Data Samples	AHP-ARAS	Match Rate
1	November	2020	19	17	84,2%
2	December	2020	19	16	89,4%
3	January	2021	19	15	78,9%
Average					84,1%

Table 1 can be seen the results of the comparison between the ranking results from the company and the ranking results from the software. In the table, it can be seen that the results of the match level in each period (November, December, and January) did not reach 100% because the criteria weights of the companies and the weights generated by the AHP method were different. Although the difference between the criteria weights from companies and the weights generated by the AHP method is not much different, so there are some discrepancies or differences between company rankings and software rankings. The confidence level for each period is added up and divided by the number of periods so that the average match rate is 84.1%.

5. Conclusion

Based on the implementation, the results of the experiment, and the results of the analysis that has been carried out in this study, this research concludes as follows:

1. The best employee assessment can be applied using the AHP and ARAS methods, where the AHP method is used for weighting the criteria and the ARAS method is used for alternative rankings.

2. From the results of the weighting of the criteria, the obtained weights for ability (0.31), initiative (0.04), discipline (0.08), performance (0.21), responsibility (0.13), attendance (0 .08), communication (0.04), attitude (0.08). From the results of the alternative rankings, for the November 2020 period, the first place was Hendri Gustian, the second was Eka Wingsati Sartono, and the third was Eva Maya Fadila. In the December 2020 period, the first place was Hariyadi, the second was Hendri Gustian, and the third was Deden Kurniawan. In the January 2021 period, the first place was Deden Kurniawan, the second was Hilman Djuniarto, and the third was Nurhayati Natalia.

3. The level of confidence obtained in November 2020 is 84.2%, in December 2020 is 89.4%, in January 2021 is 78.9%, from 3 periods the average yield rate The match obtained is 84.1%, so this software is quite good to use because it provides a fairly high average level of compatibility.

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