



# Implementation of the Multi-Objective Optimization Method on the Basic of Ratio Analysis (MOORA) and Entropy Weighting in New Employee Recruitment

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Submitted: 21/01/2024; Accepted: 31/01/2024; Published: 31/01/2024

**Abstract**-The problems faced by the company in managing the selection of new employees must be done in the right way so that it can help a good work cycle. The employee recruitment process still uses manual methods so the Human Resource Development (HDR) division has to sort, select and select applicants one by one. The large number of applicants means that the Human Resource Development division often experiences difficulty in selecting prospective employees and there is subjectivity when deciding which employees fit the established criteria. To overcome the problem of making employee recruitment decisions, we will use the Multi-Objective Optimization method based on ratio analysis (MOORA) and weighting using Entropy. In research, data is collected based on the position of prospective employees. The results obtained in this research determine each position that will be accepted by 3 prospective employees, namely Sales Position, Position, Graphic Design, Accounting Staff, IT Support position, Sales Project.

**Keywords:** Moora; Entropy; Employee; Decision Support System

## 1. INTRODUCTION

Laborer/Employee/Employee, is someone who works for another person or agency/office/company on a permanent basis and receives wages/salary in the form of money or goods. Workers who do not have a permanent employer are not classified as workers/employees, but as casual workers. A person is considered to have a permanent employer if they have had 1 (one) employer (person/household) in the last month, specifically in the building sector the limit is three balls. If the employer is an agency/institution, there may be more than one [1].

To get quality employees who meet qualification standards, effective recruitment efforts must be made. The problem is that sometimes companies have difficulty recruiting job applicants, so that applicants who do not actually meet the criteria or requirements are included in the interview process, or even accepted to work at the company [2].

A Decision Support System (DSS) or Decision Support System (DSS) is a system that is able to provide problem solving capabilities and communication capabilities for problems with semi-structured and unstructured conditions. This system is used to assist decision making in semi-structured situations and unstructured s where no one knows exactly how the decision should be made. In research on support systems in determining scholarship recipients for outstanding students using the alert method. Currently, technological developments in the information sector have developed rapidly. One form of technology supporting information systems is a computer. Computers have become an important medium for processing data into information that is ready to be used [3]–[8].

With the existence of SPK, it is hoped that it will be able to help in solving a problem and become an alternative for its users. A decision support system is a system that provides capabilities for problem solving and communication for semi-structured problems. [9]–[11].

Multi-Objective Optimization by Ratio Analysis (MOORA) is a method that can be used to assist the decision making process in SPK. The MOORA method was first developed by Brauers who applied it in a multi-criteria decision making process [12]–[14]. The MOORA method has a good level of selectivity in determining an alternative to a problem. The approach using the MOORA method is defined as a process simultaneously to optimize several conflicting criteria on several constraints [13]–[17].

Based on previous research that can be used as a reference in this research, among others, namely: Research conducted by Kevin Yanto Sarumaha, Handayani Simanjuntak, Fabyen Sabillah Chan. 2022 Regarding the Implementation of a Decision Support System in Recruiting New Employees Using the Multi-Objective Optimization On The Basic Of Ratio Analysis (MOORA) Method. with the highest ranking, namely Ahmad A in (A2) with a score of 22.27. So at this testing stage or research stage one of the new employees is accepted [18].

Research conducted by Asep Toyib Hidayat, et al in 2020 discussed the application of the Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) method in selecting the best salesperson with the results of the MOORA method providing excellent optimization results by including weights in the calculation process. The stages of the MOORA method are quite simple in producing the best alternative. The best alternative from the research was obtained with a value of 0.28 for 3 salespeople [19].

The research was conducted by Tanty Anggraeni, S, R. Mahdalena Simanjorang, 2019 regarding the Decision Support System for Selection for Hiring Contract Workers Using the Moora Method at the North Sumatra Regional Police Office. with results. So the results obtained using the Moora method for selecting contract workers can be ranked as follows, namely by name and the best alternative results obtained [12].

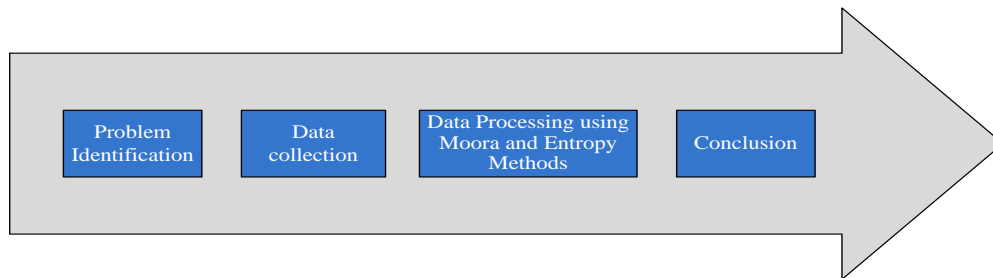
Research conducted by Fatmawati, Frisma Handayanna, Indah Purnamasari, et al in 2020 with an Online Employee Recruitment Decision Support System for Employee Recruitment Using the MOORA Method with the results of the 5 best employees being selected [20].

## 2. RESEARCH METHODOLOGY

### 2.1 Research methods

The method used in this research is the MOORA method and Entropy as weighting, this method is emphasized for the best prospective employees. To identify problems, employees are invited to provide as many thoughts as possible. The more ideas generated, the more opportunities there are to produce effective solutions. All input will be accommodated first and coordinated by the group leader. All input will be recorded as minutes so that it can later be classified according to existing needs in the field. This method can accommodate as many ideas as possible to be solved together. This method requires creativity to provide new ideas to find solutions and produce the desired output. In the end, all audiences can produce a conclusion which becomes a solution that can be agreed upon together. What is no less important in learning is using motivation and support from the audience.

### 2.2 Research Stages



**Figure 1.** Research Stages

In this research, various steps have been carried out by the author. The data collection stages used to obtain the required information include the following steps:

1. Identify the Problem  
In this initial phase, problem solving and analysis of patterns contained in the data are carried out before the design process begins.
2. Data Collection  
The second step involves data collection carried out through several methods, including observation which aims to determine criteria for prospective lecturers with the best performance.
3. Data processing with MOORA and Entropy  
In this step, research analysis is carried out after the required data has been collected. The analysis began by examining problems in the assessment of prospective new employees, including the evaluation of the old system which was still manual. Next, an analysis was carried out on the new system which uses the MOORA and Entropy methods in the calculation process
4. 4. Conclusions and Suggestions  
The last involves drawing conclusions from the entire research process. This involves evaluating whether the initial hypothesis proposed is in accordance with the research results and is the core of the overall results of this research.

### 2.3 Multi Objective Optimization on the Basis of Ratio Analysis (MOORA) Method

MOORA or what is called Multi Objective Optimization On The Basis Of Ratio Analysis is a method that is often used in making decisions. This method is often used because the steps in its application are very simple and simple so that researchers who use this method can solve problems quickly. The MOORA method is also referred to as Multi-objective which can optimize several attributes that simultaneously conflict with each other. The following are the steps for implementing the MOORA method [15]

- a Create a decision matrix starting from  $X_{11}$  to  $X_{mn}$ .

$$X = \begin{bmatrix} X_{11} & X_{12} & X_{1n} \\ X_{21} & X_{22} & X_{2n} \\ \dots & \dots & \dots \\ X_{m1} & X_{m2} & X_{mn} \end{bmatrix} \quad (1)$$



Information:

X<sub>ij</sub> : Decision Matrix of alternative i on criterion j

I : Alternative (Row)

j : Attribute/Criteria (Column)

n : Number of Attributes/Criteria

m : Number of Alternatives / Rows

- b Normalize the x matrix

$$X_{ij} = x_{ij} / \sqrt{\sum_{i=1}^m x_{ij}^2} \quad (j = 1, 2, \dots, n) \tag{2}$$

Information:

X<sub>ij</sub> : Decision Matrix for alternative i against criterion j

X\*<sub>ij</sub> : Normalization Matrix for alternative i against criterion j

i : Alternative (Row)

j : Attribute/Criteria (Column)

m : Number of Alternatives / Rows

- c Attribute optimization

$$y_i = \sum_{j=1}^g x_{ij}^* - \sum_{j=g+1}^n x_{ij}^* \tag{3}$$

Information:

X\*<sub>ij</sub> : Normalization Matrix for alternative i against criterion j

j : Attribute/Criteria (Column)

W<sub>j</sub>: Weight of alternative i on criterion j

g : Number of Attributes/Criteria (columns) with benefit criteria

g+1 : Attribute/Criteria (column) with cost criteria

n : Number of Attributes/Criteria (columns)

Y<sub>i</sub> : Optimum assessment of alternatives i

If there are weights in the normalization then you can use the following formula.

$$y_i = \sum_{j=1}^g w_j x_{ij}^* - \sum_{j=g+1}^n w_j x_{ij}^* \quad (j = 1, 2, \dots, n) \tag{4}$$

### 2.4 Entropy

The Entropy method is a method that was analyzed by Hwang and Yoon in 1981 with the aim of obtaining a weight value that is needed when carrying out the process of searching for weight values on previously determined criteria data and alternative data [16]. Therefore, to get a value using the Entropy method, you must follow the following steps:

- a Set initial data

- b Normalize the initial data

You can subtract each criterion value from the most ideal value, so that the result of the subtraction is expressed as *K<sub>ij</sub>*.

- c Find the matrix value (*a<sub>ij</sub>*)

$$a_{ij} = \frac{K_{ij}}{\sum_{i=1}^m \sum_{j=1}^n K_{ij}} \tag{5}$$

- d Calculate the Entropy value for each criterion

$$E_j = \left[ \frac{-1}{\ln m} \right] \sum_{i=1}^n [a_{ij} \ln(a_{ij})] \tag{6}$$

- e Calculate the dispersion for each criterion

$$D_j = 1 - E_j \tag{7}$$

- f Normalization of dispersion values

$$w_j = \frac{D_j}{\sum D_j} \tag{8}$$

## 3. RESULT AND DISCUSSION

Determining the best employee recruitment certainly requires a method so that it can be achieved without any doubt. In this determination, a system is created that applies a method to produce a decision. The way the MOORA method works and the weighting using Entropy is based on criteria that are determined as an assessment of each alternative to be studied. And produce rankings from these methods. The following table contains the criteria for this research.



**Table 1.** Criterion data

Code	Criteria	Weight	Type
C1	Admission Selection	0.25	Benefit
C2	Conducting Interviews	0.30	Benefit
C3	Ability/experience	0.25	Benefit
C4	Interview	0.20	Benefit

**Table 2.** Criteria Importance Weight Values

Criterion Weighting Scale	Criteria Weight
Very Good 5	5
OK 4	4
Good enough 3	3
Bad 2	2
Very bad 1	1

**3.1 Determination of Alternatives C3**

Alternative data using sample data of 10 employees can be seen in the table 3 below

**Table 3.** Alternative Data

Alternative	Name	C1	C2	C3	C4
A1	Ismail	Good	Very good		Very good
A2	Hariani	Very good	Good	Good	Good
A3	Hartati	Very good	Very good	Good	Very good
A4	Wulansari	Good	Good	Very good	Good
A5	Julianda	Good	Very good	Very good	Very good
A6	Rahman	Good	Pretty good	Pretty good	Pretty good
A7	Mustika	Good	Very good	Good	Very good
A8	Suriani	Good	Good	Good	Good
A9	F Sidabutar	Very good	Good	Pretty good	Good
A10	Abdul Rajak	Good	Pretty good	Good	Pretty good

**Table 4.** Suitability Rating

Alternative	Name	C1	C2	C3	C4
A1	Ismail	4	5	4	5
A2	Hariani	5	4	4	4
A3	Hartati	5	5	5	5
A4	Wulansari	4	4	5	4
A5	Julianda	4	5	3	5
A6	Rahman	4	3	4	3
A7	Mustika	4	5	4	5
A8	Suriani	4	4	3	4
A9	F Sidabutar	5	4	4	4
A10	Abdul Rajak	4	3	5	3

**3.2 Implementation of the Entropy**

Based on the criteria data table, there is no weight value yet to obtain a weight value that can be analyzed using the Entropy method as follows:

a Setting Initial Data

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

From Table 2 you can see all the benefit type criteria, so

$$\text{Max}(X_{ij}) = C1=5, C2=5, C3=5, C4=5$$

b Normalize initial data for benefit criteria

P1

$$K_{11} = \frac{4}{5} = 0,8$$

$$K_{12} = \frac{5}{5} = 1$$

$$K_{13} = \frac{4}{5} = 0,8$$

$$K_{14} = \frac{5}{5} = 1$$

Calculation of Normalization of Alternatives from P2 to P10 Like P1. After carrying out the normalization calculation process for all alternatives, the results of the normalized matrix data are as in table 5 below

**Table 5.** Matrix Normalization Data

Alternative	C1	C2	C3	C4
A1	0,8	1	0,8	1
A2	1	0,8	0,8	0,8
A3	1	1	1	1
A4	0,8	0,8	1	0,8
A5	0,8	1	0,6	1
A6	0,8	0,6	0,8	0,6
A7	0,8	1	0,8	1
A8	0,8	0,8	0,6	0,8
A9	1	0,8	0,8	0,8
A10	0,8	0,6	1	0,6
Sum	8,6	8,4	8,2	8,4

c Determine the matrix value ( $a_{ij}$ )

$$a_{ij} = \frac{K_{ij}}{\sum_{i=1}^m \sum_{j=1}^n K_{ij}}$$

P1

$$a_{11} = \frac{0,8}{8,6} = 0,093023256$$

$$a_{12} = \frac{1}{8,4} = 0,119047619$$

$$a_{13} = \frac{0,8}{8,2} = 0,097560976$$

$$a_{14} = \frac{1}{8,4} = 0,119047619$$

The calculation to determine the value of alternative matrices P2 to P10 is carried out like P1. Based on the calculations above, the data results obtained are the  $a_{ij}$  matrix values which can be seen in Table 6 below.

**Table 6.** Matrix Value Data  $a_{ij}$

Alternative	C1	C2	C3	C4
A1	0,093023	0,119048	0,097561	0,119048
A2	0,116279	0,095238	0,097561	0,095238
A3	0,116279	0,119048	0,121951	0,119048
A4	0,093023	0,095238	0,121951	0,095238
A5	0,093023	0,119048	0,073171	0,119048
A6	0,093023	0,071429	0,097561	0,071429
A7	0,093023	0,119048	0,097561	0,119048
A8	0,093023	0,095238	0,073171	0,095238
A9	0,116279	0,095238	0,097561	0,095238
A10	0,093023	0,071429	0,121951	0,071429

d Calculation of Entropy values for each criterion ( $E_j$ )

P1

$$E_j = \left[ \frac{-1}{\ln m} \right] \sum_{i=1}^n [a_{ij} \ln(a_{ij})]$$

$$a_{11} = [a_{11} \ln a_{11}] = [0,093023256(\ln 0,093023256)] = -0,318722303$$

$$a_{21} = [a_{21} \ln a_{21}] = [0,119047619(\ln 0,119047619)] = -0,365522539$$

$$a_{31} = [a_{31} \ln a_{31}] = [0,097560976(\ln 0,097560976)] = -0,327566049$$

$$a_{41} = [a_{41} \ln a_{41}] = [0,093023256(\ln 0,093023256)] = -0,805842652$$



To obtain  $E_2$  to  $E_{10}$  it is calculated in the same way as  $E_1$ . After calculating the Entropy value for each criterion, we obtain:

$$E_1 = -0,805842652$$

$$E_2 = 0,269807628$$

$$E_3 = -0,000817932$$

$$E_4 = 0,243805047$$

$$E_5 = -1,597904354$$

$$E_6 = 0,6219428$$

$$E_7 = -0,805842652$$

$$E_8 = -0,529712914$$

$$E_9 = 0,269807628$$

$$E_{10} = 0,744636686$$

e Calculate the dispersion for each criterion

$$D_j = 1 - E_j$$

$$D_1 = 1 - 0,119047619 = 1,805842652$$

$$D_1 = 1 - -0,805842652 = 1,805842652$$

$$D_2 = 1 - 0,269807628 = 0,730192372$$

$$D_3 = 1 - -0,000817932 = 1,000817932$$

$$D_4 = 1 - 0,243805047 = 0,756194953$$

$$D_5 = 1 - -1,597904354 = 2,597904354$$

$$D_6 = 1 - 10,6219428 = 0,3780572$$

$$D_7 = 1 - -0,805842652 = 1,805842652$$

$$D_8 = 1 - -0,529712914 = 1,529712914$$

$$D_9 = 1 - 0,269807628 = 0,730192372$$

$$D_{10} = 1 - 0,744636686 = 0,255363314$$

$$\sum 1,805842652 + 0,730192372 + 1,000817932 + 0,756194953 + 2,597904354 + 0,3780572$$

$$+ 1,805842652 + 1,529712914 + 0,730192372 + 0,255363314$$

$$= 11,59012071$$

f Normalization of dispersion values

$$w_j = \frac{D_j}{D_j}$$

$$W_1 = \frac{1,805842652}{11,59012071} = 0,155808787$$

$$W_2 = \frac{0,730192372}{11,59012071} = 0,063001274$$

$$W_3 = \frac{1,000817932}{11,59012071} = 0,08635095$$

$$W_4 = \frac{0,756194953}{11,59012071} = 0,065244787$$

$$W_5 = \frac{2,597904354}{11,59012071} = 0,224148171$$

$$W_6 = \frac{0,3780572}{11,59012071} = 0,032618918$$

$$W_7 = \frac{1,805842652}{11,59012071} = 0,155808787$$

$$W_8 = \frac{1,529712914}{11,59012071} = 0,131984209$$

$$W_9 = \frac{0,730192372}{11,59012071} = 0,063001274$$

$$W_{10} = \frac{0,255363314}{11,59012071} = 0,022$$

**Table 7.** Criteria Weight Value Data

Alternative	C1	C2	C3	C4	Bobot	Tipe
A1	0,093023256	0,119047619	0,097560976	0,119047619	0,155808787	Benefit
A2	0,11627907	0,095238095	0,097560976	0,095238095	0,063001274	Benefit
A3	0,11627907	0,119047619	0,12195122	0,119047619	0,08635095	Benefit
A4	0,093023256	0,095238095	0,12195122	0,095238095	0,065244787	Benefit
A5	0,093023256	0,119047619	0,073170732	0,119047619	0,224148171	Benefit



Alternative	C1	C2	C3	C4	Bobot	Tipe
A6	0,093023256	0,071428571	0,097560976	0,071428571	0,032618918	Benefit
A7	0,093023256	0,119047619	0,097560976	0,119047619	0,155808787	Benefit
A8	0,093023256	0,095238095	0,073170732	0,095238095	0,131984209	Benefit
A9	0,11627907	0,095238095	0,097560976	0,095238095	0,063001274	Benefit
A10	0,093023256	0,071428571	0,12195122	0,071428571	0,022032843	Benefit

### 3.3 Implementation of MOORA Method

After obtaining alternative values that have been weighted, the process is carried out using the MOORA method

a Step 1: Create a Decision Matrix X taken from Table 4.

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

b Step 2: Normalize the Matrix to calculate the value of each Criterion, Normalize the X Matrix Using the 1st equation

$$K1 = \sqrt[4]{4^2 + 5^2 + 5^2 + 4^2 + 4^2 + 4^2 + 4^2 + 4^2 + 5^2 + 4^2} = \sqrt[4]{187} = 34969$$

$$A1 = \frac{4}{34969} = 0,29250897$$

$$A2 = \frac{5}{34969} = 0,365636212$$

$$A3 = \frac{5}{34969} = 0,365636212$$

$$A4 = \frac{4}{34969} = 0,29250897$$

$$A5 = \frac{4}{34969} = 0,29250897$$

$$A6 = \frac{4}{34969} = 0,29250897$$

$$A7 = \frac{4}{34969} = 0,29250897$$

$$A8 = \frac{4}{34969} = 0,29250897$$

$$A9 = \frac{5}{34969} = 0,365636212$$

$$A10 = \frac{4}{34969} = 0,29250897$$

To obtain K2 to K4 it is calculated in the same way as K1.

c Step 3 weighted normalization matrix. The results of normalizing matrix

$$X = \begin{bmatrix} 0,29250897 & 0,370624658 & 0,304114369 & 0,370624658 \\ 0,36563621 & 0,296499727 & 0,304114369 & 0,296499727 \\ 0,36563621 & 0,370624658 & 0,380142961 & 0,370624658 \\ 0,29250897 & 0,296499727 & 0,380142961 & 0,296499727 \\ 0,29250897 & 0,370624658 & 0,228085776 & 0,370624658 \\ 0,29250897 & 0,222374795 & 0,304114369 & 0,222374795 \\ 0,29250897 & 0,370624658 & 0,304114369 & 0,370624658 \\ 0,29250897 & 0,296499727 & 0,228085776 & 0,296499727 \\ 0,36563621 & 0,296499727 & 0,304114369 & 0,296499727 \\ 0,29250897 & 0,222374795 & 0,380142961 & 0,222374795 \end{bmatrix}$$

d Step 4: Process of Optimizing Attributes, Namely the Results of Multiplication by Criteria Weights.

$$y_i = \sum_{j=1}^g x_{ij}^* - \sum_{j=g+1}^n x_{ij}^*$$

$$K_1 = A_{11} = 0,25 \times 0,29250897$$

$$K_2 = A_{12} = 0,25 \times 0,36563621$$

$$K_3 = A_{13} = 0,25 \times 0,36563621$$

$$K_4 = A_{14} = 0,25 \times 0,29250897$$

$$K_5 = A_{15} = 0,25 \times 0,29250897$$

$$K_6 = A_{16} = 0,25 \times 0,29250897$$

$$K_7 = A_{17} = 0,25 \times 0,29250897$$

$$K_8 = A_{18} = 0,25 \times 0,29250897$$

$$K_9 = A_{19} = 0,25 \times 0,36563621$$

$$K_{10} = A_{10} = 0,25 \times 0,29250897$$



e Calculate the  $Y_i$  value

Table 8.  $Y_i$  Value Search

Alternative	Max = (C1+C2+C3+C4)				Min	$Y_i = \text{Max} - \text{Min}$
A1	0,073127242	0,111187397	0,076028592	0,074124932	0	0,334468164
A2	0,091409053	0,088949918	0,076028592	0,059299945	0	0,315687508
A3	0,091409053	0,111187397	0,095035740	0,074124932	0	0,371757122
A4	0,073127242	0,088949918	0,095035740	0,059299945	0	0,316412846
A5	0,073127242	0,111187397	0,057021444	0,074124932	0	0,315461016
A6	0,073127242	0,066712438	0,076028592	0,044474959	0	0,260343232
A7	0,073127242	0,111187397	0,076028592	0,074124932	0	0,334468164
A8	0,073127242	0,088949918	0,057021444	0,059299945	0	0,278398550
A9	0,091409053	0,088949918	0,076028592	0,059299945	0	0,315687508
A10	0,073127242	0,066712438	0,095035740	0,044474959	0	0,279350380
						<b>0,371757122</b>

f Next Step Ranking of calculation results

Table 9. Ranking Results

Alternative	$Y_i$	Rank
A3	0,371757122	1
A1	0,334468164	2
A7	0,334468164	2
A9	0,315687508	2
A10	0,27935038	2
A4	0,316412846	3
A5	0,315461016	4
A8	0,27839855	4
A2	0,315687508	5
A6	0,260343232	6

From table 9 of the rankings that have been carried out, it can be seen that the Hartati Alternative is the highest alternative with a value of 0.371757122, which is the highest ranking with rank 1, so it can be declared the best alternative

### 4. CONCLUSION

After the author has conducted research, the author can conclude that the application of the MOORA and ENTROPY methods is one of the techniques in completing research because this method can find employees whose criteria meet the company's needs, namely Hartati. The results of the research can determine that alternative A3 is the best alternative with a value of 0,371757122. Therefore, the author applies the MOORA and ENTROPY methods to find accurate and logical results.

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