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Comparison of MOOSRA and MOORA Methods in the Decision Support System for the Selection of Outstanding Students

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Abstract−Outstanding student is a student activity in every achievement of high performance in the form of curricular, co-curricular or extracurricular to choose and give an award. In both public and private universities, they select outstanding students using a decision support system. A decision support system is a computer-based system that produces information in solving a problem to support or encourage a decision-making process in a semi-structured and unstructured situation. To solve the problem in this case, the decision support system applies the MOOSRA (Multi-objective Optimization on the Basis of Simple Ratio Analysis) and MOORA (Multi-objective Optimization on the Basis of Ratio Analysis) methods. The author has prepared seven alternative data and seven criteria data along with the weighting using the ROC (Rank Order Centroid) method. From the calculation of the two methods, the highest alternative results are different. From the calculation of the MOOSRA method, the highest alternative was obtained, namely Rohan (A6) with a final preference value of 66.7937, while for the calculation of the MOORA method, the highest alternative was obtained, namely Khairunisa (A4) with a final preference value of 0.3955.

Keywords: Decision Support System (DSS); MOOSRA Method; MOORA Method; Outstanding Student

1. INTRODUCTION

Outstanding students are a student activity in every high performance achievement in the form of curricular, co-curricular, or extracurricular to select and give an award [1],[2]. Students who are expected not only to pursue knowledge in their fields, but also to develop *soft skills* Each of them to become independent, initiative-driven, meticulous and responsible graduates. In this study, the selection of outstanding students to carry out the selection of outstanding students (Pilmapres) can be applied in stages starting from the faculty, university, and national levels with established procedures. Budi Darma University Medan is one of the private universities that has quite a lot of students. In the University, the selection of outstanding students is carried out which is useful to motivate students, give an award to students for their performance and encourage the environment of a university in facilitating students to achieve an achievement [3],[4][5].

The selection of outstanding students at state and private universities is an election that many students look forward to. To conduct the selection, of course, Budi Darma University has determined several criteria that have their own weight value as a determination for the selection of outstanding students in the form of Semester Achievement Index (IPS), Scientific Writings, Superior Achievements, English, Personality, Active Students and Semesters [6]. For the social studies criterion is one of the very important assessments of the semester scores obtained by students, for the criteria for Scientific Writing, namely students who are able in scientific writings published in the media, for the criteria for Achievement that is superior, namely the assessment of the results achieved by students in any activity, for the English criterion, namely students who are able to speak good English, for the Personality criterion, namely students must have a very good personality, for the Active Student criterion, namely students who are active in organizing is very important in honing their abilities, and the last is the Semester criterion, namely the semester that students are currently undergoing, which is very influential in the assessment [7]. Because many students have the same criteria, a problem arises, namely the lack of effectiveness in selecting outstanding students. With this problem, it is necessary that one of the systems used in this study is a decision support system (DSS) to make it easier to select outstanding students.

Decision Support System (DSS) is a computer-based system that produces information in solving a problem to support or encourage a decision-making process that is semi-structured and unstructured [8]. In this study, a decision support system will be built with methods such as the MOOSRA method *(Multi-objective Optimization on the Basis of Simple Ratio Analysis)* and MOORA *(Multi-objective Optimization on the Basis of Ratio Analysis)*. With the method applied in the decision support system (DSS) above, the author is interested in comparing alternative values that have been determined as a reference in this study. The methods commonly used in the decision support system are the MOORA, MOOSRA, SAW, WP, MAUT and TOPSIS methods.

Several studies have applied the Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) method in various areas of decision-making. Christy, Aditia, and Ananda In 2024 apply the MOORA method in selecting outstanding students by utilizing various assessment criteria such as academics, attitudes, and student activeness to produce objective and accurate decisions [9]. Furthermore, Nasution and Irmayani in 2022 used the MOORA method in the selection of proposals for the best Independent Entrepreneurial Student activities, where this method is able to help the process of ranking proposals based on feasibility, innovation, and benefits criteria in a

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systematic and transparent manner. Furthermore, research conducted by Rahma Yuni Simanullang and Mesran in 2023 which discusses the application of the Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA) method with the weighting of Rank Order Centroid (ROC) in a decision support system [10]. This study emphasizes that the combination of MOORA and ROC methods is able to produce a more objective alternative ranking process because the weight of the criteria is determined systematically based on the priority level [3].

From the explanation of the above statement, the author can conclude that the purpose of this study is to help the selection of outstanding students in universities and private universities by using a decision support system (DSS) assisted by the application of the MOOSRA and MOORA methods In this study, the author hopes that it will provide more accurate and appropriate information in determining the selection of outstanding students at Budi Darma University Medan.

2. RESEARCH METHODOLOGY

2.1 Research Stages

In conducting this research, the author carried out several stages where the stages are also described in the flow diagram in Figure 1. Here's the explanation:

a. Problem Analysis
   In this stage, analyze alternative values, criteria along with the weighting and ranking of problems that apply the decision support system with its methods.
b. Literature Study
   In this stage, data or information related to research cases is obtained from various sources such as books, journals, other articles and internet media.
c. Application of Methods
   In this phase, the method built to solve the problem case of this research is applied using the MAUT method from the data obtained to determine the selection of outstanding students.
d. Method Comparison Results
   For this stage, the results of the calculation method were compared with the alternative values and the final ranking results.
e. Conclusion
   At this stage, the results of the discussion in this study are expressed in the form of writing a research report.

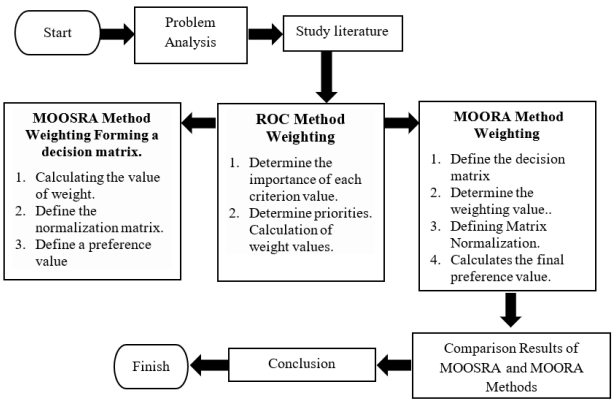

Figure 1. Research Stage Framework

2.2 Decision Support System (DSS)

Decision Support System (DSS) is a computer-based system that produces information in solving a problem to support or encourage a decision-making process that is semi-structured and unstructured [11],[12],[13].

2.3 Outstanding students

Outstanding students are students who are able to achieve high achievements, both curricular, co-curricular, and extracurricular on the criteria that have been determined to achieve an award. These achievements can be realized through success in the academic field, activeness in student organizations, participation in social activities, and achievements in various competitions at the local, national, and international levels. Outstanding students are also characterized by discipline, responsibility, integrity, and the ability to think critically and innovatively that are able to make a positive contribution to the campus environment and the wider community [14].

2.4 Multiobjective *Optimization Method on the Basis of Simple Ratio Analysis* (MOOSRA)

Multiobjective Optimization on the Basis of Simple Ratio Analysis (MOOSRA) is the formulation of alternative parameters, criteria, attributes, weights or coefficients on each criterion to measure performance related to the criteria

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in optimizing multi-purpose used to calculate alternative values, the results of weighting values from criteria that are normalized by the application of ranking [15],[16],[17]. The steps to complete the decision support system with the MOOSRA method are as follows:

a. Forming a Decision Matrix
In forming a Decision Matrix, it can be obtained from criterion and alternative data where the alternative value is connected to each criterion value is applied with the following matrix equation:

$$Xij = \begin{bmatrix} X_{1i} & X_{1j} & . & X_{1n} \\ X_{i1} & X_{ij} & . & X_{2n} \\ . & . & . & . \\ X_{m1} & X_{mj} & . & X_{mn} \end{bmatrix} \quad (1)$$

b. Defining the Normalization Matrix
The following are used to normalize the elements of the decision matrix in the MOOSRA method:

$$X_{ij}^{*} = \frac{x_{ij}}{\sqrt{|\sum_{i=1}^{m} xij^{2}|}} \quad (2)$$

c. Determining Preference Values
Furthermore, all alternative values are calculated as useful calculations in the weightless criterion values using the following formula:

$$y_{ij}^{*} = \frac{\sum_{j=1}^{g} x_{ij}^{*}}{\sum_{j=g+1}^{n} x_{ij}^{*}} \quad (3)$$

If we use the weight of interests in each criterion, it is formulated as follows:

$$y_{ij}^{*} = \frac{\sum_{j=1}^{g} wjx_{ij}^{*}}{\sum_{j=g+1}^{n} wjx_{ij}^{*}} \quad (4)$$

2.5 Multi-objective Optimization on the Basis of Ratio Analysis *(MOORA)* Method

Method *Multi-objective Optimization on the Basis of Ratio Analysis* (MOORA) is a method that analyzes alternative values based on the output of the total of all benefit criteria and cost criteria that are processed to simultaneously optimize two or more of the opposite criteria by maximizing the benefit criteria and minimizing the cost criteria [18],[19].

a. Determining the Decision Matrix
In determining a matrix, a decision is formed from the matching rating of alternative values and criteria with the following matrix equations:

$$Xij = \begin{bmatrix} X_{11} & X_{12} & . & X_{1n} \\ X_{21} & X_{22} & . & X_{2n} \\ . & . & . & . \\ X_{M1} & X_{m2} & . & X_{mn} \end{bmatrix} \quad (5)$$

b. Defining Matrix Normalization
To determine the matrix of element normalization in the MOORA method, it is formulated as follows:

$$X_{ij}^{*} = \frac{Xij}{\sqrt{[\sum_{i=1}^{m} Xij^{2}]}} \quad (6)$$

c. Calculating the final Preference Value
After that, the alternative value is calculated as the final preference value in the weightless calculation formulated as follows:

$$y_{i}^{*} = \sum_{j=1}^{g} x_{ij}^{*} - \sum_{j=g+1}^{n} x_{ij}^{*} \quad (7)$$

If using weights, it can be formulated as follows [20]:

$$y_{i}^{*} = \sum_{j=1}^{g} w_{j} x_{ij}^{*} - \sum_{j=g+1}^{n} w_{j} x_{ij}^{*} \quad (8)$$

3. RESULTS AND DISCUSSION

In the results and discussion of the application of the decision support system with the MAUT method for the completion of the selection of outstanding students. In the application of a decision support system that requires data in the form of alternatives, criteria and their weights to produce effective information, can be seen in the presentation process below:

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3.1 Application of Alternatives, Criteria and Weights

In determining the value of the Alternative, the most important criterion and weight value is to add information from each table to find out the results of the best alternative to be taken. Therefore, it can be seen in Table 1 that the author has analyzed seven alternative data for the selection of outstanding students at Budi Darma University Medan as follows:

Table 1. Alternative Student Data

Alternative	Student Name
A1	Andreas
A2	Zaza Mutiara
A3	Ahmad Ismail
A4	Khairunisa
A5	Azmi aziza
A6	Rohan
A7	Maringan Sitanggang

From the alternative student data above, the criteria data for the selection requirements for outstanding students at Budi Darma University can be determined. In the case of this study, the author determined seven criteria data in the form of benefits and costs, which can be seen in table 2 as follows:

Table 2. Criteria Data

Criterion	Information	Kind
C1	Semester Achievement Index (IPS)	Benefit
C2	Scientific Papers	Benefit
C3	Achievement	Benefit
C4	English	Benefit
C5	Personality	Benefit
C6	Organize	Benefit
C7	Semester	Cost

Description from Table 2 :
Semester Achievement Index (IPS) : The highest social studies is a great opportunity
Scientific Papers : Students have Scientific Papers that are prioritized
Achievement : The achievement with the most superiority is prioritized
English : Students must be able to speak English
Personality : Students who have a very good personality are prioritized.
Organize : Students who are active in organizations are favored
Semester : The lowest semester is preferred.

After obtaining alternative student data and criterion data, the author matches alternative data with the criteria data that has been determined as follows:

Table 3. Alternative Match Ratings with Criteria

Alternative	C1	C2	C3	C4	C5	C6	C7
A1	3.79	Exist	2	Good	Good	BPC	7
A2	3.70	Exist	1	Less	Excellent	BPC	5
A3	3.57	None	1	Less	Good	CIFOR	7
A4	3.84	Exist	3	Excellent	Excellent	CIFOR	7
A5	3.82	None	1	Less	Excellent	SSBD	7
A6	3.40	Exist	2	Good	Good	KMK	5
A7	3.65	None	1	Less	Good	CIFOR	7

Based on the data of alternative compatibility with the criteria, it is necessary to search for weight values using ROC *(Rank Order Centroid)* weighting. The calculation for weighting is as follows:

$$W_1 = \frac{1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}+\frac{1}{7}}{7} = 0.37$$

$$W_2 = \frac{0+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}+\frac{1}{7}}{7} = 0.23$$

$$W_3 = \frac{0+0+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}+\frac{1}{7}}{7} = 0.16$$

$$W_4 = \frac{0+0+0+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}+\frac{1}{7}}{7} = 0.11$$

$$W_5 = \frac{0+0+0+0+\frac{1}{5}+\frac{1}{6}+\frac{1}{7}}{7} = 0.07$$

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$$W_6 = \frac{0+0+0+0+0+\frac{1}{6}+\frac{1}{7}}{7} = 0.04$$

$$W_7 = \frac{0+0+0+0+0+0+\frac{1}{7}}{7} = 0.02$$

The search for weighted values based on the criterion value obtained C1 is 0.37, C2 is 0.23, C3 is 0.16, C4 is 0.11, C5 is 0.07, C6 is 0.04, and C7 is 0.02. In table 3 above, there are a number of linguistic data such as Scientific Writing, English, Personality, and Active Students. Data like this is weighted, the weighting can be seen in Table 4 as follows:

Table 4. The Value of Scientific Writing

Information	Weight
Exist	2
None	1

The following Table 5 presents the assessment criteria for students' English proficiency which is grouped into three categories, namely excellent, good, and poor, with each weight that has been determined as the basis for assessment.

Table 5. English Language Values

Information	Weight
Excellent	3
Good	2
Less	1

Table 6 shows the classification of the assessment of students' personality aspects which are divided into three main categories, namely excellent, good, and poor, each of which has a certain weight as an indicator of character assessment.

Table 6. Personality Values

Information	Weight
Excellent	3
Good	2
Less	1

Table 7 illustrates the assessment of student activity based on participation in various organizational activities, such as BPC, CIFOR, KMK, and SSBD, each of which is given weight as a form of participation assessment.

Table 7. Active Student Value

Information	Weight
BPC	1
CIFOR	1
KMK	1
SSBD	1

Based on the table above, original data has been obtained from alternative data and weighted criteria, the match rating data is obtained, which can be seen in Table 8 as follows:

Table 8. Match Rating Data

Alternative	C1	C2	C3	C4	C5	C6	C7
A1	3.79	2	2	2	2	1	7
A2	3.70	2	1	1	3	1	5
A3	3.57	1	1	1	2	1	7
A4	3.84	2	3	3	3	1	7
A5	3.82	1	1	1	3	1	7
A6	3.40	2	2	2	2	1	5
A7	3.65	1	1	1	2	1	7

3.2 Application of *the Multiobjective Optimization Method on the Basis of Simple Ratio Analysis* (MOOSRA)

Based on the match rating data above, the MOOSRA method is calculated as a solution for the selection of outstanding students. The calculation steps are as follows:

a. Preparing the Decision Matrix (*XIJ*)

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$$x_{ij}\begin{bmatrix}3.79 & 2 & 2 & 2 & 2 & 1 & 7\\ 3.70 & 2 & 1 & 1 & 3 & 1 & 5\\ 3.57 & 1 & 1 & 1 & 2 & 1 & 7\\ 3.84 & 2 & 3 & 3 & 3 & 1 & 7\\ 3.82 & 1 & 1 & 1 & 3 & 1 & 7\\ 3.40 & 2 & 2 & 2 & 2 & 1 & 5\\ 3.65 & 1 & 1 & 1 & 2 & 1 & 7\end{bmatrix}$$

b. Defining the Normalization Matrix

For Criterion C1, namely the Semester Achievement Index (Benefit)

$$x_{1.1}^{*}=\frac{3.79}{\sqrt{3.79^2+3.70^2+3.57^2+3.84^2+3.82^2+3.40^2+3.65^2}}=\frac{3.79}{9.7478}=0.3888$$
$$x_{2.1}^{*}=\frac{3.70}{\sqrt{3.79^2+3.70^2+3.57^2+3.84^2+3.82^2+3.40^2+3.65^2}}=\frac{3.70}{9.7478}=0.3796$$
$$x_{3.1}^{*}=\frac{3.57}{\sqrt{3.79^2+3.70^2+3.57^2+3.84^2+3.82^2+3.40^2+3.65^2}}=\frac{3.57}{9.7478}=0.3662$$
$$x_{4.1}^{*}=\frac{3.84}{\sqrt{3.79^2+3.70^2+3.57^2+3.84^2+3.82^2+3.40^2+3.65^2}}=\frac{3.84}{9.7478}=0.3939$$
$$x_{5.1}^{*}=\frac{3.82}{\sqrt{3.79^2+3.70^2+3.57^2+3.84^2+3.82^2+3.40^2+3.65^2}}=\frac{3.82}{9.7478}=0.3919$$
$$x_{6.1}^{*}=\frac{3.40}{\sqrt{3.79^2+3.70^2+3.57^2+3.84^2+3.82^2+3.40^2+3.65^2}}=\frac{3.40}{9.7478}=0.3488$$
$$x_{7.1}^{*}=\frac{3.65}{\sqrt{3.79^2+3.70^2+3.57^2+3.84^2+3.82^2+3.40^2+3.65^2}}=\frac{3.65}{9.7478}=0.3744$$

For Criterion C2, namely Scientific Writing (Benefit)

$$x_{1.2}^{*}=\frac{2}{\sqrt{2^2+2^2+1^2+2^2+1^2+2^2+1^2}}=\frac{2}{4.4}=0.4588$$
$$x_{2.2}^{*}=\frac{2}{\sqrt{2^2+2^2+1^2+2^2+1^2+2^2+1^2}}=\frac{2}{4.4}=0.4588$$
$$x_{3.2}^{*}=\frac{1}{\sqrt{2^2+2^2+1^2+2^2+1^2+2^2+1^2}}=\frac{1}{4.4}=0.2294$$
$$x_{4.2}^{*}=\frac{2}{\sqrt{2^2+2^2+1^2+2^2+1^2+2^2+1^2}}=\frac{2}{4.4}=0.4588$$
$$x_{5.2}^{*}=\frac{1}{\sqrt{2^2+2^2+1^2+2^2+1^2+2^2+1^2}}=\frac{1}{4.4}=0.2294$$
$$x_{6.2}^{*}=\frac{2}{\sqrt{2^2+2^2+1^2+2^2+1^2+2^2+1^2}}=\frac{2}{4.4}=0.4588$$
$$x_{7.2}^{*}=\frac{1}{\sqrt{2^2+2^2+1^2+2^2+1^2+2^2+1^2}}=\frac{1}{4.4}=0.2294$$

For Criterion C3, namely Superior Achievement (Benefit)

$$x_{1.3}^{*}=\frac{2}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}}=\frac{2}{4.6}=0.4364$$
$$x_{2.3}^{*}=\frac{1}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}}=\frac{1}{4.6}=0.2182$$
$$x_{3.3}^{*}=\frac{1}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}}=\frac{1}{4.6}=0.2182$$
$$x_{4.3}^{*}=\frac{3}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}}=\frac{3}{4.6}=0.6547$$
$$x_{5.3}^{*}=\frac{1}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}}=\frac{1}{4.6}=0.2182$$
$$x_{6.3}^{*}=\frac{2}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}}=\frac{2}{4.6}=0.4364$$
$$x_{7.3}^{*}=\frac{1}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}}=\frac{1}{4.6}=0.2182$$

For Criterion C4 namely English (Benefit):

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$$x_{1.4}^{*} = \frac{2}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}} = \frac{2}{4.6} = 0.4364$$
$$x_{2.4}^{*} = \frac{1}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}} = \frac{1}{4.6} = 0.2182$$
$$x_{3.4}^{*} = \frac{1}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}} = \frac{1}{4.6} = 0.2182$$
$$x_{4.4}^{*} = \frac{3}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}} = \frac{3}{4.6} = 0.6547$$
$$x_{5.4}^{*} = \frac{1}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}} = \frac{1}{4.6} = 0.2182$$
$$x_{6.4}^{*} = \frac{2}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}} = \frac{2}{4.6} = 0.4364$$
$$x_{7.4}^{*} = \frac{1}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}} = \frac{1}{4.6} = 0.2182$$

For Criterion C5, namely Personality (Benefit):

$$x_{1.5}^{*} = \frac{2}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{2}{6.6} = 0.3050$$
$$x_{2.5}^{*} = \frac{3}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{3}{6.6} = 0.4575$$
$$x_{3.5}^{*} = \frac{2}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{2}{6.6} = 0.3050$$
$$x_{4.5}^{*} = \frac{3}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{3}{6.6} = 0.4575$$
$$x_{5.5}^{*} = \frac{3}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{3}{6.6} = 0.4575$$
$$x_{6.5}^{*} = \frac{2}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{2}{6.6} = 0.3050$$
$$x_{7.5}^{*} = \frac{2}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{2}{6.6} = 0.3050$$

For Criterion C6, namely Organization:

$$x_{1.6}^{*} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x_{2.6}^{*} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x_{3.6}^{*} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x_{4.6}^{*} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x_{5.6}^{*} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x_{6.6}^{*} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x_{7.6}^{*} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$

For Criterion C7, namely Semester (Cost):

$$x_{1.7}^{*} = \frac{7}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{7}{17.1756} = 0.4076$$
$$x_{1.7}^{*} = \frac{5}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{5}{17.1756} = 0.2911$$
$$x_{1.7}^{*} = \frac{7}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{7}{17.1756} = 0.4076$$
$$x_{1.7}^{*} = \frac{7}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{7}{17.1756} = 0.4076$$
$$x_{1.7}^{*} = \frac{7}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{7}{17.1756} = 0.4076$$

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$$x_{1.7}^{*} = \frac{5}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{5}{17.1756} = 0.2911$$
$$x_{1.7}^{*} = \frac{7}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{7}{17.1756} = 0.4076$$

With the calculation obtained a normalized matrix, the results obtained are:

$$X_{ij}^{*} = \begin{bmatrix} 0.3888 & 0.4588 & 0.4364 & 0.4364 & 0.3050 & 0.3780 & 0.4076 \\ 0.3796 & 0.4588 & 0.2182 & 0.2182 & 0.4575 & 0.3780 & 0.2911 \\ 0.3662 & 0.2294 & 0.2182 & 0.2182 & 0.3050 & 0.3780 & 0.4076 \\ 0.3939 & 0.4588 & 0.6547 & 0.6547 & 0.4575 & 0.3780 & 0.4076 \\ 0.3919 & 0.2294 & 0.2182 & 0.2182 & 0.4575 & 0.3780 & 0.4076 \\ 0.3488 & 0.4588 & 0.4364 & 0.4364 & 0.3050 & 0.3780 & 0.2911 \\ 0.3744 & 0.2294 & 0.2182 & 0.2182 & 0.3050 & 0.3780 & 0.4076 \end{bmatrix}$$

c. Calculating Preference Values

$$y_1^{*} = \frac{(0.37*0.3888)+(0.23*0.4588)+(0.16*0.4364)+(0.11*0.4364)+(0.07*0.3050)+(0.04*0.3780)}{(0.02*0.4076)} = \frac{0.4037}{0.0082} = 49.5259$$

$$y_2^{*} = \frac{(0.37*0.3796)+(0.23*0.4588)+(0.16*0.2182)+(0.11*0.2182)+(0.07*0.4575)+(0.04*0.3780)}{(0.02*0.2911)} = \frac{0.3520}{0.0058} = 60.4637$$

$$y_3^{*} = \frac{(0.37*0.3662)+(0.23*0.2294)+(0.16*0.2182)+(0.11*0.2182)+(0.07*0.3050)+(0.04*0.3780)}{(0.02*0.4076)} = \frac{0.2837}{0.0082} = 34.8000$$

$$y_4^{*} = \frac{(0.37*0.3939)+(0.23*0.4588)+(0.16*0.6547)+(0.11*0.6547)+(0.07*0.4575)+(0.04*0.3780)}{(0.02*0.4076)} = \frac{0.4752}{0.0082} = 58.2978$$

$$y_5^{*} = \frac{(0.37*0.3919)+(0.23*0.2294)+(0.16*0.2182)+(0.11*0.2182)+(0.07*0.4575)+(0.04*0.3780)}{(0.02*0.4076)} = \frac{0.3038}{0.0082} = 37.2738$$

$$y_6^{*} = \frac{(0.37*0.3488)+(0.23*0.4588)+(0.16*0.4364)+(0.11*0.4364)+(0.07*0.3050)+(0.04*0.3780)}{(0.02*0.2911)} = \frac{0.3889}{0.0058} = 66.7937$$

$$y_7^{*} = \frac{(0.37*0.3744)+(0.23*0.2294)+(0.16*0.2182)+(0.11*0.2182)+(0.07*0.3050)+(0.04*0.3780)}{(0.02*0.4076)} = \frac{0.2867}{0.0082} = 35.1725$$

Based on the calculations that have been carried out by applying the MOOSRA (*Multi-objective Optimization on the Basis of Simple Ratio Analysis*) method, the ranking results of the calculation can be seen in Table 9 below:

Table 9. Ranking Results

Alternative	Student Name	Value preferences	Ranking
A6	Rohan	66.7937	1
A2	Zaza Mutiara	60.4637	2
A4	Khairunisa	58.2978	3
A1	Andreas	49.5259	4
A5	Azmi Aziza	37.2738	5
A7	Maringan Sitanggang	35.1725	6
A3	Ahmad Ismail	34.8000	7

Based on the results of the calculation of seven alternative data and seven criteria data along with the weight value using the MOOSRA method, it can be concluded that the highest score ranking as an outstanding student is in alternative A6 in the name of Rohan with a preference value of 66.7937.

3.3 Application of *the Multi-objective Optimization Method on the Basis of Ratio Analysis* (MOORA)

From the match rating data above, it can be applied using the MOORA method as a selection of outstanding students. Below are the calculation steps as follows:

a. Forming a Decision Matrix

$$x_{ij} \begin{bmatrix} 3.79 & 2 & 2 & 2 & 2 & 1 & 7 \\ 3.70 & 2 & 1 & 1 & 3 & 1 & 5 \\ 3.57 & 1 & 1 & 1 & 2 & 1 & 7 \\ 3.84 & 2 & 3 & 3 & 3 & 1 & 7 \\ 3.82 & 1 & 1 & 1 & 3 & 1 & 7 \\ 3.40 & 2 & 2 & 2 & 2 & 1 & 5 \\ 3.65 & 1 & 1 & 1 & 2 & 1 & 7 \end{bmatrix}$$

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b. Defining Matrix Normalization

For Criterion C1 (Semester Achievement Index)

$$x^*_{1.1} = \frac{3.79}{\sqrt{3.79^2 + 3.70^2 + 3.57^2 + 3.84^2 + 3.82^2 + 3.40^2 + 3.65^2}} = \frac{3.79}{9.7478} = 0.3888$$
$$x^*_{2.1} = \frac{3.70}{\sqrt{3.79^2 + 3.70^2 + 3.57^2 + 3.84^2 + 3.82^2 + 3.40^2 + 3.65^2}} = \frac{3.70}{9.7478} = 0.3796$$
$$x^*_{3.1} = \frac{3.57}{\sqrt{3.79^2 + 3.70^2 + 3.57^2 + 3.84^2 + 3.82^2 + 3.40^2 + 3.65^2}} = \frac{3.57}{9.7478} = 0.3662$$
$$x^*_{4.1} = \frac{3.84}{\sqrt{3.79^2 + 3.70^2 + 3.57^2 + 3.84^2 + 3.82^2 + 3.40^2 + 3.65^2}} = \frac{3.84}{9.7478} = 0.3939$$
$$x^*_{5.1} = \frac{3.82}{\sqrt{3.79^2 + 3.70^2 + 3.57^2 + 3.84^2 + 3.82^2 + 3.40^2 + 3.65^2}} = \frac{3.82}{9.7478} = 0.3919$$
$$x^*_{6.1} = \frac{3.40}{\sqrt{3.79^2 + 3.70^2 + 3.57^2 + 3.84^2 + 3.82^2 + 3.40^2 + 3.65^2}} = \frac{3.40}{9.7478} = 0.3488$$
$$x^*_{7.1} = \frac{3.65}{\sqrt{3.79^2 + 3.70^2 + 3.57^2 + 3.84^2 + 3.82^2 + 3.40^2 + 3.65^2}} = \frac{3.65}{9.7478} = 0.3744$$

For C2 Criteria (Scientific Paper)

$$x^*_{1.2} = \frac{2}{\sqrt{2^2 + 2^2 + 1^2 + 2^2 + 1^2 + 2^2 + 1^2}} = \frac{2}{4.4} = 0.4588$$
$$x^*_{2.2} = \frac{2}{\sqrt{2^2 + 2^2 + 1^2 + 2^2 + 1^2 + 2^2 + 1^2}} = \frac{2}{4.4} = 0.4588$$
$$x^*_{3.2} = \frac{1}{\sqrt{2^2 + 2^2 + 1^2 + 2^2 + 1^2 + 2^2 + 1^2}} = \frac{1}{4.4} = 0.2294$$
$$x^*_{4.2} = \frac{2}{\sqrt{2^2 + 2^2 + 1^2 + 2^2 + 1^2 + 2^2 + 1^2}} = \frac{2}{4.4} = 0.4588$$
$$x^*_{5.2} = \frac{1}{\sqrt{2^2 + 2^2 + 1^2 + 2^2 + 1^2 + 2^2 + 1^2}} = \frac{1}{4.4} = 0.2294$$
$$x^*_{6.2} = \frac{2}{\sqrt{2^2 + 2^2 + 1^2 + 2^2 + 1^2 + 2^2 + 1^2}} = \frac{2}{4.4} = 0.4588$$
$$x^*_{7.2} = \frac{1}{\sqrt{2^2 + 2^2 + 1^2 + 2^2 + 1^2 + 2^2 + 1^2}} = \frac{1}{4.4} = 0.2294$$

For Criterion C3 (Achievements that are credited)

$$x^*_{1.3} = \frac{2}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{2}{4.6} = 0.4364$$
$$x^*_{2.3} = \frac{1}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{1}{4.6} = 0.2182$$
$$x^*_{3.3} = \frac{1}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{1}{4.6} = 0.2182$$
$$x^*_{4.3} = \frac{3}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{3}{4.6} = 0.6547$$
$$x^*_{5.3} = \frac{1}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{1}{4.6} = 0.2182$$
$$x^*_{6.3} = \frac{2}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{2}{4.6} = 0.4364$$
$$x^*_{7.3} = \frac{1}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{1}{4.6} = 0.2182$$

For C4 Criteria (English)

$$x^*_{1.4} = \frac{2}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{2}{4.6} = 0.4364$$
$$x^*_{2.4} = \frac{1}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{1}{4.6} = 0.2182$$
$$x^*_{3.4} = \frac{1}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{1}{4.6} = 0.2182$$
$$x^*_{4.4} = \frac{3}{\sqrt{2^2 + 1^2 + 1^2 + 3^2 + 1^2 + 2^2 + 1^2}} = \frac{3}{4.6} = 0.6547$$

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$$x^*_{5.4} = \frac{1}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}} = \frac{1}{4.6} = 0.2182$$
$$x^*_{6.4} = \frac{2}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}} = \frac{2}{4.6} = 0.4364$$
$$x^*_{7.4} = \frac{1}{\sqrt{2^2+1^2+1^2+3^2+1^2+2^2+1^2}} = \frac{1}{4.6} = 0.2182$$

For Criterion C5 (Personality) :

$$x^*_{1.5} = \frac{2}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{2}{6.6} = 0.3050$$
$$x^*_{2.5} = \frac{3}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{3}{6.6} = 0.4575$$
$$x^*_{3.5} = \frac{2}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{2}{6.6} = 0.3050$$
$$x^*_{4.5} = \frac{3}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{3}{6.6} = 0.4575$$
$$x^*_{5.5} = \frac{3}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{3}{6.6} = 0.4575$$
$$x^*_{6.5} = \frac{2}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{2}{6.6} = 0.3050$$
$$x^*_{7.5} = \frac{2}{\sqrt{2^2+3^2+2^2+3^2+3^2+2^2+2^2}} = \frac{2}{6.6} = 0.3050$$

For Criterion C6 (Organizing):

$$x^*_{1.6} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x^*_{2.6} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x^*_{3.6} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x^*_{4.6} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x^*_{5.6} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x^*_{6.6} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$
$$x^*_{7.6} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = \frac{1}{2.6} = 0.3780$$

For Criterion C7 (Semester):

$$x^*_{1.7} = \frac{7}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{7}{17.1756} = 0.4076$$
$$x^*_{1.7} = \frac{5}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{5}{17.1756} = 0.2911$$
$$x^*_{1.7} = \frac{7}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{7}{17.1756} = 0.4076$$
$$x^*_{1.7} = \frac{7}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{7}{17.1756} = 0.4076$$
$$x^*_{1.7} = \frac{7}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{7}{17.1756} = 0.4076$$
$$x^*_{1.7} = \frac{5}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{5}{17.1756} = 0.2911$$
$$x^*_{1.7} = \frac{7}{\sqrt{7^2+5^2+7^2+7^2+7^2+5^2+7^2}} = \frac{7}{17.1756} = 0.4076$$

With the above calculation, a normalized matrix is obtained with the following results, namely:

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$$X_{ij}^{*} = \begin{bmatrix} 0.3888 & 0.4588 & 0.4364 & 0.4364 & 0.3050 & 0.3780 & 0.4076 \\ 0.3796 & 0.4588 & 0.2182 & 0.2182 & 0.4575 & 0.3780 & 0.2911 \\ 0.3662 & 0.2294 & 0.2182 & 0.2182 & 0.3050 & 0.3780 & 0.4076 \\ 0.3939 & 0.4588 & 0.6547 & 0.6547 & 0.4575 & 0.3780 & 0.4076 \\ 0.3919 & 0.2294 & 0.2182 & 0.2182 & 0.4575 & 0.3780 & 0.4076 \\ 0.3488 & 0.4588 & 0.4364 & 0.4364 & 0.3050 & 0.3780 & 0.2911 \\ 0.3744 & 0.2294 & 0.2182 & 0.2182 & 0.3050 & 0.3780 & 0.4076 \end{bmatrix}$$

c. Calculating the Final Preference Value

$y_1^* = (0.37 * 0.3888) + (0.23 * 0.4588) + (0.16 * 0.4364) + (0.11 * 0.4364) + (0.07 * 0.3050) + (0.04 * 0.3780) - (0.02 * 0.4076) = 0.3955$

$y_2^* = (0.37 * 0.3796) + (0.23 * 0.4588) + (0.16 * 0.2182) + (0.11 * 0.2182) + (0.07 * 0.4575) + (0.04 * 0.3780) - (0.02 * 0.2911) = 0.3462$

$y_3^* = (0.37 * 0.3662) + (0.23 * 0.2294) + (0.16 * 0.2182) + (0.11 * 0.2182) + (0.07 * 0.3050) + (0.04 * 0.3780) - (0.02 * 0.4076) = 0.2755$

$y_4^* = (0.37 * 0.3939) + (0.23 * 0.4588) + (0.16 * 0.6547) + (0.11 * 0.6547) + (0.07 * 0.4575) + (0.04 * 0.3780) - (0.02 * 0.4076) = 0.4670$

$y_5^* = (0.37 * 0.3919) + (0.23 * 0.2294) + (0.16 * 0.2182) + (0.11 * 0.2182) + (0.07 * 0.4575) + (0.04 * 0.3780) - (0.02 * 0.4076) = 0.2957$

$y_6^* = (0.37 * 0.3488) + (0.23 * 0.4588) + (0.16 * 0.4364) + (0.11 * 0.4364) + (0.07 * 0.3050) + (0.04 * 0.3780) - (0.02 * 0.2911) = 0.3831$

$y_7^* = (0.37 * 0.3744) + (0.23 * 0.2294) + (0.16 * 0.2182) + (0.11 * 0.2182) + (0.07 * 0.3050) + (0.04 * 0.3780) - (0.02 * 0.4076) = 0.2785$

From the calculations that have been carried out by applying the MOORA (*Multi-objective Optimization on the Basis of Ratio Analysis*) method, the ranking results from the calculation in Table 10 are as follows:

Table 10. Ranking Results

Alternative	Student Name	Value preferences	Ranking
A4	Khairunisa	0.3955	1
A1	Andreas	0.3462	2
A6	Rohan	0.2755	3
A2	Zaza Mutiara	0.4670	4
A5	Azmi Aziza	0.2957	5
A7	Maringan Sitanggang	0.3831	6
A3	Ahmad Ismail	0.2785	7

From the results of the calculation above with seven alternative data and seven criteria data along with the weight value using the MOORA method, it can be concluded that the highest score ranking as an outstanding student is in the A4 alternative on behalf of Khairunisa with a preference value.

3.4 Method Calculation Results

Based on the results of the calculations that have been carried out from both methods with alternative data and predetermined criteria, the ranking results of the two methods are obtained as follows:

Table 11. Preference comparison results

Alternative	Student Name	MOOSRA Method		MOORA Method	
		Value preferences	Rank	Value preferences	Rank
A1	Andreas	49.5259	4	0.3462	2
A2	Zaza Mutiara	60.4637	2	0.4670	4
A3	Ahmas Ismail	34.8000	7	0.2785	7
A4	Khairunisa	58.2978	3	0.3955	1
A5	Azmi Aziza	37.2738	5	0.2957	5
A6	Rohan	66.7937	1	0.2755	3
A7	Maringan Sitanggang	35.1725	6	0.3831	6

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In the table above, it can be concluded that the discussion of the case of selecting outstanding students using the MOOSRA and MOORA methods obtained the highest alternative that is different. From the calculation of the alternative MOOSRA method, the highest is A6 in the name of Rohan with a final preference value of 66.7937 while from the calculation of the alternative MOORA method, the highest is A4 in the name of Khairunisa with a final preference value of 0.3955. Furthermore, the following in Figure 2 can be seen This graph shows a comparison of the preference scores of seven students based on two decision-making methods, namely MOOSRA and MOORA. From the graph, it can be seen that the MOOSRA method produces a much larger preference value than the MOORA method due to the difference in the calculation scale. The student with the highest preference score based on the MOOSRA method is Rohan, while based on the MOORA method, the highest score is obtained by Khairunisa. This graph helps in visually seeing the difference in the pattern of assessment results between the two methods.

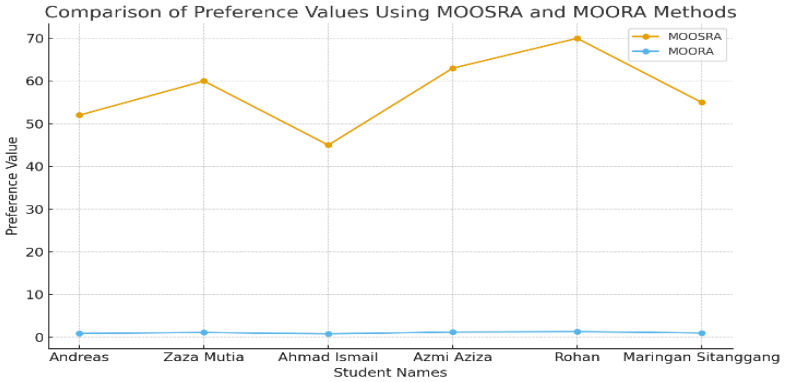

Figure 2. Comparison Chart

4. CONCLUSION

In the case of this study, it is related to the selection of outstanding students using the MOOSRA and MOORA methods. In this study, the author has prepared alternative data obtained from seven student data and determined the preferred criteria such as the Semester Achievement Index (IPS), Scientific Writing, Featured Achievements, English, Personality, Organization and Semester as well as weighting values using the ROC method. The number of students who meet these criteria makes it difficult to determine the election. With the problems faced in this study, the author chose a decision support system that applies his method as a solution in the selection of outstanding students. Based on the calculations that have been made, the final preference value is obtained that is different from the two methods. In the calculation of the MOOSRA method, the highest alternative was A6 in the name of Rohan with a final preference value of 66.7937 while from the calculation of the MOORA method, the highest alternative was A4 in the name of Khairunisa with a final preference value of 0.3955. In this study, the author hopes that all the contents listed in this article can be useful in the future both domestically and abroad and the author's suggestions to be more accurate in choosing outstanding students.

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