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Comparative Analysis of OCRA and MAUT Method in Decision Support System for Determining Outstanding Students

Irvan Siahaan[1], Mesran[2,*], Ridha Maya Faza Lubis[3], Hetty Rohayani[4]

[1] Faculty of Computer Science and Information Technology, Informatics Engineering, Universitas Budi Darma, Medan, Indonesia
[2] Management, Sekolah Tinggi Ilmu Manajemen Sukma, Medan, Indonesia
[3] Department of Business and Management, Southern Taiwan University of Science and Technology, Tainan City, Taiwan
[4] Informatics, Universitas Muhammadiyah Jambi, Jambi, Indonesia
Email: [1]irvan17chanel@gmail.com, [2,*]mesran.skom.mkom@gmail.com, [3]db01g208@stust.edu.tw, [4]hettyrohayani@gmail.com
Correspondence Author Email: mesran.skom.mkom@gmail.com

Abstract–Achieving students are students who have achieved high achievements, both curricular and co-curricular in accordance with the required criteria. At this time the data processing process for determining outstanding student candidates has used a manual system, allowing errors to occur in the process of processing outstanding student selection data. The value processing process takes a long time, especially in the determination process and ranking process. The decision support system is the right system to implement, because the decision support system can help determine which alternative to choose. The method used in this research uses the OCRA (Operational Competitiveness Rating Analysis) method and the MAUT (Multi Attribute Utility Theory) method. In this study, the criteria of GPA, written work, superior achievements/abilities, and English language skills are used. Every student has the same right to participate in the outstanding student selection program. Therefore, the selection of outstanding students should be carried out openly and transparently at the university level. However, this implementation can lead to a large number of applicants which can cause difficulties in managing data and values in determining outstanding students. The concept of a decision support system can be applied as a tool in determining outstanding students.

Keywords: Decision Support System; Outstanding Students; OCRA Method; MAUT Method

1. INTRODUCTION

Student Achievement is a selection that is carried out in stages starting from the level of study program / department / department / section, faculty, college (University / Institute / College / Polytechnic and Academy) and the national level called Pilmapres (Selection of Outstanding Students) so that later it will be sent to the University level and the rapid development of technology has provided many benefits in progress in various aspects[1][2].

According to KBBI, achievement means having an achievement in something that has been done or attempted. A student can be said to be an achiever if he is successful in the academic and non-academic fields. In addition, it can also master the field of science studied and be active in interest and talent development activities[3]. To be able to set goals and achievement targets. To achieve this, students set strategies to motivate themselves, manage themselves appropriately and motivate themselves to make progress. To achieve the progress of the nation, outstanding students are needed. Students who excel need to be given appropriate awards. It aims to provide recognition to students in a real way that is very beneficial for improving academic quality. In determining outstanding students, there are several assessment components. The field of higher education student affairs requires a system that can help solve these problems.

Currently, the advancement of information systems and technology is increasingly penetrating into all fields, including in the process of making a decision. Computer-based decision support systems are considered interactive. This system can be applied in the process of selecting outstanding students involving many components or criteria that are assessed[4].

In this study using 2 methods on decision support systems, namely the OCRA method (Operational Competitiveness Rating Analysis) MAUT method (Multi Attribute Utility Theory). The OCRA method and the MAUT method are two approaches used in decision-making analysis. The OCRA method is one of the techniques used to assess and measure the level of operational competitiveness of an organization or company[5]. Meanwhile, the MAUT method is an approach that allows decision assessment based on various attributes or criteria using the utility of each alternative[6].

Some previous studies can be used as references in the preparation of this research, including research conducted by Dasril Aldo et al in 2019 by applying the MAUT method in assessing lecturer performance. In the study, the results obtained by applying the MAUT method showed that there were 4 alternatives that had good performance and 2 alternatives had poor performance[7]. Further research conducted by Asyahri Hadi et al in 2022 with the application of the OCRA method in determining the best field weighing clerk, in this study using 5 criteria and 7 alternatives. From calculations using the OCRA method in this study it is shown that alternatives with code A2 on behalf of Libra purba who get certain preference results are 0.583[8]. Further research conducted by Abdul Karim et al in 2021 by applying the OCRA and MAUT methods in selecting permanent employee candidates. The test results obtained the best alternative that is considered eligible as a permanent employee is in the same alternative, namely A5 on behalf of Risa Sabrani. The OCRA method produces the best preference value of 1.56 while the MAUT method produces the best preference value of 0.456 as the first rank[9]. Research conducted by

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Dwina Pri Indini et al in 2021 applied the OCRA method in determining the best online learning media during the covid-19 pandemic. In alternative research and the criteria used were 5 criteria and 5 alternatives. From the calculation results of the 5 alternatives shown in table 10, the alternative chosen as the best online learning media is alternative A3, namely Moodle with a preference value of 2,296 as the best preference[10]. Further research conducted by Ahmad and Rima in 2023 in a comparative analysis of the MAUT method and the TOPSIS method in selecting candidates for village heads. In this study there were 6 alternatives and 4 criteria used. From the results of the calculation of the MAUT method with TOPSIS, it can be concluded that the two methods are equally effective. The results of the calculation using the MAUT method that was elected as the village head was A4 on behalf of Arshaka with a value of 0.950. While the results of calculations using the TOPSIS method that was selected was A4 with a value of 0.917[11].

2. RESEARCH METHODOLOGY

2.1 Decision Support System

A decision support system (DSS) is a tool used to support difficult decisions based on data. DSS combines technology, analytical models, and relevant information to help decision makers understand situations, evaluate options, and make better decisions[12][13]. The main objective of a decision support system is to provide the tools and information necessary for decision makers to understand the implications of their decisions, analyze possible consequences, and choose the best solution based on available data[14]. Decision support systems can be used in various fields and levels of organizations, such as business, project management, finance, logistics, marketing, and so on The benefits of decision support systems are accelerating the decision-making process by automating several stages and reducing dependence on manual processes, reducing uncertainty by providing relevant and reliable information[16].

2.2 Outstanding Students

The Selection of Outstanding Students (Mawapres) is a routine activity carried out annually by Dikti since 2004. Mawapres activities are activities to select and reward students who have achieved high achievements, both curricular, co-curricular, and extracurricular. With this activity, students are expected not only to pursue knowledge in their fields, but also to develop their soft skills. Therefore, in each university (PT) it is necessary to identify students who can do both and be awarded as outstanding students, namely by selecting mawapres at the university level[17][18].

2.3 Metode OCRA (*Operational Competitiveness Rating Analysis*)

The Operational Competitiveness Rating Analysis (OCRA) method is a relative performance measurement approach based on a nonparametric model[19]. The Operational Competitiveness Rating Analysis (OCRA) method was first developed by Parkan in 1994 and is a very useful and simple method for analyzing different sectors and comparing different decision units[20]. Moreover, the ability to compare and monitor the performance of decision units over time is another important feature of this method[21]. Operational Competitiveness Rating Analysis (OCRA) is a non-parametric efficiency measurement technique and was first proposed to solve the problem of performance measurement and productivity analysis. The steps of the OCRA method can be summarized as follows[22]:

1. First step of decision matrix formation

$$X = [x_{ij}]_{mxn} \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} i = 1, \dots m \; j = 1, 2, \dots, n \quad (1)$$

2. The second step of the preference ranking is calculated only the performance value of the alternatives for the criteria to be minimized according to the formula below.

$$\bar{I} = \sum_{j=1}^{g} wj \frac{\max(x_{ij})}{\min(x_{ij})} (= i = 1,2, \dots, m \; j = 1,2, \dots g) \quad (2)$$

3. The third step calculates the linear preference ranking of each alternative for the criteria to be minimized.

$$\bar{\bar{I}}_i = \bar{I}_i - min(\bar{I}_i) \quad (3)$$

4. The fourth step is preference ranking where only the performance values of the alternatives for the criteria to be maximized are calculated.

$$\bar{\bar{O}}_i = \sum_{j=g+1}^{n} wj \frac{x_{ij} - \max(x_{ij})}{\min(x_{ij})} (i = 1,2, \dots, m \; j = g+1, g+2, \dots n) \quad (4)$$

5. The fifth step calculates the linear preference ranking of each alternative for the criteria to be maximized.

$$\bar{\bar{O}}_i = \bar{\bar{O}}_i - min(\bar{\bar{O}}_i) \quad (5)$$

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6. Step six calculates the total preference value for each alternative.

$$P_1 = (\bar{\bar{I}}_i + \bar{\bar{O}}_i) - \min(\bar{\bar{I}} + \bar{\bar{O}})\ i = 1,2,\dots m \quad (6)$$

2.4 Metode MAUT (*Multi Attribute Utility Theory*)

Multi Attribute Utility Theory (MAUT) is one of the quantitative methods used as the basis for decision making through a systematic procedure that identifies and analyzes several variables[23]. A decision maker can calculate the utility of each alternative using the MAUT function and can choose the alternative with the highest utility. MAUT is a very popular evaluation scheme for evaluating products for users[24]. MAUT is used to identify and extract information about user preferences in a personal context. The overall information about user behavior that is multidimensional is divided into several parts that are unidimensional and then given a measure and weight[25]. Measurement and weighting are done by considering each type of context as one of the item attributes. The use of the MAUT approach allows for filtering information according to user preferences by identifying the influence of several attributes. The several stages in the application of the MAUT method are as follows[26]:

1. Create a decision matrix

$$X_{ij} = \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1n} \\ X_{21} & X_{22} & \cdots & X_{2n} \\ X_{m1} & X_{m2} & \cdots & X_{mn} \end{bmatrix} \quad (7)$$

2. Calculation of normalization of the decision matrix

$$r_{ij}^{*} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \quad (8)$$

$$r_{ij}^{*} = 1 + \left(\frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})}\right) \quad (9)$$

3. Calculating the marginal utility value

$$U_{ij} = \frac{exp^{(r_{ij})^2} - 1}{1.71} \quad (10)$$

4. Calculating the final utility value

$$Ui = \sum_{j=1}^{n} u_{ij}.w_j \quad (11)$$

2.5 Research Stages

The stages carried out by the author in this study can be described as the chart below:

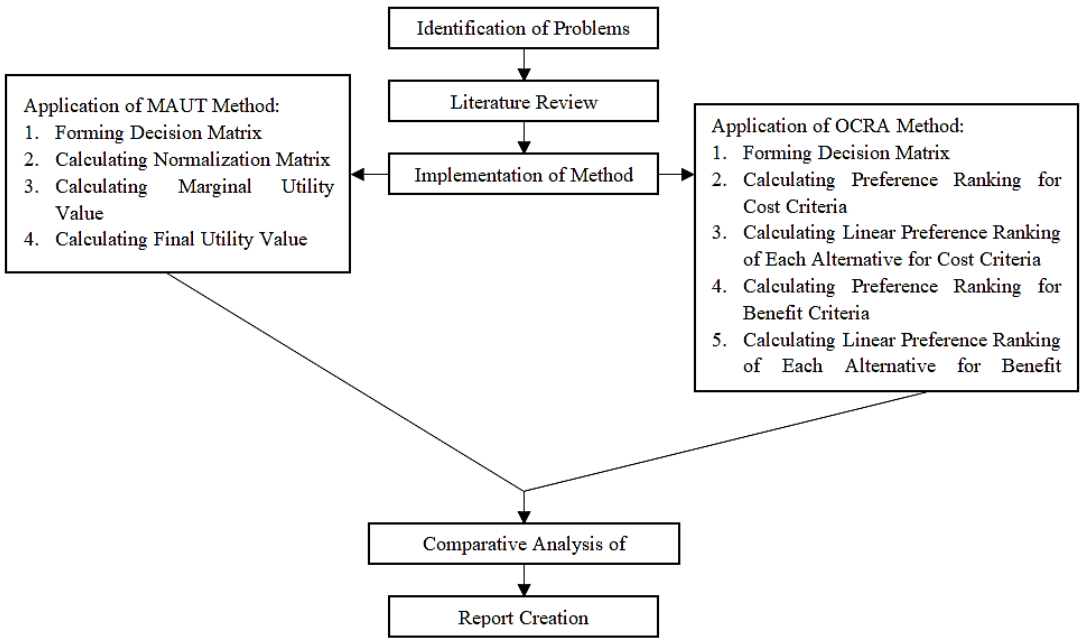

Figure 1. Research Stages

Based on Figure 1 above, the following is a detailed explanation of the stages that will be carried out in this study.

1. Problem Identification
   The author analyzes problems related to permanent employees and appropriate methods in finding solutions to problems.

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2. Literature Review
   Stages of searching for data and information related to problems through books, e-books and articles that are in accordance with the object of this research.
3. Analysis and Application of Methods
   At this stage the author uses the OCRA method and the MAUT method and weighting is carried out with the help of the ROC method to get the best solution to the problem being studied.
4. Comparative Analysis of MAUT and OCRA Methods
   Testing is done by comparing the results of the OCRA method and the MAUT method against the entire data sample including testing the criteria, weights, and alternatives used in this study.
5. Research Report
   The results of the report from the stages of research that have been carried out by the author include solutions to problems, the results of using methods, and contain conclusions from this research.

3. RESULTS AND DISCUSSION

This type of research is engineering research or development, namely the development of decision support system applications to determine outstanding students using the Operational Competitiveness Rating Analysis (OCRA) Method and the Multi-Attribute Utility Theory (MAUT) Method. In the implementation to get outstanding students must meet several existing criteria. These criteria include GPA, attendance, paper work and discipline. The above criteria really help the University in selecting outstanding students. The solution to the above problems is to create a decision support system in selecting outstanding students. So the authors use the OCRA and MAUT methods to be able to solve problems in determining outstanding students based on predetermined criteria and weights. This system is expected to help and facilitate the selection of outstanding students.

Data is very important in decision support systems. The following is data on students who take part in the selection of outstanding students, which is an alternative to be calculated by taking several samples. The following is a list of student data that participated in the selection:

3.1 Determination of Alternatives and Criteria

The application of alternatives serves to select prospective permanent achievement students who are considered to meet the predetermined criteria. The following is alternative student data as shown in table 1 below:

Table 1. Criteria

Criteria	Description	Weight	Type Criteria
C1	IPK	0.50	Benefit
C2	organizational activism	0.25	Benefit
C3	Written Work	0.15	Benefit
C4	Achievements	0.10	Cost

The criteria table displays four criteria used in the decision-making process. The first criterion is Grade Point Average (GPA) with a weight of 0.50. The second criterion is the level of organizational activity with a weight of 0.25. The third criterion is the quality and number of papers with a weight of 0.15. Finally, the fourth criterion is achievement, both academic and non-academic, with a weight of 0.10. These criteria are used to assess and compare alternatives based on several predetermined aspects.

Tab1e 2. Suitability Rating

Alternative	Criteria			
	C1	C2	C3	C4
A1	4.00	5	10	60
A2	3.30	5	15	80
A3	4.00	4	9	80
A4	3.30	3	8	90
A5	4.00	2	7	90

The suitability rating table shows the rating value for each alternative based on four predetermined criteria. For GPA criteria (C1), alternatives A1 and A3 have a value of 4.00, while A2 and A4 have a value of 3.30, and A5 has a value of 4.00. For the organizational activity criteria (C2), alternatives A1, A2, and A3 have a score of 5, while A4 has a score of 3, and A5 has a score of 2. For the paper criteria (C3), A2 has the highest score of 15, followed by A1 with a score of 10, A3 with a score of 9, A4 with a score of 8, and A5 with a score of 7. Finally, for the achievement criteria (C4), A4 and A5 have the highest score of 90, followed by A2 and A3 with 80, and A1 with 60.

3.2 Implementation of OCRA Method

The steps for calculating data on the suitability rating with the OCRA method are as follows:

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1. Create a decision matrix

$$X_{ij} = \begin{bmatrix} 4.00 & 5 & 10 & 60 \\ 3.30 & 5 & 15 & 80 \\ 4.00 & 4 & 9 & 80 \\ 3.30 & 3 & 8 & 90 \\ 4.00 & 2 & 7 & 90 \end{bmatrix}$$

2. Calculate the preference ranking for the criteria to be minimized (Cost) For criteria C4

$$\bar{I}1 = \sum 0.1 \frac{90-60}{60} = 0.05$$

$$\bar{I}2 = \sum 0.1 \frac{90-80}{60} = 0.016$$

$$\bar{I}3 = \sum 0.1 \frac{90-80}{60} = 0.05$$

$$\bar{I}4 = \sum 0.1 \frac{90-90}{60} = 0$$

$$\bar{I}5 = \sum 0.1 \frac{90-90}{60} = 0$$

3. Calculating the linear preference ranking of each alternative for the criteria to be minimized (Cost)

$$\bar{I}1 = 0.05 - 0 = 0.05$$

$$\bar{I}2 = 0.016 - 0 = 0.016$$

$$\bar{I}3 = 0.05 - 0 = 0.05$$

$$\bar{I}4 = 0 - 0 = 0$$

$$\bar{I}5 = 0 - 0 = 0$$

4. Calculating the preference ranking for the criteria to be maximized (Benefit) For criterion C1, criterion C2, criterion C3, criterion C4, and criterion C5

$$\bar{Q}1 = \sum \left(0.50 \frac{4.00-3.30}{3.30}\right) + \left(0.25 \frac{5-2}{2}\right) + \left(0.15 \frac{10-7}{7}\right) + \left(0.10 \frac{60-60}{60}\right) = \sum 0.106 + 0.375 + 0.064 + 0 = 0.545$$

$$\bar{Q}2 = \sum \left(0.50 \frac{3.30-3.30}{3.30}\right) + \left(0.25 \frac{5-2}{2}\right) + \left(0.15 \frac{15-7}{7}\right) + \left(0.10 \frac{80-60}{60}\right) = \sum 0 + 0.375 + 0.171 + 0.033 = 0.579$$

$$\bar{Q}3 = \sum \left(0.50 \frac{4.00-3.30}{3.30}\right) + \left(0.25 \frac{4-2}{2}\right) + \left(0.15 \frac{9-7}{7}\right) + \left(0.10 \frac{80-60}{60}\right) = \sum 0.106 + 0.25 + 0.042 + 0.033 = 0.431$$

$$\bar{Q}4 = \sum \left(0.50 \frac{3.30-3.30}{3.30}\right) + \left(0.25 \frac{3-2}{2}\right) + \left(0.15 \frac{8-7}{7}\right) + \left(0.10 \frac{90-60}{60}\right) = \sum \sum 0 + 0.125 + 0.021 + 0.05 = 0.196$$

$$\bar{Q}5 = \sum \left(0.50 \frac{4.00-3.30}{3.30}\right) + \left(0.25 \frac{2-2}{2}\right) + \left(0.15 \frac{7-7}{7}\right) + \left(0.10 \frac{90-60}{60}\right) = \sum 0.104 + 0 + 0 + 0.05 = 0.154$$

5. Calculate the linear preference ranking of each alternative for the criteria to be maximized (Benefit)

$$\bar{Q}1 = 0.545 - 0.154 = 0.391$$

$$\bar{Q}2 = 0.579 - 0.154 = 0.426$$

$$\bar{Q}3 = 0.431 - 0.154 = 0.277$$

$$\bar{Q}4 = 0.196 - 0.154 = 0.042$$

$$\bar{Q}5 = 0.154 - 0.154 = 0$$

6. Calculate the total preference value for each alternative

$$P_1 = (0.05 + 0.391) - 0 = 0.441$$

$$P_2 = (0.016 + 0.426) - 0 = 0.442$$

$$P_3 = (0.05 + 0.277) - 0 = 0.327$$

$$P_4 = (0 + 0.042) - 0 = 0.042$$

$$P_5 = (0 + 0) - 0 = 0$$

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Based on calculations with the Operational Competitiveness Rating Analysis (OCRA) method that has been carried out, the results of ranking all alternatives can be seen in Table 3.

Table 3. Preference Value

Alternative	Rank Preference	Value
A1	0.441	2
A2	0.442	1
A3	0.327	3
A4	0.042	4
A5	0	5

Table 3 displays the total score or preference value for each alternative based on the MAUT method calculation. Alternative A2 scores the highest with 0.442, ranking it first, followed by A1 with 0.441 in second place. Alternative A3 is ranked third with a value of 0.327. While A4 and A5 are ranked fourth and fifth with 0.042 and 0 respectively. Thus, the A2 alternative is considered the best alternative based on the predetermined criteria.

3.3 Implementation of MAUT Method

The following are the processing steps for the match rating data using the MAUT method:

1. Form a decision matrix

$$X_{ij} = \begin{bmatrix} 4.00 & 5 & 10 & 60 \\ 3.30 & 5 & 15 & 80 \\ 4.00 & 4 & 9 & 80 \\ 3.30 & 3 & 8 & 90 \\ 4.00 & 2 & 7 & 90 \end{bmatrix}$$

2. Calculating the Normalization Matrix
   Criteria C1 (Benefit)

$$r_{11}^{*} = \frac{4.00-3.30}{4.00-3.30} = 1$$

$$r_{21}^{*} = \frac{3.30-3.30}{4.00-3.30} = 0$$

$$r_{31}^{*} = \frac{4.00-3.30}{4.00-3.30} = 1$$

$$r_{41}^{*} = \frac{3.30-3.30}{4.00-3.30} = 0$$

$$r_{51}^{*} = \frac{3.99-3.30}{4.00-3.30} = 1.014$$

   Criteria C2 (Benefit)

$$r_{12}^{*} = \frac{5-2}{5-2} = 1$$

$$r_{22}^{*} = \frac{5-2}{5-2} = 1$$

$$r_{32}^{*} = \frac{4-2}{5-2} = 0.666$$

$$r_{42}^{*} = \frac{3-2}{5-2} = 0.333$$

$$r_{52}^{*} = \frac{2-2}{5-2} = 0$$

   Criteria C3 (Benefit)

$$r_{13}^{*} = \frac{10-7}{15-7} = 0.375$$

$$r_{23}^{*} = \frac{15-7}{15-7} = 1$$

$$r_{33}^{*} = \frac{9-7}{15-7} = 0.25$$

$$r_{43}^{*} = \frac{8-7}{15-7} = 1.25$$

$$r_{53}^{*} = \frac{7-7}{15-17} = 0.125$$

   Criteria C4 (Cost)

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Volume 2, No 1, December 2024, Page: 1−10
ISSN 3026-7315 (media online)
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$r_{14}^{*} = 1 + \frac{60-60}{90-60} = 1$

$r_{24}^{*} = 1 + \frac{60-80}{90-60} = 1.66$

$r_{34}^{*} = 1 + \frac{60-80}{90-60} = 1.66$

$r_{44}^{*} = 1 + \frac{60-90}{90-60} = 2$

$r_{54}^{*} = 1 + \frac{60-90}{90-60} = 2$

Based on the results of the above calculations, the normalized matrix results are obtained as shown in Table 4 below:

Table 4. Normalization Value

Alternative	C1	C2	C3	C4
A1	1	1	0.375	1
A2	0	1	1	1.66
A3	1	0.666	0.25	1.66
A4	0	0.333	1.25	2
A5	1.014	0	0.125	2

3. Calculating the Utility Margin Value
   Criteria C1

$U11 = \frac{e(1)2}{1.71} = 0.584$

$U21 = \frac{e(0)2}{1.71} = 0$

$U31 = \frac{e(1)2}{1.71} = 0.584$

$U41 = \frac{e(0)2}{1.71} = 0$

$U51 = \frac{e(1.014)2}{1.71} = 0.601$

Criteria C2

$U12 = \frac{e(1)2}{1.71} = 0.584$

$U22 = \frac{e(1)2}{1.71} = 0.584$

$U32 = \frac{e(0.666)2}{1.71} = 0.624$

$U42 = \frac{e(0.333)2}{1.71} = 0.064$

$U52 = \frac{e(0)2}{1.71} = 0$

Criteria C3

$U13 = \frac{e(0.375)2}{1.71} = 0.082$

$U23 = \frac{e(1)2}{1.71} = 0.644$

$U33 = \frac{e(0.25)2}{1.71} = 0.036$

$U43 = \frac{e(1.25)2}{1.71} = 0.091$

$U53 = \frac{e(0.125)2}{1.71} = 0.009$

Criteria C4

$U14 = \frac{e(1)2}{1.71} = 0.584$

$U24 = \frac{e(1.66)2}{1.71} = 1.61$

Volume 2, No 1, December 2024, Page: 1−10
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$$U34 = \frac{e(1.66)2}{1.71} = 0.161$$

$$U44 = \frac{e(2)2}{1.71} = 2.33$$

$$U54 = \frac{e(2)2}{1.71} = 2.33$$

Based on the results of the above calculations, the marginal utility value is obtained as shown in Table 5 below:

Table 5. Marginal Value of Utility

Alternatif	C1	C2	C3	C4
A1	0.584	0.584	0.082	0.583
A2	0	0.584	0.644	1.61
A3	0.584	0.624	0.036	0.161
A4	0	0.064	0.091	2.33
A5	0.601	0	0.009	2.33

4. Calculating the Final Utility Value

$$U1 = (0.50 * 0.584) + (0.25 * 0.584) + (0.15 * 0.082) + (0.10 * 0.583) = 0{,}509$$

$$U2 = (0.50 * 0) + (0.25 * 0.584) + (0.15 * 0.644) + (0.10 * 0.161) = 0{,}259$$

$$U3 = (0.50 * 0.584) + (0.25 * 0.624) + (0.15 * 0.036) + (0.10 * 0.161) = 0{,}470$$

$$U4 = (0.50 * 0) + (0.25 * 0.064) + (0.15 * 0.091) + (0.10 * 2.33) = 0.263$$

$$U5 = (0.50 * 0.601) + (0.25 * 0) + (0.15 * 0.009) + (0.10 * 2.33) = 0{,}535$$

The results of the calculation of the Final Utility Value by including weights will look like table 6 below:

Table 6. Final Utility Value

Alternatif	Preference Value	Ranking
A1	0.509	2
A2	0.259	4
A3	0.470	3
A4	0.263	5
A5	0.535	1

3.4 Method Comparison Results

The results of the comparison of the application of the OCRA method and the MAUT method which produces the best preference value can be seen in Table 7 below:

Table 7. Comparison of Preference Values

Alternatif	Metode OCRA		Metode MAUT	
	Preference Value	Ranking	Ui Value	Ranking
A1	0.441	2	0.5204	2
A2	0.442	1	0.2581	4
A3	0.327	3	0.3081	3
A4	0.042	4	0.466	5
A5	0	5	0.6035	1

Table 7 compares the preference value and ranking for each alternative based on the OCRA method and the MAUT method. In the OCRA method, alternative A2 is ranked first with a preference value of 0.442, while with the MAUT method, A5 has the highest preference value of 0.6035 and is ranked first. It should be noted that the ranking of alternatives may differ between these two methods. For example, A2, which is ranked first with the MAUT method, drops to fourth with the OCRA method. This shows that decision-making results can be affected by the evaluation method used.

4. CONCLUSION

Based on the research results and data that have been tested, it can be concluded that the application of the OCRA method and the MAUT method to the decision support system is effective as a tool in obtaining more objective and accurate decision-making results. OCRA and MAUT methods each provide a different perspective in alternative assessment, but both remain consistent in determining the best alternative. This can be seen from the comparison results of the two methods which show that both produce the same decision, with alternative A5 ranked first in the

MAUT method and fifth in the OCRA method. This alignment confirms the credibility and reliability of both methods in the decision-making process. The combined use of OCRA and MAUT methods allows for a more comprehensive and in-depth view in the evaluation of alternatives, thus improving the quality and accuracy of the decisions taken. This suggests that the integration of these methods can make a positive contribution in improving the efficiency and effectiveness of the decision-making process in various contexts.

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