

Combination of Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) and Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA) in Determining the Best Cashier

Sanriomi Sintaro¹, Ahmad Ari Aldino², Setiawansyah^{3,*}, Very Hendra Saputra⁴

¹Faculty of Mathematics and Natural Sciences, Information Systems, Universitas Sam Ratulangi, Manado, Indonesia

²Centre for Learning Analytics, Monash University, Victoria, Australia

³Faculty of Engineering and Computer Science, Informatics, Universitas Teknokrat Indonesia, Bandar Lampung, Indonesia

⁴Faculty of Letters and Education, Mathematics Education, Universitas Teknokrat Indonesia, Bandar Lampung, Indonesia

Email: ¹sanriomi@unsrat.ac.id, ²ahmad.aldino@monash.edu, ^{3*}setiawansyah@teknokrat.ac.id, ⁴very_hendra@teknokrat.ac.id

Email Corresponding Author: setiawansyah@teknokrat.ac.id

Abstract—MOORA (Multi-Objective Optimization by Ratio Analysis) method is one of the multi-criteria analysis techniques used for alternative selection based on several different criteria or objectives. In the context of selecting the best cashier, by using the MOORA method to select cashiers based on several relevant criteria. While Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA) is a method used to assess the importance of criteria relative to each other in the context of multi-criteria analysis. This method helps in determining the weight of criteria used in multi-criteria decision making. The combination of MOORA and PIPRECIA will produce the best cashier selection based on the criteria used. The results of the best cashier assessment ranking using the Multi-Objective Optimization method on the basis of Ratio Analysis (MOORA) and the Simplified Pivot Pairwise Relative Criteria Importance Assessment weighting method obtained results, namely for Rank 1 obtained by Rini Maya with a final value of 0.343.

Keywords: Best Cashier; Combination; MOORA; PIPRECIA; Ranging

1. INTRODUCING

Information Systems are a core element of the digital age that has fundamentally changed the way we collect, manage, and utilize data. In the context of an increasingly connected modern society, information systems play a central role in supporting decision making, optimizing business processes, and facilitating the rapid exchange of information. Effective and sustainable management of information systems is a crucial element in achieving the strategic objectives of the organization[1]. In an era where information is a valuable asset, timely and accurate decision making is key to achieving competitive advantage. By managing information systems well, organizations can improve operational efficiency, speed up the decision-making process, and enable faster innovation. In addition, sustainable management also includes data protection and security, which is important to mitigate risks and maintain stakeholder trust[2]. Thus, a solid understanding of the management of information systems becomes the core of achieving the strategic objectives of organizations in an increasingly related and rapidly changing business environment[3].

A cashier is an individual who works in different types of businesses, especially in the retail, restaurant, or customer service business sectors, and has primary responsibility for managing financial transactions between businesses and customers. The duties of the cashier involve receiving payment from customers for products or services purchased, calculating the amount of money received, and giving change if needed. The role of the cashier also includes recording transactions, managing electronic payment systems (such as credit cards or digital payments), and ensuring that transactions run smoothly. The role of the cashier is an important part of maintaining business operational efficiency and providing a positive experience to customers. Therefore, integrity, speed, accuracy, and good customer service are important traits in the job as a cashier. The selection of the best cashier is an important step in maintaining the quality of service and customer experience in various types. One of the best cashier selection methods is using a decision support system model.

Decision Support System (DSS) is an important concept in the world of science and technology that has experienced rapid development in recent decades[4], [5]. With the advancement of information technology, DSS has become a tool that not only helps in complex decision making, but also increases efficiency, productivity, and quality of decisions in various aspects of life. DSS has proven to be a very useful tool in dealing with uncertainty and complexity in decision making, both at the individual and large organizational levels. With a better understanding of DSS, it is expected to recognize its added value in various aspects of life and apply it effectively to improve the decision-making process in the future[9]. One method in decision making is Multi-Objective Optimization on the basis of Ratio Analysis (MOORA).

Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) is a powerful decision-making technique that plays an important role in dealing with complex problems with several conflicting goals[6]. MOORA allows decision makers to evaluate and rank alternative options by considering multiple criteria simultaneously[7]. Using ratio analysis, MOORA facilitates a comprehensive evaluation of the performance of each alternative related to predefined objectives. This approach not only aids in informed decision making, but also provides a clear understanding of the balance between various competing goals. MOORA has found application in various fields, including finance, engineering, and environmental management, where stakeholders often face challenges in optimizing multiple objectives while

maintaining transparency and objectivity in the process of developing[8]. MOORA's advantage lies in its ability to transform complex multi-purpose problems into a structured, easy-to-interpret format. This method offers a systematic framework for evaluating alternatives, considering not only their performance within individual criteria, but also their importance relative to each other[9]. MOORA assists in informed decision making with objectives that are in line with the organization's goals and vision. In addition, this approach promotes transparency and accountability by providing a clear basis for the selection of selected alternatives, making it a valuable tool for organizations and individuals seeking ways to address the complexities of multi-purpose decision-making[10].

Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA) is a method used to evaluate and identify the importance of various criteria in a multi-criteria decision-making process[11]. PIPRECIA focuses on understanding the relative between criteria used in decision making, allowing decision makers to identify the most significant criteria in a given context[12]. This method involves comparing two criteria at a time, asking the decision maker to determine which criteria are more important than a given pair of criteria. This process continues until all pairs of criteria are compared. The result of PIPRECIA is a relative ranking that indicates the extent to which different criteria contribute to the objective or decision being evaluated[13]. PIPRECIA provides great benefits in more informed decision making[14]. By analyzing the relative between criteria, decision makers.

Research related to the research conducted includes [15] the results obtained by the MOORA method provide excellent optimization results by including weight in the calculation process. The stages of the MOORA method are quite simple in producing the best alternative. The best alternative from the study was obtained with a value of 0.28 as many as 3 salespeople. The next research [16] is this study aims to implement the Multi-Objective Optimization algorithm on the Basis of Ratio Analysis (MOORA) as a Decision Support in choosing Direct Cash Transfer recipients in Ilomangga Village, Gorontalo. With a dataset of 169 potential beneficiaries, this study focuses on developing an efficient approach to assist village heads in the beneficiary selection process. By combining multi-objective optimization and ratio analysis, the MOORA algorithm objectively evaluates and sorts recipients based on feasibility and suitability. The findings of this study demonstrate the effectiveness of MOORA in simplifying the selection process, ensuring transparency, and optimizing resource allocation for those most in need. This research contributes to decision support systems by demonstrating the practical implementation of MOORA. The last research [17] is The results obtained from the research conducted, that the MOORA (Multi-Objective Optimization on the basis of Ratio Analysis) method can select alternatives and rank in recommending the best organic masks based on predetermined criteria where the alternative Lea Gloria (A4) as the best organic face mask with a value of $Y_i(\max) = 0.7218$.

This study aims to determine the best cashier using the Combination of Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) and Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA) and the criteria used in selecting the best cashier, namely integrity, speed, accuracy, and customer service.

2. RESEARCH METHODOLOGY

2.1 Stages of Research

Research is a systematic process that follows a number of structured stages to collect data, analyze information, and achieve predetermined research objectives. Each stage in research has a key role in ensuring that research is conducted efficiently and the results are reliable[18]. Careful planning helps direct the entire research process, while data analysis and interpretation of results are critical steps to extract meaning from the information that has been collected. Report preparation is a way to share research findings with the scientific community or other stakeholders. Rigorous and structured research stages are an important foundation for achieving new knowledge and deeper understanding in various research fields[19]. The stages in this study are as shown in figure 1 below.



Figure 1. Stage of Research

The process of the research stages carried out is to determine problems in determining the best cashier using criteria namely integrity, speed, accuracy, and customer service. Based on the problem and existing provide a solution using a decision support system model using a combination of MOORA and PIPRECIA so that it will produce the best alternative cashier recommendation ranking.

2.2 Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA)

The stages of weighting calculation using PIPRECIA are as follows.

- Establishes the relative significance of the s_j of each criterion, except the first one using the following equation.

$$S_j = \begin{cases} 1 & \text{if } c_j > c_1 \\ 1 & \text{if } c_j = c_1 \\ 1 & \text{if } c_j < c_1 \end{cases} \quad (1)$$

Dimana $j \neq 1$

jika $c_j = c_1$ masuk dalam interval nilai 1

jika $c_j > c_1$ masuk dalam interval nilai (1 sampai 1,9)

jika $c_j < c_1$ masuk dalam interval nilai (0,1 sampai 1)

b. Set the value of the k_j coefficient using the following equation.

$$k_j = \begin{cases} 1 & \text{if } j = 1 \\ 2 - s_j & \text{if } j > 1 \end{cases} \quad (2)$$

c. Calculating weights q_j using the following equation.

$$q_j = \begin{cases} 1 & \text{jika } j = 1 \\ \frac{1}{k_j} & \text{jika } j > 1 \end{cases} \quad (3)$$

d. Calculate the relative final weight of the criterion using the following equation.

$$w_j = \frac{q_j}{\sum_{k=1}^n q_k} \quad (4)$$

2.3 Multi-Objective Optimization on the basis of Ratio Analysis (MOORA)

The MOORA method consists of four main steps, namely: Making decision matrix, Normalization, Reducing maximum and minimum values, and Ranking[20]. Creating a Decision Matrix is to represent all the information available to each attribute in the form of a decision matrix presented as $X_m \times n$ matrix. Where x_{ij} is the performance measurement of the i^{th} alternative in the attribute j^{th} , m is the number of alternatives and n is the number of attributes/criteria. Then a ratio system was developed in which each performance of an alternative in an attribute is compared with the denominator that is representative for all alternatives to that attribute[21]. Here is the change of criteria values into a decision matrix[22]:

$$X = \begin{bmatrix} x_{i1} & \cdots & x_{in} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \quad (5)$$

The next stage of normalization aims to unite each element of the matrix so that the elements in the matrix have uniform values. This ratio can be expressed in the following equation

$$X_{ij}^* = \frac{x_{ij}}{\sqrt{[\sum_{j=1}^n x_{ij}^2]}} \quad (6)$$

The next stage is to assign a weight value to the criteria, provided that the maximum criteria type weight value is greater than the minimum criteria type weight value. To indicate that an attribute is more important it can be multiplied by the appropriate weight (coefficient of significance). The following formula calculates the value of MOORA Multiobjective Optimization, multiplication of the weight of the criterion against the maximum attribute value minus the multiplication of the weight of the criterion against the minimum attribute value, if formulated then

$$Y_i^* = \sum_{j=1}^g W_j X_{ij}^* - \sum_{j=g+1}^n W_j X_{ij}^* \quad (7)$$

3. RESULTS AND DISCUSSION

The solution to solve the problem using the MOORA and PIPRECIA methods for the selection of the best cashier makes the criteria table used, the criteria table can be seen below.

3.1 Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA)

The solution to solve the problem using the MOORA and PIPRECIA methods for the selection of the best cashier makes the criteria table used, the criteria table can be seen below.

Table 1. Criteria Data

Criteria Code	Criteria Name
C1	Integrity
C2	Speed
C3	Accuracy
C4	Customer Service

The next stage determines the weight of each criterion using equation (1), the relative significance of the s_j of each criterion as shown in the following table.

Table 2. Value S_j

Criteria Code	Criteria Name	S_j
C1	Integrity	1
C2	Speed	1
C3	Accuracy	0.6
C4	Customer Service	0.8

Set the value of the k_j coefficient using (2), the calculation result is as follows.

Table 3. Value K_j Coefficient

Criteria Code	Criteria Name	S_j	K_j
C1	Integrity	1	1
C2	Speed	1	1
C3	Accuracy	0.6	1.4
C4	Customer Service	0.8	1.2

Set the weight q_j value using (3), the calculation result is as follows.

Table 4. Value Weight Q_j

Criteria Code	Criteria Name	S_j	K_j	Q_j
C1	Integrity	1	1	1
C2	Speed	1	1	1
C3	Accuracy	0.6	1.4	0.714
C4	Customer Service	0.8	1.2	0.833

Calculating the relative final weight of the criterion using (4), the calculation results as follows.

$$w_1 = \frac{1}{1+1+0.714+0.833} = \frac{1}{3.547} = 0.282$$

$$w_2 = \frac{1}{1+1+0.714+0.833} = \frac{1}{3.547} = 0.282$$

$$w_3 = \frac{0.714}{1+1+0.714+0.833} = \frac{0.714}{3.547} = 0.201$$

$$w_4 = \frac{0.833}{1+1+0.714+0.833} = \frac{0.833}{3.547} = 0.235$$

Based on the calculation of the weighting of criteria using the PIPRECIA method, the weight of each criterion is obtained as shown in table 5 below.

Table 5. Criteria Weights

Criteria Code	Criteria Name	Criteria Weights
C1	Integrity	0.282
C2	Speed	0.282
C3	Accuracy	0.201
C4	Customer Service	0.235

3.2 Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) in the Selection of The Best Cashier

Solving to overcome the problem of using the MOORA and PIPRECIA methods for the selection of the best cashier by creating an alternative table of candidates there are 9 cashier data that will be candidates, alternative data for the best cashier selection candidates can be seen in table 6 below.

Table 6. Alternative Data

ID	Candidate Name
ID-KS-0001	Putri Subandi
ID-KS-0002	Ahmad Budi
ID-KS-0003	Alvira Rosa
ID-KS-0004	Siti Salpira
ID-KS-0005	Muhammad Handi
ID-KS-0006	Mega Kurnia Sari
ID-KS-0007	Rini Maya

ID	Candidate Name
ID-KS-0008	Rosa Melvina
ID-KS-0009	Tini

Furthermore, making an assessment table for each of the best cashier candidate alternatives based on existing criteria obtained from the assessment team in the company in determining the assessment of cashier performance, the results of the assessment of the best cashier candidate alternatives can be seen in the following table 7 below.

Table 7. Best Cashier Candidate Assessment Results Data

ID	C1	C2	C3	C4
ID-KS-0001	85	89	79	87
ID-KS-0002	83	87	78	85
ID-KS-0003	85	89	80	87
ID-KS-0004	84	88	79	86
ID-KS-0005	87	90	81	88
ID-KS-0006	86	90	81	88
ID-KS-0007	88	92	83	90
ID-KS-0008	85	89	80	87
ID-KS-0009	88	92	83	90

After all the necessary data is obtained then using the method of Stages of Multi-Objective Optimization Method on the basis of Ratio Analysis in the selection of the best cashier, this stage we make a decision matrix (X) from the assessment results of each alternative based on table 7 using (5). The results of the decision matrix can be seen below.

$$X = \begin{bmatrix} x_{11} & x_{21} & x_{31} & x_{41} \\ x_{12} & x_{22} & x_{32} & x_{42} \\ x_{13} & x_{23} & x_{33} & x_{43} \\ x_{14} & x_{24} & x_{34} & x_{44} \\ x_{15} & x_{25} & x_{35} & x_{45} \\ x_{16} & x_{26} & x_{36} & x_{46} \\ x_{17} & x_{27} & x_{37} & x_{47} \\ x_{18} & x_{28} & x_{38} & x_{48} \\ x_{19} & x_{29} & x_{39} & x_{49} \end{bmatrix}$$

The results of the decision matrix of the 9 existing alternatives for each alternative can be seen below.

$$X = \begin{bmatrix} 85 & 89 & 79 & 87 \\ 83 & 87 & 78 & 85 \\ 85 & 89 & 80 & 87 \\ 84 & 88 & 79 & 86 \\ 87 & 90 & 81 & 88 \\ 86 & 90 & 81 & 88 \\ 88 & 92 & 83 & 90 \\ 85 & 89 & 80 & 87 \\ 88 & 92 & 83 & 90 \end{bmatrix}$$

The next stage of the MOORA method is to normalize the decision matrix that has been made in the previous stage so that it will produce a normalization matrix, the result of normalizing the decision matrix as below using equation (3).

$$x_{11} = \frac{85}{\sqrt{85^2+83^2+85^2+84^2+87^2+86^2+88^2+85^2+88^2}} = \frac{85}{257.05} = 0.331$$

$$x_{12} = \frac{83}{\sqrt{85^2+83^2+85^2+84^2+87^2+86^2+88^2+85^2+88^2}} = \frac{83}{257.05} = 0.323$$

$$x_{13} = \frac{85}{\sqrt{85^2+83^2+85^2+84^2+87^2+86^2+88^2+85^2+88^2}} = \frac{85}{257.05} = 0.331$$

$$x_{14} = \frac{84}{\sqrt{85^2+83^2+85^2+84^2+87^2+86^2+88^2+85^2+88^2}} = \frac{84}{257.05} = 0.327$$

$$x_{15} = \frac{87}{\sqrt{85^2+83^2+85^2+84^2+87^2+86^2+88^2+85^2+88^2}} = \frac{87}{257.05} = 0.338$$

$$x_{16} = \frac{86}{\sqrt{85^2+83^2+85^2+84^2+87^2+86^2+88^2+85^2+88^2}} = \frac{86}{257.05} = 0.335$$

$$x_{17} = \frac{88}{\sqrt{85^2+83^2+85^2+84^2+87^2+86^2+88^2+85^2+88^2}} = \frac{88}{257.05} = 0.342$$

$$x_{18} = \frac{85}{\sqrt{85^2+83^2+85^2+84^2+87^2+86^2+88^2+85^2+88^2}} = \frac{85}{257.05} = 0.331$$

$$x_{19} = \frac{88}{\sqrt{85^2+83^2+85^2+84^2+87^2+86^2+88^2+85^2+88^2}} = \frac{88}{257.05} = 0.342$$

$$x_{21} = \frac{89}{\sqrt{89^2+87^2+89^2+88^2+90^2+90^2+92^2+89^2+92^2}} = \frac{89}{268.71} = 0.331$$

$$x_{22} = \frac{87}{\sqrt{89^2+87^2+89^2+88^2+90^2+90^2+92^2+89^2+92^2}} = \frac{87}{268.71} = 0.324$$

$$x_{23} = \frac{89}{\sqrt{89^2+87^2+89^2+88^2+90^2+90^2+92^2+89^2+92^2}} = \frac{89}{268.71} = 0.331$$

$$x_{24} = \frac{88}{\sqrt{89^2+87^2+89^2+88^2+90^2+90^2+92^2+89^2+92^2}} = \frac{88}{268.71} = 0.327$$

$$x_{25} = \frac{90}{\sqrt{89^2+87^2+89^2+88^2+90^2+90^2+92^2+89^2+92^2}} = \frac{90}{268.71} = 0.335$$

$$x_{26} = \frac{90}{\sqrt{89^2+87^2+89^2+88^2+90^2+90^2+92^2+89^2+92^2}} = \frac{90}{268.71} = 0.335$$

$$x_{27} = \frac{92}{\sqrt{89^2+87^2+89^2+88^2+90^2+90^2+92^2+89^2+92^2}} = \frac{92}{268.71} = 0.342$$

$$x_{28} = \frac{89}{\sqrt{89^2+87^2+89^2+88^2+90^2+90^2+92^2+89^2+92^2}} = \frac{89}{268.71} = 0.331$$

$$x_{29} = \frac{92}{\sqrt{89^2+87^2+89^2+88^2+90^2+90^2+92^2+89^2+92^2}} = \frac{92}{268.71} = 0.342$$

$$x_{31} = \frac{79}{\sqrt{79^2+78^2+80^2+79^2+81^2+81^2+83^2+80^2+83^2}} = \frac{79}{241.38} = 0.327$$

$$x_{32} = \frac{78}{\sqrt{79^2+78^2+80^2+79^2+81^2+81^2+83^2+80^2+83^2}} = \frac{78}{241.38} = 0.323$$

$$x_{33} = \frac{80}{\sqrt{79^2+78^2+80^2+79^2+81^2+81^2+83^2+80^2+83^2}} = \frac{80}{241.38} = 0.331$$

$$x_{34} = \frac{79}{\sqrt{79^2+78^2+80^2+79^2+81^2+81^2+83^2+80^2+83^2}} = \frac{79}{241.38} = 0.327$$

$$x_{35} = \frac{81}{\sqrt{79^2+78^2+80^2+79^2+81^2+81^2+83^2+80^2+83^2}} = \frac{81}{241.38} = 0.336$$

$$x_{36} = \frac{81}{\sqrt{79^2+78^2+80^2+79^2+81^2+81^2+83^2+80^2+83^2}} = \frac{81}{241.38} = 0.336$$

$$x_{37} = \frac{83}{\sqrt{79^2+78^2+80^2+79^2+81^2+81^2+83^2+80^2+83^2}} = \frac{83}{241.38} = 0.344$$

$$x_{38} = \frac{80}{\sqrt{79^2+78^2+80^2+79^2+81^2+81^2+83^2+80^2+83^2}} = \frac{80}{241.38} = 0.331$$

$$x_{39} = \frac{83}{\sqrt{79^2+78^2+80^2+79^2+81^2+81^2+83^2+80^2+83^2}} = \frac{83}{241.38} = 0.344$$

$$x_{41} = \frac{87}{\sqrt{87^2+85^2+87^2+86^2+88^2+88^2+90^2+87^2+90^2}} = \frac{87}{262.71} = 0.331$$

$$x_{42} = \frac{85}{\sqrt{87^2+85^2+87^2+86^2+88^2+88^2+90^2+87^2+90^2}} = \frac{85}{262.71} = 0.324$$

$$x_{43} = \frac{87}{\sqrt{87^2+85^2+87^2+86^2+88^2+88^2+90^2+87^2+90^2}} = \frac{87}{262.71} = 0.331$$

$$x_{44} = \frac{86}{\sqrt{87^2+85^2+87^2+86^2+88^2+88^2+90^2+87^2+90^2}} = \frac{86}{262.71} = 0.327$$

$$x_{45} = \frac{88}{\sqrt{87^2+85^2+87^2+86^2+88^2+88^2+90^2+87^2+90^2}} = \frac{88}{262.71} = 0.335$$

$$x_{46} = \frac{88}{\sqrt{87^2+85^2+87^2+86^2+88^2+88^2+90^2+87^2+90^2}} = \frac{88}{262.71} = 0.335$$

$$x_{47} = \frac{90}{\sqrt{87^2+85^2+87^2+86^2+88^2+88^2+90^2+87^2+90^2}} = \frac{90}{262.71} = 0.343$$

$$x_{48} = \frac{87}{\sqrt{87^2+85^2+87^2+86^2+88^2+88^2+90^2+87^2+90^2}} = \frac{87}{262.71} = 0.331$$

$$x_{49} = \frac{90}{\sqrt{87^2+85^2+87^2+86^2+88^2+88^2+90^2+87^2+90^2}} = \frac{90}{262.71} = 0.343$$

Next calculate the optimization value based on the results of matrix normalization from the previous stage. At the stage of calculating the optimization value using equation (7), because each criterion has a weight calculated using the PIPRECIA method. The results of the calculation of the optimization value are as follows.

$$Y_1^* = (x_{11} * w_1 + x_{12} * w_2 + x_{13} * w_3 + x_{14} * w_4)$$

$$Y_1^* = (0.331 * 0.282 + 0.332 * 0.282 + 0.327 * 0.201 + 0.331 * 0.235) = 0.33$$

$$Y_2^* = (x_{11} * w_1 + x_{12} * w_2 + x_{13} * w_3 + x_{14} * w_4)$$

$$Y_2^* = (0.323 * 0.282 + 0.324 * 0.282 + 0.323 * 0.201 + 0.324 * 0.235) = 0.323$$

$$Y_3^* = (x_{11} * w_1 + x_{12} * w_2 + x_{13} * w_3 + x_{14} * w_4)$$

$$Y_3^* = (0.331 * 0.282 + 0.332 * 0.282 + 0.331 * 0.201 + 0.331 * 0.235) = 0.331$$

$$Y_4^* = (x_{11} * w_1 + x_{12} * w_2 + x_{13} * w_3 + x_{14} * w_4)$$

$$Y_4^* = (0.327 * 0.282 + 0.328 * 0.282 + 0.327 * 0.201 + 0.327 * 0.235) = 0.327$$

$$Y_5^* = (x_{11} * w_1 + x_{12} * w_2 + x_{13} * w_3 + x_{14} * w_4)$$

$$Y_5^* = (0.338 * 0.282 + 0.335 * 0.282 + 0.336 * 0.201 + 0.335 * 0.235) = 0.336$$

$$Y_6^* = (x_{11} * w_1 + x_{12} * w_2 + x_{13} * w_3 + x_{14} * w_4)$$

$$Y_6^* = (0.335 * 0.282 + 0.335 * 0.282 + 0.336 * 0.201 + 0.335 * 0.235) = 0.335$$

$$Y_7^* = (x_{11} * w_1 + x_{12} * w_2 + x_{13} * w_3 + x_{14} * w_4)$$

$$Y_7^* = (0.342 * 0.282 + 0.343 * 0.282 + 0.344 * 0.201 + 0.343 * 0.235) = 0.343$$

$$Y_8^* = (x_{11} * w_1 + x_{12} * w_2 + x_{13} * w_3 + x_{14} * w_4)$$

$$Y_8^* = (0.331 * 0.282 + 0.332 * 0.282 + 0.3313 * 0.201 + 0.331 * 0.235) = 0.331$$

$$Y_9^* = (x_{11} * w_1 + x_{12} * w_2 + x_{13} * w_3 + x_{14} * w_4)$$

$$Y_9^* = (0.342 * 0.282 + 0.339 * 0.282 + 0.344 * 0.201 + 0.343 * 0.235) = 0.342$$

After obtaining the final score in the calculation of the MOORA and PIPRECIA methods, the last makes an alternative ranking based on the highest final value of each alternative or the best cashier candidate. The results of the best cashier selection ranking are shown in table 8 below.

Table 8. Best Cashier Selection Ranking

ID	Candidate Name	Final Total Grade	Rank
ID-KS-0007	Rini Maya	0.343	1
ID-KS-0009	Tini	0.342	2
ID-KS-0005	Muhammad Handi	0.336	3
ID-KS-0006	Mega Kurnia Sari	0.335	4
ID-KS-0003	Alvira Rosa	0.331	5
ID-KS-0008	Rosa Melvina	0.331	6
ID-KS-0001	Putri Subandi	0.33	7
ID-KS-0004	Siti Salpira	0.327	8
ID-KS-0002	Ahmad Budi	0.323	9

Based on the results of the best cashier assessment ranking using the Multi-Objective Optimization method on the basis of Ratio Analysis (MOORA) and Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA), the results were obtained for Rank 1 obtained by Rini Maya with a final value of 0.343, Rank 2 obtained by Tini with a final value of 0.342, Rank 3 obtained by Muhammad Handi with a final value of 0.336.

4. CONCLUSION

MOORA (Multi-Objective Optimization by Ratio Analysis) method is one of the multi-criteria analysis techniques used for alternative selection based on several different criteria or objectives. In the context of selecting the best cashier, by using the MOORA method to select cashiers based on several relevant criteria. While Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA) is a method used to assess the importance of criteria relative to each other in the context of multi-criteria analysis. This method helps in determining the weight of criteria used in multi-criteria decision making. The combination of MOORA and PIPRECIA will produce the best cashier selection based on the criteria used.

The selection of the best cashier using a combination of the Multi-Objective Optimization decision model on the basis of Ratio Analysis (MOORA) and Simplified Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA-S) helps in the selection of the best cashier because the weight of the resulting criteria is not based on the assumptions of the decision maker. The results of the best cashier assessment ranking using the Multi-Objective Optimization method on the basis of Ratio Analysis (MOORA) and the Simplified Pivot Pairwise Relative Criteria Importance Assessment weighting method obtained results, namely for Rank 1 obtained by Rini Maya with a final value of 0.343.

REFERENCES

- [1] S. Sintaro, "Permodelan Sistem Informasi Pembelian dan Penjualan Berbasis Website," *J. Ilm. Inform. dan Ilmu Komput.*, vol. 1, no. 1, pp. 25–32, 2022.
- [2] S. Maryana and D. Suhartini, "Implementasi Certainty Factor Untuk Diagnosa Penyakit Sapi," *Chain J. Comput. Technol. Comput. Eng. Informatics*, vol. 1, no. 1, pp. 14–20, 2023.
- [3] Ariyadi Dwi Saputra and Lathifah, "Pemodelan Aplikasi Pramuka Ambaraka Berbasis Web Menggunakan ISO 25010," *J. Data Sci. Inf. Syst.*, vol. 1, no. 2 SE-Articles, pp. 77–83, May 2023, doi: 10.58602/dimis.v1i2.48.
- [4] R. D. Gunawan and F. Ariany, "Implementasi Metode SAW Dalam Sistem Pendukung Keputusan Pemilihan Plano Kertas," *J. Artif. Intell. Technol. Inf.*, vol. 1, no. 1, pp. 29–38, 2023.
- [5] A. F. O. Pasaribu and N. Nuroji, "Sistem Pendukung Keputusan Penentuan Pelanggan Terbaik Menggunakan Profile Matching," *J. Data Sci. Inf. Syst.*, vol. 1, no. 1, pp. 24–31, 2023.
- [6] S. Chakraborty, H. N. Datta, K. Kalita, and S. Chakraborty, "A narrative review of multi-objective optimization on the basis of ratio analysis (MOORA) method in decision making," *OPSEARCH*, pp. 1–44, 2023.
- [7] C. S. Dhanalakshmi, M. Mathew, and P. Madhu, "Biomass material selection for sustainable environment by the application of multi-objective optimization on the basis of ratio analysis (MOORA)," in *Materials, Design, and Manufacturing for Sustainable Environment: Select Proceedings of ICMDMSE 2020*, Springer, 2021, pp. 345–354.
- [8] P. Dauni, A. Wahana, F. Anjani, and K. Manaf, "Recommendation for giving loans using the Multi Objective Optimization method based on Ratio Analysis," in *IOP Conference Series: Materials Science and Engineering*, IOP Publishing, 2021, p. 32096.
- [9] T. Barik, S. Parida, and K. Pal, "Optimizing the input parameters setting for least hole defects while drilling CFRP laminates by multi-objective optimization on the basis of ratio analysis (MOORA) method," in *Journal of Physics: Conference Series*, IOP Publishing, 2023, p. 12007.
- [10] D. U. Iswavigra, "Online Shop Recommendations: Decision Support System Based on Multi-Objective Optimization on the Basis of Ratio Analysis," in *2020 8th International Conference on Cyber and IT Service Management (CITSM)*, IEEE, 2020, pp. 1–6.
- [11] D. Stanujkic, D. Karabasevic, G. Popovic, and C. Sava, "Simplified pivot pairwise relative criteria importance assessment (PIPRECIA-S) method," *Rom. J. Econ. Forecast.*, vol. 24, no. 4, p. 141, 2021.
- [12] D. Stanujkic, D. Karabasevic, and G. Popovic, "RANKING ALTERNATIVES USING PIPRECIA METHOD: A CASE OF HOTELS' WEBSITE EVALUATION," *J. Process Manag. new Technol.*, vol. 9, no. 3–4, pp. 62–68, 2021.
- [13] S. Setiawansyah, "Kombinasi Pembobotan PIPRECIA-S dan Metode SAW dalam Pemilihan Ketua Organisasi Sekolah," *J. Ilm. Inform. dan Ilmu Komput.*, vol. 2, no. 1, pp. 32–40, 2023.
- [14] A. Blagojević, Ž. Stević, D. Marinković, S. Kasalica, and S. Rajilić, "A novel entropy-fuzzy PIPRECIA-DEA model for safety evaluation of railway traffic," *Symmetry (Basel)*, vol. 12, no. 9, p. 1479, 2020.
- [15] A. T. Hidayat, N. K. Daulay, and Mesran, "Penerapan Metode Multi-Objective Optimization on The Basis of Ratio Analysis (MOORA) dalam Pemilihan Wiraniaga Terbaik," *J. Comput. Syst. Informatics*, vol. 1, no. 4, pp. 367–372, 2020.
- [16] T. P. Handayani, P. I. Wantu, I. Ibrahim, and H. Gani, "Penerapan Metode Multi Objective Optimization on The Basic of Ratio Analysis (MOORA) Untuk Pemilihan Penerima Bantuan Langsung Tunai di Desa Ilongga," *J. Ilm. Tek. Mesin, Elektro dan Komput.*, vol. 3, no. 2, pp. 229–243, 2023.
- [17] A. D. Amanda, F. N. Arieni, and A. P. Windarto, "Penerapan Metode Multi Objective Optimization on The Basic of Ratio Analysis (MOORA) pada Pemilihan Masker Organik Wajah Berdasarkan Kriteria," *J. Sist. Komput. dan Inform.*, vol. 2, no. 3, pp. 289–296, 2021.
- [18] M. S. Sihaloho and T. Ardiansah, "Sistem Informasi Pembayaran Iuran Berbasis Mobile pada Kompleks Barokah," *J. Media Borneo*, vol. 1, no. 1, pp. 21–27, 2023.
- [19] B. Bramantyo, M. P. K. Putra, and N. Hendrastuty, "Implementasi Recurrent Neural Network Pada Multiclass Text Classification Judul Berita," *J. Media Borneo*, vol. 1, no. 1, pp. 1–11, 2023.
- [20] K. Munthe, T. R. A. Syahputra, A. A. Pasuli, and M. A. Hasibuan, "Sistem Pendukung Keputusan Pemilihan Pegawai Honorer Kelurahan Medan Sinembah Menerapkan Metode ROC dan MOORA," *Bull. Informatics ...*, vol. 1, no. 1, 2022, [Online]. Available: <https://ejournal.pdsi.or.id/index.php/bids/article/view/5%0Ahttps://ejournal.pdsi.or.id/index.php/bids/article/download/5/4>
- [21] A. Yanda and M. Mesran, "Penentuan Penerima Bantuan Pangan Non Tunai (BPNT) Menerapkan Metode Multi Objective Optimization on the Basis of Ratio Analysis (MOORA)," *Bull. Informatics Data Sci.*, vol. 1, no. 2, pp. 38–45, 2022.
- [22] A. I. A. Lubis and A. Fau, "Sistem Pendukung Keputusan Pemilihan Ketua Organisasi BKM (Badan Keswadayaan Masyarakat) Menerapkan Metode MOORA," *J. Informatics, Electr. Electron. Eng.*, vol. 2, no. 4, pp. 131–137, 2023.