



## Best E-Wallet Selection Decision Support System using MOORA Method and ROC Weighting

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**Abstract**—E-wallet is an electronic payment service that is widely used by Indonesian people. Currently, there are many e-wallets on the market, making people confused about choosing an e-wallet that suits their needs. This research implements this system in a simulation environment to test and validate the effectiveness of the approach in selecting the best E-Wallet. Experimental results show that the proposed approach can provide more accurate and relevant recommendations for users in choosing an E-Wallet that suits their preferences. This research aims to build a decision support system for selecting the best e-wallet using the Multi-Objective Optimization by Ratio Analysis method (MOORA) and ROC weighting. MOORA is a multi-objective system that optimizes two or more conflicting properties simultaneously. This method is used to perform complex mathematical calculations. Decision support systems can help in the above problems. The aim of this research is to apply the MOORA algorithm to help users choose the best e-wallet that suits their needs. For the process of inputting alternative criteria weight values, the results of the system and manual process are the same, according to the results of the validity of the MOORA calculation. Where the application of the MOORA method is carried out by calculating alternative values from the algorithm and weighting, then calculations are carried out to determine the best option. The four e-wallets that are alternatives in this research are GoPay, OVO, ShopeePay, and DANA. Where the application of the Moora method is carried out by calculating alternative values from the algorithm and weighting then, calculations are carried out to determine the best option. The final results of this research showed that Alternative 1 (DANA) was chosen as the best alternative in the Best E-Wallet Selection with a preference value of 0.507.

**Keywords:** E-Wallet; Electronic; MOORA Method; ROC Method; DSS

### 1. INTRODUCTION

E-Wallet stands for electronic wallet. It is an application or digital platform that allows users to electronically store money, make payments, or transfer funds through electronic devices such as smart phones or computers. E-Wallets are usually linked to the user's bank account or credit card, and often offer various additional features such as bill management, ticket purchase, or other online purchases. Users can usually top up their e-wallet balance through bank transfers, debit/credit cards, or at cooperating physical stores. In this era of growing globalization, information technology is increasingly recognized and has a place in almost all aspects of all forms of human life in the world. Technological advances now present many innovations that are developing in financial services or better known as financial technology (fintech) which has replaced the role of cash into non-cash payment transactions, so many other financial services have emerged such as digital payments which are used to support the ease of transactions anywhere and anytime for its users. With this digital payment, even payment transactions become more practical, fast and safe. of course, there are also many attractive offers such as discounts when making online or offline shopping payments using one of these digital payments. This has made many electronic money providers in Indonesia take advantage of smartphones to improve their services through digital wallet / E-wallet applications. E-wallet is an application that allows users to transact non-cash to buy goods or services such as money transfers, bill payments, credit purchases and merchant payments.

Choosing the best e-wallet can be a challenge, as there are many factors to consider depending on individual needs and preferences. Here are some of the issues that are usually taken into consideration in choosing the best e-wallet. Security E-Wallets should have a high level of security to protect users' information and funds from unauthorized access. Ease of use Intuitive interface and fast payment process are important factors for user convenience. The availability of a popular and widely used E-Wallet may be more practical as it can be accepted by more retailers and merchants. Additional features Some e-wallets offer additional features such as bill management, discount offers, or loyalty programs that can increase the value of use. Fees Note the fees associated with using an e-wallet, such as transaction fees, withdrawal fees, or monthly service fees. Integration with other payment systems: The ability to integrate e-wallets with other payment systems such as credit cards or PayPal can be an added advantage. Customer support It is important to consider the quality of customer support provided by the e-wallet provider, including the availability of customer service and ease of troubleshooting. Based on these problems, a system is needed that is useful to help people provide recommendations for the best e-wallet choices to people. using one of the solution techniques in the IT field, especially the decision support system (DSS).

Decision Support System is a system that can be used to help a person or institution in making decisions (Susilawati & Pristiwanto, 2021)(Mesran et al., 2024)(Setiawansyah et al., 2024). The function of the Decision Support System (DSS) is to improve the ability of decision makers by providing more or better decision alternatives, so that it



can help to formulate the problems and circumstances at hand (Septilia et al., 2020). Decision support systems are designed to help decision makers make semi-structured or unstructured problem decisions by adding human wisdom and computer information (Lestari et al., 2021). The advantages of DSS can produce solutions relatively quickly and the results can be relied upon to be used as a reference (J. Hutagalung et al., 2022).

Methods that are often used in the implementation of decision support systems are WP (Weighted Product), SAW (Simple Additive Weighting), WASPAS (Weighted Aggregate Total Product Assessment), MOORA, MOOSRA, ROC, TOPSIS, AHP etc. The researcher made a DSS design by applying this research method using the MOORA method and ROC Weighting.

This method shows the selectivity of choosing options well. While the ROC (Rank Order Centroid) method is based on the level of importance or importance of criteria, while the ROC (Rank Order Centroid) method assigns weights to each criterion based on the order of importance, which is evaluated based on priority. A rank usually consists of the sentence "criterion 1 is more important than criterion 2, which is more important than criterion 3", etc., until it says the nth criterion. Indicates priority according to the rule, with the highest value being the most important among other values (S. Hutagalung et al., 2023).

Multi-Objective Optimization by Ratio Analysis method or MOORA method. MOORA is a multi-objective system that optimizes two or more conflicting properties simultaneously. This method is used to perform complex mathematical calculations (Nazrul Azizi et al., 2023)(Zai et al., 2025).

Based on previous research published in 2024 discussing the "Best E-Wallet Selection Decision Support System Using the Analytical Hierarchy Process (AHP) Method". by Dinda Oktaviani Waruwu et al Draw conclusions: AHP is used as a tool to help make smart and efficient decisions. Through AHP, various relevant criteria or factors are assessed and prioritized, which helps in determining the most suitable e-wallet. A decision based on AHP analysis ensures that the selection of an e-wallet meets the needs and preferences of the users, such as convenience, security, cost, and features provided. This helps individuals and businesses in choosing an e-wallet that suits their goals and interests in electronic financial management. Thus, the use of AHP in e-wallet selection can help optimize the use of e-wallet technology according to user preferences and needs (Waruwu, 2024).

Furthermore, research by Muhammad Naufal Rifqi et al "Decision Support System for Best Wedding Organizer Recommendations Applying the MOORA Method and ROC Weighting" published in 2023. Based on the research that has been done, the authors conclude that the MOORA and ROC methods can be implemented to find Wedding Organizer recommendations that best suit the needs of the criteria that support decision making, namely price, service quality, reputation, portfolio and experience. So that from the results of calculations using the MOORA and ROC methods that have been carried out from 8 alternatives, the results of recommendations for wedding organizers are getting 4 highly recommended alternatives while the other 4 alternatives are quite recommended. The research findings show that the application of the MOORA method with the ROC Method assessment is able to provide recommendations that are more precise and in accordance with the criteria set, helping couples make accurate and efficient decisions when choosing a wedding organizer that best suits their wishes and needs (Rifqi & Iskandar, 2023).

Next in the research "E-Wallet Selection Decision Support System Using the Analytic Hierarchy Process (TOPSIS) Method" by Windy Amelia Putri, et al in 2023 that the AHP and TOPSIS methods can be used as alternatives to determine the best E-Wallet. Based on the calculations obtained ranking results where ShopeePay is the best alternative, followed by Gopay, Dana, OVO and LinkAja. This is based on the acquisition of a consistency value that shows the results of the calculation are consistent or valid with a value of 0.048 (Putri et al., 2022).

Furthermore, in a study entitled "Application of the MOORA Method and ROC Weighting in the Selection of Birth Control Devices" by Teddy Erlambang, et al in 2023. According to the results of the study, it can be concluded that the MOORA method can be used in determining contraceptives for couples of childbearing age that are suitable and in accordance with their needs. In this study set 7 assessment criteria including: price, age, menstrual history, effectiveness, period, childbirth history, and number of children. In this study, it was found that the MOORA method can select alternatives and perform ranking when recommending suitable contraceptives to suit your needs. Where the alternative with code (A5) is the pill is a contraceptive for couples of childbearing age that suits their needs. The highest  $Y_i$  (Max) value is 0.2249 (Teddy et al., 2023).

Next in the research "Decision Support System in the Selection of the Best Midwife for the Medan Region Applying the MOORA Method with ROC Weighting" by Dodi Kurniawan et al in 2022. Based on the results and discussion, it can be explained that the assessment of the best midwife selection is carried out and determined by each alternative and an assessment is carried out in determining the choice of the best midwife, namely the MOORA method. And the final result of the calculation of the best alternative using the MOORA method falls to the midwife with alternative A3 named Lisna Nainggolan is 0.282 (Kurniawan & Pristiwanto, 2022).

## 2. RESEARCH METHODOLOGY

### 2.1 Research Stages

During the implementation of the research, the author took several steps, namely:

### 1. Problem Analysis

Analyzing a problem, the author tries to analyze the problem. What problems arise, what causes the problem and what methods are used.

### 2. Data Collection

The author makes observations that help understand the data collection procedure.

### 3. Literature Study

Is an adaptation to make the analysis and classification collected in the research conducted. The purpose of literature is to obtain schematic principles that support the solution of the problem being investigated.

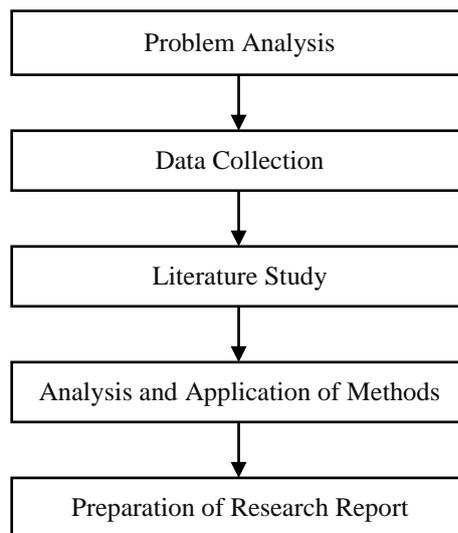
### 4. Analysis and Application of Methods

The author uses the ROC and MOORA methods to determine the best E-Wallet.

### 5. Preparation of Research Report

The author decides all the results of the steps taken by the author.

The chart image of the research stages can be seen in Figure 1 below:



**Figure 1.** Research Stages

## 2.2 Decision Support System

A decision support system is a system to support management decision makers in semi-structured decision situations, intended as a tool for decision makers to improve their skills, not as a substitute for their judgment. SDM is intended as a tool for decision makers to improve their skills but not replace their judgment. In addition, decision support systems are oriented towards decisions that require consideration or decisions that do not require decisions (Eryzha et al., 2019). A decision support system is a system that can help solve the problem of making accurate and targeted decisions (Siregar et al., 2022). A decision support system is an effective system for making complex decisions, with the help of decision rules, analytical models, extensive databases, and the knowledge of the decision maker himself (Mahendra & Ernanda Aryanto, 2019).

## 2.3 E-Wallet

E-wallet or digital wallet is an application or platform that allows users to store money electronically, perform financial transactions, and even send or receive payments without the need to use physical cash (Nadhilah et al., 2021). Generally, e-wallets are linked to a user's bank account or credit card, and can be used for a wide range of purchases, from online shopping, bill payments, to money transfers between individuals. E-wallets often utilize NFC (Near Field Communication) or QR code technology to facilitate transactions easily and quickly (Abrilia, 2020).

## 2.4 Metode Rank Order Centroid (ROC)

The ROC method is a method used to find the weight for each criterion according to its level (Nasution et al., 2022). ROC weighting is based on the needs and priority levels of various criteria. In the ROC process, these weights are assigned to each criterion according to the rank estimated based on the priority level (Valentine et al., 2022). As when forming several phrases or criteria such as criteria 1, criteria 2, criteria 3 and so on. And it can also be called the symbols C1, C2, C3 and so on (Rohayani et al., 2023). The formula for the ROC method is:

$$W_n = \frac{1}{m} \sum_{i=1}^m \left( \frac{1}{i} \right) \quad (1)$$

The explanation of the above formula is:

$W_n$  is the ROC weight value.



$m$  is the number of criteria.

$\sum_{i=1}^m \left(\frac{1}{i}\right)$  is the total value of the division of values for each criterion.

$i$  is the order of priority.

### 2.5 Multi-Objective Optimazation on the Basis of Ratio Analysis (MOORA) Method

MOORA is a method introduced by Zavadskas and Brauers (2006). This method is relatively new and has been applied by Brauers (2003) to determine several decision criteria. MOORA is easy to adapt and understand because it uses a set of subjective decision evaluation criteria with diverse characteristics (Haeruddin, 2022). In the MOORA method, the multiplication result is used to combine various attributes. The attributes must first be squared using their associated values. This method is used to solve complex mathematical calculation problems (Amalia et al., 2019). The calculation stages in MOORA are as follows (Astuti, 2020):

1. Form a decision matrix

$$X_{ij} = \begin{bmatrix} X_{11} & X_{12} & \dots & \dots & X_{1n} \\ X_{21} & X_{22} & \dots & \dots & X_{2n} \\ \dots & \dots & \dots & \dots & \dots \\ X_{m1} & X_{m2} & \dots & \dots & X_{mn} \end{bmatrix} \tag{2}$$

2. Normalize the Fuzzy Decision Matrix

$$X_{ij}^* = \frac{X_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \tag{3}$$

3. Calculating the Optimization Value

$$Y_i^* = \sum_{j=1}^g W_j X_{ij}^* - \sum_{j=g+1}^n W_j X_{ij}^* \tag{4}$$

$G$  is the number of attributes to be maximized.

$(n-g)$  is the number of attributes to be minimized.

$Y_i$  is the normalized assessment value of alternative 1 there are all attributes.

4. Establish alternative ranking

## 3. RESULTS AND DISCUSSION

The MOORA method and ROC weighting are used in the process of solving problems in choosing the best E-Wallet, where to get the best alternative. Requires a set of criteria and preference weights as a means of selecting these problems.

### 3.1 Alternative Data

Alternative data is very important data in decision support systems. The following is the data of the candidates who will be taken into consideration which can be seen in the following Table 1:

**Table 1.** Alternative Data

Alternative	E-Wallet
A1	DANA
A2	OVO
A3	SHOPE PAY
A4	LINK AJA
A5	GOPAY

Table 1 displays alternative data in the form of types of e-wallet services used as options in the decision evaluation process. Each e-wallet is given a unique code in the form of A1 to A5 to facilitate identification and reference during analysis.

### 3.2 Creation of Criteria, Weights, and Alternatives

At this stage, criteria are needed that are used to determine the best e-wallet. This study uses 5 criteria starting from C1 (Total Transaction Limit), C2 (Number of Users), C3 (Application Rating), C4 (Top Up Method), C5 (Merchant) and 5 Alternatives namely, A1 (DANA), A2 (OVO), A3 (SHOPE PAY), A4 (LINK AJA), A5 (GOPAY). Weighting on each criterion is the first step used as a consideration between the level of importance of each criterion.

**Table 2.** Criteria Data

Criteria	Description	Type
C1	Total Transaction Limit	Benefit



Criteria	Description	Type
C2	Number of Users	Benefit
C3	Application Rating	Benefit
C4	Top up Method	Benefit
C5	Merchant	Benefit

Table 2 lists the criteria used to evaluate various e-wallet alternatives. Each criterion has a type of “Benefit,” which indicates that the higher the value of the criterion, the better the evaluation results for that alternative.

**Table 3.** Weighting of Each Criterion

Criteria	Category	Weight
	Very good	4
C1, C2,	Good	3
C3, C4, C5	Good enough	2
	Less than	1

Table 3 shows the weight given to each category of criteria based on quality assessment. This weighting is used to determine how important each criterion is in decision making.

**Table 4.** Suitability Rating Data

Alternative	C1	C2	C3	C4	C5
A1	4	4	3	4	2
A2	4	3	4	3	1
A3	3	4	3	3	3
A4	2	4	4	3	2
A5	3	1	4	2	3

Table 4 presents the results of the evaluation of e-wallet alternatives based on predetermined criteria. Each alternative is rated on each criterion with a certain value scale (e.g. 1 to 4), where a higher number reflects a better match against that criterion.

### 3.3 Implementation of ROC Method

Based on the above criteria, weighting is carried out by the Rank Order Centroid (ROC) method with equation 1. Calculated from equation 3 as follows:

$$W_1 = \frac{1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0,456$$

$$W_2 = \frac{0 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0,256$$

$$W_3 = \frac{0 + 0 + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0,156$$

$$W_4 = \frac{0 + 0 + 0 + \frac{1}{4} + \frac{1}{5}}{5} = 0,090$$

$$W_5 = \frac{0 + 0 + 0 + 0 + \frac{1}{5}}{5} = 0,040$$

So that the weighting value is obtained, namely:  $C_1 = 0,456$ ,  $C_2 = 0,256$ ,  $C_3 = 0,156$ ,  $C_4 = 0,090$ ,  $C_5 = 0,040$ .

### 3.4 Implementation of MOORA Method

In an effort to solve the above problem by applying the MOORA method, the calculation steps are required, namely as follows:

1. Form a decision matrix

$$X_{ij} = \begin{bmatrix} 4 & 4 & 3 & 4 & 2 \\ 4 & 3 & 4 & 3 & 1 \\ 3 & 4 & 3 & 3 & 3 \\ 2 & 4 & 4 & 3 & 2 \\ 3 & 1 & 4 & 2 & 3 \end{bmatrix}$$

2. Normalize the Fuzzy Decision Matrix  
C1

$$X_{11}^* = \frac{4}{\sqrt{4^2 + 4^2 + 3^2 + 2^2 + 3^2}} = \frac{4}{\sqrt{54}} = \frac{4}{7,348} = 0,544$$



$$X_{12}^* = \frac{4}{\sqrt{4^2+3^2+4^2+4^2+1^2}} = \frac{4}{\sqrt{58}} = \frac{4}{7,615} = 0,525$$

$$X_{13}^* = \frac{3}{\sqrt{3^2+4^2+3^2+4^2+4^2}} = \frac{3}{\sqrt{66}} = \frac{3}{8,124} = 0,369$$

$$X_{14}^* = \frac{4}{\sqrt{4^2+3^2+3^2+3^2+2^2}} = \frac{4}{\sqrt{47}} = \frac{4}{6,855} = 0,583$$

$$X_{15}^* = \frac{2}{\sqrt{2^2+1^2+3^2+2^2+3^2}} = \frac{2}{\sqrt{27}} = \frac{2}{5,196} = 0,384$$

C2

$$X_{21}^* = \frac{4}{\sqrt{4^2+4^2+3^2+2^2+3^2}} = \frac{4}{\sqrt{54}} = \frac{4}{7,348} = 0,544$$

$$X_{22}^* = \frac{3}{\sqrt{4^2+3^2+4^2+4^2+1^2}} = \frac{3}{\sqrt{58}} = \frac{3}{7,615} = 0,393$$

$$X_{23}^* = \frac{4}{\sqrt{3^2+4^2+3^2+4^2+4^2}} = \frac{4}{\sqrt{66}} = \frac{4}{8,124} = 0,492$$

$$X_{24}^* = \frac{3}{\sqrt{4^2+3^2+3^2+3^2+2^2}} = \frac{3}{\sqrt{47}} = \frac{3}{6,855} = 0,437$$

$$X_{25}^* = \frac{1}{\sqrt{2^2+1^2+3^2+2^2+3^2}} = \frac{1}{\sqrt{27}} = \frac{1}{5,196} = 0,192$$

C3

$$X_{31}^* = \frac{3}{\sqrt{4^2+4^2+3^2+2^2+3^2}} = \frac{3}{\sqrt{54}} = \frac{3}{7,348} = 0,408$$

$$X_{32}^* = \frac{4}{\sqrt{4^2+3^2+4^2+4^2+1^2}} = \frac{4}{\sqrt{58}} = \frac{4}{7,615} = 0,525$$

$$X_{33}^* = \frac{3}{\sqrt{3^2+4^2+3^2+4^2+4^2}} = \frac{3}{\sqrt{66}} = \frac{3}{8,124} = 0,369$$

$$X_{34}^* = \frac{3}{\sqrt{4^2+3^2+3^2+3^2+2^2}} = \frac{3}{\sqrt{47}} = \frac{3}{6,855} = 0,437$$

$$X_{35}^* = \frac{3}{\sqrt{2^2+1^2+3^2+2^2+3^2}} = \frac{3}{\sqrt{27}} = \frac{3}{5,196} = 0,577$$

C4

$$X_{41}^* = \frac{2}{\sqrt{4^2+4^2+3^2+2^2+3^2}} = \frac{2}{\sqrt{54}} = \frac{2}{7,348} = 0,272$$

$$X_{42}^* = \frac{4}{\sqrt{4^2+3^2+4^2+4^2+1^2}} = \frac{4}{\sqrt{58}} = \frac{4}{7,615} = 0,525$$

$$X_{43}^* = \frac{4}{\sqrt{3^2+4^2+3^2+4^2+4^2}} = \frac{4}{\sqrt{66}} = \frac{4}{8,124} = 0,492$$

$$X_{44}^* = \frac{3}{\sqrt{4^2+3^2+3^2+3^2+2^2}} = \frac{3}{\sqrt{47}} = \frac{3}{6,855} = 0,437$$

$$X_{45}^* = \frac{2}{\sqrt{2^2+1^2+3^2+2^2+3^2}} = \frac{2}{\sqrt{27}} = \frac{2}{5,196} = 0,384$$

C5

$$X_{51}^* = \frac{3}{\sqrt{4^2+4^2+3^2+2^2+3^2}} = \frac{3}{\sqrt{54}} = \frac{3}{7,348} = 0,408$$

$$X_{52}^* = \frac{1}{\sqrt{4^2+3^2+4^2+4^2+1^2}} = \frac{1}{\sqrt{58}} = \frac{1}{7,615} = 0,131$$

$$X_{53}^* = \frac{4}{\sqrt{3^2+4^2+3^2+4^2+4^2}} = \frac{4}{\sqrt{66}} = \frac{4}{8,124} = 0,492$$

$$X_{54}^* = \frac{2}{\sqrt{4^2+3^2+3^2+3^2+2^2}} = \frac{2}{\sqrt{47}} = \frac{2}{6,855} = 0,291$$

$$X_{55}^* = \frac{3}{\sqrt{2^2+1^2+3^2+2^2+3^2}} = \frac{3}{\sqrt{27}} = \frac{3}{5,196} = 0,577$$

The following is the normalization of the calculation using equation 3.



$$X_{ij} = \begin{bmatrix} 0,544 & 0,525 & 0,369 & 0,583 & 0,384 \\ 0,544 & 0,393 & 0,492 & 0,437 & 0,192 \\ 0,408 & 0,525 & 0,369 & 0,437 & 0,577 \\ 0,272 & 0,525 & 0,492 & 0,437 & 0,384 \\ 0,408 & 0,131 & 0,492 & 0,291 & 0,577 \end{bmatrix}$$

3. Calculating the Optimization Value

$$Y_1 = ((0,456 * 0,544) + (0,256 * 0,525) + (0,156 * 0,369) + (0,090 * 0,583) + (0,040 * 0,384)) = 0,507$$

$$Y_2 = ((0,456 * 0,544) + (0,256 * 0,393) + (0,156 * 0,492) + (0,090 * 0,437) + (0,040 * 0,192)) = 0,472$$

$$Y_3 = ((0,456 * 0,408) + (0,256 * 0,525) + (0,156 * 0,369) + (0,090 * 0,437) + (0,040 * 0,577)) = 0,440$$

$$Y_4 = ((0,456 * 0,272) + (0,256 * 0,525) + (0,156 * 0,492) + (0,090 * 0,437) + (0,040 * 0,384)) = 0,389$$

$$Y_5 = ((0,456 * 0,408) + (0,256 * 0,131) + (0,156 * 0,492) + (0,090 * 0,291) + (0,040 * 0,577)) = 0,345$$

4. Establish alternative ranking

**Table 5.** Alternative Ranking Results

Alternative	E-Wallet	Value	Ranking
A1	DANA	0,507	1
A2	OVO	0,472	2
A3	SHOPE PAY	0,440	3
A4	LINK AJA	0,389	4
A5	GOPAY	0,345	5

Based on the ranking obtained using the MOORA and ROC methods, it can be concluded that Alternative 1 (DANA) gets the highest value, namely 0.507 and is in first place to become the best E-Wallet.

## 4. CONCLUSION

The use of MOORA and ROC weighting in this decision support system not only increases the accuracy of choosing the best E-Wallet, but also increases the transparency and readability of the overall decision-making process. The following are the results of the research “Decision Support System for Choosing the Best E-Wallet Using the MOORA Method and ROC Weighting” The objectives and results of the research conducted can be concluded that when choosing an electronic payment method (ewallet) using the MOORA method, the best alternative is DANA with a value of 0.507, followed by OVO 0.472 and SHOPE PAY 0.440.

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