JURNAL TEKNOINFO
Volume 18, Nomor 1, Januari 2024, Page 160-172
ISSN: 1693-0010(Print), ISSN: 2615-224X(Online)
Available online at https://ejurnal.teknokrat.ac.id/index.php/teknoinfo/index

DECISION SUPPORT SYSTEM FOR SELECTING POINT OF SALE APPLICATIONS USING ARAS AND ROC APPROACHES

Trinugi Wira Harjanti

Informatics Engineering Study Program, Sekolah Tinggi Teknologi Informasi NIIT
Jl. Asem Dua No.22, Cipete Selatan, Cilandak, Kota Jakarta Selatan, DKI Jakarta, Indonesia
Email: trinugi@i-tech.ac.id

Abstract

The variety of Point of Sale (POS) applications available on the market with different features, prices, and advantages means that business owners often face challenges in choosing the POS application that best suits their needs and budget. To choose a POS application, a business owner must know, one by one, the characteristics of the application to be chosen. This makes business owners experience difficulties, and it takes a long time to determine which application to choose. Although POS applications promise great benefits, selecting the right application can be a complicated and crucial task. So, this research was carried out with the aim of building a Decision Support System (DSS) for selecting Point of Sale (POS) applications using a combination of ARAS (Additive Ratio Assessment) and ROC (Rank Order Centroid) methods. The ROC approach in this research functions to determine weight values based on priority levels. Meanwhile, the ARAS method compares and ranks alternatives based on attribute utility performance to determine the best alternative. The SPK software was developed on a website basis, with features including managing criteria data, alternatives, alternative values, ARAS method calculations, and viewing alternative ranking results. From the case studies carried out, the highest to lowest utility values were obtained, namely: Majoo (A2) got a value of 0.8626, Moka POS (A2) got a value of 0.8412, Loyverse POS (A1) got a value of 0.8078, Smart Kasir (A5) got a value of 0.7546, and Olsera POS (A3) obtained a value of 0.7136. The output produced by the system obtains the same value as the manual calculation, meaning that the implementation of the ARAS method in the system is declared valid. In terms of testing, usability testing produces an average score of 87.5%. This shows that this system is suitable for use because it has functionality that is considered to be in accordance with user requirements.

Keyword: *additive ratio assessment, decision support system, point of sale applications, rank order centroid, usability testing.*

1. INTRODUCING

In an era of business that continues to grow and is increasingly digitalized, Point of Sale (POS) applications play a key role in managing transactions, inventory, and sales data for various types of businesses, including retail stores, restaurants, cafes, and other retail businesses. POS applications are software used by businesses to carry out product or service sales transactions to customers [1]. POS applications have experienced significant development; this can be seen in the emergence of POS applications that can be run via smartphone using either the iOS or Android operating systems. However, with a variety of POS applications available on the market with different features, prices, and advantages, business owners often face challenges in choosing the POS application that best suits their needs and budget [2]. To choose a POS application, a business owner must know, one by one, the characteristics of the application to be chosen. This makes business owners experience difficulties, and it takes a long time to determine which application to choose. Although POS applications promise great benefits, selecting the right application can be a complicated and crucial task. For this reason, software is needed that makes it easy to choose a POS application that is able to recommend the best options based on the decision-maker's needs.

A Decision Support System (DSS) can be defined as a computer-based device or application designed to help individuals or business entities make better and more informative decisions [3]. The main objective of DSS is to provide support in the decision-making process by integrating various data sources and utilizing algorithms and analytical methods to produce recommendations or alternative decisions [4]. The development of decision support systems for choosing software or applications in the business world has been carried out by previous researchers with various applications of decision completion methods. The first research is related to the development of a decision support system to determine the best Enterprise Resource Planning (ERP) application by applying the AHP (Analytical Hierarchy

JURNAL TEKNOINFO
Volume 18, Nomor 1, Januari 2024, Page 160-172
ISSN: 1693-0010(Print), ISSN: 2615-224X(Online)
Available online at https://ejurnal.teknokrat.ac.id/index.php/teknoinfo/index

Process) approach [5]. This approach obtains the best alternative by evaluating alternatives based on different criteria and assigning a relative score to each alternative. The next research is the application of the SAW (Simple Additive Weighting) approach to developing a decision support system for determining business and financial management software [6]. The SAW approach determines the alternative selected based on the value of each option obtained based on the sum of the importance levels of the criteria. Next, the research solves the decision problem of selecting Peer-to-Peer Lending (P2P Lending) applications by creating decision support system software using the COPRAS (Complex Proportional Assessment) method [7]. The approach used is able to outline and prioritize alternatives based on a number of weighted criteria.

Based on the alleged research that has been presented, what differentiates this research from previous research is that this research focuses on developing a decision support system for selecting Point of Sales (POS) applications using a combination of ARAS (Additive Ratio Assessment) and ROC (Rank Order Centroid) methods. The ARAS approach is a multi-criteria decision completion method used to compare and rank alternatives based on performance and utility attributes to get the best recommendation [8]. The ARAS method has the ability to handle situations where the relative preference between criteria is a very important factor [9]. This method provides a strong framework for comparing alternatives in a more systematic and objective way, so that it can assist decision-makers in the process of ranking and selecting the most suitable alternative. Meanwhile, the ROC method is used to determine weightings based on the order of importance or priority of criteria. The ROC method has the advantage of simplicity in the process of determining weights [10]. This is because the weight values are determined based on the order of importance, which is adjusted to the needs of the decision-maker [11].

This research aims to develop a decision support system that can provide recommendations for Point of Sales (POS) applications easily and quickly using a combination of ARAS and ROC methods. The ROC method functions to determine the weight of criteria based on the order of importance that has been determined by the decision-maker. Next, the ARAS method will determine the best alternative by providing alternative performance values based on the utility of these alternatives and then ranking them to get the alternative with the highest value. The criteria used to select Point of Sale (POS) applications are based on expert articles published on the MyBest web page [12]. These criteria include the completeness of features, ease of use, application fee, application compatibility, and application ratings. The system developed is built on a website to make it easier for users to use the application and access it.

2. RESEARCH METHODS

2.1 Research Stages

Research stages refer to the steps necessary to design, carry out, and evaluate research using scientific methods [13]. The function of the research stage is to ensure that the research runs in a structured and systematic manner, thereby allowing for the validity, reliability, and generalization of the research results [14]. The steps in carrying out research are visualized in Figure 1.

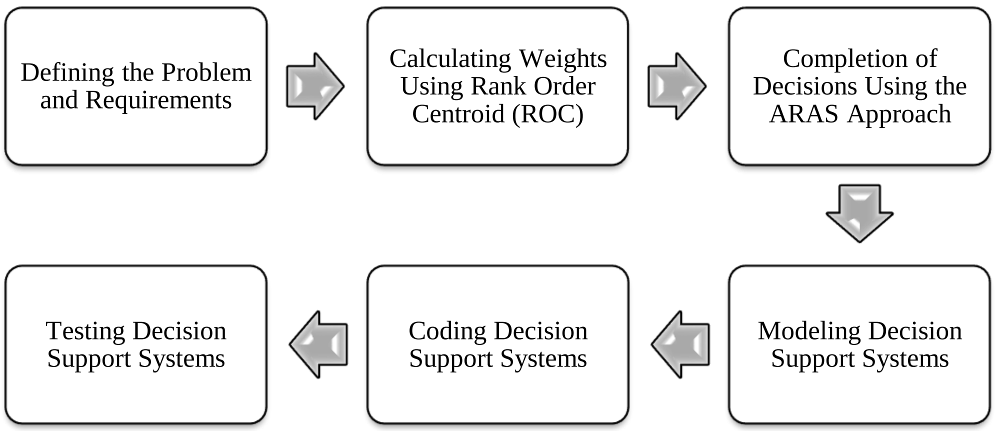

Figure 1. Research Steps

From the chart of research steps in Figure 1, each step is explained in more detail as follows:

1) Defining the Problem and Requirements
   Problem identification involves recognizing and understanding existing problems or gaps that need to be addressed [15]. Based on the problems that have been obtained, needs are determined through needs analysis. Needs analysis involves a deeper understanding of what is needed to solve the problem [16]. By understanding the existing problem and the needs that must be met, system developers can design appropriate solutions, ensuring that the system developed will provide added value, increase efficiency, and meet user expectations.
2) Calculating Weights Using Rank Order Centroid (ROC)
   Giving weight to each criterion is important in finalizing decisions. The Rank Order Centroid (ROC) approach provides weights based on their level of importance in the decision-making process [10]. The ROC method has the ability to handle several alternatives that need to be sorted based on a number of criteria, and the weight of each criterion varies greatly [17]. Each criterion certainly has different priorities based on the needs of the decision-maker. The ROC approach determines weights based on the priority order determined by the decision-maker.
3) Completion of Decisions Using the ARAS Approach
   The ARAS (Additive Ratio Assessment) method is an approach that resolves decisions by providing utility function values to get an idea of how well different options work [8]. The values and weights used to find the best solution have a direct relationship to the impact of the different options. The ARAS approach refers to an approach that takes into account the ratio of different criteria in the assessment process [18]. The final result of the ARAS method is a ranking or score that allows decision-makers to identify the alternative that best suits their highest preferences.
4) Modeling Decision Support Systems
   Systems modeling refers to the process of planning, developing, and building a conceptual or physical representation of a system [19]. This process involves the transformation of the analysis results into a design or model that is used as a reference in system development.
5) Coding Decision Support Systems
   Systems coding refers to the process of developing and implementing software or computer programs in order to produce a functioning system [20]. It entails creating computer program code using a particular programming language, which describes the instructions that the computer will follow to accomplish a predetermined goal. Therefore, the outcomes at this stage take the form of a decision support system that users can use in accordance with the findings of analysis and modeling.
6) Testing Decision Support Systems
   System testing is an important step in the cycle of creating software or systems that aims to ensure that the system that has been developed can function according to predetermined specifications [21]. The testing technique used is usability testing. Usability testing is a technique for assessing how well intended users can use a product or computer application [22]. Usability testing is one aspect of ISO 9126, which is related to software quality monitoring. The sub-criteria used in usability testing include understandability, learnability, operability, and attractiveness.

2.2 Rank Order Centroid (ROC) Weighting Technique

Determining weights is an important aspect of solving decision problems. The weight is determined by the decision maker, but often the decision maker cannot determine the exact level of importance for each criterion used to make a decision. To make it easier for decision-makers to obtain weight values for each criterion, a weighting technique is needed. The Rank Order Centroid (ROC) weighting method is an approach to determining weights where each criterion is given a weight based on its level of importance in the decision-making process [10]. The ROC method is useful in situations where criteria have varying weights and judgments based on relative comparisons are more relevant than absolute judgments [23]. This approach will rank the priority of each criterion, and the criteria will be ordered based on their priority [17]. To obtain weight values for each criterion using the ROC approach, they can be calculated using equation (1).

$$w_k = \frac{1}{k}\sum_{i}^{k} = 1\left(\frac{1}{i}\right) \quad (1)$$

where, w_k refers to the weight value for each criterion that has been normalized, i refers to the number of criteria, and k refers to the priority order for each criterion.

2.3 Additive Ratio Assessment (ARAS) Method

The ARAS (Additive Ratio Assessment) approach began to emerge in 2010 as an alternative solution to multi-criteria

JURNAL TEKNOINFO
Volume 18, Nomor 1, Januari 2024, Page 160-172
ISSN: 1693-0010(Print), ISSN: 2615-224X(Online)
Available online at https://ejurnal.teknokrat.ac.id/index.php/teknoinfo/index

decision problems put forward by Zavadskas and Turskis [24]. The ARAS method is a multi-criteria decision-making technique used to compare and rank alternatives based on attribute utility performance to determine the best alternative [8]. This approach is useful for situations where relative preferences between criteria are important and assists decision-makers in the process of ranking alternatives by considering the weights given to the criteria [25]. In the ARAS method, each criterion is given a relative weight based on its level of importance, and each alternative is assessed against each criterion [26]. Then, normalization is carried out, and the optimal value and utility value are searched to determine the aggregate value of each alternative [27]. The alternative with the highest aggregate value is considered the best choice according to the given preferences. For more details, the steps in calculating the ARAS approach are as follows:

1) Determine the optimum value for each attribute
   Each value for each attribute in the alternative criteria will be searched for the optimum value, or X_{0j}. The determination of the optimum value (X_{0j}) is based on the type of criteria, whether benefit criteria or cost criteria. The benefit criteria prioritize the highest value, while the cost criteria prioritize the lowest value. So, to get the optimum value (X_{0j}) for the benefit criteria, equation (2) is used, while for the cost criteria, equation (3) is used.

$$X_{0j} = \frac{Max}{1} \tag{2}$$

$$X_{0j} = \frac{Min}{1} \tag{3}$$

   where X_{0j} refers to the optimum value to be sought.
2) Prepare a decision matrix for each existing attribute
   The next process creates a matrix containing all attribute values, including the optimum value. Making the matrix is guided by equation (4).

$$X = \begin{bmatrix} x_{01} & x_{0j} & \cdots & x_{0n} \\ x_{11} & x_{1j} & \cdots & x_{1n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{n1} & x_{mj} & \cdots & x_{mn} \end{bmatrix} \tag{4}$$

   where m refers to the number of alternatives, n is the total criteria used, and x_{0j} refers to the optimum value for each attribute.
3) Perform matrix normalization
   In order to get uniform values for each attribute, these attributes need to be normalized. To normalize the matrix, if the criterion is benefit, use equation (5), and if the criterion is cost, use equation (6).

$$x_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \tag{5}$$

$$x_{ij} = \frac{1}{x_{ij}^*};\ x_{ij}^* = \frac{X_{ij}}{\sum_{i=1}^{m} X_{ij}} \tag{6}$$

   where x_{ij} refers to the performance assessment of alternative i against criterion j.
4) Get the weighted normalization value
   After normalization, the next step is to normalize by multiplying by the weight. So, the weighted normalization value can be calculated via equation (7).

$$D_{ij} = x_{ij} \times w_{ij} \tag{7}$$

   where D_{ij} is the weighted normalization value and w_{ij} is the weight of criteria i to j.
5) Looking for optimal value and utility value
   The next step is to carry out calculations to obtain the optimal value (S_i) for each alternative through equation (8).

$$S_i = \sum_{j=1}^{n} D_{ij} \tag{8}$$

   where S_i refers to the optimal value of each alternative.

JURNAL TEKNOINFO
Volume 18, Nomor 1, Januari 2024, Page 160-172
ISSN: 1693-0010(Print), ISSN: 2615-224X(Online)
Available online at https://ejurnal.teknokrat.ac.id/index.php/teknoinfo/index

Then proceed with calculating the utility value (K_i) to get an aggregate value for each alternative, where the highest K_i value is the best choice. To get the utility value (K_i), it can be solved using equation (9).

$$K_i = \frac{S_i}{S_0} \quad (9)$$

where S_i and S_0 refer to the number of optimal criteria, while K_i refers to the utility value of each alternative.

3. RESULT AND DISCUSSIONS

To implement the ARAS and ROC approaches in the decision support system for selecting Point of Sale (POS) applications, the criteria used as considerations in selecting the application must first be determined. The criteria used in this research are based on an article written by experts on the MyBest website. An explanation of the criteria used is as follows:

1) Completeness of Features
   This criterion relates to the features available in the Point of Sale (POS) application, which can make it easier for users to manage their sales.
2) Ease of Use
   User ease relates to whether the application is easy to use or not and whether the user does not experience difficulties using the application.
3) Application Fee
   Application costs are the amount of costs incurred by users to subscribe to or use the Point of Sale (POS) application.
4) Application Compatibility
   Compatibility refers to the ability of an application to operate or function properly on different platforms, operating systems, hardware, or environments. For example, the application supports hardware such as printers, barcode scanners, and cash drawers.
5) Application Rating
   Application ratings are seen from user assessments of the Point of Sale (POS) application on the Google Play Store. Application ratings on the Google Play Store are a metric used to evaluate and provide user feedback on the quality and satisfaction of an application.

Then, based on these criteria, the weight values determined by the decision-maker are searched. To make it easier for the decision-maker to determine the weight of the criteria, the ROC approach is used. The ROC approach determines the weight of each criterion based on its level of importance in the decision-making process. This means that this approach will rank the priority of each criterion, and the criteria will be ordered based on their priority. So, the decision-maker will determine the priority order for each criterion. The priority order for each criterion in this case study is presented in Table 1.

Table 1. Order of Priority for Each Criteria

Criteria Code	Criterion Name	Order of Priority
C1	Completeness of Features	1
C2	Ease of Use	2
C3	Application Fee	3
C4	Application Compatibility	4
C5	Application Ratings	5

Table 1 shows the order of priority or level of importance for each criterion that has been determined. The next step is to find the weight value of each criterion based on their priority order using the ROC approach via equation (1). The calculation to obtain the weight value for each criterion using the ROC approach is as follows:

$$w_1 = \frac{1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0.4567$$

$$w_2 = \frac{0 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0.2567$$

$$w_3 = \frac{0 + 0 + \frac{1}{3} + \frac{1}{4} + \frac{1}{5}}{5} = 0.1567$$

$$w_4 = \frac{0 + 0 + 0 + \frac{1}{4} + \frac{1}{5}}{5} = 0.0900$$

$$w_5 = \frac{0 + 0 + 0 + 0 + \frac{1}{5}}{5} = 0.0400$$

After calculating the weight values using ROC, these values are then used as the weight for each criterion, as presented in Table 2.

Table 2. Results of Criteria Weight Values Using the ROC Approach

Criteria Code	Criterion Name	Order of Priority
C1	Completeness of Features	0.4567
C2	Ease of Use	0.2567
C3	Application Fee	0.1567
C4	Application Compatibility	0.0900
C5	Application Ratings	0.0400

Table 2 shows the weights of the criteria that will be used in decision-making. The next step determines the value range and value conversion for each alternative. This is used to make calculations easier because there are several criteria that constitute qualitative data. The conversion values for each criterion are presented in Table 3.

Table 3. Conversion of Values for Each Criteria Used

Criteria Code	Criterion Name	Value	Value Conversion
C1	Completeness of Features	Incomplete	1
		Quite complete	2
		Complete	3
		Very Complete	4
C2	Ease of Use	Not easy	1
		Quite easy	2
		Easy	3
		Very Easy	4
C3	Application Fee	< 100.000	1
		>= 100.000 and < 400.000	2
		>= 400.000 and < 700.000	3
		>= 700.000	4
C4	Application Compatibility	1 Devices	1
		2 Devices	2
		3 Devices	3
		4 Devices	4
C5	Application Ratings	< 3.5	1
		>= 3.5 and < 4.0	2
		>= 4.0 dan < 4.5	3
		>= 4.5	4

In Table 3, it can be seen that each criterion given has a conversion value because it makes calculations easier, and there are criteria with qualitative data. The process continues by determining the alternative that will be chosen by the decision-maker. For this case study, the Point of Sale (POS) applications used as alternatives are as follows: Loyverse POS (A1), Maju (A2), Olsera POS (A3), Moka POS (A4), and Kasir Pintar (A5). Then, these options are given a value based on their characteristics against predetermined criteria. The value for each option against the criteria is presented in Table 4.

JURNAL TEKNOINFO
Volume 18, Nomor 1, Januari 2024, Page 160-172
ISSN: 1693-0010(Print), ISSN: 2615-224X(Online)
Available online at https://ejurnal.teknokrat.ac.id/index.php/teknoinfo/index

Table 4. Value of the Option to be Selected

Alternative Code	Alternative Name	Criteria				
		C1	C2	C3	C4	C5
A1	Loyverse POS	Complete	Easy	90.000	3	4.5
A2	Majoo	Very Complete	Easy	500.000	4	4.1
A3	Olsera POS	Complete	Easy	328.000	4	3.7
A4	Moka POS	Very Complete	Very Easy	500.000	3	4.1
A5	Kasir Pintar	Quite Complete	Very Easy	70.000	3	4.7

Based on Table 4, which contains alternative assessments, the value will then be changed based on Table 3, which is used to carry out the value conversion. The results of the value conversion are then presented in Table 5.

Table 5. Value Conversion Results for Each Alternative

Alternative Code	Alternative Name	Criteria				
		C1	C2	C3	C4	C5
A1	Loyverse POS	3	3	1	3	4
A2	Majoo	4	4	3	4	3
A3	Olsera POS	3	3	2	4	2
A4	Moka POS	4	4	3	3	3
A5	Kasir Pintar	2	4	1	3	4

Table 5 shows alternative values for the criteria that have been converted into values to facilitate the calculation process. The next step is to solve this decision problem using the ARAS approach in order to get the best option. This process begins by determining the optimum value (Xo). However, beforehand, it is necessary to first analyze the type of criteria used, whether these criteria are benefit or cost criteria. Based on the type, in this case study, it can be identified that those included in the benefit criteria are: C1, C2, C4, and C5. Meanwhile, the cost criteria are in C3. The optimum value can be calculated using equation (2) for benefit criteria and equation (3) for cost criteria. So, the optimum value (X0) obtained is: {4; 4; 1; 4; 4}. Then all these values are entered into a matrix guided by equation (4). The following are the results of the decision matrix:

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

The next process is to normalize all the attributes in the decision matrix. To get normalized attribute values, use equation (5) if the criterion is benefit and equation (6) if the criterion is cost. The following is the process of obtaining normalized attribute values:

$$X_{01} = \frac{4}{4+3+4+3+4+2} = 0.20$$

$$X_{11} = \frac{4}{4+3+4+3+4+2} = 0.15$$

$$X_{21} = \frac{4}{4+3+4+3+4+2} = 0.20$$

$$X_{31} = \frac{4}{4+3+4+3+4+2} = 0.15$$

$$X_{41} = \frac{4}{4+3+4+3+4+2} = 0.20$$

JURNAL TEKNOINFO
Volume 18, Nomor 1, Januari 2024, Page 160-172
ISSN: 1693-0010(Print), ISSN: 2615-224X(Online)
Available online at https://ejurnal.teknokrat.ac.id/index.php/teknoinfo/index

$$X_{51} = \frac{4}{4+3+4+3+4+2} = 0.10$$

This step is carried out for all the same attributes as the X_{55} attributes. If all attributes have obtained normalized values, then a normalized matrix is prepared as follows:

$$X_{ij} = \begin{bmatrix} 0.20 & 0.18 & 0.24 & 0.19 & 0.20 \\ 0.15 & 0.14 & 0.24 & 0.14 & 0.20 \\ 0.20 & 0.18 & 0.08 & 0.19 & 0.15 \\ 0.15 & 0.14 & 0.12 & 0.19 & 0.10 \\ 0.20 & 0.18 & 0.08 & 0.14 & 0.15 \\ 0.10 & 0.18 & 0.24 & 0.14 & 0.20 \end{bmatrix}$$

Based on the normalized matrix, calculations are then carried out to obtain the weighted normalization values to form a weighted normalization decision matrix. The weighted normalization value is obtained from the normalized attributes and then multiplied by the weight as in equation (7). The weight value for each criterion is guided by Table 2. The process for obtaining the weighted normalization value is as follows:

$$D_{01} = 0.20 \times 0.4567 = 0.0900$$

$$D_{11} = 0.15 \times 0.4567 = 0.0675$$

$$D_{21} = 0.20 \times 0.4567 = 0.0900$$

$$D_{31} = 0.15 \times 0.4567 = 0.0675$$

$$D_{41} = 0.20 \times 0.4567 = 0.0900$$

$$D_{51} = 0.10 \times 0.4567 = 0.0450$$

This step is carried out for all the same attributes as the D_{55} attribute. If all attributes have been normalized with their weights, then they are entered into a weighted normalized matrix as follows:

$$D_{ij} = \begin{bmatrix} 0.0900 & 0.0473 & 0.0384 & 0.0171 & 0.0080 \\ 0.0675 & 0.0355 & 0.0384 & 0.0129 & 0.0080 \\ 0.0900 & 0.0473 & 0.0128 & 0.0171 & 0.0060 \\ 0.0675 & 0.0563 & 0.0192 & 0.0171 & 0.0040 \\ 0.0900 & 0.0355 & 0.0128 & 0.0129 & 0.0060 \\ 0.0450 & 0.0473 & 0.0384 & 0.0129 & 0.0080 \end{bmatrix}$$

After all attributes have been normalized with their weights, then proceed with the optimum value (S_i) using equation (8). The Si value is obtained from the sum of the attribute values that have been weighted and normalized for each alternative. The following is the process for obtaining the S_i value:

$$S_0 = 0.0900 + 0.0473 + 0.0384 + 0.0171 + 0.0080 = 0.2008$$

$$S_1 = 0.0675 + 0.0355 + 0.0384 + 0.0129 + 0.0080 = 0.1622$$

$$S_2 = 0.0900 + 0.0473 + 0.0128 + 0.0171 + 0.0060 = 0.1732$$

$$S_3 = 0.0675 + 0.0355 + 0.0192 + 0.0171 + 0.0040 = 0.1433$$

$$S_4 = 0.0900 + 0.0473 + 0.0128 + 0.0129 + 0.0060 = 0.1689$$

$$S_5 = 0.0450 + 0.0473 + 0.0384 + 0.0129 + 0.0080 = 0.1515$$

The S_i value is then continued by finding the utility value (K_i) of the performance of each alternative using equation (9). The results of these calculations can be seen in the following process:

$$K_1 = \frac{0.1622}{0.2008} = 0.8078$$

$$K_2 = \frac{0.1732}{0.2008} = 0.8626$$

$$K_3 = \frac{0.1433}{0.2008} = 0.7136$$

$$K_4 = \frac{0.1689}{0.2008} = 0.8412$$

$$K_5 = \frac{0.1515}{0.2008} = 0.7546$$

The utility value (K_i) obtained is used as a reference in determining the best alternative, where the alternative that has the highest utility value is the alternative that is the main choice. Next, all utility values for each alternative were ranked from highest to lowest, as presented in Table 6.

Table 6. Ranking of Alternatives from Highest to Lowest Value

Alternative Code	Alternative Name	Utility Value	Ranking
A2	Majoo	0.8626	1
A4	Moka POS	0.8412	2
A1	Loyverse POS	0.8078	3
A5	Kasir Pintar	0.7546	4
A3	Olsera POS	0.7136	5

In Table 6, the highest to lowest utility values are obtained, namely: Majoo (A2) got a score of 0.8626, Moka POS (A2) got a score of 0.8412, Loyverse POS (A1) got a score of 0.8078, Smart Kasir (A5) got a score of 0.7546, and Olsera POS (A3) got a score of 0.7136. So, alternative A2, namely Majoo, is the best choice because it gets the highest utility value.

After the analysis and modeling processes have been carried out, they are then realized in the form of a decision support system through the coding stage. This stage is related to the process of developing and implementing software or computer programs in order to produce a functioning system. The decision support system for choosing a Point of Sale (POS) application was built based on a website using JavaScript with a text editor, namely Emacs, and using MySQL as the database. The decision support system for choosing a Point of Sale (POS) application begins with the user logging in to the system. After the user has successfully logged in, they will find the dashboard as the main menu. The dashboard contains the main features of the system and displays a graph of utility values using the ARAS approach. The main features of this system include managing criteria data, alternatives, alternative values, and WASPAS calculations. The dashboard interface display of the main menu of the decision support system for selecting the POS application is visualized in Figure 2.

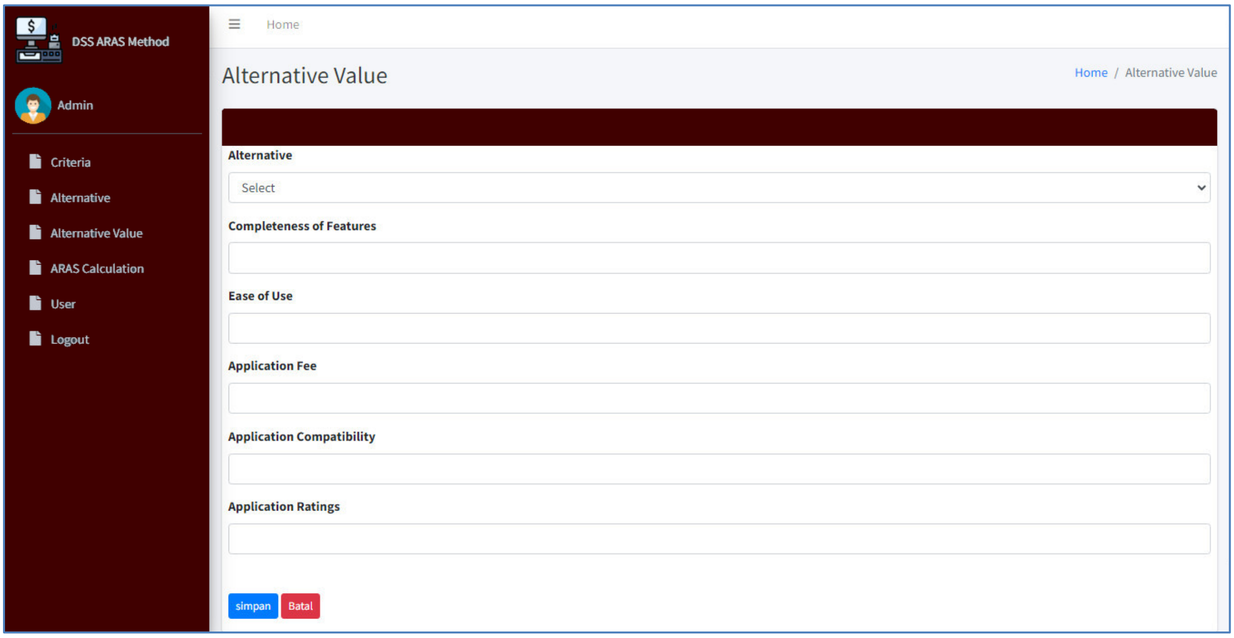

Figure 2. Decision Support System Dashboard Interface Display for Selecting Point of Sale Applications

Volume 18, Nomor 1, Januari 2024, Page 160-172
ISSN: 1693-0010(Print), ISSN: 2615-224X(Online)
Available online at https://ejurnal.teknokrat.ac.id/index.php/teknoinfo/index

To be able to select the POS application, the user must first fill in the criteria data. In this menu the user will enter the criteria code, criteria name and criteria weight. After the user has input the criteria data, the user will then enter the alternative that will be selected through the alternative feature. In this feature, users can add, change and delete alternative data. Next, users can provide a value for each alternative in the alternative value feature. In this feature, users can provide values according to the characteristics of each alternative against the criteria as seen in Figure 3.

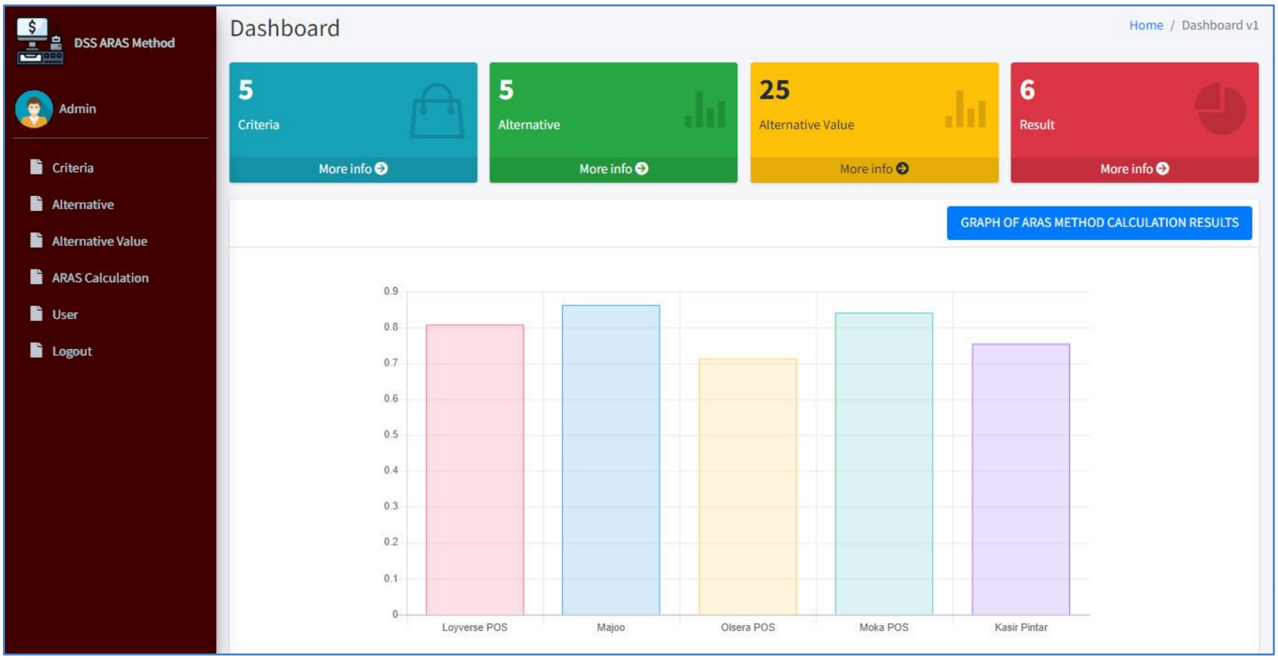

Figure 3. Interface Display Providing Alternative Values

After the alternative value has been input, the user can perform automatic ARAS method calculations on the system via the ARAS calculation feature. This feature will display Step by Step in calculating the ARAS approach. Apart from that, in this feature the system will also display a ranking from highest to lowest utility value, making it easier for users to make decisions. The ARAS calculation interface is visualized in Figure 4.

Optimum Value and Utility Value

No	Alternative	Completeness of Features	Ease of Use	Application Fee	Application Compatibility	Application Ratings	Optimum Value (S_i)	Utility Value (K_i)
-	Bobot	45 % (Benefit)	26 % (Benefit)	16 % (Cost)	9 % (Benefit)	4 % (Benefit)		
	A0	0.09	0.0472727272727	0.0384	0.0171428571428	0.008	0.200815584416	
1	Loyverse POS	0.0675	0.0354545454546	0.0384	0.0128571428571	0.008	0.162211688312	0.80776444111
2	Majoo	0.09	0.0472727272727	0.0128	0.0171428571428	0.006	0.173215584416	0.862560467703
3	Olsera POS	0.0675	0.0354545454546	0.0192	0.0171428571428	0.004	0.143297402597	0.713577101168
4	Moka POS	0.09	0.0472727272727	0.0128	0.0128571428571	0.006	0.16892987013	0.84121892542
5	Kasir Pintar	0.045	0.0472727272727	0.0384	0.0128571428571	0.008	0.15152987013	0.754572263755

Rangking

No	Alternative	Utility Value
1	Majoo	0.862560467703
2	Moka POS	0.84121892542
3	Loyverse POS	0.80776444111
4	Kasir Pintar	0.754572263755
5	Olsera POS	0.713577101168

Figure 4. ARAS Method Calculation Process Interface

JURNAL TEKNOINFO
Volume 18, Nomor 1, Januari 2024, Page 160-172
ISSN: 1693-0010(Print), ISSN: 2615-224X(Online)
Available online at https://ejurnal.teknokrat.ac.id/index.php/teknoinfo/index

Figure 4 shows the output of the decision support system being developed, where the values obtained from the ARAS method calculation results are: Majoo (A2) with a score of 0.8626; Moka POS (A2) with a score of 0.8412; Loyverse POS (A1) with a score of 0.8078; Smart Kasir (A5) with a score of 0.7546; and Olsera POS (A3) with a score of 0.7136. If you look at the output results of the ARAS method calculations from the case studies that have been carried out, it produces values that are no different from the manual calculation results. This means that the output produced by the system is valid. Based on the analysis of the results of the case study that has been carried out, it shows that the ARAS method is able to obtain the best alternative by providing a utility function value to take into account the ratio of different criteria in the assessment process which is then compiled in the form of a performance ranking.

After the system has been built, it continues to the testing stage through usability testing so that it can be ensured that this software is suitable for use. Usability testing aims to carry out evaluations designed to measure the extent to which the software can be used effectively, efficiently and satisfactorily by end users. The sub-criteria used in usability testing are understandability, learnability, operability and attractiveness. This testing is carried out by distributing questionnaires which will be filled out by users who will select investment applications. The questionnaire was prepared using the Guttman scale, where there are only two answer choices, namely agree and disagree. This aims to get extreme answers from users. The questionnaire contains 10 questions and will be filled in by 20 respondents. Then, the results of the questionnaire are managed by calculating the agree and disagree answers and converted into a percentage. The results of this usability testing are visualized in graphic form presented in Figure 5.

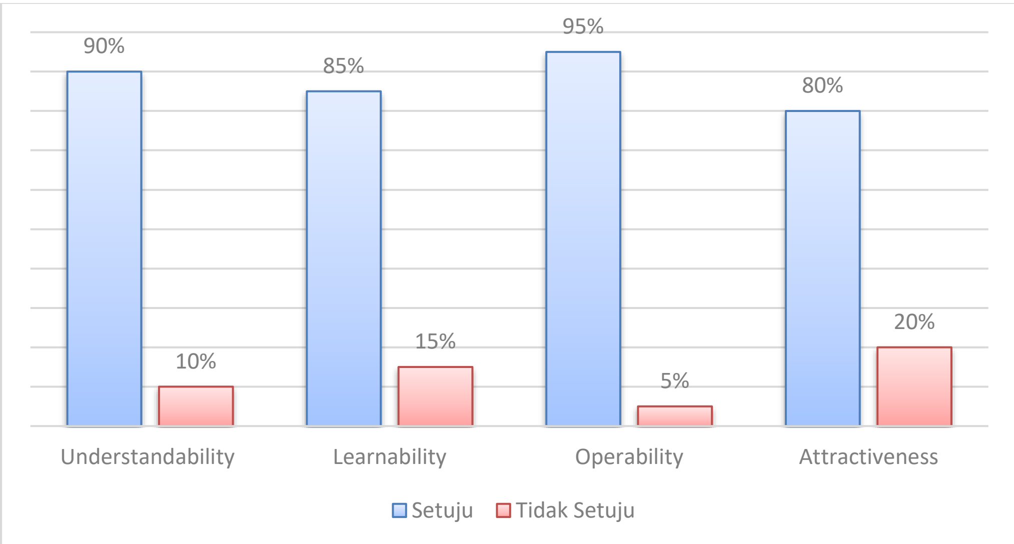

Figure 5. Usability Testing Assessment Chart

Figure 5 is a graph that shows the results of each sub-criteria in usability testing, where the results are: understandability gets a score of 90%, learnability gets a score of 85%, operability gets a score of 95% and attractiveness gets a score of 80%. From all the values obtained, the average value was then found and the results obtained from usability testing were 87.5%. The average value is then put into a grouping with the following criteria: "Good", the value is between 76% to 100%; “Fair”, the value is between 56% and 75%; “Not Good”, the value is between 40% to 55%, and “Not Good”, less than 40% [28]. So, the test results that have been carried out fall within the "Good" criteria. This means that the decision support system for selecting the Point of Sale (POS) application that was built is suitable for use because it has the functionality desired by the user.

4. CONCLUSION

This research has developed a decision support system for selecting Point of Sale (POS) applications by implementing the ARAS method and ROC weighting techniques. The ROC approach in this research functions to determine weight values based on priority levels. Meanwhile, the ARAS method compares and ranks alternatives based on attribute utility performance to determine the best alternative. The resulting decision support system has features that make it easier for decision makers to determine Point of Sale (POS) applications. These features include managing criteria data, alternatives, alternative values, ARAS method calculations, and viewing alternative ranking results. Based on the case studies that have been carried out, the highest to lowest utility values are obtained, namely: Majoo (A2) gets a value of 0.8626, Moka POS (A2) gets a value of 0.8412, Loyverse POS (A1) gets a value of 0.8078, Smart Kasir (A5) gets a value of 0.7546, and Olsera POS (A3) obtains a value of 0.7136. The output produced by the decision support system produces the same value as manual calculations. This means that the implementation of the ARAS method on the system can be declared valid. Apart from that, the usability testing obtained an average score of 87.5%. This means that the system is suitable for use because it is considered to have the functionality desired by users. However, as a suggestion for future research, there are several things that need to be improved, namely that the ROC weighting technique is susceptible to non-objectivity in determining rankings, so you can use fuzzy logic to be able to reason logically. Apart from that, this research carried out value conversion for qualitative data, which needs to be studied further on how to determine the conversion value in order to get a value that can truly be represented.

REFERENCES

[1] A. Wirawan and J. Santosa, “Design of Point of Sales (POS) Information Systems Based on Web and Quick Response (QR) Code,” in *Proceedings of the 1st International Conference on Applied Economics and Social Science (ICAESS 2019)*, Dec. 2019, pp. 288–293. doi: 10.2991/icaess-19.2019.14.

[2] M. Andarwati, F. Amrullah, E. Thamrin, and A. R. Muslikh, “An Analysis of Point of Sales (POS) Information Systems in SMEswith The Black Box Testing and PIECES Method,” *IOSR J. Bus. Manag.*, vol. 22, no. 9, pp. 20–25, 2020, doi: 10.9790/487X-2209052025.

[3] S. Bandyopadhyay, *Decision Support System: Tools and Techniques*. Boca Raton: CRC Press, 2023.

[4] N. Nugroho, “Decision Support System for Selection of Virtual Reality Head-Mounted Display Using the WASPAS Method,” *J. Inf. Syst. Res.*, vol. 4, no. 3, pp. 811–819, 2023, doi: 10.47065/josh.v4i3.3272.

[5] S. N. Khasanah and S. J. Kuryanti, “Sistem Pendukung Keputusan Pemilihan Program Enterprise Resource Planning (ERP) Menggunakan Metode AHP,” *IJNS - Indones. J. Netw. Secur.*, vol. 10, no. 4, pp. 234–240, 2021, doi: 10.55181/ijns.v10i4.1753.

[6] N. Narti and F. Fatmawati, “Implementasi Metode SAW dalam Memilih Software Manajemen Bisnis dan Keuangan,” *Evolusi J. Sains dan Manaj.*, vol. 9, no. 2, pp. 1–9, 2021, [Online]. Available: https://ejournal.bsi.ac.id/ejurnal/index.php/evolusi/article/view/10664

[7] M. Bagir, U. Riyanto, R. Nuraini, and D. Kustiawan, “Sistem Pendukung Keputusan Pemilihan Platform Investasi P2P Lending Menggunakan Metode Complex Proportional Assessment (COPRAS),” *Build. Informatics, Technol. Sci.*, vol. 4, no. 4, pp. 1975–1985, 2023, doi: 10.47065/bits.v4i4.3246.

[8] V. Sihombing *et al.*, “Additive Ratio Assessment (ARAS) Method for Selecting English Course Branch Locations,” in *Virtual Conference on Engineering, Science and Technology (ViCEST)*, 2021, pp. 1–5. doi: 10.1088/1742-6596/1933/1/012070.

[9] I. Nanda, R. Jafar Rumandan, and A. Aristo Jansen Sinlae, “Implementation of Additive Ratio Assessment (ARAS) in Decision Support Systems for Wi-Fi Repeater Selection,” *Appl. Technol. Comput. Sci. J.*, vol. 5, no. 2, pp. 50–63, 2022, doi: 10.33086/atcsj.v5i2.3738.

[10] I. M. Pandiangan, M. Mesran, R. I. Borman, A. P. Windarto, and S. Setiawansyah, “Implementation of Operational Competitiveness Rating Analysis (OCRA) and Rank Order Centroid (ROC) to Determination of Minimarket Location,” *Bull. Informatics Data Sci.*, vol. 2, no. 1, pp. 1–8, 2023.

[11] H. A. Aziz *et al.*, “Application of the Simple Additive Weighting (SAW) & Rank Order Centroid (ROC) Methods in The Selection of Outstanding Students at SMK Al-Huda Sadananya,” *JISICOM (Journal Inf. Syst. Informatics Comput.*, vol. 7, no. 1, pp. 1–14, 2023, doi: 10.52362/jisicom.v7i1.1073.

[12] Tim Editorial mybest, “10 Rekomendasi Aplikasi Kasir Terbaik untuk Android dan iOS (Terbaru Tahun 2023),” *mybest*, 2023. https://id.my-best.com/139452

[13] R. I. Borman, F. Rossi, Y. Jusman, A. A. A. Rahni, S. D. Putra, and A. Herdiansah, “Identification of Herbal Leaf Types Based on Their Image Using First Order Feature Extraction and Multiclass SVM Algorithm,” in *International Conference on Electronic and Electrical Engineering and Intelligent System (ICE3IS)*, 2021, pp. 12–17.

[14] H. Mayatopani, R. I. Borman, W. T. Atmojo, and A. Arisantoso, “Classification of Vehicle Types Using Backpropagation Neural Networks with Metric and Ecentricity Parameters,” *J. Ris. Inform.*, vol. 4, no. 1, pp. 65–70, 2021, doi: 10.34288/jri.v4i1.293.

[15] R. D. Gunawan, R. Napianto, R. I. Borman, and I. Hanifah, “Implementation of Dijkstra’s Algorithm in Determining the Shortest Path (Case Study: Specialist Doctor Search in Bandar Lampung),” *Int. J. Inf. Syst. Comput. Sci.*, vol. 3, no. 3, pp. 98–106, 2019.

[16] Y. Fernando, R. Napianto, and R. I. Borman, “Implementasi Algoritma Dempster-Shafer Theory Pada Sistem Pakar Diagnosa Penyakit Psikologis Gangguan Kontrol Impuls,” *Insearch (Information Syst. Res. J.*, vol. 2, no. 2, pp. 46–54, 2022.

[17] S. P. Tamba, A. Purba, Y. E. Kusuma, M. A. Santi, V. Vidyastuti, and S. Dharma, “Implementation of the Rank Order Centroid (ROC) Method to Determine the Favorite Betta Fish,” *J. Infokum*, vol. 9, no. 2, pp. 381–386, 2021.

[18] D. Meidelfi, R. Idmayanti, F. Maulidani, M. Ilham, and F. A. Muhlis, "Additive Ratio Assessment (ARAS) Method in The Selection of Popular Mobile Games," *Int. J. Adv. Sci. Comput. Eng.*, vol. 4, no. 1, pp. 56–66, 2022.

[19] R. I. Borman, A. T. Priandika, and A. R. Edison, "Implementasi Metode Pengembangan Sistem Extreme Programming (XP) pada Aplikasi Investasi Peternakan," *JUSTIN (Jurnal Sist. dan Teknol. Informasi)*, vol. 8, no. 3, pp. 272–277, 2020.

[20] I. Ahmad, E. Suwarni, R. I. Borman, A. Asmawati, F. Rossi, and Y. Jusman, "Implementation of RESTful API Web Services Architecture in Takeaway Application Development," in *International Conference on Electronic and Electrical Engineering and Intelligent System (ICE3IS)*, 2022, pp. 132–137. doi: 10.1109/ICE3IS54102.2021.9649679.

[21] I. Ahmad, Y. Rahmanto, D. Pratama, and R. I. Borman, "Development of augmented reality application for introducing tangible cultural heritages at the lampung museum using the multimedia development life cycle," *Ilk. J. Ilm.*, vol. 13, no. 2, pp. 187–194, 2021.

[22] H. Firdaus and A. Zakiah, "Implementation of Usability Testing Methods to Measure the Usability Aspect of Management Information System Mobile Application (Case Study Sukamiskin Correctional Institution)," *I.J. Mod. Educ. Comput. Sci.*, vol. 5, pp. 58–67, 2021, doi: 10.5815/ijmecs.2021.05.06.

[23] M. Walid, B. Satria, and M. Makruf, "Seleksi Karyawan Baru Menggunakan Metode Composite Perfomence Index (CPI) dan Rank Order Centroid (ROC)," *J. Ilm. Ilk.*, vol. 5, no. 1, pp. 11–18, 2022.

[24] A. Aswar, A. Anto, and H. Hamria, "Decisions Support System About The Granting Aid of Machinery Ketinting for The Fisher From Bajo Village Uses The Method Additive Ratio Assessment," *Explor. J. Comput. Sci. Inf. Technol.*, vol. 3, no. 1, pp. 7–14, 2023.

[25] B. Satria, "Implementation Of Additive Ratio Assessment (ARAS) Method on Decision Support System for Recipient of Inhabitable House," *JITK (Jurnal Ilmu Pengetah. dan Teknol. Komputer)*, vol. 6, no. 1, pp. 121–128, 2020, doi: 10.33480/jitk.v6i1.1389.

[26] S. Susliansyah, H. Sumarno, H. Priyon, L. Maulida, and F. Indriyani, "Application of A Decision Support System on Additive Ratio Assessment (ARAS) Method in Determining Best-Selling Korean Snacks," *Int. J. Inf. Syst. Technol.*, vol. 6, no. 4, pp. 469–476, 2022.

[27] B. Priyopradono, "Multiple Criteria Decision Analysis Menggunakan Additive Ratio Assessment Pada Pemilihan Uninterruptible Power Supply (UPS)," *Insearch Inf. Syst. Res. J.*, vol. 2, no. 2, pp. 55–63, 2022, doi: 10.15548/isrj.v2i02.4360.

[28] R. I. Borman, D. A. Megawaty, and A. Attohiroh, "Implementasi Metode TOPSIS Pada Sistem Pendukung Keputusan Pemilihan Biji Kopi Robusta yang Bernilai Mutu Ekspor (Studi Kasus: PT. Indo Cafco Fajar Bulan Lampung)," *Fountain Informatics J.*, vol. 5, no. 1, pp. 14–20, 2020, doi: 10.21111/fij.v5i1.3828.