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Implementation of Complex Proportional Assessment and Rank Order Centroid Methods for Selecting Delivery Services

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Abstract−Choosing the right delivery service partner is an important thing for companies to consider. This is because the selection of the right delivery service partner can minimize the risks involved. Generally, choosing a delivery partner service is done by looking at the profile of the freight forwarder's partner. It takes time to determine the right delivery service partner. This study aims to apply the Complex Proportional Assessment (COPRAS) and Rank Order Centroid (ROC) methods in a decision support system for selecting delivery service partners to make it easier to make the right decisions and meet needs. The ROC weighting method is used to determine the value of the criteria based on priority. Meanwhile, the COPRAS approach is used to determine the best solution based on an analysis of the existing options through alternative assessments by providing interval-based utility judgments. In the case study conducted, the best alternative was obtained, namely J&T Express with a score of 100, followed by JNE Express with a value of 92.09, SiCepat with a value of 91.89, Ninja Express with a value of 91.42. The COPRAS calculation results on the system developed with the manual calculation results show the same value, this means that the calculations on the system are valid. The usability scores, on the other hand, have an average value of 88.33% and are considered good.

Keywords: Complex Proportional Assessments; Decision Support System; Delivery service; Rank Order Centroid; ROC

1. INTRODUCTION

Today, business and business data are run online, where companies can sell their products through internet media. Online business will indirectly make the market wider. Because the market is getting wider, companies must be able to provide excellent service, especially in the delivery of goods. This must be followed by excellent service, especially in the delivery of goods. This means that today's delivery services and business operations will always be in touch, especially if the business is conducted online [1]. Services for goods delivery can assist in getting the sold goods into customers' hands [2]. So, choosing the right delivery service partner is an important thing for companies to consider. Even though a third party is handling the delivery service, this will have an impact on the company's services. The selection of the right shipping service partner can minimize the risks involved. In general, choosing a shipping partner is done by looking at the profile of the shipping partner and what services can be provided. In general, entrepreneurs engaged in online sales to select shipping partners are done by looking at the profiles of shipping partners and what services can be provided. This will take a long time because the company has to study the profiles of the delivery service partners one by one. So it requires a system that is able to assist in recommending the right delivery service partners according to their needs. The challenge of choosing delivery partners can therefore be resolved by developing a decision support system.

Decision Support Systems (DSS) are pieces of software that help decision-makers reach decisions and solve semi-structured problems by providing the best possible recommendations [3]. DSS is also defined as software that can provide information, make recommendations, and offer assistance while choices are made to find the best solution through logical patterns based on facts and data [4], [5]. DSS offers a paradigm that is applied to find mathematical and statistical solutions to issues [6]. A strategy or model for decision-making is needed to construct DSS. Several academics have conducted prior research on the creation of decision support systems for choosing goods delivery services, using a variety of decision-settlement approaches. Concerning the use of the SAW (Simple Additive Weighting) approach to decision support systems for choosing goods delivery services is one of them [7]. The SAW method in this study can seek alternatives through assessments based on the criteria values and weights on each criterion. Another study, research on decision support systems for selecting goods delivery services by implementing the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) approach [8]. This approach can determine the best alternative by taking into account the distance between the negative ideal solution and the positive ideal solution. Next, research on the determination of freight forwarding services through a decision support system using the MOORA (Multi-Objective Optimization by Ratio Analysis) method [9]. The method used is able to provide decision recommendations based on the optimization of two or more conflicting attributes simultaneously.

Based on several previous studies, the method used has not considered the utility or proportionality of the significance level of alternative uses. In utility decision problems need to be taken into account to determine the best solution. In addition, in previous research, weighting was carried out based on direct assessment, not considering the priority level of each criterion. So that what distinguishes research conducted from previous research is the use of utility assessments in obtaining optimal solutions through the Complex Proportional Assessment (COPRAS) approach

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and determining weights using Rank Order Centroid (ROC) by considering priority. The COPRAS technique is a strategy that examines options with different properties and presupposes options with utility judgment such that the qualities of each option are ordered based on intervals to make the process more precise and efficient [10]. This method is a decision-making approach that estimates linkages and predicts the significance level of alternative interests [11]. The COPRAS approach can get around the issue of different criteria when there are criteria of the positive type of benefit criteria and the negative type of cost criteria that are addressed individually to evaluate each alternative [12]. Because the COPRAS technique considers the assessment of utility, where the level of usefulness of each alternative is compared, it has the advantage of superior precision and accuracy [13]. Meanwhile, Rank Order Cetroid (ROC) is a weighting technique that prioritizes the order of importance of the criteria, by determining the weight value for each criterion according to the order that is assessed based on priority [14]. The ROC method has the advantage that it is simple in its process where in determining the weight value based on the priority order of the criteria starting from the first, second and so on [15]. Even though ROC has a weakness if more criteria are used, it is not a problem if the order of priority can be clearly determined. So that the decision maker only determines the order of priority, the ROC method will produce a weight value based on the priority. In addition, in this study the criteria for determining decisions were obtained from interviews with entrepreneurs engaged in online sales who were involved in selecting goods delivery service partners. The criteria used in this study are Timeliness of Delivery, Security of Delivery, Ease of Returns, Company Experience and Price.

Referring to the previous explanation, this study aims to apply Complex Proportional Assessments (COPRAS) and Rank Order Centroid (ROC) methods in a decision support system for selecting delivery service partners so that it can make it easier to make decisions correctly and in accordance with need. The COPRAS approach is used to determine the best solution based on an analysis of the existing options through alternative assessments by providing interval-based utility judgments. The ROC weighting method determines the weight value for each criterion according to the order in which it is assessed based on priority. The decision support system created is built on a website, making it simple for users to use and access.

2. RESEARCH METHODOLOGY

2.1 Research Stages

The phases of the research process are necessary for the implementation of the research to be well-organized and planned. The stages of research are actions or steps arranged in an organized manner to achieve research objectives [16]. In Figure 1, these phases are shown.

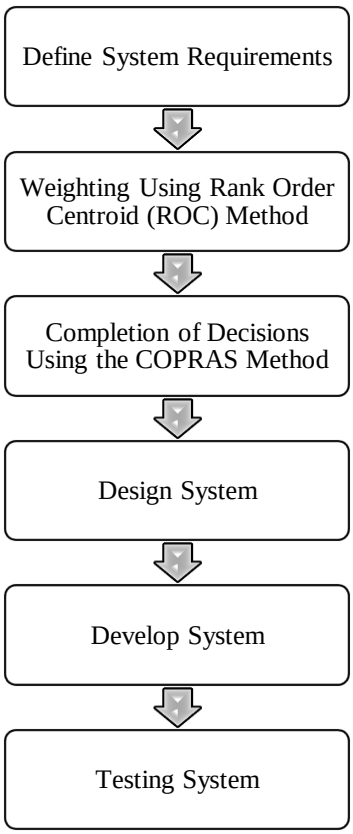

Figure 1. Research Stages

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Figure 1 depicts the steps involved in doing research. The stages of the research that was done are described in more detail below:

a. Define System Requirements
To do a needs analysis, the issue must first be recognized. In helping the problem will be explored regarding the constraints encountered in the case study conducted [17]. The study of system requirements should be done once the problems that need to be solved have been identified. To do a system requirements analysis, a requirement statement in the form of a functional requirements analysis is made [18]. An explanation of the system's capabilities and functions is the analysis' outcome. In addition, in solving the problem of the decision to select goods delivery services, it is necessary to determine the criteria used in the selection. This criterion was obtained from interviews with entrepreneurs engaged in online sales who were involved in selecting goods delivery services. The criteria used in this study are Timeliness of Delivery, Delivery Security, Ease of Return, Company Experience and Price.

b. Weighting Using Rank Order Centroid (ROC) Method
The Rank Order Centroid (ROC) technique is utilized to establish the weighting level for each criterion. This method establishes the weight by arranging the criteria in order of increasing relevance. in order to calculate the weight based on how important each condition is.

c. Completion of Decisions Using the COPRAS Method
This study's decision-making procedure for selecting the product delivery service partners was done using the Complex Proportional Assessment (COPRAS) approach. The COPRAS approach is used to assess solutions with varied characteristics and order the features of each option depending on intervals by assuming alternatives with utility judgment.

d. Design System
This stage aims to make it easier to understand the software requirements, so that the system will be visually assembled and modeled during the design stage [19]. Thus it will make the current system design, which will then be changed to become software.

e. Develop System
The system coding step is another name for this phase. The results of the analysis and design stages are embodied in the system as part of the implementation or coding phase [20]. The programming language used to create a decision support system website for selecting delivery service partners is PHP with an editor, namely Sublime Text 3. Meanwhile, MySQL is used for the database.

f. Testing System
System testing serves to ensure that the system being developed can perform as it should and that there are no functions that are inappropriate for use when the system is run [21]. Usability testing is a method of testing that aims to determine how well a built system is understood, how satisfied users are with it, and how simple it is to use [22]. The ISO 9126 standard for evaluating software quality includes this test. There are four sub-criteria that make up the usability component that was used in this test: understandability, learnability, operability and attractiveness.

2.2 Rank Order Centroid (ROC) Method

The Rank Order Centroid (ROC) method is an approach to provide simple criteria weights based on the priority order of each criterion [14]. ROC gives weight to each criterion according to the ranking being assessed, meaning that the order of the criteria shows the priority level of the criteria [15]. Determination of the ranking of these criteria is based on the order of the criteria used. Criteria with the first order, for instance, show that the criterion is more significant than the second criterion, the second criterion is more significant than the third criterion, and so on. The order of each criterion shows the level of importance of the predetermined criteria. So, if criterion 1 ≥ criterion 2 ≥ criterion 3 ≥ up to criterion n, then weight 1 (w_1) ≥ weight 2 (w_2) ≥ weight 3 (w_3) ≥ up to weight n (w_n). Based on this, then to determine the weighting using ROC can be found through equation (1).

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

where, w_k represents the ratio of the estimated weight scale that has been normalized, i represents the total number of objectives while k represents the rank of the objectives in i.

2.3 Complex Proportional Assessment (COPRAS) Method

The Complex Proportional Assessment method, or COPRAS as it is commonly known, is a model that analyzes alternatives with various characteristics and assumes that each alternative has utility judgment so that each alternative's characteristics are arranged based on intervals to make the process more accurate and efficient [23]. A decision-making strategy that evaluates links and forecasts the relevance level of alternative interests is also described as the COPRAS approach [24]. Because the COPRAS technique takes into account an assessment of utility, where the level of usefulness of each alternative is assessed, it has the advantage of having good precision and accuracy [13].

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The COPRAS approach can get around the issue of different criteria, where there are criteria that are positive (benefit) or criteria that are negative (cost) and are addressed separately to evaluate each alternative. The type of benefit criteria is when the criterion seeks a high value, whereas the type of cost criteria is when the criterion seeks a low value. Typically, the COPRAS technique is used in the calculating process to resolve decision problems through the steps below:

a. Arranging alternative values in the decision matrix.
The value of each alternative to the criteria is entered into the matrix to facilitate the calculation process using equation (1).

$$D = \begin{bmatrix} x_{11} & x_{12} & x_{13} & x_{14} \\ x_{21} & x_{22} & x_{23} & x_{24} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & x_{m3} & x_{mn} \end{bmatrix} \quad (2)$$

b. Normalize the matrix.
The decision matrix that has been obtained is then normalized using equation (3).

$$X_{ij} = \frac{X_{ij}}{\sum_{i=1}^{m} X_{ij}} \quad (3)$$

c. Compile a weighted normalized matrix.
The next step is to create a weighted normalization matrix, where each attribute will be multiplied by its weight through equation (4).

$$D' = d_{ij} = X_{ij} \times W_{ij} \quad (4)$$

d. Look for the maximum and minimum index values.
Next, calculate the maximum index value and minimum index value using equation (5) and equation (6).

$$S_{+i} = \sum_{j=1}^{n} y_{+ij} \quad (5)$$

$$S_{-i} = \sum_{j=1}^{n} y_{-ij} \quad (6)$$

e. Obtain relative weight values.
After the maximum and minimum index values are obtained, then proceed with finding the relative weight values. This process can be calculated using the equation (7) and equation (8).

$$Q_i = S_{+i} + \frac{S_{-\min} \sum_{i=1}^{m} S_{-i}}{S_{-i} \sum_{i=1}^{m} S_{-i} \left(S_{\min} / S_i \right)} \quad (7)$$

$$Q_i = S_{+i} + \frac{\sum_{i=1}^{m} S_{-i}}{S_{-i} \sum_{i=1}^{m} S_{-i} \left(1 / S_i \right)} \quad (8)$$

f. Calculating the utility value of each alternative.
The last stage is to find the value of Utility or U_i, where the highest U_i value is the best alternative. This utility value is obtained by calculating using equation (9).

$$U_i = \frac{Q_i}{Q_{max}} \quad (9)$$

3. RESULT AND DISCUSSION

In developing a decision support system for determining delivery service partners using the ROC weighting method and finalizing decisions using the COPRAS method, it begins with determining the criteria and weights. The criteria applied in this study are: price, company experience, timely delivery, delivery security and ease of return. To get the weight value in this case study, the ROC approach is applied, which determines the priority order of the criteria for weighting. The order of priority criteria from the criteria that have been determined in this case study are: Timeliness of Delivery (C1), Security of Delivery (C2), Ease of Return (C3), Company Experience (C4) and Price (C5). This

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means C1 will become w_1, C2 will become w_2, C3 will become w_3, C4 will become w_4 and C5 will become w_5. Then, based on the order of priority, then the weighting for each criterion is determined using the ROC method through equation (1) which has been discussed previously. So that the weight value of each criterion is as follows:

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

$$w_2 = \frac{0+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}}{5} = 01567$$

$$w_3 = \frac{0+0+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}}{5} = 0.2567$$

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

$$w_4 = \frac{0+0+0+0+\frac{1}{5}}{5} = 0.0400$$

Based on the weighting value that has been obtained from the calculation of the ROC method, it is then entered into the weighting criteria table which can be seen in Table 1.

Table 1. Criteria Weight

Criteria Code	Criteria	Criteria Type	Weight
C1	Timeliness of Delivery	Benefit	0.4567
C2	Delivery Security	Benefit	0.1567
C3	Ease of Return	Benefit	0.2567
C4	Company Experience	Benefit	0.0900
C5	Price	Cost	0.0400

After weighing the criteria, proceed with determining the alternative to be selected later. Alternatives are adjusted to the existing options that are possible for the decision maker to choose, where the decision maker is a person or company engaged in online sales that requires goods delivery services. As samples in this study using the following alternatives: JNE Express (A1), J&T Express (A2), SiCepat (A3), and Ninja Express (A4). Then, each alternative is given an assessment based on predetermined criteria. The assessment is determined based on existing criteria by the decision-maker. Assessment uses a Likert scale, which is used to measure attitudes or opinions using a value of 1 to 5. These values represent 1 = Not good, 2 = Not good, 3 = Fairly good, 4 = good, and 5 = Very good. Based on this range of values, an assessment is obtained for each alternative, which is presented in Table 2.

Table 2. Alternative Values

Alternative Code	Alternative	Criteria				
		C1	C2	C3	C4	C5
A1	JNE Express	4	4	4	5	3
A2	J&T Express	5	5	3	3	2
A3	SiCepat	5	4	3	3	4
A4	Ninja Express	4	4	4	4	2

Based on Table 2, it will then be calculated using the COPRAS method through the following steps:

a. Arranging alternative values in the decision matrix.

All alternative attributes or values to the criteria will be included in the decision matrix using equation (2). So, for the initial decision matrix in this case is as follows:

$$D = \begin{bmatrix} 4 & 4 & 4 & 5 & 3 \\ 5 & 5 & 3 & 3 & 2 \\ 5 & 4 & 3 & 3 & 4 \\ 4 & 4 & 4 & 4 & 2 \end{bmatrix}$$

b. Normalize the matrix.

Based on the decision matrix obtained, it is then normalized using equation (3). So the calculation for normalization in this case study is as follows:

$$X_{11} = \frac{4}{4+5+5+4} = 0.2222$$

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$$X_{21} = \frac{5}{4+5+5+4} = 0.2778$$
$$X_{31} = \frac{5}{4+5+5+4} = 0.2778$$
$$X_{41} = \frac{4}{4+5+5+4} = 0.2222$$

This process is repeated until all attributes or up to X_{45}. After all values have been normalized, then arranged into a normalized decision matrix. The results of the normalized decision matrix are as follows:

$$X_{ij} = \begin{bmatrix} 0.2222 & 0.2353 & 0.2857 & 0.3333 & 0.2727 \\ 0.2778 & 0.2941 & 0.2143 & 0.2000 & 0.1818 \\ 0.2778 & 0.2353 & 0.2143 & 0.2000 & 0.3636 \\ 0.2222 & 0.2353 & 0.2857 & 0.2667 & 0.1818 \end{bmatrix}$$

c. Compile a weighted normalized matrix.

The decision matrix that has been normalized is then converted into a weighted normalized decision matrix which is obtained through equation (4). The value for each criterion weight refers to Table 1. The calculation process to obtain a weighted normalized matrix is as follows:

$$d_{11} = 0.2222 \times 0.4567 = 0{,}050$$
$$d_{21} = 0.2778 \times 0.4567 = 0{,}075$$
$$d_{31} = 0.2778 \times 0.4567 = 0{,}100$$
$$d_{41} = 0.2222 \times 0.4567 = 0{,}050$$

This process is repeated until all attributes or up to d_{45}. After all values have been weighted normalized, they are then arranged into a weighted normalized decision matrix. The results of the decision matrix that have been weighted normalized are as follows:

$$D_{ij} = \begin{bmatrix} 0.1000 & 0.0612 & 0.0457 & 0.0300 & 0.0109 \\ 0.1250 & 0.0765 & 0.0343 & 0.0180 & 0.0073 \\ 0.1250 & 0.0612 & 0.0343 & 0.0180 & 0.0145 \\ 0.1000 & 0.0612 & 0.0457 & 0.0240 & 0.0073 \end{bmatrix}$$

d. Look for the maximum and minimum index values.

Next is the process of finding the maximum and minimum index values obtained based on equations (5) and (6). Before the calculation is carried out, it is first identified the types of criteria used, namely the criteria of benefits and costs. The benefit criteria consist of C1, C2, C3 and C4 criteria, while the cost criteria are C5 criteria. Thus, the process of calculating the maximum index (S_{+i}) is as follows:

$$A_1 = 0.1000 + 0.0612 + 0.0300 + 0.0109 = 0.2369$$
$$A_2 = 0.1250 + 0.0765 + 0.0180 + 0.0073 = 0.2538$$
$$A_3 = 0.1250 + 0.0612 + 0.0180 + 0.0145 = 0.2385$$
$$A_4 = 0.1000 + 0.0612 + 0.0240 + 0.0109 = 0.2309$$

Meanwhile, the minimum index value (S_{-i}) for each alternative is as follows:

$$A_1 = 0.0109$$
$$A_2 = 0.0073$$
$$A_3 = 0.0145$$
$$A_4 = 0.0073$$

e. Obtain relative weight values.

Relative weight values are calculated based on equations (7) and (8). Thus, the relative weight value can be calculated as follows:

$$Q_1 = 0.2369 + \frac{0.0400}{4.7500} = 0.2453$$
$$Q_2 = 0.2538 + \frac{0.0400}{3.1667} = 0.2664$$
$$Q_1 = 0.0145 + \frac{0.0400}{6.3333} = 0.2448$$

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$$Q_4 = 0.2309 + \frac{0.0400}{3.1667} = 0.2435$$

f. Calculating the utility value of each alternative.

This stage is the final stage of the COPRAS calculation, where the utility value (U_i) will be sought. The utility value is obtained by using equation (9). Before calculating the utility value, the Q_{max} value must first be determined, which based on previous calculations, it was found that the Q_{max} value was 0.2664. The calculation process to find the utility value is as follows:

$$U_1 = \frac{0.2453}{0.2664} \times 100\% = 92.09$$

$$U_2 = \frac{0.2664}{0.2664} \times 100\% = 100$$

$$U_3 = \frac{0.2448}{0.2664} \times 100\% = 91.89$$

$$U_4 = \frac{0.2435}{0.2664} \times 100\% = 91.42$$

Based on the calculation process above, the alternative that has the highest utility is the best alternative. Then the utility value (U_i) that has been obtained is arranged into a ranking table from the highest to the lowest value. The results of ranking utility values can be seen in Table 3.

Table 3. Ranking of Utility Values (U_i)

Alternative Code	Alternative	Utilities Value	Rank
A2	J&T Express	100	1
A1	JNE Express	92.09	2
A3	SiCepat	91.89	3
A4	Ninja Express	91.42	4

In Table 4 in this case study the best alternative is J&T Express (A2) with a score of 100, followed by JNE Express (A1) with a value of 92.09, SiCepat (A3) with a value of 91.89, Ninja Express (A4) with a value of 91.42.

The next stage is system implementation, or coding, where the system will be developed into a decision support system so that users can use it. This system is intended for people or companies engaged in online sales that require delivery services for goods. So that users can enter alternatives and criteria according to their needs in the system. The programming language used to create a decision support system website for selecting delivery service partners is PHP with an editor, namely Sublime Text 3. Meanwhile, MySQL is used for the database. The system built is website-based and can be accessed online. This decision support system begins with the user entering a username and password to access the system. Furthermore, users can access the main menu in the form of a dashboard which is presented in Figure 2.

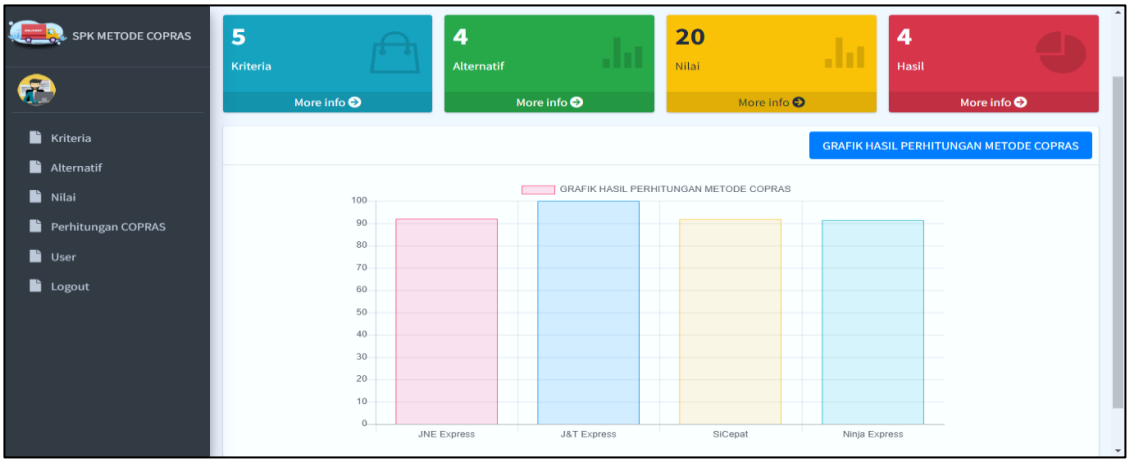

Figure 2. Main Menu Interface Display

The decision support system built has functionality such as managing criteria data and weights, managing alternative data, managing alternative value data, calculating the COPRAS method, and displaying the best alternative in the form of a ranking. To manage user criteria data, you can do this on the Criteria menu. In this menu, the user can enter criteria data, change it, and delete it. The criteria menu display can be seen in Figure 3.

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Figure 3. Criteria Menu Interface

If the user has entered criteria data, then the user can manage alternative data via the Alternative menu. In this feature, users can enter alternative data, make data changes, and delete data. Next, the user can manage the value for each alternative that has been previously entered on the Alternative Value menu. In this menu, the user can enter alternative value data, change it, and delete it. The alternative value input form interface display is visualized in Figure 4.

Figure 4. Alternative Menu Interface

After each alternative has been inputted in value, the user can select a goods delivery service partner using the COPRAS method on the COPRAS Calculation menu. The COPRAS Calculation feature will display a step-by-step calculation of the COPRAS method in getting the best alternative. The COPRAS Calculation Menu Interface is visualized in Figure 5.

Figure 5. COPRAS Method Calculation Interface

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Figure 6 shows the interface display of the calculation results with the COPRAS method, where with the same case study the system can produce the best alternative, namely J&T Express with a value of 100, followed by JNE Express with a value of 92.09, SiCepat with a value of 91.89, and Ninja Express with a value of 91.42. The results obtained by the system and the results of manual calculations show the same value. This means that the developed system produces valid calculations.

After the system has been built, the next step is testing. This seeks to guarantee that using the system is practical. Usability testing is the method used to test the applied system. The usability aspects used include understandability, learnability, operability, and attractiveness. Furthermore, from the usability elements, questions were prepared in the form of a questionnaire, which would later be used for measurement. There are 10 questions used to measure usability testing in this study. These questions include the following: System features are as desired, system features are too complicated, system features are easy to use, there is assistance in using existing features, existing features are integrated with each other, existing features are consistent, existing features can be learned quickly, existing features are practical when used, there is confidence in using these features, and existing features can be learned in their use. The Guttman scale is used for assessing the questionnaire because the scale has extreme characteristics so that the answers from the respondents are only two, namely agree and disagree. The number of respondents used was 30 people who are business actors who use goods delivery service partners. Thus, the respondents used are related to decision making for selecting goods delivery services. After the respondent answered the question, the percentage of the respondent's answers that either agreed or disagreed was calculated. Usability testing results obtained from respondents' answers to the questionnaires that have been distributed can be seen in Figure 6.

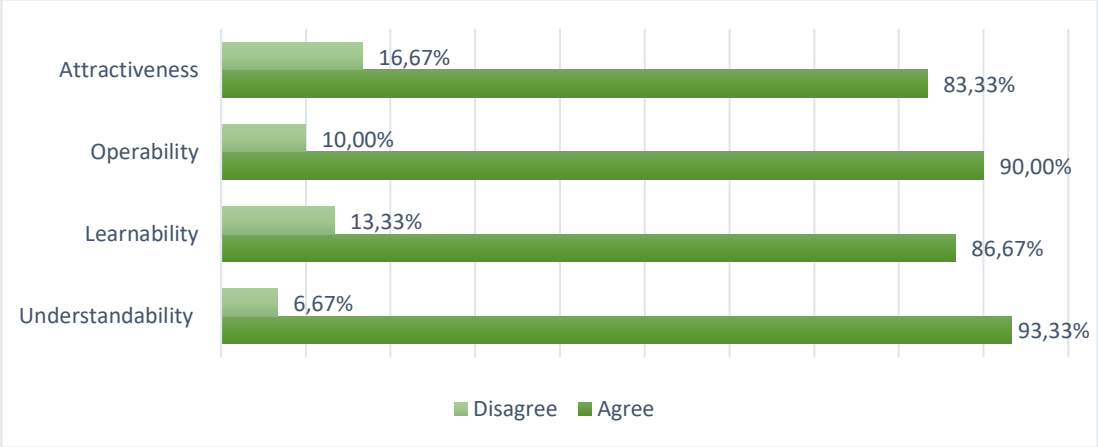

Figure 6. Usability Testing Results

Based on Figure 6, the results show the results of answers from respondents for each aspect of usability testing. Respondents answered that they agreed with the understandability aspect to get a score of 88.33%, learnability to get a score of 90%, operability to get a score of 86.67%, and attractiveness to get a score of 93.33%. If the average is calculated for all aspects, it will get a value of 88.33%. Then the results of the usability test are transformed into the following criteria: If you get a value between 76% and 100, then it is in the Good category; if you get a value between 56% to 75% then it is in the Good category; if you get a score between 40% to 55% then it is in the Less Good category; if less than 40% fall into the Not Good category [25]. This means that the results of the usability test for the decision support system for selecting delivery service partners are in the good category. This demonstrates that, based on usability testing, the developed solution is implementable.

4. CONCLUSION

This research has applied the Complex Proportional Assessment (COPRAS) approach and determined the weights using the rank-order centroid (ROC). The ROC method is used to facilitate the determination of weights because this method determines weights through a sequence of criteria based on their level of importance. Whereas the COPRAS approach implies alternatives with utility judgement so that the features of each alternative are grouped based on intervals, analysis of alternatives that have different characters, and the ability to choose the best alternative. Based on the case study conducted, the best alternative was obtained, namely J&T Express with a score of 100, followed by JNE Express with a value of 92.09, SiCepat with a value of 91.89, and Ninja Express with a value of 91.42. The calculation results obtained on the built-in system show the same value as the manual calculation results, which means that the calculations on the system are valid. With the results of this ranking, it can make it easier for decision-makers, especially for people or companies engaged in online sales that require the selection of goods delivery services. In addition, in this study, the results of usability testing were obtained with an average value of 88.33% and included in the good category. These results indicate that this decision support system can be implemented and is feasible to use. However, this research needs improvement and development for further research. In further research, it can be

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developed using other multi-criteria methods in order to get more representative results. Not only that, there needs to be additional features, such as election results reports per period, so that decision-makers can evaluate the performance of the selected freight forwarding services. The system also needs to be developed on a mobile basis so that it can be accessed via a smartphone without having to open a browser.

REFERENCES

[1] A. E. Putro, *Manajemen Kurir dalam Perspektif Proses Bisnis*. Pekalongan: Penerbit NEM, 2022.
[2] M. F. Zulfikar and M. K. Sujono, *Manajemen Pengiriman Barang Paket di PT Pos Indonesia*. Jombang: Lembaga Penelitian dan Pengabdian kepada Masyarakat Universitas KH. A. Wahab Hasbullah, 2021.
[3] R. I. Borman, M. Mayangsari, and M. Muslihudin, "Sistem Pendukung Keputusan Menentukan Lokasi Perumahan Di Pringsewu Selatan Menggunakan Fuzzy Multiple Attribute Decision Making," *JTKSI (Jurnal Teknol. Komput. dan Sist. Informasi)*, vol. 01, no. 01, pp. 5–9, 2018, doi: 10.56327/jtksi.v1i1.874.
[4] R. T. Sutton, "An overview of clinical decision support systems: benefits, risks, and strategies for success," *npj Digit. Med.*, vol. 17, pp. 1–10, 2020, doi: 10.1038/s41746-020-0221-y.
[5] M. Cinelli, M. Kadzi, G. Miebs, M. Gonzalez, and R. Słowi, "Recommending multiple criteria decision analysis methods with a new taxonomy-based decision support system," *Eur. J. Oper. Res.*, vol. 302, pp. 633–651, 2022, doi: 10.1016/j.ejor.2022.01.011.
[6] 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.
[7] S. Wasiyanti and A. Putri, "Pemilihan Jasa Pengiriman Barang Menggunakan Metode Simple Additive Weighting (SAW)," *SATIN - Sains dan Teknol. Inf.*, vol. 6, no. 1, pp. 10–19, 2020, doi: 10.33372/stn.v6i1.577.
[8] R. Risnawati and N. Manurung, "Sistem Pendukung Keputusan Dalam Penentuan Mitra Jasa Pengiriman Barang Terbaik Di Kota Kisaran Menggunakan Metode TOPSIS," *JURTEKSI (Jurnal Teknol. dan Sist. Informasi)*, vol. 5, no. 2, pp. 133–138, 2019, doi: 10.33330/jurteksi.v5i2.357.
[9] R. F. Siregar, "Sistem Pendukung Keputusan Pemilihan Mitra Jasa Pengiriman Barang PT. Global Jet Express (JNT) Pada Cabang Medan Johor Dengan Metode MOORA," *J. CyberTech*, vol. 2, no. 4, pp. 1–11, 2019.
[10] D. Kang, R. Jaisankar, V. Murugesan, and K. Suvitha, "A novel MCDM approach to selecting a biodegradable dynamic plastic product: a probabilistic hesitant fuzzy set-based COPRAS method," *J. Environ. Manage.*, vol. 340, no. 117967, pp. 1–10, 2023, doi: 10.1016/j.jenvman.2023.117967.
[11] S. B. Patil, T. A. Patole, R. S. Jadhav, S. S. Suryawanshi, and S. J. Raykar, "Complex Proportional Assessment (COPRAS) based Multiple-Criteria Decision Making (MCDM) paradigm for hard turning process parameters," *Mater. Today Proc.*, vol. 59, pp. 835–840, 2022, doi: 10.1016/j.matpr.2022.01.142.
[12] L. Irvana and N. Mariana, "Penerapan Metode COPRAS Untuk Pemilihan SMK Jurusan TKJ Kota Semarang," *J. SISFOKOM (Sistem Inf. dan Komputer)*, vol. 11, no. 2, pp. 201–207, 2022.
[13] R. P. Saragih, S. M. Tondang, D. Pratiwi, A. Wanto, and A. P. Windarto, "Analisis Metode COPRAS Dalam Pemilihan Tempat Usaha Kuliner Berdasarkan Penilaian Konsumen," *CSRID (Computer Sci. Res. Its Dev. Journal)*, vol. 13, no. 3, pp. 263–272, 2021.
[14] M. Mesran, T. M. Diansyah, and F. Fadlina, "Implemententasi Metode Rank Order Centroid (ROC) dan Operational Competitiveness Rating Analysis (OCRA) dalam Penilaian Kinerja Dosen Komputer Menerapkan (Studi Kasus: STMIK Budi Darma)," in *Prosiding Seminar Nasional Riset Information Science (SENARIS)*, 2019, pp. 822–834.
[15] I Made Arya Budhi Saputra, "Penentuan Lokasi Stup Menggunakan Pembobotan Rank Order Centroid (ROC) dan Simple Additive Weighting (SAW)," *J. Sist. dan Inform.*, vol. 15, no. 1, pp. 48–53, 2020, doi: 10.30864/jsi.v15i1.340.
[16] 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, doi: 10.26418/justin.v8i3.40273.
[17] R. D. Gunawan, R. Napianto, R. I. Borman, and I. Hanifah, "Penerapan Pengembangan Sistem Extreme Programming Pada Aplikasi Pencarian Dokter Spesialis di Bandar lampung Berbasis Android," *J. Format*, vol. 8, no. 2, pp. 148–157, 2019.
[18] I. Ahmad, A. T. Prastowo, E. Suwarni, and R. I. Borman, "Pengembangan Aplikasi Online Delivery Sebagai Upaya Untuk Membantu Peningkatan Pendapatan," *JMM (Jurnal Masy. Mandiri)*, vol. 5, no. 6, pp. 4–12, 2021.
[19] 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.
[20] M. Akbar, Q. Quraysh, and R. I. Borman, "Otomatisasi Pemupukan Sayuran Pada Bidang Hortikultura Berbasis Mikrokontroler Arduino," *J. Tek. dan Sist. Komput.*, vol. 2, no. 2, pp. 15–28, 2021.
[21] 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.
[22] M. I. Farouqi, I. Aknuranda, and A. D. Herlambang, "Evaluasi Usability Pada Aplikasi UBER Menggunakan Pengujian Usability," *J. Pengemb. Teknol. Inf. dan Ilmu Komput.*, vol. 2, no. 9, pp. 2599–2606, 2018.
[23] A. Fathurrozi, A. Damuri, A. T. Prastowo, and Y. Rahmanto, "Sistem Pendukung Keputusan Pemilihan Lahan Tanaman Kopi Menggunakan Metode Complex Proportional Assessment (COPRAS)," *KLIK Kaji. Ilm. Inform. dan Komput.*, vol. 3, no. 3, pp. 228–237, 2022.
[24] M. D. Irawan, H. Situmorang, R. Sitanggang, and D. Sawitri, "Sistem Pendukung Keputusan Untuk Menentukan Mutasi Pegawai Menggunakan Metode COPRAS," *CESS (Journal Comput. Eng. Syst. Sci.*, vol. 8, no. 1, pp. 220–234, 2023.
[25] R. I. Borman and Y. Purwanto, "Impelementasi Multimedia Development Life Cycle pada Pengembangan Game Edukasi," *JEPIN (Jurnal Edukasi dan Penelit. Inform.*, vol. 5, no. 2, pp. 119–124, 2019.