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DSS for best e-commerce selection using AHP-WASPAS and AHP-MOORA methods

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Abstract: eIQ Consumer Pulse 2019 determines the 6 largest e-commerce in Indonesia, namely Blibli, Bukalapak, JD.id, Lazada Indonesia, Shopee and Tokopedia. This is due to an increase in e-commerce transactions. The COVID-19 pandemic, which emphasizes social distancing and physical distancing, has also played a role in increasing these transactions. Indonesia is also predicted to become the market leader in Southeast Asia due to this. On the other hand, each e-commerce customer has their preferences in choosing e-commerce to use in transactions. Various criteria make customers confused due to intense competition between e-commerce companies. DSS is a solution in choosing the right e-commerce for each customer's preferences. The AHP-WASPAS and AHP-MOORA methods can be used in calculations for determining favorite e-commerce in Indonesia. The CRISP-DM framework also helps in preparing the research flow well. 3 decision-makers are used to provide weighting criteria using AHP. The results of this study indicate that the Tokopedia alternative is the best e-commerce, with a preference value of 0.8964 for AHP-WASPAS and 0.4245 for AHP-MOORA. The second and third places are Bukalapak and Lazada, respectively. The weighting of the criteria by the decision-maker, the alternative normalization process and the calculation technique for the preference value have a significant impact on the ranking results.

Keywords: AHP, DSS, e-commerce, MOORA, WASPAS

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Introduction

Given that 96% of internet users in Indonesia have used e-commerce, it is hoped that e-commerce in Indonesia can develop rapidly and become a leader in the Southeast Asian market [1]. According to 2019 data, the value of e-commerce transactions in Indonesia is the US $ 21 billion and is estimated to reach the US $ 82 billion in transaction value by 2025 [2]. The current situation regarding the impact of COVID-19 on the global e-commerce industry shows that daily web traffic has increased significantly by more than 50%, which may be due to the social and physical restrictions experienced by consumers [3]. The government also protects consumers when transacting through e-commerce through preventive and repressive methods [4]. This situation allows e-commerce to penetrate deeper and gain growth in the Indonesian market. E-commerce is also required to always maintain its excellence in providing quality products and services. Indonesia has a lot of e-commerce, and Indonesia has the 6 largest e-commerce companies consisting of Blibli, Bukalapak, JD.id, Lazada, Shopee, and Tokopedia [5]. Behind the convenience provided, there are still several negative factors, such as product mismatches, delivery problems, security of payment methods, and customer service. Due to intense competition, many consumer considerations, it is difficult to choose between the same products but the prices offered are different, so that consumers are still confused about choosing the right and trusted e-commerce transaction. To solve this problem, a decision support system (DSS) can be used to provide advice in choosing the right e-commerce. DSS itself is an effective system that can assist

users in making complex decisions. This system uses decision rules, analysis models, comprehensive databases, and decision-maker knowledge [6], [7], [8].

In this study, the method used was a combination of AHP-WASPAS and AHP-MOORA. This combination of methods was chosen because AHP is a functional hierarchy with the main input being human perception [9], [10], [11], [12], [13]. The WASPAS method can reduce errors or optimize evaluation to select the highest and lowest scores [14], [15], [16], [17]. The MOORA method has a good level of selectivity in determining an alternative [18], [19], [20], [21]. In previous studies, the combination of these methods in the DSS has been applied well, decision-makers can weigh the criteria and greatly influence the results of recommendations but have not been implemented in software [22], [23], [24]. Regarding the choice of e-commerce, several studies have compared different alternative criteria and methods, and achieved good results [25], [26], [27], [28]. However, there has been no comprehensive analysis on how to compare how the combination of these methods is implemented in the software, taking into account the weighting of criteria for different Decision Maker.

Therefore, this study aims to be able to perform calculations manually and implement a combination of the AHP-WASPAS and AHP-MOORA methods in a software product. The urgency of this research, if not realized, could result in obstruction of the development of the DSS method which can only reach the calculation and design stages manually, thus hindering innovation in the DSS field. Based on the background previously described, it is necessary to realize a combination of the AHP-WASPAS and AHP-MOORA methods to determine the best e-commerce using DSS.

Methodology

The research method used in this study follows the various stages of the CRISP-DM model [29]. Data-related problems such as data mining and DSS can use the CRISP-DM method, which is expected to analyze business problems and current conditions, provide appropriate data conversion to provide a model that can evaluate the effectiveness, and record the results obtained. CRISP-DM solves this problem by defining a process model related to data mining and DSS, regardless of the problem department or technology used.

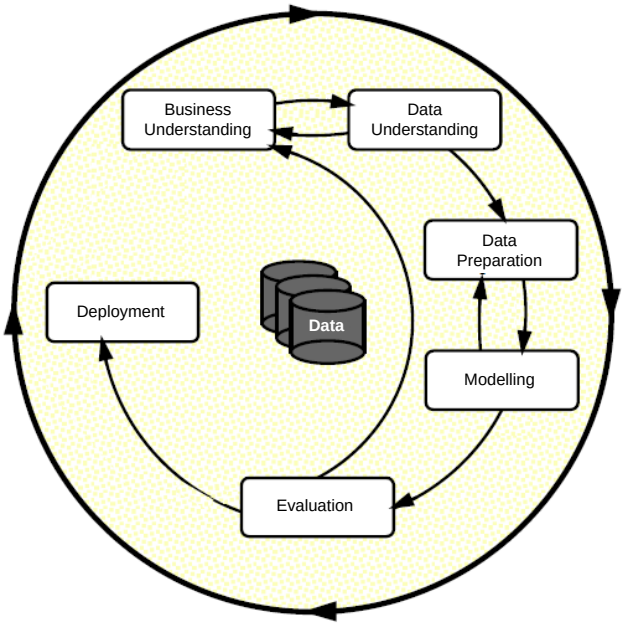


Figure 1. Current process model phase related to CRISP-DM [29]

Business understanding is the stage used to determine business goals, analyze business conditions, and determine the objectives of the DSS. At this stage, a thorough understanding is

carried out based on the results of the analysis of observations, interviews, and supporting documents for the objectives and results of the research. Several options can be found when determining the best e-commerce in Indonesia. Based on the alternatives obtained, calculations are made to determine the ranking. The best e-commerce results can be the best recommendations for consumers to make digital transactions. On the other hand, an e-commerce that has not achieved the best results can still improve its performance to gain a better market share. When determining the number and alternative criteria for the best e-commerce candidates, refer to the assessment in the 2019 Consumer Pulse eIQ survey and get 6 alternatives namely Blibli, Bukalapak, JD.id, Laza-da Indonesia, Shopee, and Tokopedia. The decision-makers used are 3 netizens who are actively using e-commerce. The weights of the criteria were obtained from the Decision Maker and were calculated using AHP, while the evaluation of the alternative ranking used the WASPAS and MOORA methods.

At data understanding stage, it starts with the process of data collection, data analysis, and evaluation of the quality of the data used in the study. To be able to use the AHP-WASPAS and AHP-MOORA methods correctly, appropriate criteria and alternative data are needed. The criteria used in this study include (C1) reputation, (C2) price, (C3) product, (C4) customer service, (C5) delivery, (C6) application & UX, (C7) payment, and (C8) security. & Policy. Reputation is a good name for e-commerce in society. Price is the nominal amount that consumers have to pay, and how cheap it is compared to competing e-commerce. Products cover product range, product authenticity, product selection, and product quality. Customer service is good customer service. De-livery includes the speed of delivery, the conditions of free shipping, and the time it takes to process the shipment. App & UX includes easy-to-use apps, mobile apps, and UX that satisfy users. Payment methods cover a variety of payment methods, payment processing, and the quality of each payment method. Security and policies relating to returns, membership programs, promotions, and safety.

At data preparation stage includes selecting the data used and published to be included in the DSS calculation. At this stage, data cleaning is also carried out to repair, remove or ignore the noise in the data. At the business understanding stage, the tools, techniques, or methods used in this study have been selected. In this Modeling stage, AHP-WASPAS and AHP-MOORA methods were chosen to determine the best e-commerce in Indonesia. Before continuing the research, you can do a test design with the data to prove the method can be used. A flowchart of the method used can be seen in Figure 2.

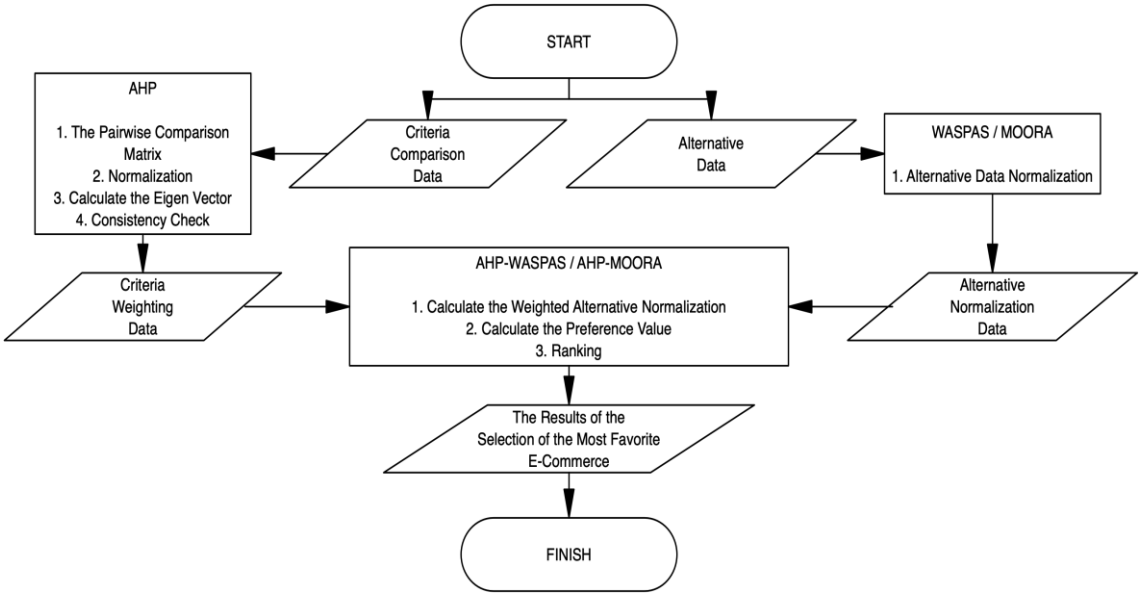


Figure 2. Flowchart of using the AHP-WASPAS and AHP-MOORA methods

The first step is to prepare comparison data between the criteria provided by the decision-maker as a resource and alternative data is Indonesian e-commerce data based on the 2019 eIQ Consumer Pulse survey. Starting from the determination of the pairwise comparison matrix, the

AHP method is used to determine the criteria weighting data, then normalize it, compute eigenvectors and check hierarchy consistency. To calculate the consistency index using AHP can be seen in equation (1), and to calculate the consistency ratio can be seen in equation (2) [30].

$$CI = \frac{(\lambda_{max} - n)}{(n-1)} \quad (1)$$

$$CR = \frac{CI}{IR} \quad (2)$$

Furthermore, the WASPAS method and the MOORA method are used to normalize alternative data to produce normalized alternative data. Criteria weight data results from the calculation of the AHP method, and alternative data normalized using the WASPAS and MOORA methods are used for weighted normalization calculations and calculating preference values, as well as producing ratings based on preference values that can determine the best e-commerce ranking. This can be a reference for customers or input as a refinement of e-commerce, which still lacks in some aspects. To calculate the preference value using WASPAS using equation (3), which consists of calculations using WSM in equation (4) and WPM in equation (5) [14]. Normalization using MOORA using equation (6) and preference value using MOORA using equation (7) [19].

$$Q_i = \frac{1}{2}\left(Q_i^{(1)} + Q_i^{(2)}\right) \quad (3)$$

$$Q_1^{(1)} = \sum_{j=1}^{n} x_{ij} w_j \quad (4)$$

$$Q_1^{(2)} = \prod_{j=1}^{n} x_{ij} w_j \quad (5)$$

$$X^*_{ij} = \frac{x_{ij}}{\sqrt{\left[\sum_{j=1}^{m} (x_{ij})^2\right]}} \quad (6)$$

$$y^*_j = \sum_{j=1}^{g} w_j x^*_{ij} - \sum_{i=g+1}^{n} w_j x^*_{ij} \quad (7)$$

At the evaluation stage, testing is carried out based on the results of the DSS recommendations and the performance of the methods used. Calculations must be tested manually, and the results obtained when implemented in software have the same value to have compatibility between the two. Sensitivity testing is used to compare the performance between the WASPAS and MOORA methods to measure which method is more sensitive to changes in weighting criteria, therefore the more sensitive the better. At the Deployment stage, a deployment plan is carried out based on previous assessments. If the test results show good results, further implementation can be planned. Apart from deployment planning, monitoring and maintenance plan can also be planned to produce a final report on the research results.

Results and Discussions

Results

This research is based on questionnaire data from users who are very familiar with e-commerce, the questionnaire is transformed using the AHP method into weighting criteria and e-commerce data as an alternative. The number of Decision Makers used to produce weighting criteria is 3 people, and the amount of e-commerce data used is 6 companies. The calculation starts using the AHP method. There are 8 criteria, namely (C1) reputation, (C2) price, (C3) product, (C4) customer service, (C5) delivery, (C6) application & UX, (C7) payment methods, and (C8) security & policies. Pairwise comparison matrices from Decision Maker 1. 2 and 3 are shown in Table 1. Table 2 and Table 3. Equally important weights are not shown in the table. EQ means equally important, MD means moderate important, ST means strongly important, DM means demonstrated important and EX means extremely important.

Table 1. Pairwise comparison matrix from decision maker 1

Criteria		C1	C2	C3	C4	C5	C6	C7	C8
Reputation	C1	-	MD		MD	MD	MD	MD	
Price	C2		-						
Product	C3		MD	-					
Customer Service	C4				-				
Delivery	C5					-			
Application & UX	C6						-		
Payment Methods	C7							-	
Security & Policies	C8		MD	MD	MD	MD	MD		-

Table 2. Pairwise comparison matrix from decision maker 2

Criteria		C1	C2	C3	C4	C5	C6	C7	C8
Reputation	C1	-	MD		MD	MD	MD	MD	
Price	C2		-						
Product	C3	MD	MD	-					
Customer Service	C4				-				
Delivery	C5					-			
Application & UX	C6						-		
Payment Methods	C7							-	
Security & Policies	C8	MD	ST	ST	ST	ST	ST	ST	-

Table 3. Pairwise comparison matrix from decision maker 3

Criteria		C1	C2	C3	C4	C5	C6	C7	C8
Reputation	C1	-	MD		MD	MD	MD	MD	
Price	C2		-						
Product	C3	MD		-	MD	MD	MD		
Customer Service	C4				-				
Delivery	C5					-			
Application & UX	C6						-		
Payment Methods	C7							-	
Security & Policies	C8	MD				MD	MD		-

Furthermore, the calculation is focused on Decision Maker 1. The calculation steps for other decision-makers are the same as the calculation for Decision Maker 1. The criteria comparison matrix for decision-maker 1 is translated, based on the Saaty scale presented in Table 4. The results of the pairwise comparison matrix transformation using Saaty scale are presented in Table 5.

Table 4. Saaty scale

Intensity	Description / Linguistics
1	Equaly Important (EQ)
3	Moderate Important (MD)
5	Strongly Important (ST)
7	Demonstrated Important (DM)
9	Extremely Important (EX)
2,4,6,8	Intermediate Value

Table 5. Pairwise comparison matrix translated using the saaty scale from decision maker 1

Criteria		C1	C2	C3	C4	C5	C6	C7	C8
Reputation	C1	1	3	1	3	3	3	3	1
Price	C2	1/3	1	1/3	1	1	1	1	1/3
Product	C3	1	3	1	1	1	1	1	1/3
Customer Service	C4	1/3	1	1	1	1	1	1	1/3
Delivery	C5	1/3	1	1	1	1	1	1	1/3
Application & UX	C6	1/3	1	1	1	1	1	1	1/3
Payment Methods	C7	1/3	1	1	1	1	1	1	1
Security & Policies	C8	1	3	3	3	3	3	1	1
SUM		4 2/3	14	9 1/3	12	12	12	10	4 2/3

Normalization in the AHP method is done by dividing the element values by the number of column values. The eigenvector value is generated based on the number of criteria for each row, as follows.

$$C_{11} = \frac{1}{4^2/_3} = 0.214 \qquad C_{12} = \frac{3}{14} = 0.214 \qquad C_{13} = \frac{1}{9^1/_3} = 0.107 \qquad C_{14} = \frac{3}{12} = 0.250$$

$$C_{15} = \frac{3}{12} = 0.250 \qquad C_{16} = \frac{3}{12} = 0.250 \qquad C_{17} = \frac{3}{10} = 0.300 \qquad C_{18} = \frac{1}{4^2/_3} = 0.214$$

$$EV\ C_1 = \frac{0.214 + 0.214 + 0.107 + 0.250 + 0.250 + 0.250 + 0.300 + 0.214}{8} = \frac{1.800}{8} = 0.2250$$

For the following criteria, use the same formula to produce the eigenvector values shown in table 6. as follows.

Table 6. Eigen vector for decision-maker 1

Criteria		Eigen Vector
Reputation	C1	0.225
Price	C2	0.075
Product	C3	0.120
Customer Service	C4	0.084
Delivery	C5	0.084
Application & UX	C6	0.084
Payment Methods	C7	0.101
Security & Policies	C8	0.227

After obtaining the eigenvector for each criterion, λ_{max} can be calculated from the pairwise comparison matrix multiplied by the eigenvector[30]. Each product yield is divided by the feature vector, and the average value is λ_{max}. Use the following steps to determine the λ_{max} of Decision Maker 1.

$$\lambda = \begin{bmatrix} 1.0 & 3.0 & 1.0 & 3.0 & 3.0 & 3.0 & 3.0 & 1.0 \\ 0.3 & 1.0 & 0.3 & 1.0 & 1.0 & 1.0 & 1.0 & 0.3 \\ 1.0 & 3.0 & 1.0 & 1.0 & 1.0 & 1.0 & 1.0 & 0.3 \\ 0.3 & 1.0 & 1.0 & 1.0 & 1.0 & 1.0 & 1.0 & 0.3 \\ 0.3 & 1.0 & 1.0 & 1.0 & 1.0 & 1.0 & 1.0 & 0.3 \\ 0.3 & 1.0 & 1.0 & 1.0 & 1.0 & 1.0 & 1.0 & 0.3 \\ 0.3 & 1.0 & 1.0 & 1.0 & 1.0 & 1.0 & 1.0 & 1.0 \\ 1.0 & 3.0 & 3.0 & 3.0 & 3.0 & 3.0 & 1.0 & 1.0 \end{bmatrix} \begin{bmatrix} 0.225 \\ 0.075 \\ 0.120 \\ 0.084 \\ 0.084 \\ 0.084 \\ 0.102 \\ 0.227 \end{bmatrix} = \begin{bmatrix} 1.857 \\ 0.619 \\ 0.999 \\ 0.699 \\ 0.699 \\ 0.699 \\ 0.850 \\ 1.893 \end{bmatrix}$$

$$\lambda_{max} = \frac{\left(\frac{0.1857}{0.225} + \frac{0.619}{0.075} + \frac{0.999}{0.120} + \frac{0.699}{0.084} + \frac{0.699}{0.084} + \frac{0.699}{0.084} + \frac{0.850}{0.102} + \frac{1.893}{0.227}\right)}{8}$$

$$\lambda_{max} = \frac{8.254 + 8.254 + 8.348 + 8.326 + 8.326 + 8.326 + 8.351 + 8.346}{8} = 8.317$$

After getting λ_{max}, the following steps can be used to calculate the decision-maker 1 consistency index, using equation (1).

$$CI = \frac{(8.317-8)}{(8-1)} = \frac{0.317}{7} = 0.0453$$

After obtaining the consistency index (CI), then the consistency ratio can be calculated for Decision Maker 1 [30]. Based on the Alonso-lamata RI values, which are presented in Table 7. considering the number of criteria is 8. the IR used is 1.4056. CR can be calculated using equation (2).

Table 7. Alonso-Lamata RI values

Number of Elements	3	4	5	6	7	8
Alonso-Lamata RI Values	0.5245	0.8815	1.1086	1.2479	1.3417	1.4056

$$CR = \frac{0.0453}{1.4056} = 0.0322$$

Because CR is less than 0.1. the hierarchy is considered consistent, so the calculation is declared true and can be used as a criterion weight. The same steps as Decision Maker 1 are also used to calculate the comparison matrix between Decision Maker 2 and 3 to obtain the eigenvector value of all Decision Maker. To find the weighted average of all Decision Maker, the geometric mean (GEOMEAN) calculation is carried out based on the weighting of the criteria for all Decision Maker, the results of which are presented in Table 8. If the number of weighted criteria from GEOMEAN does not equal 1. the weighting of the criteria is normalized. The steps for obtaining the weighted average criteria are as follows.

Table 8. Eigen value by the Three Decision Maker and the Geometric Mean (GEOMEAN)

Criteria		**EV N1**	**EV N2**	**EV N3**	**Geomean EV**	**Normalized Geomean EV**
Reputation	C1	0.225	0.165	0.189	0.192	0.196
Price	C2	0.075	0.062	0.102	0.078	0.080
Product	C3	0.120	0.124	0.197	0.143	0.146
Customer Service	C4	0.084	0.070	0.087	0.080	0.082
Delivery	C5	0.084	0.070	0.073	0.075	0.077
Application & UX	C6	0.084	0.070	0.073	0.075	0.077
Payment Methods	C7	0.102	0.070	0.102	0.090	0.092
Security & Policies	C8	0.227	0.369	0.177	0.245	0.251
SUM		1	1	1	0.979	1

After getting the weighted criteria results, continue using the WASPAS method and the MOORA method to calculate the preference value. When using the WASPAS method to calculate, starting from the alternative normalization calculation, calculating the preference value and ranking. The e-commerce data used includes Blibli (EC1), Bukalapak (EC2), JD.ID (EC3), Lazada (EC4), Shopee (EC5) and Tokopedia (EC6). Based on predetermined e-commerce data, the results are shown in Table 9 below.

Table 9. E-commerce alternative value

Alternative		**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**
Blibli	EC1	14.8	29.9	138.6	18.4	48.1	19.8	13.6	15.0
Bukalapak	EC2	13.0	21.9	141.8	23.3	32.7	32.4	13.7	21.4
JD.ID	EC3	12.9	26.4	143.7	8.3	54.2	22.8	17.2	13.7
Lazada	EC4	13.7	23.5	143.0	15.8	46.2	19.5	16.1	22.2
Shopee	EC5	10.9	23.6	144.6	18.7	48.4	23.0	9.9	22.4
Tokopedia	EC6	14.3	21.7	145.5	21.4	30.7	31.6	12.2	22.7

Based on these alternative data, the WASPAS method can be used to calculate the alternative normalization. By dividing the criteria value by the maximum value of the criteria in the column, welfare conditions can be standardized using the WASPAS method [14]. The following

calculation shows an example of the criteria in the EC1 alternative. For the next alternative, use the same formula to generate the priority and rating values shown in Table 10, as follows.

$r_{11} = \frac{14.8}{14.8} = 1;$ $r_{12} = \frac{29.9}{29.9} = 1;$ $r_{13} = \frac{138.6}{145.5} = 0.953;$ $r_{14} = \frac{18.4}{23.3} = 0.790;$

$r_{15} = \frac{48.1}{54.2} = 0.887;$ $r_{16} = \frac{19.8}{32.4} = 0.611;$ $r_{17} = \frac{13.6}{17.2} = 0.791;$ $r_{18} = \frac{15.0}{22.7} = 0.661;$

Table 10. E-commerce alternative normalization data using WASPAS

Alternative		C1	C2	C3	C4	C5	C6	C7	C8
Blibli	EC1	1.00	1.00	0.95	0.79	0.89	0.61	0.79	0.66
Bukalapak	EC2	0.88	0.73	0.97	1.00	0.60	1.00	0.80	0.94
JD.ID	EC3	0.87	0.88	0.99	0.36	1.00	0.70	1.00	0.60
Lazada	EC4	0.93	0.79	0.98	0.68	0.85	0.60	0.94	0.98
Shopee	EC5	0.74	0.79	0.99	0.80	0.89	0.71	0.58	0.99
Tokopedia	EC6	0.97	0.73	1.00	0.92	0.57	0.98	0.71	1.00

After obtaining the alternative normalization value, the calculation of the preference value in WASPAS is obtained from the combination of additive importance and multiplicative importance values [14]. The following calculation shows the calculation of the value of the importance of the AHP-WASPAS additive in alternative 1, using formula (4), and the calculation of the AHP-WASPAS multiplicative importance value in alternative 1, using formula (5).

$$Q_1{}^{(1)} = \sum \begin{bmatrix} (0.196 \times 1.00); (0.080 \times 1.00); (0.146 \times 0.95); (0.082 \times 0.79) \\ (0.077 \times 0.89); (0.077 \times 0.61); (0.092 \times 0.79); (0.251 \times 0.66) \end{bmatrix}$$
$$Q_1{}^{(1)} = 0.196 + 0.080 + 0.139 + 0.064 + 0.068 + 0.047 + 0.073 + 0.166 = 0.8330$$

$$Q_1{}^{(2)} = \prod \begin{bmatrix} (1.00^{0.196}); (1.00^{0.080}); (0.95^{0.146}); (0.79^{0.082}) \\ (0.89^{0.077}); (0.61^{0.077}); (0.79^{0.092}); (0.66^{0.251}) \end{bmatrix}$$
$$Q_1{}^{(2)} = 1.000 \times 1.000 \times 0.993 \times 0.981 \times 0.991 \times 0.963 \times 0.979 \times 0.901 = 0.8196$$

For the next alternative, use the same formula to produce additive and multiplicative importance values. Furthermore, the calculation of preference values can be done using AHP-WASPAS using formula (3), with the results of the preference values shown in Table 11.

$$Q_1 = \frac{1}{2}(0.8330 + 0.8196) = 0.8263$$

Table 11. Preference value and ranking using AHP-WASPAS

No	Alternative		Preference Value	Ranking
1	Tokopedia	EC6	0.8964	Ranked 1st
2	Bukalapak	EC2	0.8834	Ranked 2nd
3	Lazada	EC4	0.8814	Ranked 3rd
4	Shopee	EC5	0.8356	Ranked 4th
5	Blibli	EC1	0.8263	Ranked 5th
6	JD.ID	EC3	0.7737	Ranked 6th

After getting the preference value on the AHP-WASPAS, to find the preference value using the MOORA method, it can be done by calculating alternative normalization, calculating the optimization value, and ranking it. Based on predetermined alternative data, the following calculation shows an example of calculating the normalized value for the EC1 alternative using formula (6).

$$X^*{}_{11} = \frac{14.8}{\sqrt{[(14.8)^2+(13)^2+(12.9)^2+(13.7)^2+(10.9)^2+(14.3)^2]}} = 0.453$$
$$X^*{}_{12} = \frac{29.9}{\sqrt{[(29.9)^2+(21.9)^2+(26.4)^2+(23.5)^2+(23.6)^2+(21.7)^2]}} = 0.495$$

$$X^*_{13} = \frac{138.6}{\sqrt{[(138.6)^2+(141.8)^2+(143.7)^2+(143)^2+(144.6)^2+(145.5)^2]}} = 0.396$$
$$X^*_{14} = \frac{18.4}{\sqrt{[(18.4)^2+(23.3)^2+(8.3)^2+(15.8)^2+(18.7)^2+(21.4)^2]}} = 0.411$$
$$X^*_{15} = \frac{48.1}{\sqrt{[(48.1)^2+(32.7)^2+(54.2)^2+(46.2)^2+(48.4)^2+(30.7)^2]}} = 0.444$$
$$X^*_{16} = \frac{19.8}{\sqrt{[(19.8)^2+(32.4)^2+(22.8)^2+(19.5)^2+(23)^2+(31.6)^2]}} = 0.318$$
$$X^*_{17} = \frac{13.6}{\sqrt{[(13.6)^2+(13.7)^2+(17.2)^2+(16.1)^2+(9.9)^2+(12.2)^2]}} = 0.397$$
$$X^*_{18} = \frac{15}{\sqrt{[(15)^2+(21.4)^2+(13.7)^2+(22.2)^2+(22.4)^2+(22.7)^2]}} = 0.307$$

For the next alternative, use the same formula to produce the alternative normalized values shown in Table 12 as follows.

Table 12. E-commerce alternative normalization data using MOORA

Alternative		C1	C2	C3	C4	C5	C6	C7	C8
Blibli	EC1	0.45	0.49	0.40	0.41	0.44	0.32	0.40	0.31
Bukalapak	EC2	0.40	0.36	0.41	0.52	0.30	0.52	0.40	0.44
JD.ID	EC3	0.40	0.44	0.41	0.19	0.50	0.37	0.50	0.28
Lazada	EC4	0.42	0.39	0.41	0.35	0.43	0.31	0.47	0.46
Shopee	EC5	0.33	0.39	0.41	0.42	0.45	0.37	0.29	0.46
Tokopedia	EC6	0.44	0.36	0.42	0.48	0.28	0.51	0.36	0.47

After obtaining the alternative normalization value, the calculation of the preference value in MOORA is continued with the calculation of the optimization value. The following calculation shows the preference value calculated using AHP-MOORA [19]. Table 13 shows the results of preference values and ratings using AHP-MOORA, using formula (7).

$$y^*_1 = \sum \begin{bmatrix} (0.196 \times 0.45); (0.080 \times 0.49); (0.146 \times 0.40); (0.082 \times 0.41); \\ (0.077 \times 0.44); (0.077 \times 0.32); (0.092 \times 0.40); (0.251 \times 0.31) \end{bmatrix} = 0.3919$$

Table 13. Preference value and ranking using AHP-MOORA

No	Alternative		Preference Value	Ranking
1	Tokopedia	EC6	0.4245	Ranked 1st
2	Bukalapak	EC2	0.4186	Ranked 2nd
3	Lazada	EC4	0.4159	Ranked 3rd
4	Shopee	EC5	0.3955	Ranked 4th
5	Blibli	EC1	0.3919	Ranked 5th
6	JD.ID	EC3	0.3707	Ranked 6th

Discussions

The results of manual calculations using AHP-WASPAS and AHP-MOORA have also been applied to web-based software, and the results are in accordance with manual calculations that have been tested previously using Microsoft Excel. Figure 3 shows the pairwise comparisons normalization between criteria using AHP. Figure 4 shows the eigenvector calculations results using AHP.

Figure 5 shows the Web-Based Implementation of the Alternative Data. Figure 6 shows the preference value calculation results using AHP-WASPAS. Figure 7 shows the preference value calculation results using AHP-MOORA. Figure 8 shows the preference value comparison using AHP-WASPAS and AHP-MOORA. Figure 9 shows the preference value graph comparison using AHP-WASPAS and AHP-MOORA.

Matriks AHP

Nama Kriteria		C1	C2	C3	C4	C5	C6	C7	C8
		BEN	BEN	BEN	BEN	BEN	BEN	BEN	BEN
		CF	SF	CF	CF	SF	CF	CF	CF
Reputasi	C1	1.0000	3.0000	1.0000	3.0000	3.0000	3.0000	3.0000	1.0000
Harga	C2	0.3333	1.0000	0.3333	1.0000	1.0000	1.0000	1.0000	0.3333
Produk	C3	1.0000	3.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.3333
Customer Service	C4	0.3333	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.3333
Pengiriman	C5	0.3333	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.3333
Aplikasi & UX	C6	0.3333	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.2000
Metode Pembayaran	C7	0.3333	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.3333
Keamanan & Kebijakan	C8	1.0000	3.0000	3.0000	3.0000	3.0000	5.0000	3.0000	1.0000
SUM		4.6667	14.0000	9.3333	12.0000	12.0000	14.0000	12.0000	3.8667

Figure 3. Web-based implementation of the pairwise comparisons normalization between criteria using AHP

Eigen Vector

Nama Kriteria	Nilai Kriteria
Reputasi	0.2198
Harga	0.0733
Produk	0.1179
Customer Service	0.0822
Pengiriman	0.0822
Aplikasi & UX	0.0779
Metode Pembayaran	0.0822
Keamanan & Kebijakan	0.2645
SUM	1.0000

Figure 4. Web-based implementation of the eigenvector calculations results using AHP

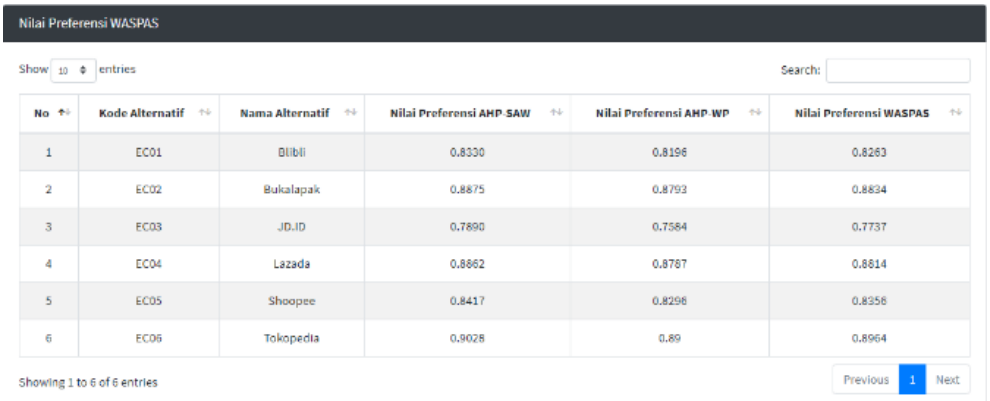
Data Alternatif

Show 10 entries Search:

Kode Alternatif	(C1)	(C2)	(C3)	(C4)	(C5)	(C6)	(C7)	(C8)
EC01	14.8	29.9	138.6	18.4	48.1	19.8	13.6	15
EC02	13	21.9	141.8	23.3	32.7	32.4	13.7	21.4
EC03	12.9	26.4	143.7	8.3	54.2	22.8	17.2	13.7
EC04	13.7	23.5	143	15.8	46.2	19.5	16.1	22.2
EC05	10.9	23.6	144.6	18.7	48.4	23	9.9	22.4
EC06	14.3	21.7	145.5	21.4	30.7	31.6	12.2	22.7
MIN	10.9	21.7	138.6	8.3	30.7	19.5	9.9	13.7
MAX	14.8	29.9	145.5	23.3	54.2	32.4	17.2	22.7

Showing 1 to 6 of 6 entries Previous 1 Next

Figure 5. Web-based implementation of the alternative data



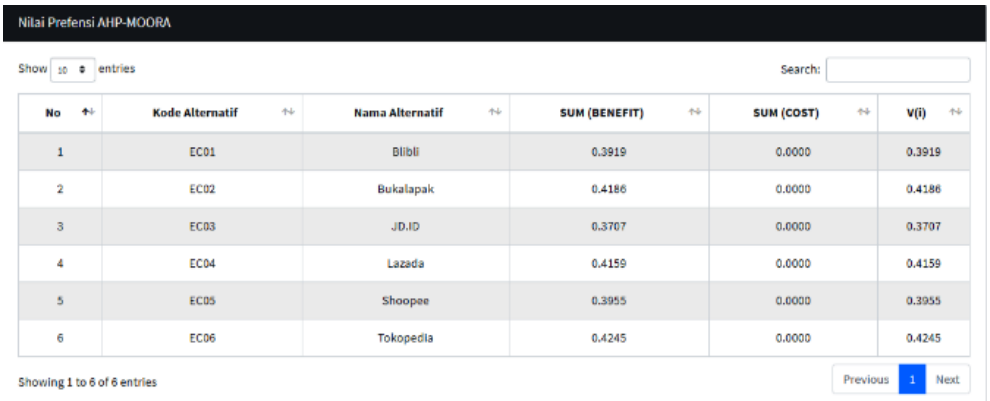
Nilai Preferensi WASPAS

Show 10 entries Search:

No	Kode Alternatif	Nama Alternatif	Nilai Preferensi AHP SAW	Nilai Preferensi AHP WP	Nilai Preferensi WASPAS
1	EC01	Blibli	0.8330	0.8196	0.8263
2	EC02	Bukalapak	0.8875	0.8793	0.8834
3	EC03	JD.ID	0.7890	0.7584	0.7737
4	EC04	Lazada	0.8862	0.8787	0.8814
5	EC05	Shoopee	0.8417	0.8296	0.8356
6	EC06	Tokopedia	0.9028	0.89	0.8964

Showing 1 to 6 of 6 entries Previous 1 Next

Figure 6. Web-based implementation of the preference value calculations results using AHP-WASPAS



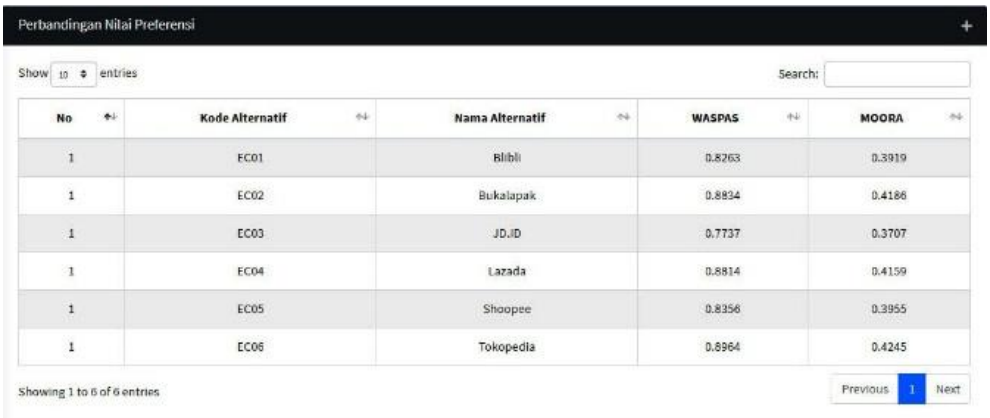
Nilai Prefensi AHP-MOORA

Show 10 entries Search:

No	Kode Alternatif	Nama Alternatif	SUM (BENEFIT)	SUM (COST)	V(i)
1	EC01	Blibli	0.3919	0.0000	0.3919
2	EC02	Bukalapak	0.4186	0.0000	0.4186
3	EC03	JD.ID	0.3707	0.0000	0.3707
4	EC04	Lazada	0.4159	0.0000	0.4159
5	EC05	Shoopee	0.3955	0.0000	0.3955
6	EC06	Tokopedia	0.4245	0.0000	0.4245

Showing 1 to 6 of 6 entries Previous 1 Next

Figure 7. Web-based implementation of the preference value calculations results using AHP-MOORA



Perbandingan Nilai Preferensi

Show 10 entries Search:

No	Kode Alternatif	Nama Alternatif	WASPAS	MOORA
1	EC01	Blibli	0.8263	0.3919
1	EC02	Bukalapak	0.8834	0.4186
1	EC03	JD.ID	0.7737	0.3707
1	EC04	Lazada	0.8814	0.4159
1	EC05	Shoopee	0.8356	0.3955
1	EC06	Tokopedia	0.8964	0.4245

Showing 1 to 6 of 6 entries Previous 1 Next

Figure 8. Web-based implementation of the preference value comparison using AHP-WASPAS and AHP-MOORA

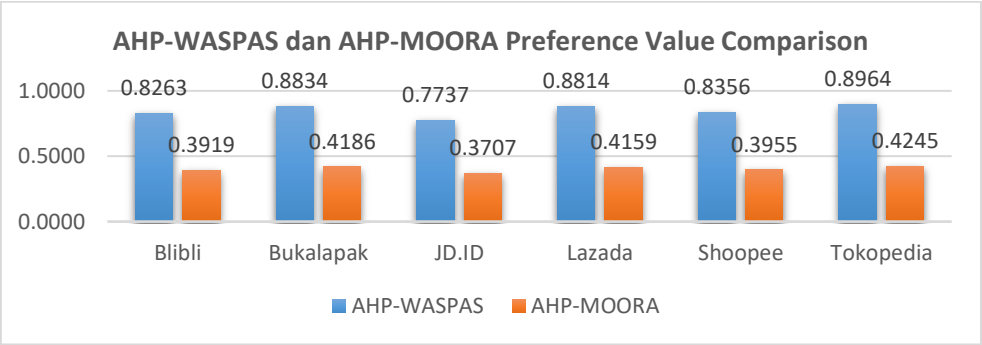


Figure 9. Preference value comparison graph using AHP-WASPAS and AHP-MOORA

Conclusion

Based on the comparative research results of the AHP-WASPAS and AHP-MOORA methods on DSS to determine the best e-commerce in Indonesia, it can be concluded that the AHP-WASPAS and AHP-MOORA methods can be used to determine the best e-commerce in Indonesia. Can be calculated manually and implemented into web-based software. The best e-commerce in Indonesia is determined based on weighting the criteria of 3 users who actively use e-commerce and based on the results of alternative evaluations obtained from the 2019 eIQ Consumer Pulse survey, which states that the e-commerce alternative "Tokopedia" as the best e-commerce has value. AHP-WASPAS preference is 0.8964 and AHP-MOORA is 0.4245. The second and third ranks were "Bukalapak" and "Lazada", respectively. The weighting of the criteria by the Decision Maker, the alternative normalization process, and the calculation technique for the preference value have an impact on the ranking.

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