Online Version Available at: http://bsti.ubd.ac.id/e-jurnal

JOURNAL OF TECH-E

|2581-1916 (Online) | 2598-7585 (Printed) |

Article

Implementation of the FUCOM-SAW Method on E-Commerce Selection DSS in Indonesia

Gede Surya Mahendra[1]

[1]*STMIK STIKOM Indonesia, Informatics Engineering Study Program, Bali, Indonesia*

SUBMISSIONTRACK

Recieved: Sep 21, 2021
Final Revision: Sep 29, 2021
AvailableOnline: Sep 29, 2021

KEYWORD

FUCOM, SAW, DSS, E-Commerce

CORRESPONDENCE

E-mail: gede.mahendra@stiki-indonesia.ac.id

A B S T R A C T

Tokopedia, Shopee, Bukalapak, Lazada Indonesia, Blibli, and JD.id are the 6 major e-commerce sites in Indonesia based on the eIQ survey in 2019. The increase in economic growth is also influenced by the significant increase in e-commerce transactions. Customers have their personal opinions in choosing the e-commerce they use.Various criteria in choosing e-commerce often confuse customers in choosing e-commerce according to their needs while the fierce competition in e-commerce makes the choice difficult for customers.In providing the most suitable e-commerce options for customers, DSS can be used for that selection. In this study, the use of FUCOM-SAW is able to be used in calculating the selection of e-commerce based on the preferences of the decision maker assisted by the CRISP-DM framework in the process. 4 decision makers assign weighting criteria using FUCOM and assessments from the eIQ survey are used as alternative data and are used to generate the best preferences for e-commerce customers.The results of calculations using FUCOM-SAW show that Bukalapak is the favorite e-commerce with a value of 0.8701 while Blibli and Tokopedia are in second and third positions. The preference by the decision maker greatly affects the results of the weighting of the criteria.

INTRODUCTION

Indonesia is likely to become a leader in the Southeast Asian market through e-commerce transactions, because almost all active Internet users in Indonesia have used e-commerce to transact continuously [1]. Based on 2019 data, e-commerce transactions in Indonesia have reached 21 billion US dollars and surprisingly these transactions will continue to increase over time and in 2025 it is predicted to reach 82 billion US dollars [2]. The increase in internet use in Indonesia, especially during the COVID-19 pandemic which imposed a series of restrictions on social distancing, WFH habits, led to a spike of up to 50% in the increase in daily web traffic [3]. The active role of the government related to consumer protection which has penetrated into the realm of transactions from e-commerce has increased consumer

confidence in using e-commerce and encouraged the growth of e-commerce in Indonesia [4]. This is not wasted by e-commerce companies to be able to increase company profits by spreading their services and also deepening market penetration. E-commerce companies also need not only looking for profit, but also need to provide promotions, maintain transaction security, price wars and improve service quality to retain existing customers and attract new customers.Indonesia has a lot of e-commerce to establish transactions with customers, but only the 6 largest e-commerce companies can penetrate the market well, including Tokopedia, Shopee, Bukalapak, Lazada Indonesia, Blibli, and JD.id [5]. Ease of use of e-commerce in transactions, it is not always comfortable to be accepted by customers. there are various problems such as differences between product displays and those received by customers, packaging and delivery problems, transaction security, customer service or the use of applications that sometimes have too many advertisements or are not friendly to some user segments.

The Decision Support System (DSS) can be used to provide customers with suggestions to help them choose the right e-commerce based on their personal preferences. DSS is an effective system that can help users make complex decisions based on alternatives, standards, and their own preferences [6]–[8]. DSS uses decision rules, analysis models, comprehensive databases and decision maker knowledge [9]–[12].

This study chose a combination of the FUCOM-SAW method. FUCOM-SAW was chosen in providing solutions in the selection of e-commerce because FUCOM is good at simpler algorithms, more reliable standardized result weights, fewer comparisons between standards, and allows the use of predetermined integers, decimals, or comparisons in decisions between standards value, making it better than AHP or BWM [13]–[16]. SAW is a simple method that is able to analyze existing alternatives to produce a decision easily [17]–[19]. Several previous studies have compared different alternatives, criteria and methods, and have achieved good results in using DSS to select the best e-commerce [20]–[23]. Based on the background described above, this study hopes to use the FUCOM-SAW method for calculations to assist e-commerce customers in selecting the most appropriate e-commerce to use according to personal preferences.

I. LITERATURES REVIEW

1. E-Commerce

E-commerce is the process of selling, buying, exchanging, transferring products, services or information through computer networks connected to the internet. E-commerce uses traditional business process forms and uses social networks through the Internet [24]. If done well, business strategies can be successful, ultimately increasing customer engagement, brand awareness and revenue, and increasing customer satisfaction. E-commerce can run well based on the 4C principles, such as connection, creation, consumption, control. E-commerce can provide a boost to consumers that leads to the company's return on investment (ROI), where this can be calculated by active participation such as feedback or reviews from consumers, sharing consumers on their social media or even recommending e-commerce to be used by others.

The six major e-commerce mentioned earlier, in a more in-depth way, each has its own merits.Based on the 2019 Consumer Pulse eIQ survey, it shows that people shop on the site for certain reasons. If customers are interested in buying fashion products at affordable prices, they will use Shopee for transactions. If customers plan to look for Mom & Baby or Grocery products, they can transact using JD.id or Blibli. This shows that each e-commerce has built differentiation even though there are still very tight price and quality wars.

2. Decision Support System (DSS)

DSS is an advanced information system that is closely related to management, computerized in such a way that it communicates interactively with users to provide ratings based on alternatives and criteria [25]–[27]. Multi Criteria Decision Making (MCDM) is a method in DSS that can provide a ranking of the best alternatives from a number of alternatives and criteria that have been prepared in advance [28], [29]. MCDM is divided into two categories, namely Multiple Objective Decision Making (MODM) and Multiple Attribute Decision Making (MADM).

3. Full Consistency Method (FUCOM)

Full Consistency Method (FUCOM) was developed by Dragan Pamučar, ŽeljkoStević and SinišaSremac in 2018 and was developed based on the principle of pairwise comparison and validation of deviation from full consistency (DFC) [15]. In addition to having a small number of pairwise comparison criteria, FUCOM has the ability to validate results by defining deviations from the maximum consistency of comparisons and appreciating transitivity (complementary) in pairwise comparison criteria. FUCOM also accommodates the subjective influence of decision makers on the final score of the criteria weights. This refers to the first and second steps in FUCOM, where decision makers rank criteria based on their personal preferences and perform pairwise comparisons by ranking the criteria that have been determined [30]–[32].

The following is a procedure for obtaining the weighting of the criteria using FUCOM. In the first step, the criteria from a set of evaluation criteria are defined and ranked. The ranking is carried out according to the suitability of the criteria, starting from the criteria that are expected to have the highest coefficient weight to the least significant criteria. Thus, the criteria are sorted according to the expected value of the weight coefficient obtained [33]:

$$C_{j(1)} > C_{j(2)} > \cdots > C_{j(k)}$$

In the second step, a comparison of the ranking criteria is carried out and the comparative priority $\left(\varphi_{\frac{k}{k+1}}\right), k = 1,2,\ldots,n;$ where k represents the ranking criteria) of the evaluation criteria:

$$\Phi = \left(\varphi_{\frac{1}{2}}, \varphi_{\frac{2}{3}}, \ldots, \varphi_{\frac{k}{k+1}}\right)$$

In the third step, the final value of the weight coefficient of the evaluation criteria is calculated

$$\left|\frac{w_k}{w_{k+1}} = \varphi_{\frac{k}{k+1}}\right| \leq \chi, \forall j$$

$$\left|\frac{w_k}{w_{k+2}} = \varphi_{\frac{k}{k+1\otimes}}\varphi_{\frac{k+1}{k+2}}\right| \leq \chi, \forall j$$

$$\sum_{j=1}^{n} w_j = 1, \forall j$$

$$w_j \geq 0, \forall j$$

4. Simple Additive Weighting (SAW)

The SAW method is often also known as the weighted addition method [34]. The SAW method has the basic concept of finding the weighted sum of the performance ratings for each alternative on all attributes. The SAW method requires the process of normalizing the decision matrix (X) to a scale that can be compared with all alternative ratings. In this study, the weighting has been completed using the FUCOM method, followed by ranking calculations using the SAW method starting from the alternative normalization on SAW to getting the preference value.

The preference value ($\boldsymbol{V_i}$) is obtained based on the sum of the normalized matrix row elements ($\boldsymbol{R}$) with the preference weights ($\boldsymbol{W}$) corresponding to the matrix column elements.

$$\boldsymbol{V_i} = \sum_{\boldsymbol{j=1}}^{\boldsymbol{n}} \boldsymbol{w_j r_{ij}}$$

II. CRISP-DM FRAMEWORK

Cross-industry Data Mining Standard Process (CRISP-DM) is a standard for data mining, decision support system and knowledge discovery project development, because it is most widely used in this type of development process [35]–[38]. The CRISP-

DM reference model provides an overview of the data mining project life cycle, which can be broken down into six phases, namely Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation and Deployment [39].

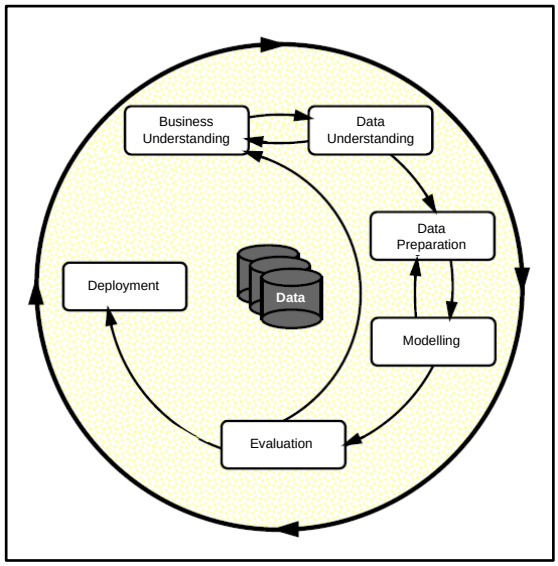

Fig 1: CRISP-DM framework

III. METHODS

This research model uses CRISP-DM with several stages from business understanding, continued to the data understanding stage, then data preparation, modeling, evaluation and ends at the deployment stage. At the business understanding stage, a full understanding of the existing problem conditions is carried out by conducting observations, interviews, research document studies to obtain a clear analysis to achieve the objectives and results of the research.The problem that arises in this study is the confusion of customers in choosing their favorite e-commerce that can be used. The purpose of this research is to assist customers in choosing the right e-commerce according to their personal preferences. E-commerce companies also get an evaluation of their shortcomings to be able to develop their business better in the future.This study will use FUCOM-SAW as a method for determining e-commerce with 6 criteria and 6 alternatives based on a survey from eIQ Consumer Pulse released in 2019. The criteria used are reputation & safety, prices, products, customer service & payment, delivery, and user experience, applications, & policies. The alternatives used are the 6 largest e-commerce sites in Indonesia, namely Tokopedia, Shopee, Bukalapak, Lazada Indonesia, Blibli, and JD.id. There are 4 decision makers who actively use e-commerce as their daily transactions.

Furthermore, at the data understanding stage, an evaluation of the quality of the data used in this study was carried out. Some things that can be done include data collection, data analysis and research on the validity of the data. Then at the data preparation stage, the right data selection is carried out so that it can be used and gives good results in DSS calculations. In the modeling stage, the FUCOM-SAW method will be implemented in the calculation stage in determining e-commerce according to the preferences of its users.Research flow chart can be seen in Figure 2.

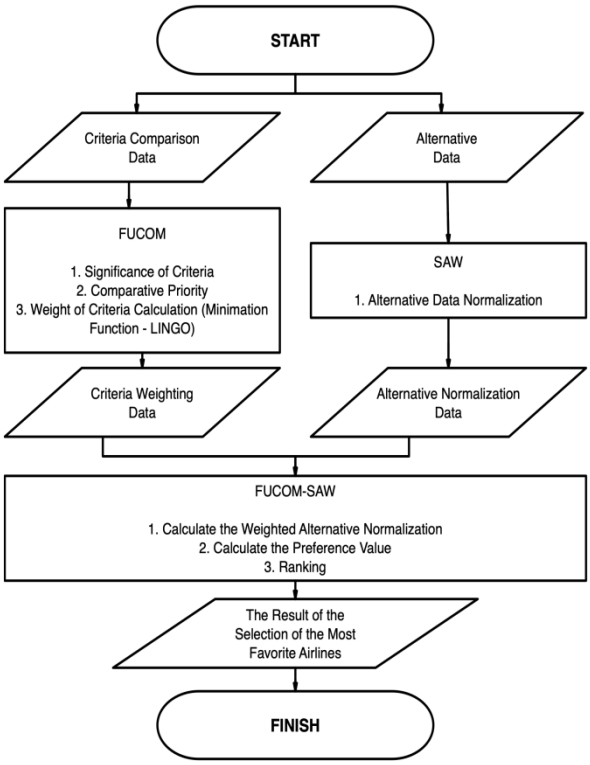

Fig 2: Research flow chart

The first stage in the application of FUCOM-SAW is the selection of data on the comparison of significance between criteria

given by the decision maker. This data will be processed using FUCOM with stages in the form of comparison of significance between criteria, determining priority comparisons and generating criteria weights by calculating the minimization function assisted by the use of the LINGO application. if there are several decision makers, then the average calculation of the weight of criteria will be carried out using the geometric mean and normalization will be carried out. Alternative data will be calculated using the SAW method or also known as the WSM (Weighted Sum Model) method. Alternative data will be calculated to obtain normalized alternative data. Normalized alternative data from the SAW method and weight of criteria data from FUCOM will be calculated which results in weighted normalized alternative data. Based on this weighted normalized alternative data, the preference value will be calculated to determine the most favorite e-commerce in Indonesia from the customer's choice.

The alternative with the highest preference value is selected as the superior alternative. After the modeling stage is complete, it is continued with the evaluation stage which tests the results of the DSS recommendations which provide results in the form of preference values and ratings. The final stage of the CRISP-DM model is deployment where at this stage the results are distributed both in compiling final reports, publishing scientific articles or distributing software if software implementation is carried out.

IV. RESULT

In order to realize the calculation of favorite e-commerce by the FUCOM-SAW method, the judgment criteria of favorite e-commerce are weighted based on questionnaire data from decision makers who have a good understanding and are active in the use of e-commerce, converted to weighted standard criteria. To generate the weight of criteria using FUCOM, the number of decision makers (DM) used are 4 people who are actively using e-commerce and understand well about e-commerce, which will be called the Decision Maker 1 (DM1), Decision Maker 2 (DM2), Decision Maker 3 (DM3) and Decision Maker 4 (DM4). The number of e-commerce used is 6 mayor e-commerce company in Indonesia. Using the FUCOM method, these four decision makers provide a weighted standardized evaluation by providing a standardized level of importance, and calculation of mathematical coefficient and transitivity ratios. The decision maker chooses the most preferred standard and assigns a value of 1, which is the same as the previous value, or adds an ordinal or decimal value at the end before the next standard of choice, so the lower the weight, the better. Table 1 lists the weights of the four decision makers on each criterion.

Table 1. Weighted criteria based on the four decision makers

Criteria	C1	C2	C3	C4	C5	C6
DM1	1,4	1,0	2,2	2,0	2,5	1,7
DM2	1,5	1,2	1,0	2,5	2,0	1,7
DM3	1,5	1,2	1,0	2,0	1,7	1,6
DM4	1,4	1,0	2,2	2,0	2,5	1,7

In addition, calculations are focused on decision maker 1 (DM1), and calculations from other sources will follow computations of DM1. Carry out the DM1 weighting from the smallest to the largest weight. In addition, the value of comparison priority calculation is the calculation of the weight coefficient ratio, and mathematical transitive calculations are also carried out based on the ratio of the weight coefficient. Table 2 shows the standard weighted rating of DM1.

Table 2. Weighted criteria based on the DM1 and sorted ascending

Criteria	C2	C1	C6	C4	C3	C5
DM1	1	1,4	1,7	2	2,2	2,5

Comparative priority calculation and weight coefficient ratio on DM1, calculated using the following steps, using equation (1).

$$\varphi_{C2/C1} = {}^{1.4}/_{1.0} = 1.40000;\ {}^{w2}/_{w1} = 1.40000$$
$$\varphi_{C1/C6} = {}^{1.7}/_{1.4} = 1.21429\ ;\ {}^{w1}/_{w6} = 1.21429$$

$$\varphi_{C6/C4} = {}^{2.0}/_{1.7} = 1.17647;\ {}^{w6}/_{w4} = 1.17647$$
$$\varphi_{C4/C3} = {}^{2.2}/_{2.0} = 1.10000;\ {}^{w4}/_{w3} = 1.10000$$
$$\varphi_{C3/C5} = {}^{2.5}/_{2.2} = 1.13636;\ {}^{w3}/_{w5} = 1.13636$$

Calculation of mathematical transivity from the calculation of the weight coefficient ratio on DM1, calculated using the following steps, using equation (2).

$${}^{w2}/_{w6} = 1.40000 \times 1.21429 = 1.70000$$
$${}^{w1}/_{w4} = 1.21429 \times 1.17647 = 1.42857$$
$${}^{w6}/_{w3} = 1.17647 \times 1.10000 = 1.29412$$
$${}^{w4}/_{w5} = 1.10000 \times 1.13636 = 1.25000$$

The final results of mathematical modeling to determine the evaluation criteria weight coefficient for DM1 are as follows.

$$\min \chi$$
$$s.t.$$
$$\left|\frac{w_2}{w_1} - 1.40000\right| \le \chi, \left|\frac{w_1}{w_6} - 1.21429\right| \le \chi, \left|\frac{w_6}{w_4} - 1.17647\right| \le \chi, \left|\frac{w_4}{w_3} - 1.10000\right| \le \chi, \left|\frac{w_3}{w_5} - 1.13636\right| \le \chi,$$

$$\left|\frac{w_2}{w_6} - 1.70000\right| \le \chi, \left|\frac{w_1}{w_4} - 1.42857\right| \le \chi, \left|\frac{w_6}{w_3} - 1.29412\right| \le \chi, \left|\frac{w_4}{w_5} - 1.25000\right| \le \chi,$$

$$\sum_{j=1}^{6} w_j = 1,$$
$$w_j \ge 0, \forall j$$

Then the mathematical modeling obtained is solved using the help of the LINGO application program to perform the minimization function. The notation and results of the minimization function to find the weight coefficient of the FUCOM evaluation criteria using LINGO can be seen in Figure 3. Because it uses 4 decision makers, it is necessary to get the average of the weight of criteria by calculating based on the geometric mean and doing normalization, where the calculation results can be seen in table 3. The Weight Coefficient Evaluation Criteria pie chart, are presented in Figure 4. The results of the normalization of the weight of criteria from all decision makers show that the price factor (C2) which reached 23,13% was a factor that became the main focus of e-commerce selection followed by product (C3) which reached 19,64%, and reputation & security (C1) became the next biggest factor which reached 16,77%.

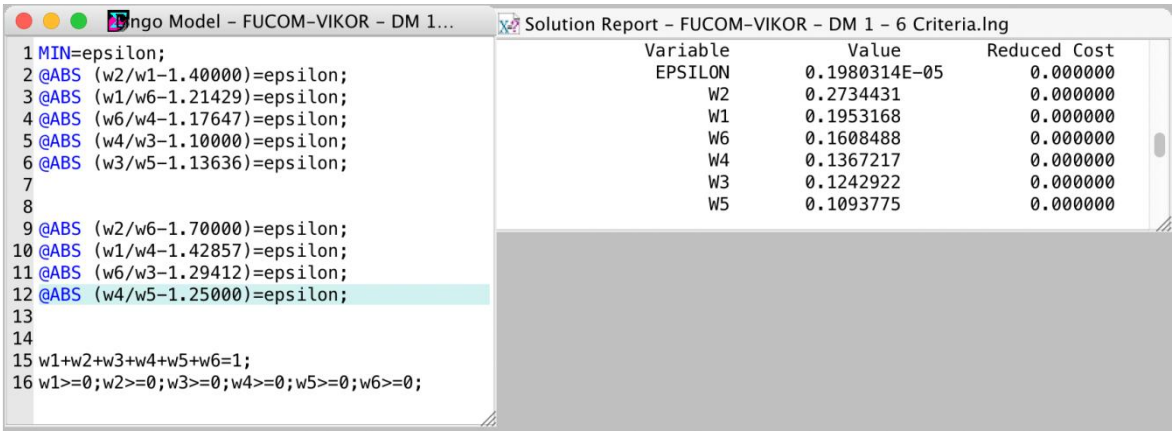

Fig 3: Notation and Minimation Function Results to Find the Weight Coefficient of FUCOM Evaluation Criteria Using LINGO

Table 3. The weight coefficient of evaluation criteria for the four decision makers and in normalized geomean using FUCOM

Criteria	W1	W2	W3	W4	W5	W6	SUM
DM1	0,19532	0,27344	0,12429	0,13672	0,10938	0,16085	1
DM2	0,16317	0,19832	0,24560	0,10411	0,13655	0,15224	1
DM3	0,14999	0,25498	0,19614	0,12142	0,12749	0,14999	1
DM4	0,15823	0,19779	0,23735	0,11867	0,13962	0,14834	1
Geomean	0,16584	0,22868	0,19416	0,11967	0,12769	0,15278	0,16584

Norm Geomean	0,16771	0,23127	0,19635	0,12103	0,12913	0,15451	1

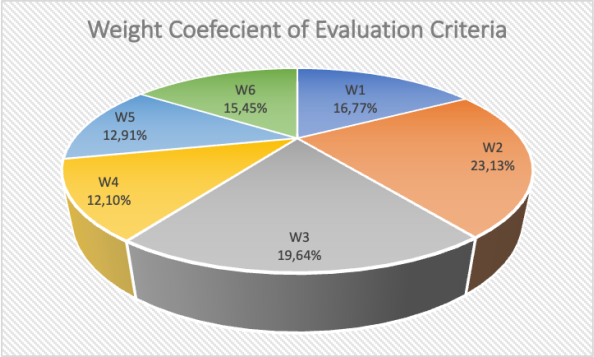

Fig 4: Weight Coefficient Evaluation Criteria using FUCOM

After using FUCOM to obtain the weighting standard, you can use SAW to calculate the preference value. Generally speaking, when calculating the preference value, start from the normalization of the substitute value, and calculate the preference value and ranking by weighting the normalization of the substitute value. The alternatives used are Blibli (Alt1), Bukalapak (Alt2), JD.ID (Alt3), Lazada (Alt4), Shoopee (Alt5), and Tokopedia (Alt6) sorted by name from e-commerce. Based on the pre-determined E-Commerce data, the resulting data is shown in Table 4 as follows.

Table 4. E-Commerce Alternative Data

Alter-native	C1	C2	C3	C4	C5	C6
Alt1	29,8	29,9	138,6	32,0	48,1	19,8
Alt2	34,4	21,9	141,8	37,0	32,7	32,4
Alt3	26,6	26,4	143,7	25,5	54,2	22,8
Alt4	35,9	23,5	143,0	31,9	46,2	19,5
Alt5	33,3	23,6	144,6	28,6	48,4	23,0
Alt6	37,0	21,7	145,5	33,6	30,7	31,6
MIN	26,6	21,7	138,6	25,5	30,7	19,5
MAX	37,0	29,9	145,5	37,0	54,2	32,4

Based on the previously determined alternative data, followed by the calculation of the normalized alternative data using the SAW method.The normalization of the SAW method under benefit conditions is done by dividing the value of the criteria by the maximum value of the criteria in the column. An example of normalization in 1st alternative, is shown in the calculation as follows:

$$r_{11} = \frac{29,8}{37,0} = 0,805; \qquad r_{12} = \frac{29,9}{29,9} = 1,000;$$
$$r_{13} = \frac{138,6}{145,5} = 0,953; \qquad r_{14} = \frac{32}{37,0} = 0,865;$$
$$r_{15} = \frac{48,1}{54,2} = 0,887; \qquad r_{16} = \frac{19,8}{32,4} = 0,611;$$

For other alternatives, use the same steps to be able to produce normalized alternative values, where the calculation results are shown in table 5.

Table 5. E-Commerce Normalization Alternative Data Using SAW

Alter-native	C1	C2	C3	C4	C5	C6
Alt1	0,805	1,000	0,953	0,865	0,887	0,611
Alt2	0,930	0,732	0,975	1,000	0,603	1,000
Alt3	0,719	0,883	0,988	0,689	1,000	0,704
Alt4	0,970	0,786	0,983	0,862	0,852	0,602
Alt5	0,900	0,789	0,994	0,773	0,893	0,710
Alt6	1,000	0,726	1,000	0,908	0,566	0,975

Each alternative value is normalized for each alternative, then it is necessary to calculate the weighted normalization alternative value and then the results of the weighted normalization alternative values are added up line by line to get the preference value, where the criteria weight is generated in the FUCOM method and the substitute normalization value in the SAW method. Example of calculating preference value using FUCOM-SAW in 1st alternative, is shown in the calculation as follows:

$$V_i = \sum_{j=1}^{n} w_j r_{ij}$$

$$V_1 = \sum \begin{pmatrix} (0,16771 \times 0,805); (0,23127 \times 1,000); \\ (0,19635 \times 0,953); (0,12103 \times 0,865); \\ (0,12913 \times 0,887); (0,15451 \times 0,611) \end{pmatrix}$$

$$V_1 = \sum \begin{pmatrix} 0.1351; 0.2313; 0.1870; \\ 0.1047; 0.1146; 0.0944 \end{pmatrix}$$
$$V_1 = 0{,}8671$$

For other alternatives, use the same steps to be able to produce preference value, where the calculation results are shown in table 5.

Table 6. Preference value determination of favorite e-commerce using FUCOM-SAW

Alternative		Preference Value	Rank
Alt1	Blibli	0,8671	2nd
Alt2	Bukalapak	0,8701	1st
Alt3	JD.ID	0,8400	6th
Alt4	Lazada	0,8449	5th
Alt5	Shoopee	0,8472	4th
Alt6	Tokopedia	0,8656	3rd

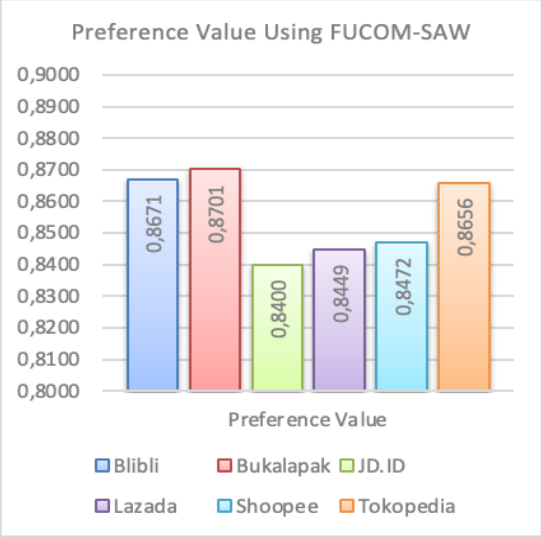

Fig 5: Preference value determination of favorite e-commerce using FUCOM-SAW

V. CONCLUSION

This study succeeded in implementing calculations using FUCOM-SAW, based on the decision maker used, using 6 criteria and also 6 alternatives tested to determine the favorite e-commerce in Indonesia. When using FUCOM to calculate standard weights, it can be seen that the price factor (C2) is the most considered factor by decision makers, followed by product (C3) and reputation & security (C1) factors. Using the FUCOM-SAW calculation, Bukalapak is the most popular e-commerce in Indonesia, followed by Blibli in the second position, and Tokopedia in the third position, and respectively Shopee, Lazada and JD.ID ranked last among the alternatives tested. The result of this calculation is closely related to the weight assigned to each criterion by the decision maker at the beginning. If the decision maker changes the weight, the ranking results may change.It is hoped that this FUCOM-SAW calculation can assist customers in determining the e-commerce that suits their preferences and the e-commerce business can correct the weaknesses they currently have.

REFERENCES

[1] Y. Pusparisa and S. Fitra, "96% Pengguna Internet di Indonesia Pernah Menggunakan E-Commerce," *katadata.co.id*, pp. 1–1, 2019.
[2] Y. Pusparisa and S. Fitra, "Transaksi E-Commerce Indonesia Terbesar di Asia Tenggara," *katadata.co.id*, pp. 1–1, 2019.
[3] D. A. Widiastuti, "Covid-19 berdampak signifikan bagi E-Commerce," *tek.id*, pp. 1–1, 2020.
[4] S. Rongiyati, "Pelindungan Konsumen dalam Transaksi Dagang Melalui Sistem Elektronik," *Negara Hukum: Membangun Hukum untuk Keadilan dan Kesejahteraan*, vol. 10, no. 1, pp. 1–25, 2019, doi: 10.22212/jnh.v10i1.1223.
[5] EIQ, "EIQ Consumer Pulse: Uncovering the Value of Indonesia's Top Online Platform," *https://ecommerceiq.asia*, pp. 1–1, 2018.

[6] I. G. Hendrayana and G. S. Mahendra, "Perancangan Metode AHP-MOORA Pada Sistem Pendukung Keputusan Pemilihan Paket Wisata," *Prosiding Seminar Nasional Pendidikan Teknik Informatika (SENAPATI) Ke-10*, vol. 1, no. 1, pp. 143–149, 2019.
[7] G. S. Mahendra and I. G. B. Subawa, "Perancangan Metode AHP-WASPAS Pada Sistem Pendukung Keputusan Penempatan ATM," *Prosiding Seminar Nasional Pendidikan Teknik Informatika (SENAPATI) Ke-10*, vol. 1, no. 1, pp. 122–128, 2019.
[8] G. S. Mahendra and N. K. A. P. Sari, "Perancangan Sistem Pendukung Keputusan Dengan Metode Ahp-Vikor Dalam Penentuan Pengembangan Ekowisata Pedesaan (Decision Support System Design With Ahp-Vikor Method In Determination Of Rural Ecotourism Development)," 2019, pp. 15–34.
[9] G. S. Mahendra and E. Hartono, "Komparasi Analisis Konsistensi Metode AHP-MAUT dan AHP-PM pada SPK Penempatan Siswa OJT," *Jurnal Teknologi Informasi Informasi dan Komputer*, vol. 7, no. 2, 2021.
[10] N. K. A. P. Sari, "Implementation of the AHP-SAW Method in the Decision Support System for Selecting the Best Tourism Village," *Jurnal Teknik Informatika C.I.T Medicom*, vol. 13, no. 1, pp. 22–31, Mar. 2021.
[11] A. Q. Adyan, B. Susilo, and D. Andreswari, "Sistem Pendukung Keputusan Penempatan Praktik Kerja Lapangan Berdasarkan Nilai Kompetensi Dasar dan Nilai Sikap Siswa Menggunakan Metode Pembobotan Rank Order Centroid dan Metode Profile Matching (Studi Kasus: SMKN 1 Kota Bengkulu)," *Jurnal Rekursif*, vol. 8, no. 1, pp. 11–22, 2020.
[12] I. G. I. Sudipa, "Decision Support System dengan Metode AHP, SAW Dan ROC untuk Penentuan Pemberian Beasiswa (Studi Kasus : STMIK STIKOM Indonesia)," *JUTIK*, vol. 4, no. 1, pp. 18–30, Sep. 2018, doi: 10.36002/jutik.v4i1.391.
[13] M. Thelwall, "The Precision of the Arithmetic Mean, Geometric Mean and Percentiles for Citation Data: An Experimental Simulation Modelling Approach," *Journal of Informetrics*, vol. 10, no. 1, pp. 110–123, 2016, doi: 10.1016/j.joi.2015.12.001.
[14] M. Adnan, R. Adin, Z. Nunić, Ž. Stević, and S. Sremac, "Selection of transportation mean using integrated FUCOM-ARAS model," *st and*, p. 6, 2019.
[15] D. Pamučar, Ž. Stević, and S. Sremac, "A new model for determiningweight coefficients of criteria in MCDM models: Full Consistency Method (FUCOM)," *Symmetry*, vol. 10, no. 9, pp. 1–22, 2018, doi: 10.3390/sym10090393.
[16] I. Badi and A. Abdulshahed, "Ranking the Libyan airlines by using Full Consistency Method (FUCOM) and Analytical Hierarchy Process (AHP)," *Operational Research in Engineering Sciences: Theory and Applications*, vol. 2, no. 1, pp. 1–14, 2019, doi: 10.31181/oresta1901001b.
[17] F. Agustini and E. R. Ariska, "Penerapan Metode Simple Additive Weighting (Saw) Dengan Model Fuzzy Model Attribute Decision Making (Fmadm) Penilaian Kinerja Karyawan Dtpeduli," *Jurnal Techno Nusa Mandiri*, vol. 16, no. 1, pp. 21–28, 2019, doi: 10.33480/techno.v16i1.107.
[18] G. S. Mahendra and K. Y. E. Aryanto, "SPK Penentuan Lokasi ATM Menggunakan Metode AHP dan SAW," *Jurnal Nasional Teknologi dan Sistem Informasi*, vol. 5, no. 1, pp. 49–56, 2019, doi: 10.25077/TEKNOSI.v5i1.2019.49-56.
[19] A. Amarullah and T. S. Saragih, "Penerapan Algoritma Simple Additive Weighting (Saw) Dalam Sistem Pendukung Keputusan Kelanjutan Proyek Pada PT XYZ," *Jurnal Sisfokom (Sistem Informasi dan Komputer)*, vol. 8, no. 2, pp. 184–184, 2019, doi: 10.32736/sisfokom.v8i2.640.
[20] I. Pratiwi and W. Andalia, "Perancangan Model Keputusan Multikriteria Pemilihan Layanan E-Commerce Untuk Kepuasan Pelanggan," 2018, pp. 1–10. [Online]. Available: https://jurnal.umj.ac.id/index.php/semnastek/article/view/3505/2638

[21] I. Pratistha, I. P. A. Mahadewa, and P. Sugiartawan, "Sistem Pendukung Keputusan Kelompok Pemilihan E-Commerce/Marketplace Menggunakan Metode Profile Matching dan BORDA," *Jurnal Sistem Informasi dan Komputer Terapan Indonesia (JSIKTI)*, vol. 1, no. 1, pp. 13–24, 2018, doi: 10.33173/jsikti.9.
[22] A. Setiyadi and R. D. Agustia, "Penerapan Metode AHP Dalam Memilih Marketplace E-Commerce Berdasarkan Software Quality and Evaluation ISO/IEC 9126-4 Untuk UMKM," *Jurnal IKRA-ITH Informatika*, vol. 2, no. 3, pp. 61–70, 2018.
[23] H. S. Setiawan and A. Pamuji, "Membangun Sistem Pendukung Keputusan Untuk Rekomendasi Pada E-Commerce Melalui Penerapan Logika Fuzzy Tahani," *Faktor Exacta*, vol. 9, no. 4, pp. 341–352, 2016.
[24] J. E. S. Casym and D. N. Oktiara, "Aplikasi Analytical Hierarchy Process dalam Mengidentifikasi Preferensi Laptop Bagi Mahasiswa," 2020, pp. 636–640.
[25] G. S. Mahendra and E. Hartono, "Implementation of AHP-MAUT and AHP-Profile Matching Methods in OJT Student Placement DSS," *Jurnal Teknik Informatika CIT Medicom*, vol. 13, no. 1, p. 9, 2021, doi: https://doi.org/10.35335/cit.Vol13.2021.56.pp13-22.
[26] I. G. I. Sudipa and I. A. D. Puspitayani, "Analisis Sensitivitas AHP-SAW dan ROC-SAW dalam Pengambilan Keputusan Multikriteria," *International Journal of Natural Sciences and Engineering*, vol. 3, no. 2, pp. 87–95, 2019.
[27] G. S. Mahendra and P. G. S. C. Nugraha, "Komparasi Metode AHP-SAW dan AHP-WP pada SPK Penentuan E-Commerce Terbaik di Indonesia Comparison of AHP-SAW and AHP-WP Methods on DSS to Determine the Best E-Commerce in Indonesia," *Jurnal Sistem dan Teknologi Informasi (JUSTIN)*, vol. 08, no. 4, pp. 346–356, 2020, doi: 10.26418/justin.v8i4.42611.
[28] G. S. Mahendra and I. P. Y. Indrawan, "Metode AHP-TOPSIS Pada Sistem Pendukung Keputusan Penentuan Penempatan Atm," *JST (Jurnal Sains dan Teknologi)*, vol. 9, no. 2, pp. 130–142, 2020, doi: 10.23887/jst-undiksha.v9i2.24592.
[29] G. S. Mahendra, I. W. W. Karsana, and A. A. I. I. Paramitha, "DSS for best e-commerce selection using AHP-WASPAS and AHP-MOORA methods," *MATRIX*, vol. 11, no. 2, pp. 81–94, Jul. 2021, doi: 10.31940/matrix.v11i2.2306.
[30] Ž. Stević and N. Brković, "A Novel Integrated FUCOM-MARCOS Model for Evaluation of Human Resources in a Transport Company," *Symmetry*, vol. 4, no. 1, pp. 4–4, 2020, doi: 10.3390/logistics4010004.
[31] Cao, Esangbedo, Bai, and Esangbedo, "Grey SWARA-FUCOM Weighting Method for Contractor Selection MCDM Problem: A Case Study of Floating Solar Panel Energy System Installation," *Energies*, vol. 12, no. 13, p. 2481, Jun. 2019, doi: 10.3390/en12132481.
[32] I. Đalić, Ž. Stević, Ž. Erceg, P. Macura, and S. Terzić, "Selection of a distribution channel using the integrated FUCOM-MARCOS model," *International Review*, vol. 4, no. 3, pp. 80–96, 2020, doi: 10.5937/intrev2003080Q.
[33] Ž. Erceg, V. Starčević, D. Pamučar, G. Mitrović, Ž. Stević, and S. Žikić, "A New Model for Stock Management in Order to Rationalize Costs: ABC-FUCOM-Interval Rough CoCoSo Model," *Symmetry*, vol. 11, no. 12, p. 1527, Dec. 2019, doi: 10.3390/sym11121527.
[34] Anita and K. Fitri, "Sistem Pendukung Keputusan Untuk Menentukan Tingkat Minat Masyarakat dalam Memilih Tanaman Hias Menggunakan Metode SAW," *Rang Teknik Journal*, vol. 4, no. 1, p. 7, 2021.
[35] E. Exenberger and J. Bucko, "Analysis of Online Consumer Behavior - Design of CRISP-DM Process Model," *AOL*, vol. 12, no. 3, pp. 13–22, Sep. 2020, doi: 10.7160/aol.2020.120302.

[36] P. G. S. C. Nugraha and G. S. Mahendra, "Explorasi Algoritma C4.5 dan Forward Feature Selection untuk Menentukan Debitur Baik dan Debitur Bermasalah pada Produk Kredit Tanpa Agunan (KTA)," *j. sains. teknologi.*, vol. 9, no. 1, pp. 39–46, Jun. 2020, doi: 10.23887/jst-undiksha.v9i1.24627.

[37] N. W. Wardani, *Penerapan Data Mining dalam Analytic CRM*, 1st ed., vol. 1. Denpasar: Yayasan Kita Menulis, 2020. [Online]. Available: https://books.google.co.id/books?hl=en&lr=&id=1L78DwAAQBAJ

[38] N. W. Wardani and N. K. Ariasih, "Analisa Komparasi Algoritma Decision Tree C4.5 dan Naïve Bayes untuk Prediksi Churn Berdasarkan Kelas Pelanggan Retail," *International Journal of Natural Sciences and Engineering*, vol. 3, no. 3, pp. 103–112, 2019.

[39] F. A. K. Wardani and T. Kristiana, "Implementasi Data Mining Penjualan Produk Kosmetik Pada PT. Natural Nusantara Menggunakan Algoritma Apriori," *Jurnal Sistem Informasi, Teknik Informatika, Software Engineering, dan Multimedia*, vol. 22, no. 1, pp. 85–90, Apr. 2020, doi: 10.31294/p.v22i1.6520.

BIOGRAPHY

Gede Surya Mahendra, Graduated from computer science study program (S2) from Universitas Pendidikan Ganesha in 2018, currently as a lecturer at STMIK STIKOM Indonesia.