International Journal of Scientific Research and Management (IJSRM)
||Volume||12||Issue||05||Pages||1196-1206||2024||
Website: https://ijsrm.net ISSN (e): 2321-3418
DOI: 10.18535/ijsrm/v12i05.ec04

Application of Fuzzy - AHP - Topsis in Online Shopping Selection On B2C E-Commerce Websites

Tran Trung Dung[1], Le Thi Minh Hai[2], Hoang Tra My[3], Nguyen Hoang Mai[4], Cao Ha Khanh Linh[4]

[1,2,3,4]Hanoi University of Natural Resources and Environment

Abstract:
In today's digital age, online shopping is not only a trend but also an indispensable part of our daily lives. With the convenience and diversity of e-commerce websites, consumers can easily experience and choose goods and services from all over the world in just a few clicks. However, making online shopping decisions is not always easy. Consumers often have to face a number of factors such as price, product quality, brand, after-sales service, delivery time and many other factors, as well as facing uncertainty and ambiguity in the information. reviews. To help users choose products effectively, the Fuzzy - AHP - Topsis integration model has been applied in this research topic to propose evaluation criteria for choosing to buy products on 4 B2C websites including Shopee, Tiki, Lazada, Sendo.

Keywords: Online B2C website shopping, Fuzzy set theory, Fuzzy - AHP model, TOPSIS model, B2C e-commerce model.

1. Introduction

Nowadays, online shopping on B2C (Business-to-Consumer) websites has become a popular trend. However, the diversity of products and services along with the uncertainty about the quality and reliability of products makes the purchasing decision complex for consumers. B2C websites often offer thousands of different products, making it difficult for consumers to evaluate and compare them. Meanwhile, consumers may have different criteria when evaluating products such as price, quality, delivery time, etc. To make the online shopping process easier for consumers, this study will use the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) to support consumers in the process of choosing online B2C website shopping.

2. Literature Review

Fuzzy - AHP - Topsis model in choosing a logistics service provider (Nguyen Thi Le Thuy, 2023, Can Tho University). The author's article pointed out that choosing a good and suitable logistics service provider will help businesses reduce costs for processes and increase the quality of service provided.

Fuzzy - AHP - Topsis model to evaluate online shopping websites (Tran Thi Tham, 2020, Can Tho University). The author's article mentioned that the important content is to evaluate online shopping websites will have to be based on the competitive advantage that businesses have to build evaluation criteria and rank online websites according to survey results and evaluation from experts.

Wismar R. Wijayanti, Wini R. Dewi and Fahmi Ardi (2018) wrote an article on combining the Fuzzy AHP and TOPSIS models to evaluate the quality of e-commerce website services. The authors found that with the development of e-commerce today along with the emergence of many competitors, B2C retailers need to create a competitive advantage for themselves by increasing the quality of website services using 7 criteria.

3. Research Methodology

Primary Data Collection Method: Distributing surveys to 150 consumers and conducting interviews with 3 experts.

Secondary Data Collection Method: Utilizing magazines, online newspapers, e-commerce association websites, television, etc.

Analysis Method: The collected data will be analyzed using the Fuzzy-AHP-TOPSIS model.

Statistical Method: MS Excel will be used for data processing. Statistical analysis of survey responses will be conducted to analyze the current situation and propose solutions.

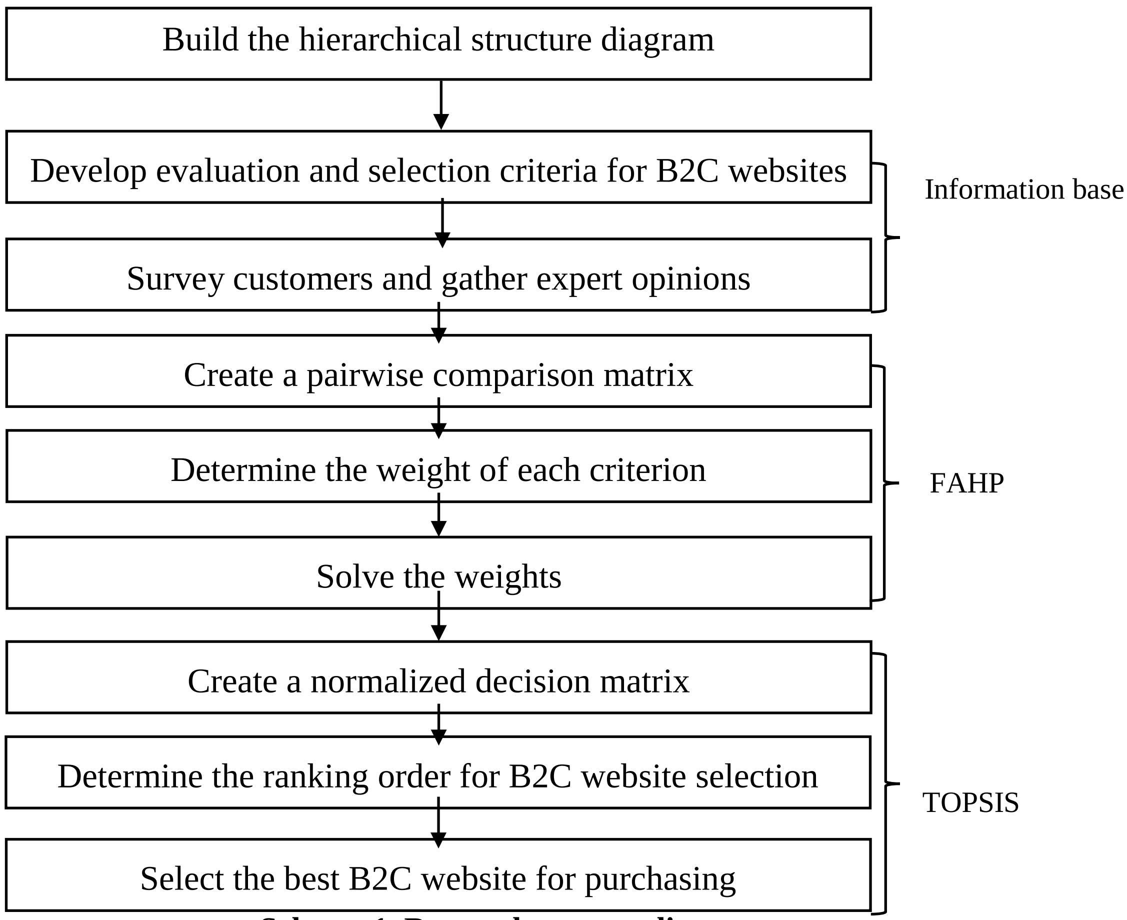
4. Theoretical Basis of the Fuzzy-AHP-TOPSIS Model

Fuzzy logic theory: Fuzzy logic theory was first introduced by Zadeh, L.A. in 1965. This theory solves problems in a way very close to human thinking. Fuzzy logic theory has now developed strongly and is applied in many fields of life. It can be said that fuzzy logic is the foundation for building practical fuzzy systems.

AHP method: The AHP method was proposed by Satty in 1977 to solve unstructured problems in economics, society and management science. AHP is a widely used analytical tool for researching and solving complex multi-criteria decision problems and for the flexibility in analyzing qualitative and quantitative data.

TOPSIS method: The TOPSIS method is widely applied to decision making in multi-criteria cases. The idea of this algorithm is built on the set of crisp values, based on the positive ideal solution (PIS) and the negative ideal solution (NIS). This model is based on fuzzy set theory to solve complex selection problems involving multiple criteria with multiple choices. The TOPSIS method of Hwang and Yoon is a popular tool for solving multi-criteria decision problems

The research procedure is described as follows:



Scheme 1. Research process diagram

Step 1: Build a hierarchical diagram

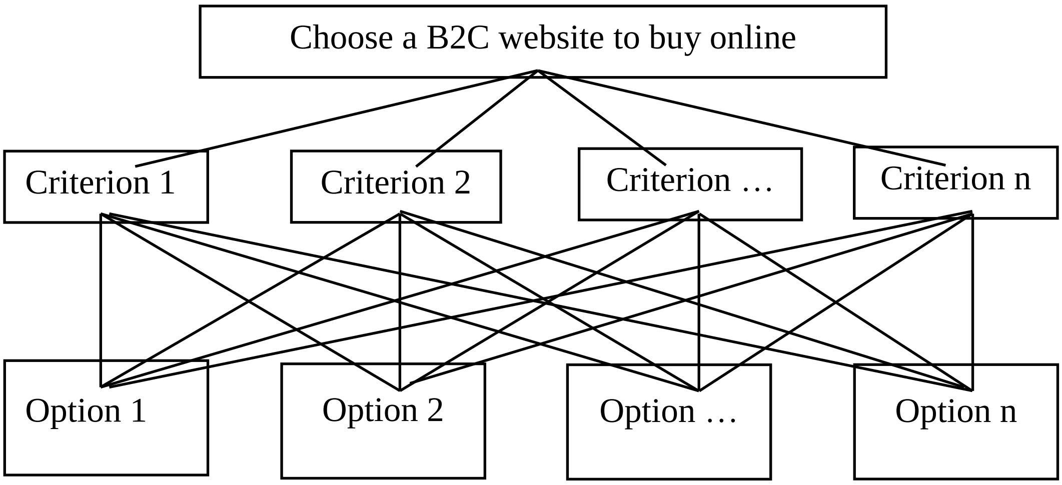


Diagram 2. Hierarchical structure diagram

A hierarchical structure diagram should have at least 3 levels: The problem's objective at level 1; The evaluation criteria at level 2; The selection options at level 3.

Step 2: Build the evaluation criteria and select a B2C website

The criteria are constructed based on survey results. The criteria used for evaluation and selection should align with the model and the issues being addressed.

The evaluation criteria should encompass the content and meaning of the evaluation and selection. The number of criteria used for evaluation depends on the objectives and perspectives of the researcher.

Step 3: Survey customers and consult experts

After building the criteria from step 2 through customer surveys and conducting interviews with experts on the criteria used for evaluation, it's important to assess their suitability, check the correlation among criteria, decide which criteria should be merged or discarded, and ultimately identify a suitable set of criteria for the research purposes.

Step 4: Construct a pairwise comparison matrix

In this study, a scale from 1 to 9 (Sodhi & Prabhakar, 2012) will be used to convert linguistic variables into Fuzzy numbers. The conversion will be divided into 5 ranges.

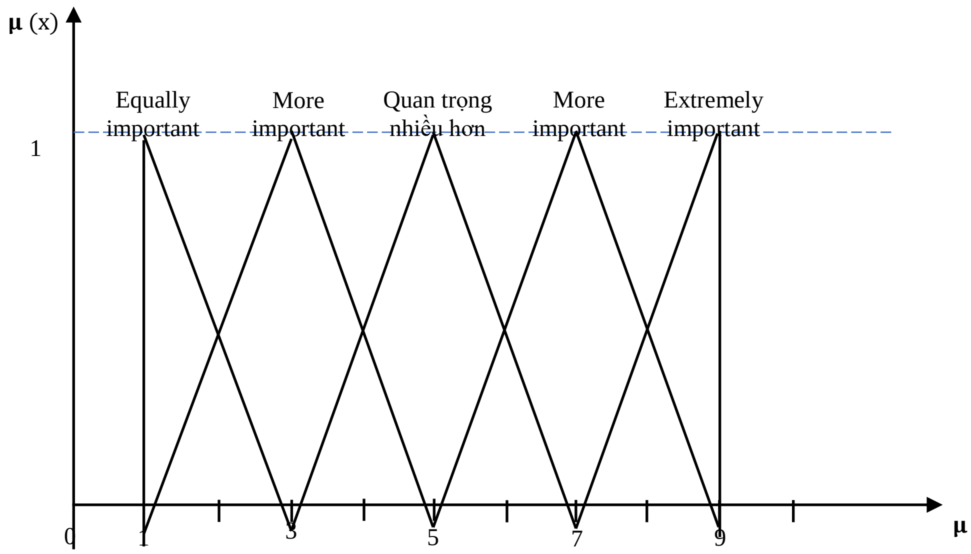


Figure 1. Fuzzy numerical representation graphs corresponding to language variables

To perform pairwise comparisons between fuzzy parameters, the language variable is defined corresponding to the following evaluation levels:

Table 1. Table of linguistic variables and their corresponding fuzzy numbers

Language Variable	Language Variable Code	Corresponding Triangular Fuzzy Numbers	Inverse of Triangular Fuzzy Numbers
Equally Important	1	(1, 1, 3)	(1/3, 1/1, 1/1)
More Important	3	(1, 3, 5)	(1/5, 1/3, 1/1)
Much More Important	5	(3, 5, 7)	(1/7, 1/5, 1/3)
Very Important	7	(5, 7, 9)	(1/9, 1/7, 1/5)
Extremely Important	9	(7, 9, 9)	(1/9, 1/9, 1/7)

Assuming there are k experts assessing the priority of criteria, based on the average method for calculating the average score for each criterion, we have: $\tilde{\boldsymbol{a}}_{\boldsymbol{ij}}$

$$\tilde{a}_{ij} = \frac{\sum_{k=1}^{k} \tilde{a}_{ij}^{k}}{k} \qquad (1)$$

Where: $\tilde{a}_{ij}$ is the average score of the criteria, k is the number of evaluators

We will have a matrix comparing the Fuzzy pair as follows:

$$A = \begin{bmatrix} 1 & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ \tilde{a}_{21} & 1 & \dots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \dots & 1 \end{bmatrix} = \begin{bmatrix} 1 & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ 1/\tilde{a}_{12} & 1 & \dots & \tilde{a}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/\tilde{a}_{1n} & 1/\tilde{a}_{2n} & \dots & 1 \end{bmatrix} \quad (2)$$

Step 5: Determine the weight for each criterion

Apply the geometric mean method to determine the Fuzzy geometric mean and Fuzzy weight for each criterion.

$$\tilde{r}_j = (\tilde{a}_{i1} \text{ x } \tilde{a}_{i2} \text{ x} \dots \text{ x } \tilde{a}_{in})^{\frac{1}{n}} \quad (3)$$

$$\widetilde{w}_j = \tilde{r}_j \text{ x}(\tilde{r}_1 \text{ x } \tilde{r}_2 \text{ x} \dots \text{ x } \tilde{r}_n)^{-1} \quad (4)$$

Where: $\tilde{r}_j$is the Fuzzy geometric mean, which is the Fuzzy weight of the jth criterion$\widetilde{w}_j$

The value of . Where in turn represents the lowest, average and highest values of the Fuzzy weight according to the jth criterion.$\widetilde{w}_j = (L_{wj}, M_{wj}, U_{wj})$ L_{wj}, M_{wj}, U_{wj}

Step 6: Dissolve Fuzzy Weighting

Since $\widetilde{w}_j$ it is still a dim number, we use the formula according to the central area method to calculate dimming:

$$\overline{w}_j = \frac{L_{\widetilde{w}j} + M_{\widetilde{w}j} + U_{\widetilde{w}j}}{3} \quad (5)$$

Where: $\overline{w}_j$ is the real weight of the j-th criterion

Next, use the formula to convert to $\overline{w}_j$ the weighted form as follows:w_j

$$w_j = \frac{\overline{w}_j}{\sum_{i=1}^{n} \overline{w}_j} \quad (6)$$

In which: $\overline{w}_j$ is the real weight of the j-th criterion, and n is the total number of criteria.

Step 7: Build a normalized decision matrix

- First construct the decision matrix as follows:

$$D = \begin{matrix} A_1 \\ A_2 \\ \vdots \\ A_m \end{matrix} \overset{\begin{matrix} C_1 & C_2 & \cdots & C_m \end{matrix}}{\begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{m} \end{bmatrix}} \quad (7)$$

Where: i = 1.2,... m; j = 1.2,... n

A_i are the options under consideration, are the criteria to be evaluated, k is the number of evaluators, C_i $x_{ij}$is the average score value of the selection A_1 corresponding to the evaluated criterion will be calculated as follows:C_i

$$x_{ij} = \frac{1}{k}\left(x_{ij}^1 + x_{ij}^2 + \cdots + x_{ij}^k\right) \quad (8)$$

- Next, normalizing the decision matrix denoted R has the following formula:

$$R = \left[r_{ij}\right]_{m\,x\,n} \quad (9)$$ Where: i = 1.2,... m and j = 1.2,... n

The process of normalizing the matrix is carried out according to the following formula:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \; with\; i = 1, 2 \ldots m \; and \; j = 1, 2, ..\text{n}$$

$$r_{ij} = \frac{\frac{1}{x_{ij}}}{\sqrt{\sum_{i=1}^{m} \frac{1}{x_{ij}^2}}} \; with\; i = 1, 2 \ldots m \; and \; j = 1, 2, ..\text{n}$$

- Then construct a V-weighted normalized decision matrix as follows:

$$V = \left[v_{ij}\right]_{m\,x\,n} \quad (11)$$

Where: i = 1.2,... m and j = 1.2,... n

$$v_{ij} = r_{ij} \text{ x } w_j \quad (12)$$

where w_j will vary in paragraph [0,1] and $\sum_{j=1}^{n} w_j = 1$

Step 8: Determine the ranking order of B2C website selection

- First identify the positive ideal solution (PIS) and the negative ideal solution (NIS). Based on the normalized decision matrix, we determine the positive ideal solution A+ and the negative ideal solution A$^-$ as follows:

$$A^+ = (v_1^+ + v_2^+ + \cdots + v_n^+) \; với \; v_j^+ = \{(max_j(v_{ij}), j \in J'; min_j(v_{ij}), j \in J''\} \quad (13)$$

$$A^- = (v_1^- + v_2^- + \cdots + v_n^-) \; với \; v_j^- = \{(min_j(v_{ij}), j \in J'; max_j(v_{ij}), j \in J''\} \quad (14)$$

Where: is the benefit criterion, is the cost criterion$J'J''$

- Next, calculate the distance of each option from PIS and NIS as follows:

$$d_i^{\,+} = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - v_j^+\right)^2} \quad (15) \qquad d_i^{\,-} = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - v_j^-\right)^2} \quad (16)$$

Where: i = 1.2,... m and j = 1.2,... n

$d_i^{\,+}$ is the distance from option I to the positive ideal solution A^+

$d_i^{\,-}$ is the distance from option I to the negative ideal solution A^-

- Finally, calculate the proximity to the ideal *solution CCi* and rank the selection as follows:

$$CC_i = \frac{d_i^{\,-}}{d_i^{\,-} + d_i^{\,+}} \quad (17)$$

The greater this ratio, the closer the option is to the positive ideal solution. After calculating the index based on that result, we can determine the ranking order of choosing B2C websites to buy online.CC_i

Step 9: Choose the best online B2C shopping website

Based on the index results, we can find the best option in the initial choices made.CC_i

5. Results of current research

Step 1: Build a hierarchical diagram

From the survey results, the authors build a hierarchical structure diagram as follows:

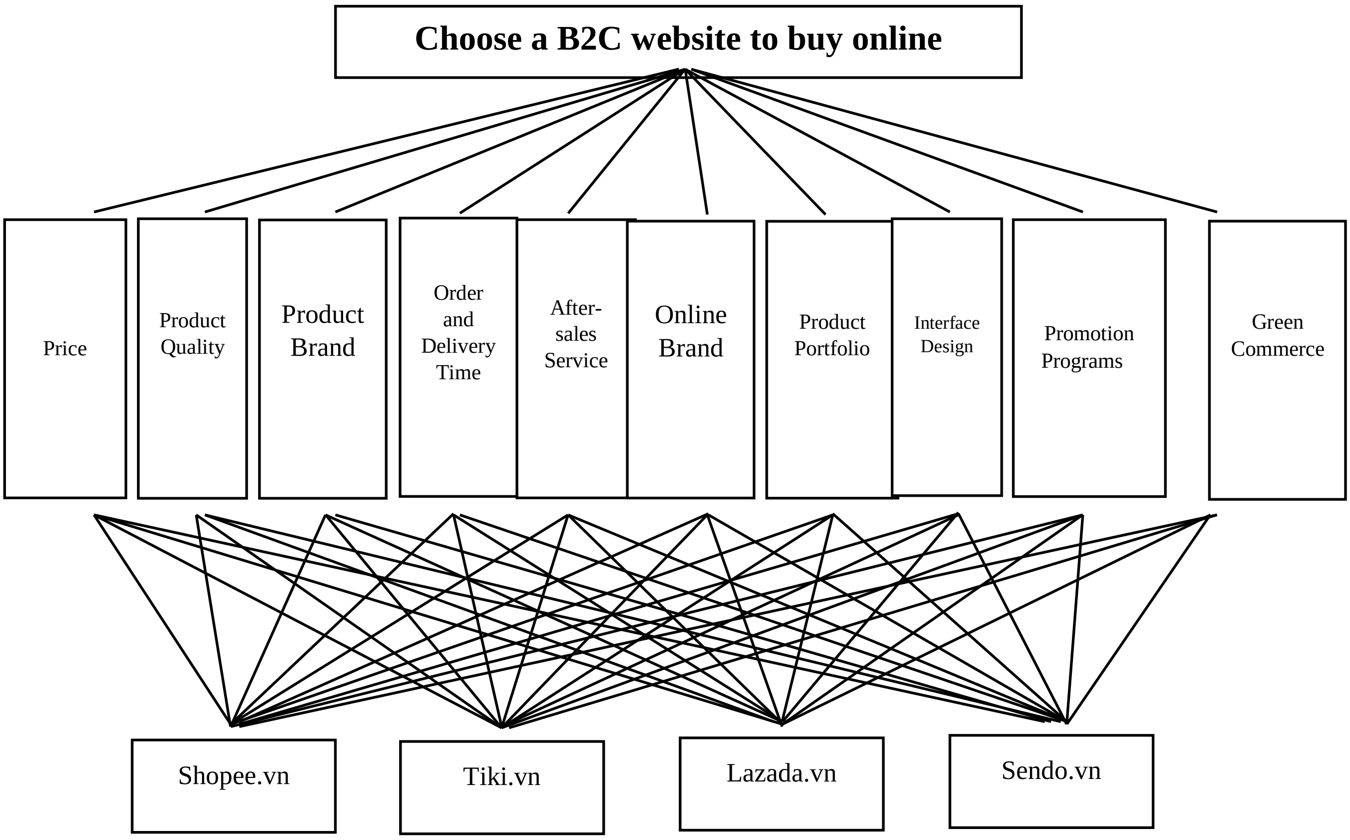


Diagram 3. Application hierarchy diagram in B2C website selection

Step 2: Develop criteria for evaluating and selecting B2C websites

Based on the results of customer surveys and expert opinions, the authors have come up with the following set of evaluation criteria:

Table 2. Table of criteria for evaluating B2C websites buying online

No.	Code	Criteria Name	Definition
1	TC1	Price	Affordable pricing, commensurate with quality, commensurate with expected value of the product,…
2	TC2	Product Quality	Appropriate for the price, ensures consumer health, meets customer needs,…
3	TC3	Product Brand	Fame of the product, customer awareness, reputation built through activities.
4	TC4	Order and Delivery Time	Fast and accurate order processing, on-time delivery without errors.
5	TC5	After-sales Service	Effective complaint resolution, enthusiastic support,…
6	TC6	Online Brand	Extent of brand dissemination to customers, market position.
7	TC7	Product Portfolio	Diversity in types, models, colors, sizes, styles.
8	TC8	Interface Design	Easy to use, visually appealing, easy to navigate, highly secure.
9	TC9	Promotion Programs	Offering various promotional activities to attract customers and influence immediate purchasing behavior.
10	TC10	Green Commerce	Providing environmentally friendly products,…

Step 3: Survey experts

Table 3. Table assessing the importance of evaluation criteria

No.	Criteria	Expert 1	Expert 2	Expert 3
1	TC1	CT	CT	RT
2	TC2	RT	RT	CT
3	TC3	NH	RT	RT
4	TC4	TH	BN	NH
5	TC5	TH	BN	NH
6	TC6	CT	RT	CT
7	TC7	BN	RT	NH
8	TC8	BN	NH	NH
9	TC9	RT	CT	RT
10	TC10	TH	RT	NH

Step 4: Construct the Pairwise Comparison Matrix

To perform pairwise comparisons between fuzzy parameters, the linguistic variables are defined according to the following evaluation levels:

Table 4. Evaluation Levels for Criteria using Triangular Fuzzy Numbers

Linguistic Variable	Code	Corresponding Triangular Fuzzy Numbers	Inverse Triangular Fuzzy Numbers
Equal Importance (BN)	1	(1, 1, 3)	(1/3, 1/1, 1/1)
More Important (TH)	3	(1, 3, 5)	(1/5, 1/3, 1/1)
Significantly More Important (NH)	5	(3, 5, 7)	(1/7, 1/5, 1/3)
Very Important (RT)	7	(5, 7, 9)	(1/9, 1/7, 1/5)
Extremely Important (CT)	9	(7, 9, 9)	(1/9, 1/9, 1/7)

Table 5. Evaluation Levels for Websites using Triangular Fuzzy Numbers

Linguistic Variable	Code	Corresponding Triangular Fuzzy Numbers	Inverse Triangular Fuzzy Numbers
Terrible (QT)	1	(1, 1, 3)	(1/3, 1/1, 1/1)
Bad (T)	3	(1, 3, 5)	(1/5, 1/3, 1/1)
Moderate (VP)	5	(3, 5, 7)	(1/7, 1/5, 1/3)
Quite Good (KT)	7	(5, 7, 9)	(1/9, 1/7, 1/5)
Very Good (RT)	9	(7, 9, 9)	(1/9, 1/9, 1/7)

After determining the criteria, based on the results collected from the questionnaire, we use formula (1) for pairwise comparison among the criteria:

Table 6. Pairwise Comparison Matrix for Criteria TC1 - TC5

Matrix	TC1	TC2	TC3	TC4	TC5
TC1	(1, 1, 1)	(1, 7/3, 13/3)	(11/3, 17/3, 23/3)	(17/3, 23/3, 9)	(11/3, 17/3, 23/3)
TC2	(3/13, 3/7, 1)	(1, 1, 1)	(19/3, 25/3, 9)	(17/3, 23/3, 9)	(13/3, 19/3, 25/3)
TC3	(3/23, 3/17, 3/11)	(1/9, 3/25, 3/19)	(1, 1, 1)	(17/3, 23/3, 9)	(13/3, 19/3, 25/3)
TC4	(1/9, 3/23, 3/17)	(1/9, 3/23, 3/17)	(1/9, 3/23, 3/17)	(1, 1, 1)	(11/3, 17/3, 23/3)
TC5	(3/23, 3/17,	(3/25, 3/19,	(3/25, 3/19,	(3/23, 3/17,	(1, 1, 1)

	3/11)	3/13)	3/13)	3/11)	
TC6	(1/9, 3/23, 3/17)	(1/9, 3/25, 3/19)	(3/11, 3/5, 1)	(3/21, 1/5, 3/11)	(3/13, 3/7, 1)
TC7	(3/25, 3/19, 3/13)	(3/25, 3/23, 3/17)	(3/11, 3/5, 1)	(3/25, 3/19, 3/13)	(3/13, 3/7, 1)
TC8	(1/9, 3/25, 3/19)	(3/19, 3/13, 3/7)	(3/17, 3/11, 3/5)	(1/9, 3/25, 3/19)	(1/9, 3/25, 3/19)
TC9	(1/5, 1/3, 3/7)	(3/17, 3/13, 3/7)	(1/5, 1/3, 3/5)	(1/5, 1/3, 3/7)	(3/19, 3/13,3/7)
TC10	(3/17, 3/13, 3/5)	(3/19, 3/13, 3/7)	(3/11, 3/5, 1)	(3/17, 3/11, 3/5)	(3/19, 3/13, 3/7)

Table 7. Table of evaluation matrix comparing pairs of criteria TC6 - TC10

Matrix	**TC6**	**TC7**	**TC8**	**TC9**	**TC10**
TC1	(17/3, 23/3, 9)	(13/3, 19/3, 25/3)	(19/3, 25/3, 9)	(7/3, 3, 5)	(5/3, 11/3, 17/3)
TC2	(19/3, 25/3, 9)	(17/3, 23/3, 25/3)	(7/3, 13/3, 19/3)	(7/3, 11/3, 17/3)	(7/3, 13/3, 19/3)
TC3	(1, 5/3, 11/3)	(1, 5/3, 11/3)	(5/3, 11/3, 17/3)	(5/3, 3, 5)	(1, 5/3, 11/3)
TC4	(11/3, 5, 7)	(13/3, 19/3, 25/3)	(19/3, 25/3, 9)	(7/3, 3, 5)	(5/3, 11/3, 17/3)
TC5	(1, 7/3, 13/3)	(1, 7/3, 13/3)	(19/3, 25/3, 9)	(7/3, 13/3, 19/3)	(7/3, 13/3, 19/3)
TC6	(1, 1, 1)	(13/3, 19/3, 23/3)	(13/3, 19/3, 23/3)	(1, 5/3, 11/3)	(1, 5/3, 11/3)
TC7	(3/23, 3/19, 3/13)	(1, 1, 1)	(1, 7/3, 13/3)	(1, 7/3, 13/3)	(1, 7/3, 13/3)
TC8	(3/23, 3/19, 3/13)	(3/13, 3/7, 1)	(1, 1, 1)	(1, 5/3, 11/3)	(5/3, 11/3, 17/3)
TC9	(3/11, 3/5, 1)	(3/13, 3/7, 1)	(3/11, 3/5, 1)	(1, 1, 1)	(7/3,13/3, 19/3)
TC10	(3/11, 3/5, 1)	(3/13, 3/7, 1)	(3/17, 3/11, 3/5)	(3/19, 3/13, 3/7)	(1, 1, 1)

Step 5: Determine the weight for each criterion

Applying the geometric mean method to determine the Fuzzy geometric mean and Fuzzy weight for each criterion according to formulas (3) and (4) we get the following results:

Table 8. Table of weighted values of criteria

Coefficient $\tilde{r}_j$	**Obtained Value**	**Weight w_j**	**Obtained Value**
$\tilde{r}_1$	(2.926, 4.372, 5.810)	$\widetilde{w}_1$	(0.142, 0.298, 0.585)
$\tilde{r}_2$	(2.638, 3.874, 5.082)	$\widetilde{w}_2$	(0.128, 0.264, 0.512)
$\tilde{r}_3$	(0.998, 1.485, 2.319)	$\widetilde{w}_3$	(0.048, 0.101, 0.233)
$\tilde{r}_4$	(1.070, 1.432, 1.904)	$\widetilde{w}_4$	(0.051, 0.097, 0.191)
$\tilde{r}_5$	(0.620, 0.959, 1.389)	$\widetilde{w}_5$	(0.029, 0.065, 0.139)
$\tilde{r}_6$	(0.539, 0.785, 1.196)	$\widetilde{w}_6$	(0.026, 0.053, 0.120)
$\tilde{r}_7$	(0.327, 0.527, 0.840)	$\widetilde{w}_7$	(0.015, 0.035, 0.084)

$\tilde{r}_8$	(0.268, 0.367, 0.586)	$\widetilde{w}_8$	(0.013, 0.025, 0.059)
$\tilde{r}_9$	(0.312, 0.515, 0.814)	$\widetilde{w}_9$	(0.015, 0.035, 0.082)
$\tilde{r}_{10}$	(0.227, 0.355, 0.665)	$\widetilde{w}_{10}$	(0.011, 0.024, 0.067)

Step 6: Dissolve Fuzzy Weighting

Since $\widetilde{w}_j$ it is still a dim number, we use formulas (5) and (6) according to the central area method to calculate the dimming solution, we have the following table of results:

Table 9. Table of real weighted values of criteria

Weighted $\overline{w}_j$	Obtained Value	Weight w_j	Obtained Value
$\overline{w}_1$	0.341	w_1	0.291
$\overline{w}_2$	0.301	w_2	0.258
$\overline{w}_3$	0.127	w_3	0.109
$\overline{w}_4$	0.113	w_4	0.096
$\overline{w}_5$	0.077	w_5	0.065
$\overline{w}_6$	0.066	w_6	0.056
$\overline{w}_7$	0.044	w_7	0.038
$\overline{w}_8$	0.022	w_8	0.019
$\overline{w}_9$	0.044	w_9	0.038
$\overline{w}_{10}$	0.034	w_{10}	0.030

Step 7: Construct the normalized decision matrix

The websites selected for evaluation, namely Shopee, Tiki, Lazada, and Sendo, will be denoted as W1, W2, W3, and W4, respectively. First, by constructing the decision matrix using formulas (7), (8), (9), (10.1), (11), and (12), we obtain the following results:

Table 10. Decision Matrix Table by Criteria

Criteria	Decision Matrix				Normalized Matrix				Weighted Normalized Matrix			
	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
TC1	8.33	9.00	5.00	5.67	0.578	0.624	0.347	0.393	0.168	0.181	0.100	0.114
TC2	9.00	9.00	4.33	4.33	0.637	0.637	0.306	0.306	0.164	0.164	0.078	0.078
TC3	7.67	9.00	8.33	7.00	0.477	0.560	0.518	0.435	0.051	0.061	0.056	0.047
TC4	7.67	8.33	5.67	7.67	0.518	0.562	0.382	0.518	0.049	0.053	0.036	0.049
TC5	8.33	8.33	5.67	5.67	0.584	0.584	0.397	0.397	0.037	0.037	0.025	0.025
TC6	9.00	7.67	7.00	6.33	0.594	0.506	0.462	0.418	0.033	0.028	0.025	0.023
TC7	7.00	7.67	8.33	9.00	0.435	0.477	0.518	0.560	0.016	0.018	0.019	0.021
TC8	7.67	7.67	5.00	6.33	0.567	0.567	0.369	0.468	0.010	0.010	0.007	0.008
TC9	7.67	5.67	4.33	6.33	0.626	0.463	0.353	0.517	0.023	0.017	0.013	0.019
TC10	5.67	5.67	3.67	3.67	0.593	0.593	0.384	0.384	0.017	0.017	0.011	0.011

Step 8: Determine the ranking order of B2C website choices

Identify the Positive Ideal Solution (PIS) and Negative Ideal Solution (NIS) using formulas (13) and (14), resulting in the following:

Table 11. PIS and NIS Table for Each Criterion

Criteria	A^+	A^-
TC1	0.181	0.100
TC2	0.164	0.078
TC3	0.061	0.047
TC4	0.053	0.036
TC5	0.037	0.025
TC6	0.033	0.023
TC7	0.021	0.016
TC8	0.010	0.007
TC9	0.023	0.013
TC10	0.017	0.011

Next, by calculating the distance of each option from the PIS and NIS using formulas (15) and (16), we obtain the following results:

Table 12. Distance Table from the Ideal Solution

Distance	Selection Option			
	W1	**W2**	**W3**	**W4**
${d_i}^+$	0.070	0.083	0.088	0.090
${d_i}^-$	0.088	0.089	0.070	0.054
${d_i}^+ + {d_i}^-$	0.158	0.172	0.158	0.144

Finally, calculating the closeness to the ideal solution CCi and ranking the options using formula (17), we have the following results:

Table 13. Closeness Index Table

Website	CCi Index	Rank
W1 (Shopee.vn)	0.556	1
W2 (Tiki.vn)	0.517	2
W3 (Lazada.vn)	0.443	3
W4 (Sendo.vn)	0.375	4

Step 9: Select the best B2C website for online shopping

Based on the CC_iindex table, we can identify the best choice among the initial options provided. The final result in Table 4.12 shows that the closeness value of option W2 is the highest, indicating that this option is closest to the positive ideal solution. Therefore, the Shopee website is the best choice for B2C online shopping compared to Tikki, Lazada, and Sendo. This result provides valuable information for consumers to consider and choose the appropriate B2C website for shopping.

6. Conclusion

In today's digital age, the choice of online shopping has become an integral part of our daily lives. The Fuzzy AHP TOPSIS combined model offers a comprehensive method for evaluating and ranking B2C websites for online shopping based on the most important criteria. This helps consumers make smart and effective purchasing decisions in the digital age with the remarkable growth of e-commerce.

References

1. Pham Thi Thanh Thuy (2017). Construction management tools and techniques - Part 3: Multi-criteria decision method, Ho Chi Minh City University of Architecture Publishing House, Ho Chi Minh City.
2. Tran Thi Tham (2020), “Fuzzy - AHP - TOPSIS integrated model to evaluate online sales websites, Scientific Journal of Can Tho University, volume 56, number 1A, pages 37 - 48.
3. H. H. Chang, Y. H. Yeh (2009), "A modified VIKOR method for multiple criteria decision making - A case study on the selection of the location of TFT-LCD fabs," European Journal of Operational Research, vol. 196, no. 2, pp. 652-659, 2009.
4. H. H. Chang, Y. H. Yeh (2011), "A survey analysis of service quality for domestic airlines," Expert Systems with Applications, vol. 38, no. 1, pp. 38-46.
5. G. A. Montibeller, F. H. A. J. Liberatore (2005), "Using decision aiding methods to enhance the design of conjoint analysis experiments in non-market valuation: A case study," Journal of Multi-Criteria Decision Analysis, vol. 13, no. 5-6, pp. 285-303, 2005.
6. H. J. Zimmerman (2012), "Fuzzy Multiattribute Decision-Making: Methods and Applications," Springer Science & Business Media.
7. Opricovic, S. (2013). Fuzzy AHP and TOPSIS methods for machine tool selection. Procedia CIRP, 7, 692-697.