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Analyzing Customer Behavior by Evaluating and Ranking Factors Influencing Customer Satisfaction when Purchasing on C2C e-commerce Websites in the Digital Economy Context Using the FUZZY-AHP-TOPSIS Model

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Abstract
In the context of a rapidly developing digital economy, C2C e-commerce is increasingly attracting a large number of consumers. However, fierce competition among e-commerce platforms creates an urgent need to improve customer satisfaction in order to maintain and expand market share. Therefore, identifying and ranking the factors influencing customer satisfaction in online shopping choices on C2C e-commerce websites is of significant importance both theoretically and practically. This study aims to evaluate and rank the factors affecting customer satisfaction when shopping online on C2C e-commerce platforms through an integrated FUZZY – AHP – TOPSIS model. The research findings not only contribute to supplementing the theoretical basis of customer behavior in C2C e-commerce from the perspective of multi-criteria decision-making, but also provide useful management implications for e-commerce platforms in improving service quality, enhancing user experience, and increasing customer satisfaction in the current digital transformation context.

Keywords: Customer Satisfaction, Customer Behavior C2C e-Commerce, Digital Economy, Fuzzy Logic Model - AHP - TOPSIS, C2C e-Commerce Website Ranking

1. Problem Statement

The rapid development of digital platforms has fundamentally changed the way consumers transact and shop, with the C2C e-commerce model becoming increasingly widespread. The increase in the number of C2C e-commerce websites has intensified competition among platforms, creating an urgent need to improve customer satisfaction for sustainable growth and development. However, customer satisfaction is simultaneously influenced by many factors with varying degrees of impact and is often ambiguous and subjective. Furthermore, previous studies on customer satisfaction in e-commerce have primarily focused on identifying relationships between variables through regression models or SEM, while lacking research that adopts a multi-criteria decision-making approach to evaluate and rank the impact of various factors and C2C e-commerce websites. Based on this practical context, this study applies the FUZZY–AHP–TOPSIS model to evaluate and rank the factors influencing customer satisfaction on C2C e-commerce websites in the digital economy, thereby providing a scientific basis for improving service quality and user experience.

2. Theoretical basis of the research

The fuzzy set theory proposed by Zadeh (1965) aims to address the uncertainty and ambiguity in human perception. In customer behavior research, evaluations of products or shopping experiences are often subjective and expressed in terms like "important," "very important," or "less important," making accurate quantification difficult. Therefore, the FUZZY method is widely used to model these sentimental evaluations more appropriately than traditional quantitative methods. In this study, FUZZY is not applied through membership functions in the range [0,1], but through triangular fuzzy numbers to represent pairwise comparison evaluations according to the Saaty scale. This approach allows for better reflection of the ambiguity in customer perception and is suitable for the goal of evaluating factors affecting customer satisfaction on C2C e-commerce websites in the context of the digital economy.

The Analytical Hierarchy Process (AHP), proposed by Saaty (1980) [12], is one of the popular multi-criteria decision-making

tools, allowing for the analysis of complex problems by breaking them down into a structure of objectives, criteria, and alternatives. In the context of customer satisfaction research, AHP allows for the determination of the relative importance of influencing factors, thereby providing a basis for comparing and evaluating e-commerce platforms. However, in customer behavior research, requiring respondents to provide exact pairwise comparisons using the traditional AHP scale does not fully reflect the ambiguity in their perceptions and feelings. Therefore, combining AHP with fuzzy set theory through the FUZZY-AHP method allows for better modeling of the ambiguity in evaluators' perceptions in customer satisfaction studies.

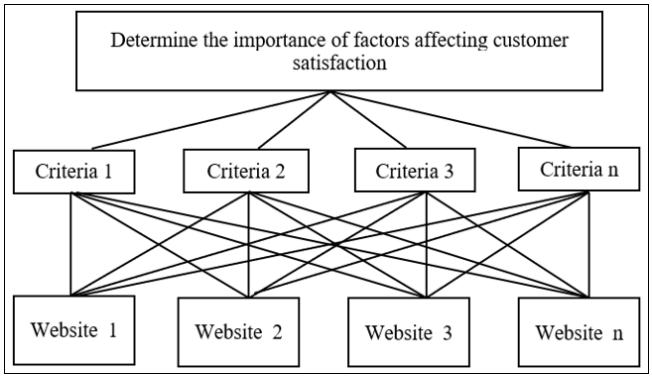
TOPSIS, proposed by Hwang and Yoon (1981) [13], is a multi-criteria decision-making method that ranks alternatives based on their proximity to a positive ideal and distance from a negative ideal. In this study, the alternatives considered are C2C e-commerce websites that will be evaluated based on criteria affecting customer satisfaction.

3. Research Methodology

The study, conducted over three months, surveyed 1,000 consumers and seven professionals from various positions within the e-commerce field, including four e-commerce research and teaching lecturers, one e-commerce director, one marketing manager, and one customer service manager.

Step 1: Define the research objectives and target audience.
Step 2: Develop evaluation criteria.
Step 3: Design the questionnaire and survey.
Step 4: Standardize the evaluation criteria.
Step 5: Build the hierarchical model
Step 7: Create a Fuzzy Logic (AHP) Evaluation Matrix
Step 7: Rank the criteria that influence customer satisfaction.
Step 8: Prioritize C2C websites in order of ranking.

4. General research model



Source: Research model proposed by the authors

Diagram 1.1: Hierarchical structure diagram

5. Research Results

The survey results show that Shopee.vn is the most preferred platform among consumers, with 85.3% using this website to make purchases. This reflects Shopee's clear leading position in the C2C e-commerce market in Vietnam, thanks to its wide market coverage, large number of sellers, competitive prices, and convenient user experience. Taobao.com comes in second with 47.5% of users choosing it, indicating its relatively high popularity. Notably, it caters to customers who prefer cross-border shopping and are willing to accept longer delivery times. Tiki.vn ranks next with 38.6%, reflecting its advantages in product quality and after-sales service, although its popularity is not yet equal to Shopee. Meanwhile, Lazada.vn is only chosen by 14.5% of users, indicating a lower presence and frequency of use compared to the leading platforms. Chotot.com has the lowest selection rate (8.7%), reflecting the characteristics of its C2C model, which focuses on local transactions, used products, and a narrower user base.

Overall, the survey results show a significant difference in popularity among C2C e-commerce websites, confirming Shopee.vn as the dominant platform in customer choice. These results also suggest that website evaluation and ranking should be based on multiple criteria influencing customer satisfaction, rather than solely on popularity or the number of users.

Furthermore, the survey results show that customer ratings of factors influencing satisfaction in shopping on C2C e-commerce websites vary significantly across criteria. Among the surveyed factors, price was the most highly rated by customers, with 75.8% choosing it. This accurately reflects the core characteristics of the C2C e-commerce model, where consumers are particularly price-sensitive and tend to prioritize platforms offering competitive prices. This result is also consistent with the high popularity of platforms like Shopee and Taobao, which stand out for their price advantage. Following this is trust and experience, accounting for 61.5%, indicating a significant influence on customer satisfaction. In the C2C environment, product quality and seller experience are inconsistent. Therefore, factors such as reviews, ratings, buyer protection policies, and platform user experience play a crucial role in mitigating perceived risk and driving purchasing decisions. Payment (48.5%), seller (43.2%), delivery (39.7%), and product (37.5%) were rated as average. This indicates that customer satisfaction depends not only on price but is also significantly influenced by payment convenience, seller reputation, delivery process, and product suitability to individual needs.

Conversely, the factors of e-commerce platform (20.4%), after-sales service (22.3%), online store personalization (18.5%), and e-commerce community (12.8%) had lower selection rates. This indicates that these factors play a supporting role and indirectly influence customer satisfaction, rather than being direct determinants of C2C purchasing behavior. In particular, the e-commerce community factor had the lowest rate, reflecting consumers' primary focus on personal benefits in each transaction rather than community interaction.

Overall, preliminary survey results indicate that price, trust, and experience, along with factors directly related to transactions (seller, payment, delivery), are prominent influences on customer satisfaction in C2C e-commerce. These results serve as an initial empirical basis for determining the formal weighting of criteria using the FUZZY–AHP method, before applying TOPSIS to rank C2C e-commerce websites.

Based on the results of a survey of 1,000 consumers and interviews with 7 experts, 10 criteria were proposed to be included in the evaluation model.

Table 1: Table of criteria used in evaluating C2C e-commerce websites

S. No	Customer behavior	Criteria proposed in the model	Criterion code
1	Pre-purchase behavior	Product	TC1
		Selling price	TC2
		Seller	TC3
		E-commerce platform	TC4
2	Buying decision behavior	Electronic payment	TC5
		Shipping and delivery	TC6
3	Post-purchase behavior	After-sales service	TC7
		Beliefs and experiences	TC8
		Personalize your online store.	TC9
		E-commerce community	TC10

Source: Proposed by the authors

The criteria selected for evaluation are those that have a significant impact on customer satisfaction when making purchasing decisions on C2C e-commerce websites, as presented in Table 2.

Table 2: Table of linguistic variables and corresponding fuzzy numbers

Language variable	Variable symbols	Language variable code	The corresponding fuzzy triangle numbers	Inverse of triangular fuzzy numbers
Equally important	BN	1	(1, 1, 3)	(1/3, 1/1, 1/1)
More importantly	TH	3	(1, 3, 5)	(1/5, 1/3, 1/1)
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)

Source: Proposed by the authors

In this study, the authors used Saaty's pairwise comparison scale (1, 3, 5, 7, 9 and inverse values), represented as triangular fuzzy numbers using the FUZZY-AHP approach (Sodhi & Prabhakar, 2012) [9]. The selected transformation intervals included 5 intervals to perform pairwise comparisons between fuzzy parameters. Linguistic variables were transformed to suit the survey and evaluation content.

Typical websites used in the research model for evaluation are Chotot, Tiki, Shopee, Lazada, and Taobao, which will be labeled W1, W2, W3, W4, and W5 respectively for convenience in calculation. The results of constructing the normalized matrix are shown in Table 3.

Table 3: Ranking of influencing factors according to the normalized matrix and ideal solution

Criteria	Weighted normalization matrix					A^+	A^-	Ranking criteria
	W1	W2	W3	W4	W5			
TC1	0.121	0.163	0.163	0.145	0.122	0.163	0.121	7
TC2	0.157	0.172	0.127	0.129	0.123	0.123	0.172	1
TC3	0.169	0.122	0.184	0.133	0.144	0.184	0.122	10
TC4	0.112	0.154	0.128	0.128	0.134	0.154	0.112	8
TC5	0.129	0.148	0.161	0.138	0.178	0.178	0.129	9
TC6	0.138	0.145	0.145	0.12	0.126	0.118	0.145	2
TC7	0.139	0.124	0.121	0.136	0.142	0.142	0.121	4
TC8	0.144	0.141	0.129	0.139	0.128	0.144	0.128	3
TC9	0.102	0.104	0.116	0.121	0.115	0.121	0.102	5
TC10	0.097	0.101	0.103	0.114	0.116	0.116	0.097	6

Source: Author's proposed results

The ranking results of the criteria show a clear differentiation in the level of influence on customer satisfaction in C2C e-commerce, accurately reflecting the characteristics of shopping behavior in the digital economy context.

Pre-purchase behavior analysis: Price (TC2 – rank 1) is the most important factor, indicating that C2C customers are highly price-sensitive. They prioritize price comparison and promotion hunting over in-depth seller evaluation. Seller (TC3 – rank 10) ranks lowest, showing that personal trust in the seller is no longer the deciding factor. Customers are shifting their trust to the platform and buyer protection mechanisms. Product (TC1) and platform (TC4) are only average, indicating that initial expectations were not too high, and customers accept a certain level of risk. In conclusion, pre-purchase behavior shows that C2C customers act pragmatically, focusing on economic benefits (price) rather than traditional factors such as the seller or platform brand.

Analysis of purchasing decision behavior: Transportation & delivery (TC6 – rank 2) has a very strong influence, indicating that delivery speed, shipping costs, and reliability directly impact the purchase decision. Electronic payment (TC5 – rank 9) has a low influence, suggesting that payment methods have become familiar and standardized, no longer differentiating factors in satisfaction. In conclusion, the decision-making behavior shows that customers are willing to buy if the price is reasonable and delivery is convenient, while payment is only a necessary condition, not a determining factor in satisfaction.

Post-purchase behavior analysis: Trust & Experience (TC8 – rank 3) ranked very high, indicating strong satisfaction formed after using the product. After-sales service (TC7 – rank 4) shows that return, complaint, and post-sales support policies are key factors. Personalization (TC9 - rank 5) and community (TC10 - rank 6) show a positive impact on repurchase intention and electronic word-of-mouth. In conclusion, post-purchase behavior is customer satisfaction that goes beyond the transaction itself and largely depends on the overall experience and how the platform handles post-sales service.

The ranking results show that customer satisfaction on C2C e-commerce websites is most strongly influenced by factors related to price and service performance, while formal or standardized factors have a lower impact. This reflects pragmatic customer behavior, prioritizing practical experience and economic benefits throughout the entire purchasing process.

The research results reveal a significant difference between customer survey results and ranking results from the FUZZY-AHP-TOPSIS model. Specifically, survey results primarily reflect the emotional and perceptual behavior of customers at the time of the survey, strongly influenced by recent experiences, immediate psychology, and easily observable factors such as price or promotions. Therefore, these assessments are subjective and may change depending on the context or time of purchase. Conversely, ranking results obtained from the FUZZY-AHP-TOPSIS model reflect the rational and comprehensive evaluation behavior of customers through data standardization, weighting, and multi-criteria comparison. This approach clarifies the true impact of each factor on overall satisfaction while minimizing bias due to personal emotions or fleeting opinions.

Therefore, it can be affirmed that the two sets of results are not contradictory but complement each other in explaining customer behavior. Combining the analysis of perceived behavior and aggregated evaluation behavior not only helps to comprehensively reflect the customer decision-making process in the C2C e-commerce environment but also confirms the necessity and scientific value of applying multi-criteria decision-making models in customer satisfaction research.

Table 4: Table of distances between choices and proximity index

Distance	Option				
	W1	**W2**	**W3**	**W4**	**W5**
d_i^+	0.008	0.008	0.002	0.005	0.004
d_i^-	0.003	0.004	0.009	0.004	0.007
$d_i^+ + d_i^-$	0.011	0.012	0.011	0.009	0.011
CCi	0.272	0.333	0.818	0.444	0.636
Ranking	**5**	**4**	**1**	**3**	**2**

Shopee's top ranking in the CC index demonstrates that the platform best addresses the factors influencing customer behavior throughout the shopping process on C2C e-commerce websites. Specifically, Shopee aligns with customers' value-seeking behavior, quick purchase decision-making, and post-purchase behavior through its competitive pricing, efficient shipping system, and clear buyer protection mechanisms. As a result, customer satisfaction on Shopee is formed not only from immediate feelings but also from a comprehensive and stable long-term experience, reflecting a harmonious combination of perceived and evaluated customer behavior.

6. Propose some solutions to improve customer satisfaction when purchasing goods on C2C e-commerce websites

Product: C2C requires ensuring information and quality.
Pricing: In the C2C market, a competitive pricing strategy should be prioritized.
Sellers: C2C needs system standardization and monitoring.
E-commerce platforms (C2C) need to maintain system stability.
Electronic payments: C2C needs to improve its processes and standardize its systems.
Shipping and delivery: C2C needs improved reliability and delivery speed.
After-sales service: C2C needs to strengthen its after-sales activities.
Trust and experience: C2C needs to strengthen buyer protection mechanisms.
Personalizing e-commerce stores: C2C needs to enhance the personalized experience.
e-commerce community needs to encourage interaction.

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