

Evaluation of the Best E-commerce Websites in Malaysia Using Fuzzy AHP

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HIGHLIGHTS

- Fuzzy AHP is the method used in the study to ensure the researcher decides which e-commerce websites in Malaysia are the best.
- The criteria and sub-criteria are important for determining the rank of a website.
- The ranking of three alternatives which are Shopee, Lazada and PGMall shows which one is the best.

ABSTRACT

E-commerce, often known as electronic commerce, is a method of doing business that involves purchasing and selling products and services via a digital network like the internet. Since there are various types of e-commerce websites in Malaysia like Lazada, Shopee and PGMall, the consumers have difficulties choosing which e-commerce websites to access for online shopping. The organisation also finds it hard to make a judgement about which sites to use for their online transaction and human judgement for decision making is not reliable in our daily life. The Fuzzy AHP method was used in this study to select the best e-commerce websites in Malaysia. The research aim is to determine the criteria when choosing e-commerce websites, identify sub-criteria that impact e-commerce website rankings and investigate the best rank of e-commerce in Malaysia. In this study, two decision-makers examine three criteria and eight sub-criteria to determine the best e-commerce websites in Malaysia. There are three websites to choose from Shopee, Lazada, and PGMall. The criteria are system quality, information quality, and service quality. Besides, the sub-criteria are access speed, visual appearance, response time, reliable information, update information, accurate information, tracking order status, and payment alternatives. The primary data was used by distributing a set of questionnaires to the experts in the field. Shopee is the best e-commerce website in Malaysia, according to the results, with a normalised score of 0.4488. Lazada comes in second with a normalised 0.4360, and PGMall with a normalised 0.1153. As a result, Shopee outperforms the other two online transaction platforms, Lazada and PGMall.

Keywords: E-commerce, Fuzzy AHP, Criteria, Sub-criteria, Decision makers, best e-commerce websites



INTRODUCTION

The internet has been the most significant thing in this world. The development of the technology in the system requires the internet to operate steadily. The Internet provides us with effective and efficient tools to gain information and services. It includes the communication tools that have been the basic tools in the interactive market for products and services. The growth of internet technology has had a significant impact on global commerce. The internet has entered a new phase of e-commerce and offers opportunities to connect businesses worldwide through the internet (Samsudin & Ahmad, 2014).

E-commerce was introduced years ago, and people love to use it as it gives many benefits for them. According to Kabugumila (2016), e-commerce, also known as electronic commerce, is where we can buy and sell goods and services through an electronic network, such as the internet. We can also make payments and send data through e-commerce. E-commerce can be clarified into four categories which are business-to-business (B2B), business-to-customer (B2C), consumer-to-consumer (C2C) and consumer-to-business (C2B). B2B refers to the exchange of goods, information, or services between two companies. At the same time, B2C is a form of e-commerce where the company supplies goods or services directly to their customers. Next, consumer-to-consumer (C2C) is the consumer who sells or exchanges products with another consumer and C2B (consumer-to-business) is an e-commerce approach in which an individual sells a product or service to businesses. E-commerce can be used by consumers to browse the online store using their device to place orders for the products and services. Due to the fast internet network and their hectic daily schedule, most Malaysians utilise online shopping applications to purchase various things. Besides, buyers may look at the goods and compare prices with only one click. Online purchases are useful since purchasers may verify whether the item is available or out of stock without incurring any effort (Why E-Commerce Business Is Getting Important In Malaysia | Webshop999 Blog, 2013). Nevertheless, online purchasing techniques have gained popularity in recent years since it is convenient for them to shop as they do not have to face a long queue at the counter or the busy mall (Salman et al., 2020).

Moreover, during the pandemic of covid-19, e-commerce in Malaysia continued expanding since everyone is required to stay at home to prevent outbreaks of the disease. Based on the Department of Statistics Malaysia Official Portal (2021), the income of e-commerce in 2020 is RM896.4 billion, which is increasing 32.7 per cent from 2019. As the pandemic begins in early 2020, e-commerce is proving to be the instrument of choice for people to purchase throughout the crisis. Furthermore, the growing smartphone usage in this generation causes them to access e-commerce websites more often than before.

Since there are various types of e-commerce websites in Malaysia likes Lazada, Shopee and PGMall, the consumers have difficulties choosing which e-commerce websites to access for online shopping. The organisation also finds it hard to make a judgement about which sites to use for their online transactions. In addition, the rivalry among e-commerce websites to become the most popular e-commerce site has intensified. The website's quality can influence the mindset of the consumer to choose the websites. Therefore, it is important for the websites to satisfy the customer level to be the best e-commerce. Other than that, the change in the taste of some customers towards the online shopping sites creates curiosity from the company. Besides, human judgement for decision making is not reliable in our daily life. So, the study proposed the method of Fuzzy AHP to measure the performance of each of the e-commerce. Therefore, the study proposed to evaluate the e-commerce websites in Malaysia using Fuzzy AHP.

The main objective of the research is to value the best e-commerce websites in Malaysia. Therefore, the sub-objectives for this study are to determine the criteria that are needed when choosing e-commerce websites, to identify sub-criteria that impact e-commerce website rankings and to investigate the best rank of e-commerce in Malaysia. The study is focused on evaluating the e-commerce websites based on the three



criteria and three sub-criteria for each criterion. The criteria are system quality, information quality and service quality and the sub-criteria are access speed, visual appearance, response time, providing reliable information, providing update information, providing accurate information, tracking order status and payment alternatives. Three top e-commerce websites in Malaysia which are Shopee, Lazada and PGMall will be investigated to determine which one is the best. In addition, there are two experts from e-commerce websites who will be questioned about the study to get the result. From the finding, we can identify how the Fuzzy Analytical Hierarchy Process (AHP) can be used to make the decision-making on e-commerce websites. Thus, we will understand more about the importance of the approach of Fuzzy AHP in decision-making in our daily life. Moreover, we will get reliable results on which of the following shopping sites give more benefits for the consumer. On the other hand, the websites can upgrade their function to the new one which gives better services to the customer. They can also replace the old function that gets the worse feedback from the customer. This is because they will be motivated to keep improving their sites to be the best e-commerce site in Malaysia.

Fuzzy Analytical Hierarchy Process

The Fuzzy Analytical Hierarchy Process (AHP) is one of the methods used in the multicriteria decision-making process. Fuzzy AHP develops the Analytical Hierarchy Process and fuzzy set theory method. Thomas Saaty (1980) invented the AHP to deal with complicated decision-making effectively. AHP is one of the strategies for using perception, preference, experience, and intuition in decision-making systems and is also a method for logically combining personal judgement and ideals (Afriliansyah et al., 2019). Based on the study by Patil (2018), this method helps the decision-maker define priorities and make the optimal conclusion. Thus, by reducing complex judgements to a set of pairwise comparisons and then synthesising the results, to capture both subjective and objective components of a decision.

Crisp data is insufficient to simulate real-world situations in many Multiple Attribute Decision Making (MADM) scenarios. The fuzzy set theory may be employed in decision-making processes because of the inadequacies caused by the subjectivity of human judgements and the ambiguity of evidence (Aydn & Kahraman, 2013). Zadeh came up with a fuzzy set theory, and Bellman and Zadeh explained how to make decisions in fuzzy situations. Since then, many people have used fuzzy set theory to solve problems in uncertain conditions. Similarly, this research incorporates fuzzy decision-making theory, which takes into account the possibility of erroneous subjective judgements throughout the assessment process (Chen et al., 2005).

On the other hand, although the traditional AHP technique uses crisp judgements to assess criteria and options, many real-world issues need fuzzy judgements. Experts may not be able to perform pairwise comparisons. Due to uncertainty and limited knowledge, professionals may not give precise numerical values when making pairwise comparisons. As a result, the fuzzy set theory and AHP are integrated into Fuzzy AHP to utilize interval values rather than crisp values. In this method, fuzzy numbers will be used in the judgement matrix for pairwise comparison (Aydn & Kahraman, 2013). The technique used is similar to the AHP method. AHP evaluates criteria and options using a 1–9 scale. It helps decision-makers create a hierarchy to choose the best option from a set of choices. A hierarchical structure has at least three levels. The first level at the top, which is the goal, in the centre consists of the specified qualities and lastly alternatives at the bottom. After establishing the hierarchy, pairwise comparisons of alternatives or criteria are used to determine priority. Lastly, the preferences collected are pooled to identify the optimal option. The Fuzzy AHP approach converts the AHP scale into a fuzzy triangular scale accessible in priority order (Aydn & Kahraman, 2013; Dwi Putra et al., 2018).



Criteria of E-commerce Websites Selection

According to the research by Rita et al. (2019), e-commerce websites have difficulty maintaining customer satisfaction. According to the study by DeLone and McLean (2004), to measure the websites, six success dimensions of the DeLone and McLean Information System Success Model can be applied, which are system quality, information quality, service quality, and usage user satisfaction and net benefits. However, this study focuses only on three dimensions: system quality, information quality, and service quality, since they affect user satisfaction. In the Internet context, system quality refers to the required attributes of an e-commerce system. Easy use, system adaptability, system dependability, ease of learning, intuitiveness, complexity, and reaction speed are only a few examples. High-system retail websites may provide customers with a pleasurable online purchasing experience, influencing their attitudes and behaviours (Fam et al., 2020). System quality was shown to be favorably significant on sustained purchase intention on e-tailing websites, a good influence on online impulsive purchasing behaviour, and positively affect e-satisfaction in their prior research (Ihsan et al., 2020).

Next, information quality is known as the quality of online content and plays a role in determining the relevance, understandability, accuracy, conciseness, completeness, currency, timeliness, and usability. Providing consumers with up-to-date and relevant information through a user-friendly and interactive system is critical. Information quality is the degree to which visiting a website can give a good source of information and assist a user in obtaining current, relevant, and complete information (Ihsan et al., 2020). Websites with high-quality details make it easier for users to make purchase choices, making the website more attractive to customers than other websites (Fam et al., 2020). Besides, the quality of information has a significant beneficial impact on the initial purchase and ongoing through the website, which greatly affects the perception of usability, encouraging customers to buy (Ihsan et al., 2020).

Furthermore, the study stated that service quality impacts customer satisfaction, influencing customer loyalty. So, both service quality and customer contentment affected customer loyalty. Based on the research by Ihsan et al. (2020), in today's industry, providing the most excellent quality service is necessary since it may help the business compete more effectively with their market rivals. Thus, delivering superior service can improve the company's reputation, attract new consumers by amusing them and stimulate their interest in the products or services provided. Therefore, the quality of service experienced by customers when exploring the website, placing an order, making a payment, or otherwise engaging with the online business determines the quality of the website service (Sharma & Lijuan, 2015). On the other hand, many important factors have been used in the past to evaluate e-commerce based on service quality.

METHODOLOGY

Data Collection Method

The survey is conducted to evaluate the best e-commerce websites in Malaysia. The data was collected using the primary data. The questionnaire was distributed to two experts in e-commerce from e-commerce companies in Malaysia. The questionnaire consists of four sections which are Part A (demographic), Part B (the evaluation on the criteria) Part C (evaluation on the sub-criteria) and Part D (evaluation on the alternatives). Furthermore, three criteria and eight sub-criteria needed to be evaluated to find the best e-commerce in Malaysia.



Formula Implementation

Step 1: Since our study aims to determine the best e-commerce in Malaysia using the fuzzy AHP, we need to construct the hierarchy structure. The figure 1 below shows the hierarchy structure of e-commerce selection. The hierarchy structure consists of levels of goal, criteria, sub-criteria, and alternatives. Our goal is to select the best e-commerce in Malaysia. Three main criteria have been chosen to be evaluated, namely quality system, information quality and service system. Each of the criteria has been divided into sub-criteria. The quality and information system comprises three sub-criteria which are access speed, visual appearance, response time, reliable information, updated information, and accurate information, respectively. Besides, the service system is divided into two sub-criteria which are tracking order status and payment alternatives. Three alternatives have been chosen to rank: Shopee, Lazada and PGMall.

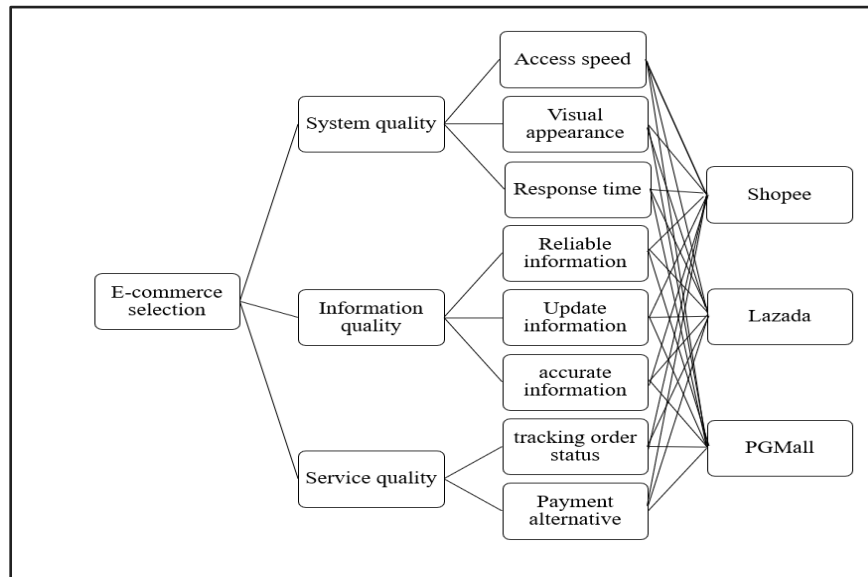


Figure 1: Hierarchy structure of e-commerce selection

Step 2: The decision-makers compare the criteria, sub-criteria and alternatives via linguistics terms shown in Table 1.

Table 1: Linguistic terms and the corresponding triangular fuzzy numbers

Saaty scale	Definition	Fuzzy Triangular Scale
1	Equally importance (EI)	(1,1,1)
3	Weakly importance (WI)	(2,3,4)
5	Fairly importance (FI)	(4,5,6)
7	Strongly importance (SI)	(6,7,8)
9	Absolutely importance (AI)	(9,9,9)
2	The intermittent values	(1,2,3)
4		(3,4,5)
6		(5,6,7)
8		(7,8,9)

Source: Saaty (1980)



Equation (1) below shows the pairwise contribution matrix. The triangular numbers \tilde{X}_{ij}^k indicate the k^{th} decision-makers preference of i^{th} criterion over j^{th} criterion. Besides, the "tilde" represents the triangular number demonstration.

$$\tilde{A}^k = \begin{bmatrix} \tilde{X}_{11}^k & \tilde{X}_{12}^k & \cdots & \tilde{X}_{1n}^k \\ \tilde{X}_{21}^k & \cdots & \cdots & \tilde{X}_{2n}^k \\ \cdots & \cdots & \cdots & \cdots \\ \tilde{X}_{n1}^k & \tilde{X}_{n2}^k & \cdots & \tilde{X}_{nn}^k \end{bmatrix} \quad (1)$$

Step 3: Check for the consistency index or consistency ratio to assure the consistency of expert judgement in the evaluation phase. The consistency of an evaluation analyzed using Equation (2),

$$CI = \frac{\lambda \max - N}{N - 1} \quad (2)$$

where consistency index (CI), is the largest eigenvalue of the comparison matrix, and N is the dimension of matrix or number of criteria. The consistency ratio (CR) is being used to solve the final inconsistency in the pairwise comparisons.

$$CR = \frac{CI}{RI} \quad (3)$$

where RI is the random index obtained from averaging the CI of a randomly generated reciprocal matrix (Saaty 1980). RI can be seen in Table 2.

Table 2: Random index

N	1	2	3	4	5	6	7	8	9	10
Random Index (RI)	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

Source: Saaty (1980)

The closer the consistency index to zero, the greater the consistency. The consistency index should be equal to or lower than 0.10 to accept the comparison. If the result is greater than 0.10, it shows the inconsistency of the judgement. So, the decision-makers should go back and redo the assessments and comparisons.

Step 4: Since there are more than one decision-maker, the average of the preference of each decision-maker will be calculated as shown in Equation (4) below.

$$\tilde{X}_{ij} = \frac{\sum_{k=1}^k \tilde{X}_{ij}^k}{k} \quad (4)$$

Step 5: The updated pair wise contribution matrices is shown after the average of preference.



$$\tilde{A} = \begin{bmatrix} \tilde{x}_{11} & \cdots & \tilde{x}_{1n} \\ \cdots & \ddots & \vdots \\ \tilde{x}_{n1} & \cdots & \tilde{x}_{nn} \end{bmatrix} \quad (5)$$

Step 6: Calculate the vector weight by the following step below:

Geometric mean method by (Buckley et al, 1985) of fuzzy comparison values of each criterion is calculated based on equation (6) below.

$$\tilde{r} = \left(\prod_{j=1}^n \tilde{x}_{ij} \right)^{\frac{1}{n}}, i = 1, 2, \dots, n \quad (6)$$

Calculate the fuzzy weight of each criterion according to:

Find the vector summation using equation (7) given by

$$\text{vector summation} = \sum \tilde{r}_i \quad (7)$$

Find the inverse of the summation vector and arrange it in increasing order.

$$r^{-1} = \frac{1}{\sum \tilde{r}_i} \quad (8)$$

Find the fuzzy weight of criterion by multiplying each r with the inverse vector.

$$\begin{aligned} \tilde{w} &= \tilde{r}_i \otimes (\tilde{r}_1 \oplus \tilde{r}_2 \oplus \dots \oplus \tilde{r}_n)^{-1} \\ &= iw_i, mw_i, uw_i \end{aligned} \quad (9)$$

Step 7: De-fuzzified the fuzzy weight for criterion since it is still in fuzzy triangular numbers using the Centre of the area by applying Equation (10).

$$E_i = \frac{iw_i, mw_i, uw_i}{3} \quad (10)$$

Step 8: Normalised the E_i because it is not a fuzzy number via Equation (11).

$$N_i = \frac{E_i}{\sum_{i=1}^n E_i} \quad (11)$$

Step 2 to step 8 above is used to calculate the normalised weights of the criterion, sub-criterion, and alternatives. Then the multiplication of sub-criterion weight with respect to criterion weight needs to be obtained to get the sub-criteria's global weight. Next, the score for the alternatives can be calculated after the multiplication of the global weight sub-criterion with respect to alternatives weight. The final score for each alternative is obtained by carrying out a fuzzy arithmetic sum over each global weight of alternatives. The result will indicate the ranking of the alternatives. The alternative with the highest score is suggested to the decision-maker. The highest score defines the best e-commerce in Malaysia.



FINDINGS AND DISCUSSIONS

Table 3 shows the result of Fuzzy Weight of criteria and Table 4 shows the global weight of sub-criteria.

Table 3: Fuzzy Weight of criteria

Criteria	Weight
System Quality	0.5600
Information Quality	0.3388
Service Quality	0.1012

Table 4: Global Weight of sub-criteria

Criteria	Sub-criteria	Global Weight
System Quality	Access Speed	0.3630
	Visual Appearance	0.1513
	Respond Time	0.0457
Information Quality	Reliable Information	0.1691
	Update Information	0.1183
	Accurate Information	0.0515
Service Quality	Tracking Order Status	0.0911
	Payment Alternative	0.0101

Table 5: Rank of alternatives

		Shopee	Lazada	PGMall
System Quality	Access Speed	0.1707	0.1707	0.0217
	Visual Appearance	0.0632	0.0632	0.0250
	Respond Time	0.0188	0.0188	0.0082
Information Quality	Reliable Information	0.0814	0.0760	0.0117
	Update Information	0.0503	0.0457	0.0222
	Accurate Information	0.0219	0.0199	0.0097
Service Quality	Tracking Order Status	0.0380	0.0380	0.0150
	Payment Alternative	0.0045	0.0038	0.0018
Total		0.4488	0.4360	0.1153
Decreasing Order		0.4488	0.4360	0.1153
Rank Of Alternatives		1	2	3

The final score for each alternative is obtained by carrying out a fuzzy arithmetic sum over each global weight of alternatives. The result will indicate the ranking of the alternatives. Table 5 shows that Shopee is the best e-commerce website in Malaysia, with a normalised 0.4488. Lazada comes in second place, with a normalised score of 0.4360. Finally, with a normalised score of 0.1153, PGMall is the lowest ranked of the three websites studied. It can conclude that Shopee is the first e-commerce website in Malaysia based on the criteria that have been evaluated by the decision makers. Even though Lazada is the first established websites among these three, it cannot pass through Shopee in becoming the best website. The result from



the evaluation of the two experts on some of the criteria that have been investigated in this research shows that Shopee is better than others. It is leading the websites to become the first websites in Malaysia after the calculation using Fuzzy AHP in the research.

CONCLUSION AND RECOMMENDATIONS

This study aims to evaluate the best e-commerce websites in Malaysia based on the criterion and the sub-criterion studied in this research by using fuzzy AHP. The objectives are to determine the requirements for selecting e-commerce websites, identify sub-criteria that influence e-commerce website rankings, and investigate the best rank of e-commerce in Malaysia. According to the findings, the criteria and sub-criteria are important for determining the rank of a website. Furthermore, the ranking for the best e-commerce websites in Malaysia was a success. According to the results, Shopee is the better e-commerce website, with a normalised score of 0.4480. followed by Lazada and PGMall with scores 0.4360 and 0.1153 respectively. As a result, we can conclude that Shopee is the superior e-commerce website in Malaysia, surpassing Lazada and PGMall. Even though the research only uses two experts in evaluating the e-commerce websites in Malaysia, the result is still acceptable since there are still two different opinions in evaluating the websites. The Fuzzy AHP method is one of the methods used to assist the researcher in making a decision. Assume the researcher wants to use the Fuzzy AHP method in the future. In that case, it is recommended to increase the number of decision-makers to ensure that different perspectives can evaluate the evaluation. As a result, the research can obtain more accurate results from the observation. Aside from that, there are numerous other methods for selecting e-commerce websites like other MCDM methods. For example Fuzzy TOPSIS, PROMETHEE, Fuzzy Delphi.

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CONFLICT OF INTEREST DISCLOSURE

All authors declare that they have no conflicts of interest to disclose

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