Applied Mathematics and Computational Intelligence
Volume 12, No.1, Apr 2023 [55-69]

Evaluation of Hotel Website and Online Accommodation Booking Platforms using Fuzzy TOPSIS

Nuridawati Baharom[1*], Nurfatihah Athirah Rahmat[2]

[1,2]Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA Cawangan Perlis, Kampus Arau, Malaysia

* Corresponding author: nuridawati@uitm.edu.my

Received: 25 October 2022
Accepted: 23 November 2022

ABSTRACT

According to researchers in the field of hospitality management, online reservation systems can improve the financial success of a business. Due to the advancement in technology, there are numerous online accommodation booking platforms and hotel websites available. The ways these websites promote themselves, their services, and the prices charged are different. In addition, some websites still do not have the criteria to attract more visitors. This study aims to determine the weightage of criteria for a hotel website and online accommodation booking platforms and to evaluate and identify the best alternative among the hotel website and online accommodation booking platforms. A case study is presented, where three alternatives; a hotel website and two online accommodation booking platforms, are evaluated based on nine criteria. The Fuzzy Techniques for Order Preference by Similarity to Ideal Solution (Fuzzy TOPSIS) was applied in this study. This method first determined the fuzzy evaluation criterion weights, and the alternatives were ranked using the generated fuzzy weights. In conclusion, the hotel website was ranked the highest compared to the other two online accommodation booking platforms. Through a comprehensive review of this study, hotel management will gain a new perspective on the customers' need to improve the websites.

Keywords: *fuzzy topsis, hotel evaluation, hotel website, online accommodation booking platforms.*

1 INTRODUCTION

Scholars in hospitality management have shown that online reservation systems can increase a company's financial success [1]. Potential customers can simply find the availability of hotel rooms by switching from phone call reservation to an online booking site. In only a few clicks, a customer may go from viewing a hotel before booking it, eliminating the complexities associated with phone call-based bookings and increasing 'impulse' sales. Customers are more likely to book hotels based on specific criteria that meet their needs. Websites must be created with the user's experience and the website's quality in mind. Website features and services that take less work may entice more visitors to visit the websites.

There are many websites to book hotel rooms, such as Traveloka, Trivago, Agoda, Trip.com, Booking.com, Hotels Combined, etc. These websites differ in how they present their websites, their services, and the price charged. On the other hand, some websites still lack specific criteria to attract more people. Customers, particularly first-time visitors, have difficulty selecting which websites are the best for booking hotel rooms.

Technology has numerous advantages. Information may be made more accessible with the use of technology. The World Wide Web, also known as www, has turned the entire world into a shared village. This is because the internet makes information from all over the world easily accessible. While much of the information shared on social media is entirely factual, image results can also be found. This is related to hotel booking where all the information, including the price, room size, room images, pax and availability, are displayed on the internet.

Additionally, technology can aid customers in time management. Nowadays, people are far too preoccupied to search for even the smallest piece of information. For example, suppose individuals want to search for a hotel at a particular place. In this case, they can search using the hotel website or online accommodation booking platforms in just a few clicks rather than taking so much time via telephone calls. Due to technological advancements, it is now easier for businesses to create websites. Numerous hotel websites and online accommodation booking platforms in Malaysia facilitate online bookings. People have plenty of websites to choose from when booking their desired hotel. Thus, most people prefer to book online via websites due to perceived time and cost savings.

Each hotel website has its range of attributes based on clients' preferences that highlight the hotel. Some of the criteria are, first impression, navigation capabilities, quality of content, attractions, ease of finding information, interactivity, browser compatibility, user's knowledge, user's satisfaction and useful information [2]. User's feedback after browsing the websites is a critical information that can be used to improve the features of the websites. Each website must be constantly updated and desired features must be added to maintain a high and consistent rating for each visit. Evaluation of hotels' websites is essential if the hotel management wants to know how well they serve their customers by supplying them with relevant and helpful data [3]. Therefore, this study was conducted to rank hotel website and online accommodation booking platforms and find the best one according to hotel website criteria.

Nowadays, there are numerous lodging options and online accommodation booking platforms. Consumers must determine which of those websites is superior and more worthwhile. Before deciding on a website, visitors want to know how well it can perform. They require information regarding which of these websites meets the criteria. Thus, there is a need for a scientific approach to assist consumers in choosing the best website for online reservations.

Multi-criteria decision-making (MCDM) is the term for making decisions in such a setting with multiple alternatives and criteria. For resolving MCDM challenges, there are various methods, techniques, and phases. Collecting decision information, which includes criteria weights and values, is the first phase of MCDM. Another way is to collect data using a particular method, then rank the options. The use of fuzzy information to portray decision information may have been a superior approach in many practical MCDM difficulties due to the fuzziness of human psychology and the complexity and ambiguity of objective things [4].

Evaluation of hotel websites is critical to determine whether they can offer users helpful and important information. Satisfied users will repurchase using the same website which will increase the visitors of the website. Quality websites will attract more users and give a competitive advantage over competitors. Various MCDM methods have been applied by previous authors to evaluate hotel websites such as Intuitionistic Fuzzy EDAS (IF EDAS) as in [5] and Fuzzy Analytic Hierarchy Process [6]. Some researchers use hybrid MCDM methods to find the most important criteria and alternatives [7, 8, 9, 10].

TOPSIS is broadly used in purchasing decisions and outsourcing provider selection [11,12], manufacturing decision-making, financial performance analysis, educational selection applications, service quality assessment, technology selection, material selection, product selection, strategy evaluation [13], and critical mission planning [14].

Other than using Fuzzy TOPSIS to evaluate websites, this method can also be used to rank automotive suppliers by identifying the main criteria and sub-criteria by considering four suppliers [15], deciding the location for a new warehouse by having the alternatives of areas [16] and comparing sustainability models in the development of electric vehicles with four different criteria and four different alternative policies in respect to location transportation decisions, regulations and directives [17].

This research looks forward to providing hotel management with a fuzzy point of view that deals with the imprecision of human judgment. The prioritization of criteria gives significant information on which the criteria should be focused on the development of a hotel website. The empirical values show the performance of a website in relation to criteria and alternatives in the website shopping industry. This research aims to determine the weightage of criteria for hotel websites and online accommodation booking platforms and to evaluate and identify the best alternative among hotel websites and online accommodation booking platforms. The Fuzzy TOPSIS method was applied to assess and rank hotel websites and online accommodation booking platforms on a scale of best to worst.

The remainder of this paper is organized as follows; the background information for the case study problem and the Fuzzy TOPSIS approach are explained in detail sequentially in the next section. Section 3 provides the results of the case study. The discussion that summarizes the empirical results and the conclusions are presented in Section 4. Finally, the last section of this paper contains some limitations and future research directions to further the study.

2 MATERIAL AND METHODS

Technique for Order Performance by Similarity to Ideal Solution (TOPSIS), was developed by Hwang and Yoon [18], which is one of the most well-known strategies in solving MCDM problems. The principle is, the chosen alternative should be the farthest away from the negative-ideal solution, that is, the solution that maximizes the cost criteria while minimizing the benefits criteria; and the shortest distance from the positive-ideal solution, that is, the solution that maximizes the benefit criteria while minimizing the cost criteria [19].

Three hotel managers were selected as decision makers (DM) to analyse a hotel website and two online accommodation booking platforms based on nine criteria. Fuzzy TOPSIS was used to evaluate and rank hotel website and online accommodation booking platforms. Hotel Website (A1), Website X (A2) and Website Y (A3) are the alternatives involved in this research.

2.1 Steps in Fuzzy TOPSIS

Step 1: Determine the weightage of evaluation criteria.

This section proposes a systematic strategy for extending TOPSIS to handle the problem of hotel website estimation in a fuzzy context. The important weights were assigned to various criteria and the ratings assigned to qualitative criteria were treated as linguistic variables in this study (as shown in Table 2) [20]. Table 1 shows the evaluation criteria of hotel websites and online accommodation booking platforms adopted from [21].

Table 1: Evaluations of 3 alternatives concerning nine criteria

Criteria		Description
C1	Content management system	The effectiveness of a group's hotel "content management system" (adaptability, accessibility, and efficient management): A "content management system" allows hotels to handle their contents with various authorization hierarchies efficiently. It will enable property-level managers to administer all of the group's hotel web pages with proper delegation.
C2	Website's ergonomic features	The website's ergonomic features (user-friendly interface).
C3	Accessibility and online help	Accessibility for visitors and online live help to assist visitors.
C4	Usability of live dashboard	Usability of the live dashboard for revenue and reservation management: Corporate revenue managers must track the reservation flow with the live dashboard to improve sales chances. Reservation administrators must use a live dashboard to keep track of the reservation flow, distribute reservations to hotels, communicate visitors' preferences with hotels, and keep track of payments received on time. The live dashboard is essential for determining the best time to change these processes.
C5	Assign proper rights and authorization	Assign proper rights and authorization to related departments or hotel properties. For procedures like publishing news and adjusting rates, each hotel (department) should be able to manage its material within a predefined authorization level.
C6	Multilingual user interfaces	Multilingual user interfaces are available in a variety of languages.

C7	Detail and quality reporting	Detail and quality reporting.
C8	Web technology efficiency	Web technology efficiency for "next-generation" (future technology adaptation): New web-programming technologies provide significant benefits to website visitors, such as mobile device compatibility, dynamic content tailored to each visitor, and a more dependable audio-visual content experience.
C9	Service-based payment software	Amount of software available as a service-based payment software (service-based software purchase may be used instead of a perpetual license due to developments in cloud technologies' web-based technology services).

Step 2: Create the fuzzy decision matrix and assign suitable linguistic variables to the choices based on the criteria.

Table 2: Linguistic scale for the importance of each criterion

Linguistic variable	Corresponding triangular fuzzy number
Very low (VL)	(0.0,0.1,0.3)
Low (L)	(0.1,0.3,0.5)
Medium (M)	(0.3,0.5,0.7)
High (H)	(0.5,0.7,0.9)
Very high (VH)	(0.7,0.9,1.0)

$$\tilde{D} = \begin{matrix} & \begin{matrix} C_1 & C_2 & \cdots & C_n \end{matrix} \\ \begin{matrix} A_1 \\ A_2 \\ \vdots \\ A_m \end{matrix} & \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \cdots & \tilde{x}_{1j} \\ \tilde{x}_{21} & \tilde{x}_{22} & \cdots & \tilde{x}_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{x}_{i1} & \tilde{x}_{i2} & \cdots & \tilde{x}_{ij} \end{bmatrix} \end{matrix}, i = 1,2,\ldots,m; j = 1,2,\ldots n \tag{1}$$

$$\tilde{x}_{ij} = \frac{1}{k}\left(\tilde{x}_{ij}^{1} + \tilde{x}_{ij}^{2} + \cdots + \tilde{x}_{ij}^{k}\right)$$

where $\tilde{x}_{ij}^{k}$ is the rating of alternative A_i with respect to criterion C_j evaluated by an expert, and $\tilde{x}_{ij}^{k} = \left(a_{ij}^{k}, b_{ij}^{k}, c_{ij}^{k}\right)$.

Step 3: Normalize the fuzzy decision matrix.

Equation 2 shows the following formula for the normalized fuzzy decision matrix signified by $\tilde{R}$ is shown below:

$$\tilde{R}=\left[\tilde{r}_{ij}\right]_{m\times n}, i=1,2,\ldots,m;\ j=1,2,\ldots,n \tag{2}$$

Then, using the following formula, the normalization process can be completed using the following formula:

where $\tilde{r}_{ij}=\left(\frac{a_{ij}}{c_j^+},\frac{b_{ij}}{c_j^+},\frac{c_{ij}}{c_j^+}\right)c_j^+=\max_i c_{ij}$

Normalized $\tilde{r}_{ij}$ numbers are still triangular fuzzy numbers. The normalization process is identical for trapezoidal fuzzy numbers. In equations 3 and 4, the weighted fuzzy normalized decision matrix is denoted by the following matrix $\tilde{V}$:

$$\tilde{V}=[\tilde{v}_{ij}]_{m\times n}, i=1,2,\ldots,m; j=1,2,\ldots,n \tag{3}$$

$$\tilde{v}_{ij}=\tilde{r}_{ij}\otimes\tilde{w}_j \tag{4}$$

Step 4: Determine the fuzzy positive-ideal solution (FPIS) and fuzzy negative-ideal solution (FNIS)

According to the weighted normalized fuzzy decision matrix, the elements are normalized positive TFNs with ranges in the closed interval [0, 1]. The FPIS A^+ and FNIS A^- can then be defined as follows:

$$A^+=\left(\tilde{v}_1^+,\tilde{v}_2^+,\ldots,\tilde{v}_n^+\right) \tag{5}$$

$$A^-=\left(\tilde{v}_1^-,\tilde{v}_2^-,\ldots,\tilde{v}_n^-\right) \tag{6}$$

where $\tilde{v}_j^+=(1,1,1)$ and $\tilde{v}_j^-=(0,0,0), j=1,2,\ldots,n$ in formula 5 and 6.

Step 5: Determine the distance between FPIS and FNIS for each alternative.

The distances (d_i^+ and d_i^-) of each alternative A^+ and A^- can be currently calculated by the area compensation method.

$$d_i^+=\sum_{j=1}^{n} d\left(\tilde{v}_{ij},\tilde{v}_j^+\right), i=1,2,\ldots,m; j=1,2,\ldots,n \tag{7}$$

$$d_i^-=\sum_{j=1}^{n} d\left(\tilde{v}_{ij},\tilde{v}_j^-\right), i=1,2,\ldots,m; j=1,2,\ldots,n \tag{8}$$

Step 6: Calculate the closeness coefficient and rank the alternatives in order of preference.

Once the d_i^+ and d_i^- for each alternative have been determined, the CC_i is identified to ascertain the ranking order of all alternatives. Then, calculate the degree to which the current solution is comparable to the ideal solution. This step utilizes Equation 9 to resolve the similarities to an ideal solution.

$$CC_i = \frac{d_i^-}{d_i^+ + d_i^-}, i = 1,2,\ldots,m \tag{9}$$

3 EMPIRICAL RESULTS

For the evaluation of the hotel website and online accommodation booking platforms, three decision-makers were invited to answer the survey. The research framework for this study is shown in Figure 1. Three alternatives were chosen in this study which are a hotel website (A1) and two online accommodation booking platforms; Website X (A2) and Website Y (A3). Nine criteria were selected, including Content management system (C1), Website's ergonomic features (C2), Accessibility and online help (C3), Usability of the live dashboard (C4), Assignment of proper rights and authorization (C5), Multilingual user interfaces (C6), Detail and quality reporting (C7), Web technology efficiency (C8) and Service-based payment software (C9) [21].

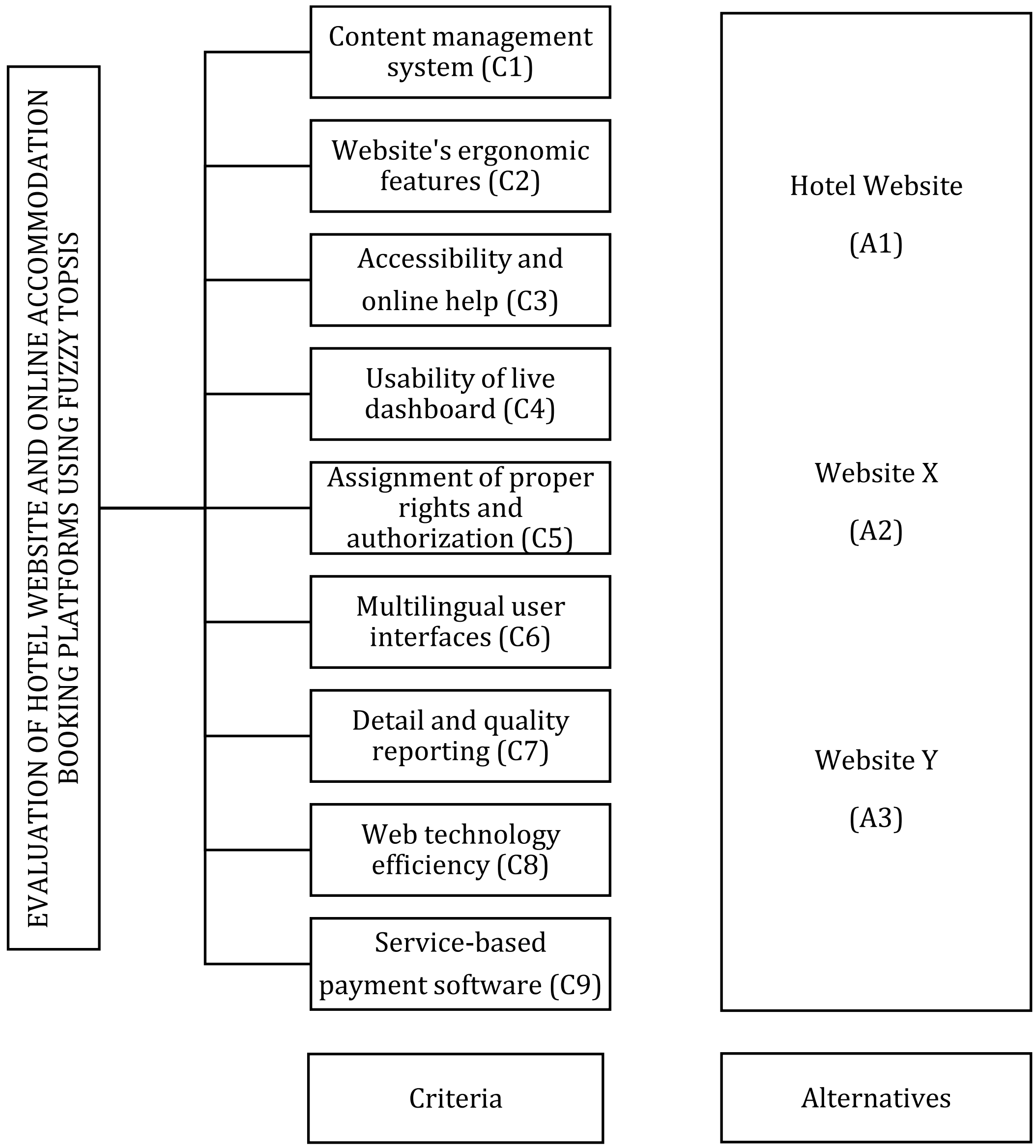

Figure 1: Research framework

Step 1: Determine the weightage of evaluation criteria.

Fuzzy TOPSIS was used to evaluate the different criteria for hotel website and online accommodation booking platforms. This study involved three decision-makers which are the hotel's Director of Sales and Marketing, Assistant Reservation Manager, and Assistant Revenue Manager.

Table 3: Aggregated Fuzzy Decision Matrix for Criteria Weightage

Criterion	Aggregated Fuzzy Weight	Average Fuzzy Weight	Rank
C1	(0.30,0.63,0.90)	0.61	6
C2	(0.30,0.70,1.00)	0.67	4.5
C3	(0.30,0.57,0.90)	0.59	7.5
C4	(0.50,0.77,1.00)	0.76	1
C5	(0.30,0.70,1.00)	0.67	4.5
C6	(0.10,0.50,0.90)	0.50	9
C7	(0.50,0.70,0.90)	0.70	2
C8	(0.30,0.77,1.00)	0.69	3
C9	(0.30,0.57,0.90)	0.59	7.5

To take the average value of the aggregated fuzzy weight of C1 as an example, the calculation process is as follows:

$$Average_{w1} = \frac{Total_{w1}}{3} = \frac{0.30 + 0.63 + 0.90}{3} = 0.61 \quad (10)$$

The average fuzzy weights for the remaining criteria are shown in Table 3. Then, each criterion was then ranked based on average fuzzy weight. The usability of live dashboard (C4) was the highest average fuzzy weight value.

Step 2: Estimate the performance.

This study focuses on determining the best alternative either by performing booking using a hotel website or online accommodation booking platforms. This study applied the method of average value to integrate fuzzy values of different decision-makers regarding the same evaluation's dimensions. The decision maker then adopted linguistic terms based on Table 4, including "Very Low", "Low", "Medium", "High" and "Very High" to express their opinions about the rating of every hotel website and online accommodation booking platforms according to each criterion.

Table 4: Fuzzy Numbers for All Alternative Ratings

Linguistic Variable	Corresponding triangular Fuzzy number
Very Low	(0,1,3)
Low	(1,3,5)
Medium	(3,5,7)
High	(5,7,9)
Very High	(7,9,10)

Table 5: Subjective Cognition Results of 3 Decision Makers

Criterion	A1	A2	A3
C1	(3,6,9)	(1,6,9)	(3,6,9)
C2	(5,8,10)	(3,7,10)	(5,8,10)
C3	(3,6,10)	(1,4,7)	(3,6,9)
C4	(5,8,10)	(3,6,9)	(3,6,9)
C5	(5,8,10)	(0,6,10)	(1,6,10)
C6	(3,6,9)	(3,6,10)	(3,5,7)
C7	(5,7,9)	(3,6,9)	(3,6,9)
C8	(5,8,10)	(3,6,10)	(1,6,10)
C9	(3,6,9)	(3,6,9)	(1,6,9)

Step 3: Normalize the fuzzy decision matrix.

Using Equation (2), the fuzzy decision matrix was normalized, as shown in Table 6 below.

Table 6: Normalized Aggregated Fuzzy Decision Matrix for Alternatives

Criterion	A1	A2	A3
C1	(0.33,0.70,1.00)	(0.11,0.63,1.00)	(0.33,0.70,1.00)
C2	(0.50,0.77,1.00)	(0.30,0.70,1.00)	(0.50,0.77,1.00)
C3	(0.30,0.63,1.00)	(0.10,0.43,0.70)	(0.30,0.57,0.90)
C4	(0.50,0.77,1.00)	(0.30,0.57,0.90)	(0.30,0.57,0.90)
C5	(0.50,0.77,1.00)	(0.00,0.57,1.00)	(0.10,0.63,1.00)
C6	(0.30,0.57,0.90)	(0.30,0.63,1.00)	(0.30,0.50,0.70)
C7	(0.56,0.78,1.00)	(0.33,0.63,1.00)	(0.33,0.63,1.00)
C8	(0.50,0.83,1.00)	(0.30,0.63,1.00)	(0.10,0.63,1.00)
C9	(0.33,0.63,1.00)	(0.33,0.63,1.00)	(0.11,0.63,1.00)

Using Equation (2), Criteria 1 (C1) Normalized Aggregated Fuzzy Decision Matrix for the first alternative is calculated as below:

= (3/max (9,9,9), 6/max (9,9,9), 9/max (9,9,9))

= (3/9, 6/9, 9/9)

= (0.33, 0.70, 1.00)

Step 4: Establish the weighted normalized fuzzy decision matrix.

The fourth step in the analysis is to find the weighted fuzzy decision matrix and the resulting fuzzy weighted decision matrix, as shown in Table 7.

Table 7: Weighted Normalized Fuzzy Decision Matrix

Criterion	A1	A2	A3
C1	(0.10,0.45,0.90)	(0.03,0.40,0.90)	(0.10,0.45,0.90)
C2	(0.15,0.54,1.00)	(0.09,0.49,1.00)	(0.15,0.54,1.00)
C3	(0.09,0.36,0.90)	(0.03,0.25,0.63)	(0.09,0.32,0.81)
C4	(0.25,0.59,1.00)	(0.15,0.43,0.90)	(0.15,0.43,0.90)
C5	(0.15,0.54,1.00)	(0.00,0.40,1.00)	(0.03,0.44,1.00)
C6	(0.03,0.28,0.81)	(0.03,0.32,0.90)	(0.03,0.25,0.63)
C7	(0.28,0.54,0.90)	(0.17,0.44,0.90)	(0.17,0.44,0.90)
C8	(0.15,0.64,1.00)	(0.09,0.49,1.00)	(0.03,0.49,1.00)
C9	(0.10,0.36,0.90)	(0.10,0.36,0.90)	(0.03,0.36,0.90)

Criteria 1 (C1) Weighted Normalized Fuzzy Decision Matrix for the first alternative is calculated as below:

= (0.33 x 0.3, 0.70 x 0.63, 1 x 0.9)

= (0.10, 0.45, 0.90)

Step 5: Determine the fuzzy positive and fuzzy negative-ideal reference points.

Then, the fuzzy positive-ideal solution (FPIS) and the fuzzy negative-ideal solution (FNIS) were defined as: A^+ and A^-. This is the fifth step of the fuzzy TOPSIS analysis.

A^+ = [(1,1,1),(1,1,1),(1,1,1),(1,1,1),(1,1,1),(1,1,1),(1,1,1)]

A^-= [(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0),(0,0,0)]

Step 6: Estimating the performance and ranking of the alternatives.

Once the distance of cluster policy from FPIS and FNIS has been determined, the closeness coefficient can be obtained using Eq. (9).

Table 8: Closeness Coefficients and Ranking

Alternative	d_1^+	d_1^-	CC_i	Rank
Hotel Website	4.829	5.050	0.511	1
Website X	5.361	4.705	0.467	3
Website Y	5.275	4.692	0.471	2

The index CC_i for the first alternative, Hotel Website is calculated as:

$$d_1^+ = \sum FPIS(A1)$$
$$= 0.5312 + 0.5589 + 0.5624 + 0.4941 + 0.5589 + 0.6179 + 0.4138 + 0.5332 + 0.5583$$
$$= 4.829$$
$$d_1^- = \sum FNIS(A1)$$
$$= 0.5555 + 0.5863 + 0.5381 + 0.555 + 0.6609 + 0.4735 + 0.4806 + 0.6648 + 0.5355$$
$$= 5.050$$
$$CC_i = \frac{5.050}{4.829 + 5.050} = 0.511$$

Finally, the rankings of hotel website and online accommodation booking platforms were determined using the value of CC_i. Hotel Website was ranked number one, followed by Website Y and the lowest rank was Website X.

4 DISCUSSION AND CONCLUSIONS

Building a fuzzy TOPSIS model to access hotel website and online accommodation booking platforms is the primary goal of this study. Through the fuzzy idea, the experts determined the significance of each criterion, and the uncertainty of human decision-making is considered through the fuzzy concept. Based on the results, which determined the weighing of each criterion for hotel websites and online accommodation booking platforms, this study concludes that it has succeeded in achieving three objectives. Thus, by utilizing the fuzzy TOPSIS method, this study analyzed the websites and identified the best alternative between hotel website and online accommodation booking platforms. From the fuzzy TOPSIS results, the first two essential criteria required for hotel website and online accommodation booking platforms are; (i)the usability of the live dashboard for revenue and reservation management, C4 and (ii)detail and quality reporting, C7. Moreover, the less critical criterion is multilingual user interfaces, C6. From the alternative evaluation results in Table 8, the best way for customers to book hotels is through the hotel website. Usability of live dashboard, C4, is very important for customers to get real-time insights and competitive analyses and use them to identify items that require urgent actions, streamlining workflows and properly purposing resources. It is crucial to update whatever inconvenience happened between the hotel management and the customer during the hotel booking process. The least favorite criterion is C6, a multilingual user interface available in various languages. This may be due to the customers' usage where most visitors can speak English rather than their mother tongue and, it is easier to have two-way communication.

5 LIMITATIONS AND FUTURE RESEARCH

This research is quite significant as it shows the scientific way of evaluating hotel websites which considered the point of view of a few decision makers. However, for future research, the data could be collected from the customers of the hotel. From that, the management of the hotel can have a different perspective in terms of customers and criteria of the website that need improvement. Furthermore, this application of hotel evaluation can use other MCDM evaluation and ranking methods such as Analytic Hierarchy Process (AHP), Best Worst Method (BWM) and Data Envelopment Analysis (DEA).

REFERENCES

[1] J. F. Sanchez and A. Satir, "Hotel yield management using different reservation modes, "*International Journal of Contemporary Hospitality Management*, vol. 17, pp. 136-146, 2005.

[2] *Website Evaluation Criteria and its Application: Tophams Hotel website*, Business Research Methodology, 2022. [Online]. Available: https://research-methodology.net/website-evaluation-criteria-and-its application-tophams-hotel-website/

[3] R. Law, "Evaluation of hotel websites: Progress and future developments," *International Journal of Hospitality Management*, vol. 76, pp. 2–9, 2019.

[4] S. Guo and H. Zhao, "Fuzzy best-worst multi-criteria decision-making method and its applications," *Knowledge-Based Systems*, vol. 121, pp. 23–31, 2017.

[5] E. Çınaroğlu and F. Zaralı, "Cappadocia hotels' website quality evaluation: A multi-criteria Intuitionistic Fuzzy EDAS (IF-EDAS) method application," vol. 10, no. 2, pp. 769-786, 2022.

[6] C. Ip, R. Law and H. A. Lee, "The Evaluation of Hotel Website Functionality by Fuzzy Analytic Hierarchy Process," *Journal of Travel & Tourism Marketing*, vol. 29, no. 3, pp. 263-278, 2012.

[7] G. Kabir and M.A.A. Hasin, "Comparative analysis of TOPSIS and Fuzzy TOPSIS for the evaluation of travel website service quality," *International Journal for Quality Research*, vol. 6, no. 3, pp. 169-185, 2012.

[8] A. Akincilar and M. Dagdeviren, "A hybrid multi-criteria decision-making model to evaluate hotel websites," *International Journal of Hospitality Management*, vol. 36, pp. 263-271, 2014.

[9] M. Ostovare and M. R. Shahraki, "Evaluation of hotel websites using the multicriteria analysis of PROMETHEE and GAIA: Evidence from the five-star hotels of Mashhad," *Tourism Management Perspectives*, vol. 30, pp. 107-116, 2019.

[10] R. Baki, "Evaluating hotel websites through the use of fuzzy AHP and fuzzy TOPSIS," *International Journal of Contemporary Hospitality Management*, 2020.

[11] M. Yucesan, S. Mete, F. Serin, E. Celik and M. Gul, "An integrated best-worst and interval type-2 fuzzy TOPSIS methodology for green supplier selection,"*Mathematics*, vol. 7, no. 2, 2019.

[12] J. Gan, S. Zhong, S. Liu and D. Yang, "Resilient Supplier Selection Based on Fuzzy BWM and GMo-RTOPSIS under Supply Chain Environment," *Discrete Dynamics in Nature and Society*, 2019.

[13] A. Norouzi and H. Ghayur Namin, "A Hybrid Fuzzy TOPSIS – Best Worst Method for Risk Prioritization in Megaprojects," *Civil Engineering Journal*, vol. 5, no. 6, pp. 1257–1272, 2019.

[14] S. Chakraborty, "TOPSIS and Modified TOPSIS: A comparative analysis," *Decision Analytics Journal*, vol. 2, pp. 100021, 2022.

[15] A. Azizi, D. O. Aikhuele and F. S. Souleman, "A Fuzzy TOPSIS Model to Rank Automotive Suppliers," *Procedia Manufacturing*, vol. 2, pp. 159–164, 2015.

[16] M. Ashrafzadeh, F. Rafiei, N. Isfahani and Z. Zare, "Application of fuzzy TOPSIS method for the selection of Warehouse Location: A Case Study," *Interdisciplinary Journal of Contemporary Research in Business*, vol. 3, no. 9, pp. 655–671, 2012.

[17] F. Samaie, H. Meyar-Naimi, S. Javadi and H. Feshki-Farahani, "Comparison of sustainability models in development of electric vehicles in Tehran using fuzzy TOPSIS method," *Sustainable Cities and Society*, vol. 53, pp. 101912, 2020.

[18] C. L. Hwang and K. Yoon, "Multiple Attribute Decision Making: Methods and Applications A State-of-the-Art Survey," Springer, 1981.

[19] S. Nadaban, S. Dzitac and I. Dzitac, "Fuzzy TOPSIS: A General View," *Procedia Computer Science* vol. 91, pp. 823-831, 2016.

[20] C. T. Chen, C. T. Lin and S. F. Huang, "A fuzzy approach for supplier evaluation and selection in supply chain management," *International Journal of Production Economics*, vol. 102, no. 2, pp. 289–301, 2006.

[21] F. Samanlioglu, A. N. Burnaz, B. Diş, M. D. Tabaş, and M. Adigüzel, "An Integrated Fuzzy Best-Worst-TOPSIS Method for Evaluation of Hotel Website and Digital Solutions Provider Firms," *Advances in Fuzzy Systems*, 2020.