



Customers segmentation in eco-friendly hotels using multi-criteria and machine learning techniques

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ABSTRACT

This study aims to investigate the travellers' choice behaviour towards green hotels through existing online travel reviews on TripAdvisor. Accordingly, a method combining segmentation and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) techniques was developed to segment travellers based on their provided reviews and to prioritize green hotel attributes based on their level of importance in each segment. The data were taken from travellers' online reviews of Malaysian eco-friendly hotels on TripAdvisor. The results showed that the sleep quality was one of the most important factors for eco-hotel selection in the majority of segments. The developed method in this study was able to analyse travellers' reviews and ratings on eco-friendly hotels to identify the future choice behaviour and aid travellers in their decision-making process. The study provides new insights for hotel managers and green policy makers on developing environmental-friendly practices.

1. Introduction

Tourism and hospitality industries have made incredible impacts on the current economic system [1]. Almost 7% of global trade and 9.8% of entire global gross domestic product in 2016 have been associated to tourism-related businesses. Meanwhile, 11% of employment opportunities all around the world were created by the tourism industry, either directly or indirectly [2,3]. However, despite this outstanding involvement in the economic development of societies, the negative impacts on climate change by the huge amount of greenhouse gases produced are indeed considerable [4]. Tourism is among the highest environmentally harmful sectors alongside the industry [5], transportation [6], energy [7], and construction [8,9] sectors. Hotels, the most important segments of the tourism industry, are the main water-intensive and energy

consumers in their daily operations [10]. Thus, over the last years, researchers have started to give substantial attention to the issue of sustainable development in the tourism industry [11], especially in the hotel sector [12–14]. The lodging sector has focused more on the implementation of a wide range of green practices to moderate its negative impacts on the environment and to meet the increasing environmental concerns of consumers [15,16]. Previous studies have found that getting involved in “green”, alternatively called “eco-friendly” or “sustainable”, hotel initiatives is not a temporary structure that will vanish in a short time, and the number of such hotels will increase exponentially [17]. Consistent with this situation, practitioners and marketers in the hotel industry become increasingly proactive in developing environmental programs and initiating green practices [18]. Going green is considered an active strategy to increase the

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competitiveness of hotels and to acquire market share by attracting more sustainability-sensitive travellers [15,16].

Nowadays, travellers' demands and interests for green lodging have been steadily growing. Customers are increasingly aware of the environmental problems caused by hotels and seek "green consciousness" in hotels' process management [15,16]. According to official reports, nearly more than 92% of users have positive feelings towards the businesses that follow environmental protection practices. However, gaining a complete understanding of what potential customers desire green consumption is still a serious challenge for hotel marketers [19]. So far, studies on consumer behaviour with respect to eco-friendly hotels have focused on tourists' green knowledge and staying behaviour [20], intention formation of customers to stay at eco-hotels [21,22], guest satisfaction and intention to return [23,24], customers' green attitudes and preferences toward green practices [19,25]. However, these studies are mostly conducted based on fix IS theoretical foundations and associated predefined constructs and hypotheses. Meanwhile, a survey or experimental design has been the most common methodology utilized to assess customers' decision and behaviour towards eco-friendly accommodations. According to Kim et al. [14]; in such studies, respondents are limited to assuming certain situations or accepting a certain hypothetical setting. Moreover, it is believed that some conflicts, such as green consumption or ethical purchasing, result in imbalanced social desirability. Meaning that customers' perceive completed survey questions in the manner which they recognize as socially acceptable [26]. In fact, travellers tend to over-report their preferences in self-reported surveys by emphasizing on their eco-friendly intentions [27].

On the other hand, online travel review websites have increasingly become dynamic platforms to share and assess customers' attributes and the performance of businesses in the current smart tourism system [14]. Travellers are relying heavily on online travel review services for their decision-making process and prefer accommodations recommended by others on such websites [28]. Online consumer assessments are supposed to be more trustworthy as data provided by one's own decision can deliver more realistic explanation of actual feelings and experience [29]. So far, many research focused on the information that can be drawn from such services in the hotel industry [28,30,31]. However, the green hotel context has been greatly overlooked in such literature. There are limited studies to reveal patterns of customers' attitude-behaviour information towards green hotel attributes from a large dataset taken from online travel review services. For example, Yu et al. [32] studied the influence of green experience on travellers' satisfaction using green reviews of hotels in the USA. Brazytė et al. [33] explored reactions of customers to the sustainability practices of green hotels by analysing reviews posted online. Kim, W.G. et al. [34,35] identified the impact of green practices in hotels on general online assessment of travellers, revisit intention, and hotel performance. This study aims to investigate travellers' choice behaviour towards green hotels through existing online travel reviews on TripAdvisor.

Structuring a huge amount of data taken from online travel reviews into distinct groups is one of the most essential modes of learning and understanding customers' preferences, needs, and behaviour [36,37]. Therefore, in this study segmentation is used to classify travellers based on their reviews posted on TripAdvisor. Since there has been always ambiguity in picking a hotel with a wide range of complex criteria, hotel selection is considered a kind of multi-criteria decision making (MCDM) problem [38]. In fact, ranking attributes and factors that impact destination choice is a compound MCDM process. Thus, this study used the MCDM technique to prioritize green hotel attributes in each segment based on their level of importance. Finally, in each segment, the relationships between the features of eco-friendly hotels and travellers' overall ratings were modelled using easy-to-understand decision rules. Consequently, the main research objectives are formulated as follows:

1. To investigate the attributes that influence travellers' choice behaviour towards green hotels.

2. To segment travellers and prioritize the attributes that influence their choice behaviour towards green hotels through segmentation and MCDM techniques using existing online travel reviews.
3. To discover the decision rules in travellers' segments through their past experiences on eco-friendly hotels.
4. To develop a method for travellers' segmentation and predicting their future choice preferences.

To have a good society, sustainability is considered as one of the important criteria. According to Brey [39]; economic and social provisions should be such that they do not impose basic harm on ecosystems in ways that pollute the environment, exhaust natural resources, and damage the ability of societies and the wellbeing of their citizens. So far, the development of new technologies has played an important role in economic development and provided new opportunities for tourism at a global level [40]. Apparently, harnessing great potentials of technologies can enhance awareness and environmental performance among consumers and other stakeholders in the hotel industry [41]. Technologies are increasingly being incorporated into the hotel sector and it is critical to understand the behaviour of customers in such environments [42]. This technological revolution has produced a large amount of data through digital devices [43]. Thus, extracting valuable information from these massive unstructured data is extremely critical for customers, organizations, and policy makers. This study developed a method to explore customers' decision making on eco-friendly hotels which can open new opportunities for researchers to model travellers' behaviours as well as for hoteliers and policy makers to get better outcomes from available online review comments and therefore design more systematic policies and plans.

This research is organized as follow. In Section 2, we provide an overview of green practices in Malaysia. In Section 3, we provide a comprehensive literature review of studies on traveller perceptions of green hotels, online travel reviews, the application of MCDM in hotel industry, and the application of clustering in the tourism industry. In Section 4, the research methodology is explained. In Section 5, the results of the data analysis are reported. Finally in Section 6, conclusions and implications are provided.

2. An overview of green practices in Malaysia

Green hotel is described by the Tourism Council Australia [44] as "a natural tourist lodging developed and managed in environment sensitive ways to maintain its business environment and provide guests with green products, green services, and healthy, refreshing, and comfortable accommodations that reflect the features of natural ecologies". In Malaysia, eco-friendly concerns seriously started in 1997 after the economic disaster [45]. The Government of Malaysia began to consider the sustainability development in the 8th and 9th Malaysia Plan and the concept was officially included in the "National Green Technology Policy 2009 (NGTP)" [46]. The NGTP2009 emphasized the growth and development of major sectors such as water and waste management, buildings, energy, and transportation as well as research and development, commercialization, and innovation with internal and external businesses. Meanwhile, NGTP2009's goals cover 10th, 11th, and 12th Malaysian Plans to protect the environment while considering economic value. Thus, different green agencies were established in 2009 (Ministry of Energy, Green Technology and Water (MEGTW), etc) to govern green technology implementation and policy making in Malaysia [47]. Malaysia is currently on its 11th Malaysia Plan (2016–2020) in which government has mainly focused on speeding up green growth. Improving governance to drive revolution, creating mechanisms for sustainable financing, and improving consciousness to generate shared responsibility are three strategies considered in this Plan. Thus, the government is working on green production and consumption, improving flexibility against natural disasters and climate change, and preserving natural resources for the next five years. Malaysia is setting a

general vision for the usage of technology, science, and innovation in order to increase socio-economic development. In this way, augmenting ecosystem management and encouraging eco-tourism are considered urgent national research and development areas (2017). In line with these policies and plans, the eco-friendly concept has steadily found its way to the Malaysia tourism industry as well [45]. Tourism is the second biggest industry in Malaysia and it is heavily reliant on hotel services [48]. From 2010 to 2015, hotel establishments in Malaysia grew significantly and reached up to 309,369 rooms in 2016. Moreover, a large number of hotel developments is projected to take pace till 2021 [49,50]. However, even though numerous green resorts and hotels are currently emerging in Malaysia, the number of hotels awarded as Green Hotel is still limited. Although there are many Malaysian resorts and hotels that involved in green initiatives in their operation (such as Golden Palm Tree Spa Resort in Sepang), only a limited number of them were awarded the Green ASEAN Hotel in 2012 [51]. In fact, initiating green practices in the Malaysian hotel industry has been slow and still at the early stages when compared to other developed countries [52]. Thus, as Mas'od and Chin [48] also emphasized, investigating green tourists' profile and their green purchase behaviour towards Malaysian hotels is a critical research direction.

3. Literature review

3.1. The studies on traveller perceptions of green hotels

In addition to the all benefits and rationales such as increased stakeholders pressure, agreement with government strategy and regulation, reputation enhancement, competitive advantage, performance improvement, and cost reduction, customers are the central reason that encourage hotels to move towards green practices [53]. Consumers normally make decisions about a specific service or product according to the features that are offered or the attributes of the service or product as a whole [54]. Nowadays, travellers are increasingly looking for hotels that follow and implement any kind of green practice [55]. However, even though many hotels have started to initiate eco-friendly strategies, less consideration has been rewarded to the role of users' preferences and interests towards eco-hotels and more in-depth research is required in this field [53]. According to a review conducted by Kim, S.-H. et al. (2017) on green research in the hospitality sector, only 33 out of 146 research focused on the consumer intentions to green initiatives. In this section, we reviewed existing studies on consumer behaviour/perception towards green hotels. A summary of the studies has been provided in Table 1 in Appendix A.

Ahn and Kwon [56] aimed to understand travellers' attitude formation process towards green hotels by using a cognitive-affective-conative framework. Data were collected from guests of green hotels in Malaysia through a questionnaire. The results showed that negative and positive anticipated emotion as well as attitude have significant influence on the behavioural intention of customers. Wang et al. [57] examined the impact of religiosity on travellers' green purchase intention by incorporating the Theory of Reasoned Action (TRA) and the Theory of Planned Behaviour (TPB). Data were collected from local visitors who had some experience with staying at green hotels. The results showed that extrinsic religiosity has significant and positive impact on green purchase attitude. Nimri et al. [58] conducted a study to understand customers' intention to stay in eco-friendly hotels in Australia. Past experience was added as an extra factor to the TPB and data were collected through a questionnaire survey. The results showed that attitude, subjective injunctive norms, perceived behavioural control, and past experience have positive influence on travellers' intentions. Preziosi et al. [59] identified the core drivers of guest loyalty formation towards green hotels. This study collected data from Portuguese eco-friendly hotels. The results confirmed the positive influence of guest environmental behaviour on guest loyalty towards green hotels. Merli, Roberto et al. [15,16] explored the influence of customers'

perceptions of hotel green practices on their behavioural intentions. Data were collected from guests of hotels in Italy through a questionnaire survey. The findings showed that green practices have positive influence on guest satisfaction and loyalty. Wang et al. [60] investigated travellers' intentions to visit green Chinese hotels. They extended TPB by adding perceived customer effectiveness and environmental concern factors. Data were collected using a questionnaire survey. Kim, W.G. et al. [34,35] identified the impact of green hotel practices on online assessment of travellers, revisit intention, and performance of hotel using focus-group interviews. Following a qualitative research approach and TPB, Nimri et al. [53] assessed beliefs that lead Australian residents to purchase green hotel accommodation. Rahman and Reynolds [55] explored consumers' behavioural decisions for or against visiting a green hotel. They investigated the interconnection between travellers' biospheric values, their behavioural intentions, and their preference to sacrifice for the environment in the context of green hotels. Mohd Suki and Mohd Suki [61] investigated the relationship between green hotel knowledge and travellers' tendency to visit an eco-friendly hotel. Han and Yoon [62] assessed customers' intention formation when choosing environmentally responsible accommodation using model of goal-directed behaviour. Considering perceived competence, perceived warmth, and service outcome, Gao and Mattila [24] predicted tourist satisfaction with green hotels. Extending the TPB, Chen and Tung [25] examined travellers' intention to visit green hotels in Taiwan. Berezan et al. [23] investigated the impacts of sustainable hotel practices on the guests' satisfaction and intention to return. Han et al. [19] examined the influences of eco-friendly attitudes on tourists' eco-friendly intentions to visit a green hotel. Using TPB as theoretical foundation, Han and Kim [22] assessed the customers' intentions formation to stay at green hotels in U.S.

3.2. Online travel reviews

Online traveller reviews have progressively become available for all variety of tourism-related services and products. Consumers normally consider online reviews a great source of reliable and detailed information based on the real experience of other consumers [63]. For the hospitality and travel industry, online review websites are active platforms for creating and sharing trustworthy information that allow travellers to express their recommendations and share their experience about points of interest, accommodation, and destinations [31]. Thus, travellers have always shown a high preference for referring to online travel information (a form of e-word-of-mouth (eWOM)) to decrease their cost/effort and level of perceived ambiguity and to have indirect purchasing experiences [14]. According to Ye et al. [64]; around 80% of travellers refer to online review websites before booking their accommodation while 84% of guests who consult review sites are significantly influenced by review comments when making a purchase decision. It is therefore critical for marketers to know what makes online reviews helpful to users and how this information impacts their choices [65]. Hotel managers steadily check online reviews to increase value by analyzing customer preferences and modifying services based on available information [66]. TripAdvisor.com is A leading online travel review website with more than 44 million members, 500 million guest reviews, and 50,000 new reviews covering more than 190 accommodation, restaurants and attractions daily [67]. This tourism community can significantly assist tourists to plan their trips, look for interesting scenic spots, good hotels, and cuisines before leaving [30]. More specifically, this platform can play a significant role in establishing the online reputation of hotels by benchmarking their guest satisfaction score against their competitors in the marketplace [31].

Recently, content and narrative analysis of customer online reviews have gained the substantial attention of scholars. D'Acunzio et al. [68] examined the way that travellers evaluate hotels' corporate social responsibility (CSR) when creating an online review about their experience in an accommodation. Based on text analysis of 480,000 reviews, it

was found that customers increasingly care about CSR factors, especially social and environmental ones. Filieri et al. [69] identified the factors that moderate the impact of tremendously negative hotel reviews on helpfulness of reviews. Online customer reviews were collected to test the assumptions. The results confirmed that tremendously negative comments are more probable to be supportive in case the review is easy to read and long. Yi et al. [70] studied the travellers' perception of green hotels by conducting a content analysis of online reviews of hotels. The results showed that users perceive most hotel green practices as positive. Travellers considered green actions, such as systems for storm water management and reflective roofing as well as guest training as useful considerations by hotels to be eco-friendly. Yu et al. [32] explored visitors' experiences at eco-friendly hotels and the influence of the green experience on customer satisfaction by referring to 727 green related reviews taken from TripAdvisor. Brazyté et al. [33] explored the reactions of customers to the sustainability practices of green hotels by analysing reviews posted online. Collecting data from travellers' reviews on TripAdvisor, Raguseo et al. [31] investigated the relationships between economic value hotels, variety of online travel agencies, and reputation through travellers' reviews. Kim et al. [14] examined the relationship between guest satisfaction and hotel green practices using customer reviews on TripAdvisor. Employing descriptive statistics with correlation coefficients between attributes, they found that a higher perception of green attitudes can indirectly increase customer satisfaction.

Filieri [71] utilized the grounded theory method to identify the level of trustworthiness of online reviews. They conducted interviews with users and found that they normally use cues related to the comment style and valence and review extremity to evaluate trustworthiness. Lee et al. [72] explored hotel visitors' awareness of green efforts by using comments on TripAdvisor. The results indicated that the majority of users feel positive toward green initiatives (such as reducing energy usage or water saving) when they realize them. Filieri [65] adopted a dual-process theory to explore the normative and informational influences of online reviews. The study found that users are generally impacted by the quality of information, user ratings and overall rankings. Filieri and McLeay [73] examined the factors that influence travellers to use information from online reviews in their decision making. According to the findings, information accuracy, product ranking, information relevance, information value-added, and information timeliness are the main drivers of the adoption of information from online reviews on accommodations. Li et al. [74] identified the hotel selection preferences of Hong Kong travellers using online reviews on TripAdvisor. Peng et al. [30] developed a hotel selection support model for guests using online reviews on TripAdvisor. Yu et al. [67] designed a new mathematical framework to facilitate appropriate hotel selection on TripAdvisor.

So far, the majority of the studies have been carried out based on psychological theories such as TRA and TPB. Experimental designs or survey questionnaires have been commonly utilized methodologies in which travellers were requested to undertake a hypothetical setting with a few and fixed number of green hotel features. A limited number of studies have been devoted to exploring the travellers' intentions towards green hotels using online travel reviews. In terms of methodology, they have mainly conducted interviews and performed content analysis to extract information from available review comments. The application of text mining and MCDM techniques have been strongly recommended to model and analyse different angles of travellers' behaviour [67,74,75]. However, these techniques have been overlooked in the decision-making process of travellers in relation to green hotels. Meanwhile, to date, less attention has been paid to customer segmentation through online reviews in the green hotel industry. This study aimed to investigate the attributes that influence travellers' choice behaviour towards green hotels by performing segmentation and MCDM techniques on existing online travel reviews. This is the first time that such a method has been used for segmenting customers of green hotels.

Market segmentation divides a marketplace into distinct customer segments based on different behaviour, requirements, and features that may require different marketing strategies. It can assist managers in better serving dissimilar markets and their customer segments. Moreover, with the help of market segmentation, industries can know more about their customers' preferences and adjust their policies for targeted segments to not only increase revenue, but also enhance travellers' satisfaction.

3.3. MCDM application in the hotel industry

MCDM is involved in projecting computational and mathematical tools to handle the assessment of a limited number of decision substitutes by a unique decision maker or team [76]. Since the 1960s, MCDM has been an interesting research area and has continuously generated applied and theoretical books and papers [77]. There is still a strong request in the literature for such techniques [74]. Over the past decades, MCDM techniques have gained great attention from practitioners and researchers in assessing, measuring and prioritizing principles across different businesses [77]. Therefore, different MCDM techniques have been proposed for different decision-making problems [78–80]. In the meantime, MCDM increasingly appears as a useful method in modelling travellers' behaviour and solving related MCDM problems in the hotel and hospitality industry. Considering the focus of this study, in this section, a review of existing research on the application of MCDM techniques in the hotel industry is provided.

Sari and Suslu [81] used the “technique for order of preference by similarity to ideal solution (TOPSIS)” method to examine the sustainability performances of hotel supply chains in Turkey. They revealed the hotel supply chains' performance score as well as the points required for hotels to have higher green performances.

Yu et al. [67] designed a new MCDM mathematical model based on linguistic distribution assessments to select the best hotels on the TripAdvisor website. Pahari et al. [82] utilized an integration of TOPSIS and intuitionistic fuzzy set methods in order to facilitate hotel choice decisions for tourists. Zhang et al. [83] developed decision support model utilizing fuzzy sets, Bonferroni mean, and detailed information for travellers on TripAdvisor. Meanwhile, it utilizes a new similarity measurement that can manage sparse data in fuzzy conditions.

Based on a novel MCDM technique, preference selection index (PSI), Aksoy and Yetkin Ozbuk [84] investigated the factors that are important in travellers' hotel location choice. Li et al. [74] proposed a novel fuzzy decision-support method for generating preference profiles of tourists in order to provide a comprehensive information on the hotel choice attitude of visitors in Hong Kong.

In order to assist the tourists and managers in making better decisions, Sohrabi et al. [38] proposed a complete model for hotel selection in Tehran by using an exploratory factor analysis (EFA) and fuzzy membership functions. Firstly, the general factors for hotel selection were identified and used as input of EFA to recognize the most important ones. The EFA results identified “comfort”, “security and protection”, “network services”, “pleasure”, “staff and their services”, “news and recreational information”, “cleanliness and room comfort”, “expenditure”, “room facilities” and “car parking” as main hotel selection factors. Next, the fuzzy sets low, moderate or high and fuzzy membership functions were defined for each factor. The results showed that “hotel comfort” and “hotel compensatory measures” are of high significance for tourists. Meanwhile, a set of fuzzy rules have been created to show the relationships between selected factors and sub-factors.

Chen et al. [85] conducted a study to assess the performance of five-star hotels in Iran and to choose the optimal ones. The study selected service quality, hotel facilities, price, security, room and front desk, and location as important factors. The “analytic network process (ANP)” was firstly used to identify the weights of factors and to determine the relationships between them. Secondly, the results of the ANP were used to perform a TOPSIS analysis to rank four well-known

five-star hotels. The findings showed that location is the most vital factor for customers and Esteghlal is the most preferred hotel.

Hsu et al. [75] developed and tested a model of “analytic hierarchy process (AHP)” and TOPSIS to explore the tourist choice of destination behaviour in Taiwan. Chou et al. [86] developed a “fuzzy multi-criteria decision making (FMCDM)” model to examine the hotel location choice behaviour of travellers in Taiwan. Benítez et al. [87] utilized a decision-making method to examine the service quality in three Gran Canaria hotels. Focusing on the perception of the degree of optimality, they designed general service performance index for each hotel through TOPSIS.

It can be concluded that MCDM techniques have been widely utilized in previous studies to model customers’ behaviour and preferences in the hotel industry. However, although MCDMs are appropriate methods in assessing green scores and ranking green hotels [88], the application of those techniques is largely overlooked in the context of green hotels. Therefore, this study aimed to use MCDM in its investigation of travellers’ choice behaviour towards green hotels.

3.4. Studies on the application of clustering in tourism industry

Cluster analysis is a formal attempt to work on algorithms and techniques for categorizing or clustering things according to perceived intrinsic or measured features or similarity. The purpose of clustering is to look for structure in unstructured data and is thus exploratory in basis. Clustering is one of the main data analysis tool used in different domains [37]. Customer segmentation is vital for businesses looking for appropriate promotion strategies development for different clusters. It is vital for a business desiring to develop suitable promotion policies based on the need of different clusters. Customers segmentation can assist in providing an in-depth understanding of their preferences, needs, and behaviour [36]. So far, segmentation/clustering techniques have been successfully applied in different context such as library records [36], online customized fashion business [89], and e-commerce [90]. The variety of customers and services in the tourism and travel industry has also engendered the different application of segmentation strategies as tactical solution in this progressively competitive marketplace [91].

Applying an activity-based segmentation, Eusébio et al. [92] explored rural tourism areas in Portugal. The study considered four clusters, and the results demonstrated the important role of providing diverse rural tourism services to these clusters. Rid et al. [93] utilized segmentation to extract dissimilar market segments for Gambia tourism activities. Georgiadis and Tang [94] divided the market into four clusters according to high vs. low show-up probability and high vs. low valuation in order to examine the best reservation plan with a non-refundable deposit in the hotel industry. Costa [95] employed market segmentation to explore the key factors influencing prices of holiday accommodations in Spain. They found that prices are impacted by accommodation regime, hotel category, and geographical settings. Guo et al. [96] focused on the finest dynamic pricing policy for market segmentation of services in reservation systems taking hotel rooms as case study. They used dynamic programming and Chebyshev’s Sum Inequality available for the non-linear and linear demand cases. They concluded that considering online reservation systems is a suitable strategy for market segmentation.

Frochot [97] conducted an exploratory study to provide wider insights into the profiles of rural travellers in Scottish sites. By considering the customers’ benefits sought, they were clustered into four distinct categories. However, the results showed little sign of the importance of the rural characteristics across the clusters. Chung et al. [98] examined three different methodologies of market segmentation on travellers of hotel guest rooms. They believed that segmentation based on data benefit and Chi-Square Automatic Interaction (CHAID) are the best fit procedures for clustering hotel customers.

It was concluded that cluster analysis in tourism industry is an explorative approach that consists of a wide variety of techniques and

recipes. Though the importance of segmentation is well recognized in current research streams, most of the attempts are based on the pre-defined groups and/or data collected through survey questionnaires that cannot comprehensively disclose behaviour patterns of travellers. The application of segmentation to discover patterns in a large dataset taken from online travel review services such as TripAdvisor and uncover possible clusters is still rare in the literature. More specifically, the concept of traveller segmentation has been largely overlooked in the green hotel context.

4. Research methodology

The data collection for this research was performed on TripAdvisor as it is the most popular online tourism review website [99]. To collect the data, a two-step approach was followed. Firstly, Malaysian green hotels listed on TripAdvisor were identified. Secondly, to avoid biases, 50 eco-friendly hotels were randomly selected by the crawler in TripAdvisor. The data were crawled from travellers’ online reviews written between 2018 and 2019 on selected Malaysian eco-friendly hotels in TripAdvisor. Accordingly, a total of 14,525 reviews and ratings were collected into the datasets. The hotel selection was not limited to a specific city in Malaysia. In addition, 4- and 5-star hotels were selected. All eco-friendly hotels had been rated by the travellers on seven features, “value (cost-benefit)”, “location”, “check-in/front desk”, “sleep quality”, “rooms”, “cleanliness” and “service”. The travellers also provided an overall rating of the hotels to show their satisfaction with the eco-friendly hotels.

This research employed segmentation and one MCDM technique to reveal the relative importance of eco-friendly hotels and to predict travellers’ choice preferences based on past online reviews. Specifically, *k*-means clustering [100], TOPSIS [101] and Classification and Regression Trees (CART) [102] techniques were used to segment travellers, select the important eco-friendly hotel criteria and predict the overall travellers’ preference, respectively. The proposed method includes three main stages—clustering the online reviews, ranking the eco-friendly hotels’ features and travellers’ choice preference—as presented in Fig. 1. In this section, we first explain the *k*-means clustering used in this study (Section 4.1) and then TOPSIS (Section 4.2) and CART (Section 4.3).

4.1. K-means clustering

K-means is undoubtedly one of the well-known and widespread clustering techniques [103]. Being easy to implement and use, fast, intuitive, efficiency, and empirical success are the key reasons for its general approval [37]. *K*-means was proposed for the first time by MacQueen [104]. Despite being introduced many years ago, it is still widely used for data clustering [37], even in the tourism and hospitality context [105,106]. The main phases of the *k*-means algorithm are choosing a basic partition with *k* clusters, creating a new partition by examining each pattern to its nearest cluster, and adding new cluster centres [107].

4.2. TOPSIS

Among different MCDM methods, TOPSIS has satisfactorily performed in various application areas to manage real-world decision difficulties. Thus, this method has increasingly received much interest from researchers in different fields [77], especially in the hotel and tourism industry [81,82]. Hwang and Yoon [108] introduced TOPSIS to aid the choosing of the finest alternative from a predetermined number of criteria. The normal TOPSIS method aims to select substitutes that concurrently have the longest distance from the negative perfect solution and the shortest distance from the positive perfect key. To utilize this method, feature values should be in numeric form, constantly decreasing or increasing, and have measurable by the same standard

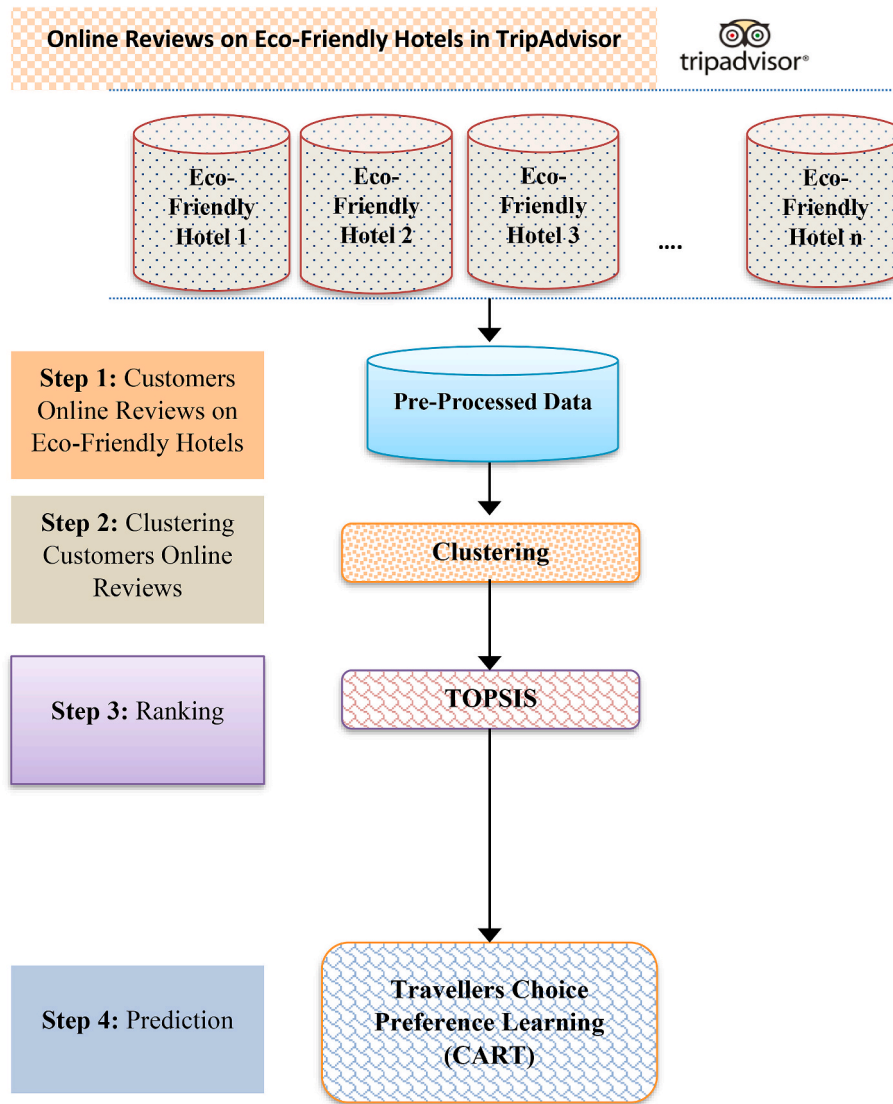


Fig. 1. Proposed method.

units [77]. The TOPSIS procedure is shown in Fig. 2.

4.3. CART

Breiman et al. [109] proposed CART. CART is generally cited as an effective technique in modelling the associations between constructs of a model by generating decision rules. This method built a decision tree using recursive splitting of nodes for continuous variables and categorical variables. For classification problems, several impurity measures such as Gini index and Chi-square are used in CART [110]. To reduce the high complexity of the generated trees, tree optimization has a significant role in choosing the right size of tree. To do so, pruning algorithms can be used for cross-validation and an optimization task on the number of points in each node in the generated tree.

5. Results

5.1. Clustering by *k*-means

In the first step of the data analysis, *k*-means was employed to cluster the data. Specifically, *k*-means clustering was used for different cluster sizes. Then Silhouette method was utilized to assess the clusters quality and select the best one for further analysis [111]. The Silhouette analysis

showed that the best clustering size is 5 clusters for *k*-means. The results of *k*-means clustering are visualized in Fig. 3 on two Principal Components (PCs) of the Principal Component Analysis (PCA). The results were presented for 10-fold cross validations for 100 trials. Each cluster included users with similar ratings and online reviews. In addition, each cluster included an overall and the feature ratings ("check-in/front desk", "value (cost-benefit)", "location", "sleep quality", "rooms", "cleanliness" and "service") provided by the traveller after their stay in eco-friendly hotels. The ratings were then used for further analysis by TOPSIS for feature ranking. In fact, the clusters obtained by *k*-means were considered as five segments which include different travelling behaviour and experience based on the reviews and ratings on green hotels. This can help better understanding of travellers' choice preferences. As seen in Fig. 3, the clusters were visualized with different colours to show that each cluster contains similar travellers' choice preferences. In addition, the frequency of keywords in the travellers' reviews on eco-hotels in each segment are presented in Fig. 4(a–f). These keywords can help better understand customers' preferences in each segment. Meanwhile, Table 1 is a summary of the sociodemographic profile of travellers.

Segment 1: Travellers within this segment are mostly male (50.40%) and travelled with family (56.30%). Natural resources, sustainable, nature walk, atmosphere, green environment, noise pollution, nice view,

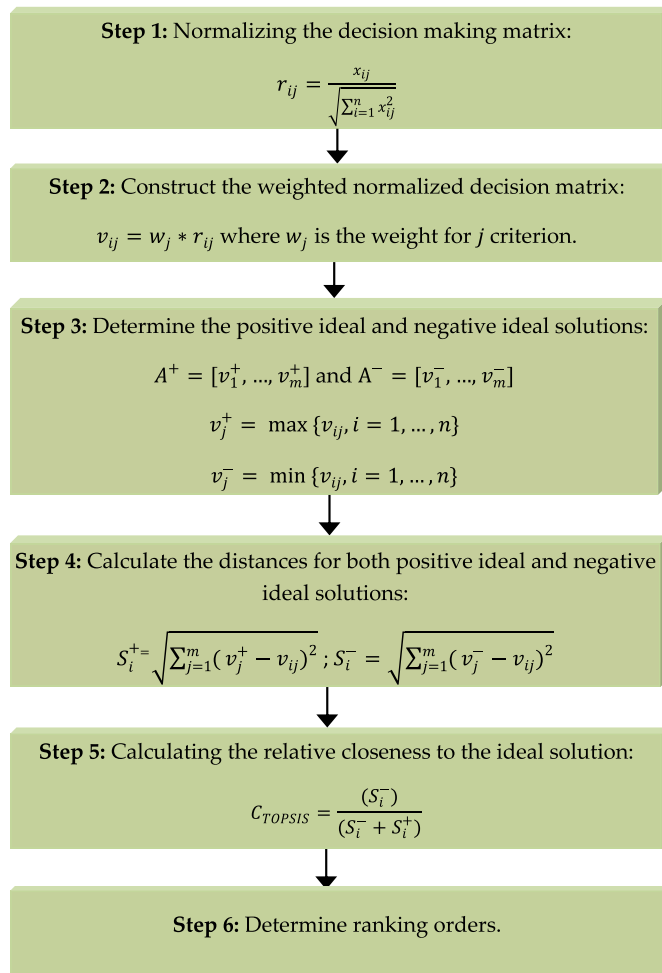


Fig. 2. TOSIS procedure.

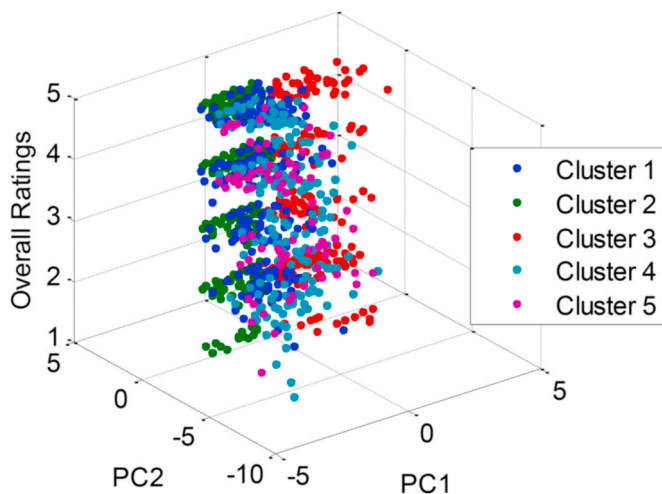


Fig. 3. Visualization of clusters generated by k-means.

boat ride, nice weather, and organic are the top ten keywords commonly repeated in the online reviews written by the travellers in this segment (Fig. 4 (a)).

Segment 2: Travellers within this segment are mostly female (8.80%) and travelled with family (53.40%). Natural resources, nature walk, sustainable, boat ride, green environment, noise pollution, atmosphere, nice view, rock climbing, fish feeding, nice weather, and

organic are the most common keywords used by these travellers (Fig. 4 (b)).

Segment 3: Travellers within this segment are mostly female (80.30%) and travelled solo (49.10%). Nature walk, sustainable, atmosphere, green environment, noise pollution, natural resources, boat ride, nice view, fish feeding, nice weather, and organic are the most common keywords in their reviews (Fig. 4 (c)).

Segment 4: This segment is mainly made up of women (59.70%) and those who travelled solo (80.40%). Natural resources, wood, sustainable, artificial lake, swimming, cold water, nature walk, poolside bar, wildlife, air pollution, boat ride, garden suite, green view, and nice weather are the most repeated keywords used by these travellers (Fig. 4 (d)).

Segment 5: This segment is mainly made up of men (63.50%) and those who travelled solo (49.10%). Natural resources, sustainable, nature walk, noise pollution, green environment, nice view, atmosphere, boat ride, nice weather, and organic are the top ten keywords commonly repeated in online reviews written by the travellers in this segment (Fig. 4 (e)).

5.2. TOPSIS results

In the second step of the analysis, the TOPSIS method was performed to find the relative importance of each factor. This helped to consider the most important features for each eco-friendly hotel. The numerical data for each hotel was selected and the TOPSIS technique was applied. The results for five clusters are presented in Table 2. It can be seen that TOPSIS has effectively obtained the rank of the eco-hotel features from the travellers ratings. Each cluster includes some of the important criteria for eco-hotel selection by travellers. It is important to note that the selection of features can play an important role in the final stage of our method, which is choice preference prediction. As seen in Table 2, the sleep quality is one of the important factors in majority of the segments (in three segments) for eco-hotel selection. Other hotel features such as location (rank 2) and service (rank 3) in the first segment; service (rank 2) and value (rank 3) in the second segment; location (rank 2) and cleanliness (rank 3) in the third segment; room (rank 1) and service (rank 3) in the fourth segment; and cleanliness (rank 1) and location (rank 3) in the fifth segment have been more important.

5.3. CART results

Finally, the online ratings from each cluster are considered sources for CART. In addition, the inputs in each CART are those selected features obtained in the previous stage by the TOPSIS method. The output of the CART technique is the overall ratings which reveal the overall satisfaction of travellers. In this stage, CART was used to predict the travellers' choice preference. In addition, CART was used to find to what extent an eco-hotel will meet the choice preferences of travellers. The CART method was performed on each cluster to find the relationship between the eco-friendly hotels' features and travellers' satisfaction level. Accordingly, in each cluster, several decision rules were generated. These rules are in the form of IF-THEN based on the selected features. In Tables 1–5 in Appendix B, all decision rules are presented. As seen from these tables, the decision rules have effectively predicted the output (traveller choice preferences) based on its input features. These decision rules can be used to predict travellers' decision making and their future choice preferences.

6. Conclusions and implications

There has been an outstanding growth in environmental awareness all around the world. The public have become increasingly aware of the negative influences of greenhouse gases on the environment and are looking for sustainable practice implementations in industrial fields [112]. Travel and tourism is cited as one of the sectors that has

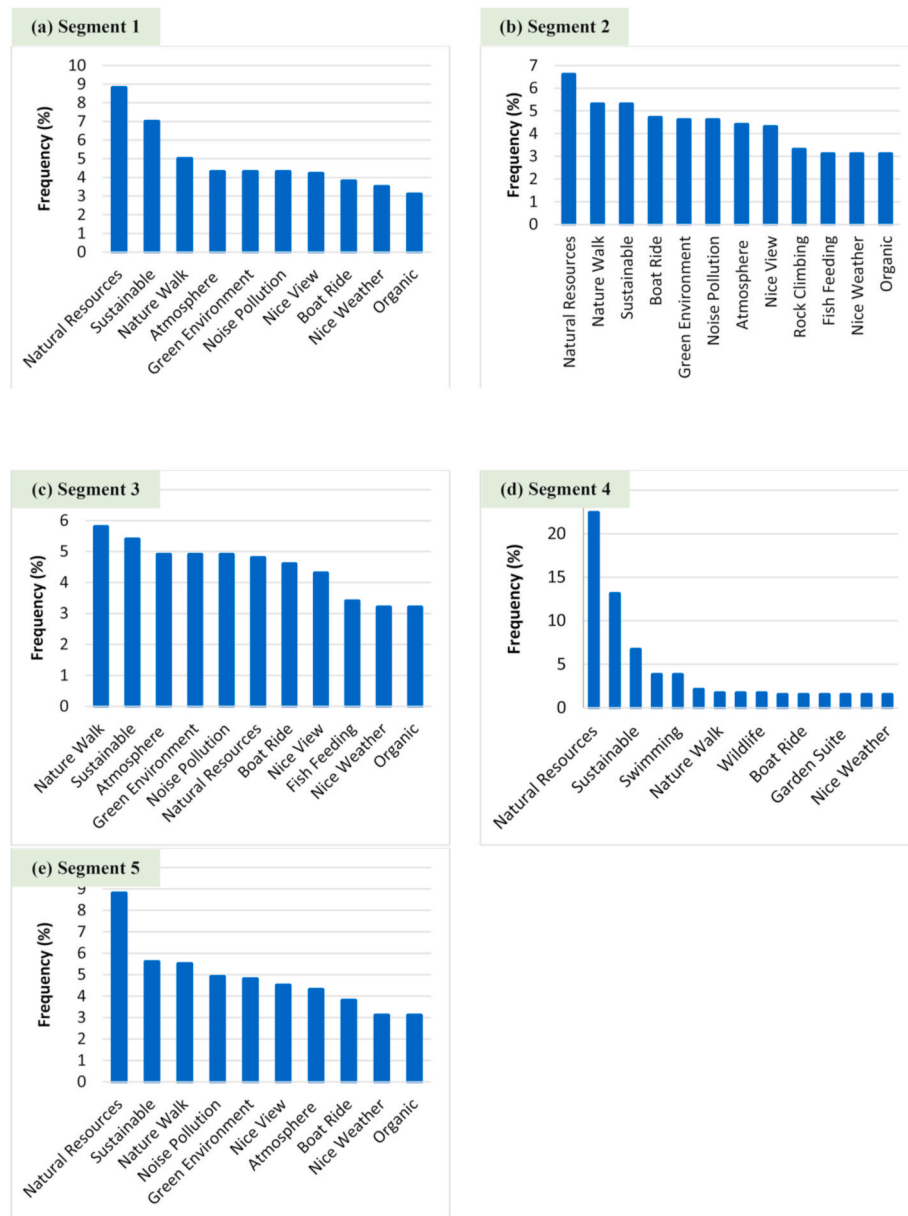


Fig. 4. The frequency of keywords in the travellers' reviews on eco-related hotels in the generated clusters.

Table 1
Sociodemographic profile of travellers.

	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
Gender					
Female	49.60%	68.80%	80.30%	59.70%	36.50%
Male	50.40%	31.20%	19.70%	40.30%	63.50%
Traveller type					
Couples	36.20%	6.00%	6.40%	2.70%	8.50%
Solo	4.10%	15.00%	49.10%	80.40%	49.10%
Families	56.30%	53.40%	38.20%	13.30%	36.60%
Friends	3.40%	25.70%	6.40%	3.60%	5.80%
Hotel Star					
4 Star	13.10%	18.60%	44.90%	86.30%	58.60%
5 Star	86.90%	81.40%	55.10%	13.70%	41.40%

substantial negative influences on the ecosystem and environment. Thus, existing barriers and challenges to tourism sustainability, such as wide-ranging water consumption, high energy use, and habitat demolition as well as development of eco-friendly hotels have become the

main focus of researchers and practitioners [4]. Meanwhile, travellers are more aware of the environmental damages caused by hotels and seek accommodations with greener standards [21]. In this way, a growing number of travellers trust and approve online consumer reviews to assess the performance and quality of hotels [69]. Travellers' behaviour is one of the popular researched topics in the field of tourism [113] which is not well explored in the context of eco-friendly hotels. Thus, this study aimed to investigate travellers' choice behaviour towards green hotels using online travel reviews on TripAdvisor. A combination of segmentation and MCDM techniques were utilized in this study. K-means was used to segment travellers based on their reviews posted on TripAdvisor and TOPSIS was used to prioritize green hotel attributes based on their level of importance in each segment. Finally, the CART method was performed on each cluster to find the relationships between the eco-friendly hotel features and travellers' satisfaction level.

The results of this study showed that the best clustering size is five clusters for *k*-means. Each cluster included "check-in/front desk", "value (cost-benefit)", "location", "sleep quality", "rooms", "cleanliness" and "service" features as provided by the traveller after their stay in eco-

Table 2
Ranking the eco-friendly hotels.

Segment	Feature of Eco-Friendly Hotel	Relative Importance
Segment 1	Check-in/front desk	4
	Value (cost-benefit)	5
	Location	2
	Sleep quality	1
	Rooms	7
	Cleanliness	6
Segment 2	Service	3
	Check-in/front desk	5
	Value (cost-benefit)	3
	Location	4
	Sleep quality	1
	Rooms	7
Segment 3	Cleanliness	6
	Service	2
	Check-in/front desk	6
	Value (cost-benefit)	7
	Location	2
	Sleep quality	1
Segment 4	Rooms	5
	Cleanliness	3
	Service	4
	Check-in/front desk	5
	Value (cost-benefit)	4
	Location	6
Segment 5	Sleep quality	2
	Rooms	1
	Cleanliness	7
	Service	3
	Check-in/front desk	7
	Value (cost-benefit)	6
	Location	3
	Sleep quality	2
	Rooms	5
	Cleanliness	1
	Service	4

friendly hotels. Next, the TOPSIS method was employed to find the relative importance of each feature from travellers' perspective in each cluster. According to the results, sleep quality was one of the most important factors in the majority of segments (first, second, and third segments). Rooms and cleanliness were the first rank factors in fourth and fifth segments, respectively. Ahani et al. [102] found that check-in, location, and room were the highest preferred Spa hotel features in the majority of the identified clusters. Ahani et al. [99] found that sleep quality, service, cleanliness are the most important features rated by travellers of Canary Islands hotels. Therefore, green hotels are advised to put more efforts to performing green activities such as reusing linens and towels, recycling, and decreasing energy and water usage while improving sleep quality, rooms and cleanliness; factors that are important to travellers. Meanwhile, to inspire hotel customers to appreciate green practices, hotels should educate and inform travellers about provided green practices [72].

This research addressed the following contributions and implications. First, travellers typically show various prospects and/or interests considering their mode of travel, purpose, and prior experience [114]. Thus, hotel managers and policy makers are progressively looking to find travellers' preferences to improve their marketing policy and gain a smarter marketplace [115,116]. Recently, tourist demands/preferences are shifting towards hotels that follow environmental protection practices. To inspire travellers to go green, hotels need to care more about the customers' perceptions of the green practices [72]. However, studies on travellers' behaviour towards green hotels using online travel review systems are scarce. Thus, this study can significantly extend the current literature by exploring perceptions of consumer towards green activities through online travel review systems such as TripAdvisor.

Second, this study highlighted the important role of travellers' reviews posted on TripAdvisor in extending green practices among customers and hoteliers. This result is in line with previous studies that

confirm the importance of online reviews in travellers' decision making processes [65,68,70]. The findings can help hotels that are currently engaged in green initiatives to generate more practical marketing strategies based on the most significant factors preferred by travellers in each segment. On the other hand, hotel managers/owners can pay special attention to the low-ranked factors in each segment and address the related issues by considering short- and long-term strategic plans. By doing so, they can receive more positive reviews on TripAdvisor, reduce the number of negative reviews shared by dissatisfied travellers and eventually benchmark their quest satisfactory reviews against their competitors in the market. Meanwhile, more positive reviews play an important role in travellers' decision to return or stay in green hotels.

Third, so far, the main focus of research have been on sustainable tourism practices in developed countries like the UK [117], US [19,21,22]. However, less attention has been paid to sustainable/eco-friendly hotels in developing countries such as Malaysia [118]. Green tourism practices in Malaysia is an under-researched area [45,118]. Thus, this research is a good starting point for providing useful information that relate to the development of eco-friendly hotels in developing countries.

Fourth, according to Yi et al. [70]; hotels need to wisely tailor the level and kinds of green practices to travellers preferences as there is an inconsistency between willingness to contribute and real acceptance level. Since serving customers with quite different needs, preferences, and desires is very difficult for an organization in a marketplace, segmentation of customers is generally recommended to cluster customers for marketing purposes [36]. The variety of services and products as well as customers in the travel and tourism industry has increasingly made segmentation strategies the finest techniques for creating suitable policies in the competitive environment [91]. Thus, segmentation strategies have been widely used to discover different aspects of travellers' behaviour and offered products/services in the tourism industry such as pricing strategies [95,96], benefits sought in products/services [97], travellers' spending behaviour [119], and tourism activities [93]. However, the majority of the research were conducted based on fixed and predefined clusters or data collected through empirical approaches ([92,93], and [94]). Despite the popularity of TripAdvisor in providing trustworthy travel information, research exploring patterns of a large dataset taken from such websites using segmentation strategies is still limited. Ahani et al. [102] classified Spa visitors into nine dissimilar segments. Ahani et al. [99] identified four customer segments ("Highly Satisfied Travelers", "Satisfied Travelers", "Moderately Satisfied Travelers", and "Unsatisfied Travelers") for Canary Islands hotels. More specifically, traveller segmentation has been largely overlooked in green hotel context. This study is the first that employed segmentation strategies, K-means, to investigate travellers' choice behaviour towards green hotels using reviews in TripAdvisor. This study classified travellers into five distinct clusters based on their reviews and ratings on eco-friendly hotels. This can assist in offering products/services and communications that would most possibly appeal and satisfy specific guest groups and therefore would increase tourist's overall satisfaction with the accommodation. Hotel managers/owners can provide further policies to maintain closer relationships with different clusters of travellers, create competitive advantage and make more profit.

Fifth, the application of MCDM methods have been highly recommended for selecting and prioritizing attributes that influence travellers' choice behaviour [38,75]. According to Li et al. [74]; "there is still a strong demand for a technique which will enable the exploration of travellers' MCDM process". However, so far, most studies have focused on assessing customers' decision/behaviour towards eco-friendly accommodation using survey questionnaires and statistical techniques. This study is the first that employed MCDM in combination with segmentation techniques to rank the attributes of eco-friendly hotels based on different clusters of travellers. Understanding tourists' decision-making process is a highly effective method for enhancing services and products [74] and is a key to success for businesses [116]. Thus, this study can help tourists, hotel managers/owners, and green

policy developers to prioritize their decisions based on more important features. In this way, tourists can select the best appropriate hotels based on the important factors that they may not care about before. On the other hand, hotel managers/owners can manage their investments on the most crucial factors.

Sixth, a set of decision rules generated by CART can help hotel managers/owners and green policy developers better detect the importance and relationship between selected hotel attributes in predicting overall travellers' satisfaction and ratings. Moreover, compared to current research in the literature that were mainly conducted with the help of simple statistical techniques, the method utilized in this study is easy to understand and put in practice by managers. This method is flexible to changes in the inputs with less human intervention.

6.1. Limitations and future research directions

Despite the unique contributions of this research, there are some limitations that need to be considered. This study focused on only Malaysia. Conducting similar research in other similar countries can be more useful for comparative studies and final conclusions on travellers' segmentation and choice behaviour. This study was limited to ranking hotel features in each segment by performing TOPSIS while overlooking their interdependence. Thus, the application of advanced soft computing techniques (such as ANFIS) and/or modelling techniques (such as SEM) is recommended in future similar studies to discover effect of interdependence of criteria and to make the method more customized and

efficient. In addition, in this study, we used text mining approach to find keywords that are commonly repeated in online reviews provided by the travellers in each segment. The Latent Semantic Analysis (LSA) and the Linguistic Inquiry Word Count (LIWC), which are widely adopted in the travel and tourism field, can be complementary to the proposed method and have potential for investigation in future studies. Finally, more qualitative and quantitative studies are recommended in order to explore the reasons behind travellers' preferences for specific characteristics in each segment, thus assisting destination managers in predicting future demands.

Author contribution

Elaheh Yadegaridehkordi: Supervision, Conceptualization, Methodology, Investigation, Software, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, Validation; Mehrbakhsh Nilashi: Supervision, Conceptualization, Methodology, Investigation, Software, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, Validation; Mohd Hairul Nizam Bin Md Nasir: Investigation, Writing – review & editing, Visualization. Saeedeh Momtazi: Supervision, Conceptualization, Investigation, Writing – review & editing, Visualization. Sarminah Samad: Supervision, Conceptualization, Investigation, Writing – review & editing, Visualization. Eko Supriyanto: Supervision, Conceptualization, Investigation, Writing – review & editing, Visualization. Fahad Ghabban: Investigation, Writing – review & editing, Visualization

Appendix A

Table 1

Summary of studies on traveller perceptions of green hotels

Author	Aim of study	Theory/framework	Data collection method	Findings
[56]	To examine the formation process of green hotel customers' attitude	Cognitive–affective–conative framework	Questionnaire	Negative and positive anticipated emotion as well as attitude have significant influence on behavioural intention of customers
(L [57].	To identify the influence of religiosity on consumer's green purchase intention towards green hotel selection	Theory of Reasoned Action (TRA) and TPB	Questionnaire	Green purchase attitude significantly and positively influenced green purchase intention, extrinsic religiosity positively and significantly influenced green purchase attitude.
[58]	To understand customers' intention to stay in eco-friendly hotels in Australia	TPB	Questionnaire	Attitude, subjective injunctive norms, perceived behavioural control, and past experience have positive influence on travellers' intentions
[59]	To explore what are the main determinants for the formation of guest loyalty toward green hotels	–	Questionnaire	Guest environmental behaviour in tourism accommodation influences guest loyalty toward green hotels and guest perception of hotel environmental communication; guest perception of hotel environmental communication influences guest perception of hotel green practices and mediates the relationship between guest environmental behaviour in tourism accommodation and guest perception of hotel green practices
[15,16]	To explore how guests perceive “green hotel” practices and to test the relationship between guest perceptions of hotel green practices and behavioural intentions.	–	Questionnaire	Customers positively recognize the hotels' environmental commitment, with a significant influence on guest satisfaction and loyalty.
(J [60].	To explore the intention of consumers to visit green hotels in China	TPB	Questionnaire	Perceived consumer effectiveness and environmental concern have positive effects on the attitude and the intention of consumers to visit green hotels. The impact of environmental concern on the intention of consumers to visit green hotels is relatively limited, and the subjective norm has a strong effect.
[34,35]	To examines the influence of hotels' green practices, recent amenities, and traditionally salient attributes on customers' overall online	–	Focus-group interviews	The availability of recently added amenities such as free Wi-Fi, pet boarding, free self-parking, multilingual staff, and airport

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Table 1 (continued)

Author	Aim of study	Theory/framework	Data collection method	Findings
	evaluation, revisit intention and hotel performance			transportation, as well as green practice initiatives, have a strong, incremental predictive power in explaining guests' overall online review ratings, price premium and revisit intention.
[53]	To identify the consumers' purchasing decisions regarding green hotel accommodation	TPB	focus groups and open-ended questionnaires	Benefits, concerns, referents, facilitators and barriers of Australian residents' about staying in green hotels were identified
[55]	To develop a comprehensive model of consumers' behavioural decisions for or against staying at green hotels	Environmental values theory + interdependence theory + environmental commitment model	Questionnaire	Biospheric values influenced consumers' willingness to sacrifice for the environment, which in turn affected their green hotel visit intentions, their willingness to sacrifice to stay at a green hotel, and their willingness to pay more to stay at a green hotel
[61]	To examine the relationship between returning consumer environmental behaviour and tourists' propensity to stay in a green hotel	TPB	Questionnaire	Returning tourists' intention to stay at a green hotel was influenced positively by perceived behavioural control and attitude
[62]	To investigate guests' intention formation when selecting an environmentally responsible hotel.	Model of Goal-directed Behaviour (MGB)	Questionnaire	Desire toward the behaviour is significantly predicted by attitude toward the behaviour, positive anticipated emotion, negative anticipated emotion, and subjective norm. Frequency of past behaviour and desire toward the behaviour have significant influence on intention to visit an environmentally responsible hotel
[24]	To examine the mediating effects of perceived warmth and competence as potential psychological mechanisms explaining consumers' reactions to green hotels. To investigate the moderating role of firm motives in influencing consumers' reactions to green initiatives	–	Questionnaire	Perceived warmth and competence mediate the relationship between service outcomes and consumer satisfaction and behavioural intentions.
[25]	To predict consumers' intention to visit green hotels.	TPB	Questionnaire	Consumers' environmental concern exert a positive influence on customer attitude toward green hotels, subjective norms, and perceived behavioural control as well as their perceived moral obligation, which in turn influence their intention to visit green hotels
[23]	To identify how sustainable hotel practices impact the satisfaction and intention to return of hotel guests from different nationalities.	–	Questionnaire	Green practices do have a positive relationship on guests' satisfaction levels and return intentions for Mexicans, Americans and other nationalities.
[19]	To identify the effect of eco-friendly attitudes on hotel customers' environmentally friendly intentions	–	Questionnaire	Customers' green attitudes are, in general, significantly associated with their expressed intentions to visit a green hotel, to spread word-of-mouth about a green hotel, and to pay more for it.
[22]	To study the formation of customers' intention to revisit a green hotel	TPB	Questionnaire	Customer satisfaction, attitude, subjective norm, perceived behavioural control, overall image, and frequency of past behaviour have significant influence on customer revisit intention.

Appendix B

Table 1
Decision tree for Segment 1

Decision tree for Segment 1
<ul style="list-style-type: none"> • Service in [Low] <ul style="list-style-type: none"> o Sleep Quality in [Very High] then Overall Rating = Moderate o Sleep Quality in [High] then Overall Rating = Moderate o Sleep Quality in [Moderate] then Overall Rating = Low • Service in [Very High] <ul style="list-style-type: none"> o Location in [High] <ul style="list-style-type: none"> • Sleep Quality in [Very High] then Overall Rating = Very High • Sleep Quality in [High] then Overall Rating = High • Sleep Quality in [Moderate] then Overall Rating = Moderate o Location in [Moderate] <ul style="list-style-type: none"> • Sleep Quality in [Very High] then Overall Rating = High • Sleep Quality in [High] then Overall Rating = High • Sleep Quality in [Moderate] then Overall Rating = Moderate o Location in [Very High] then Overall Rating = Very High

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Table 1 (continued)

Decision tree for Segment 1
<ul style="list-style-type: none"> o Location in [Low] then Overall Rating = Moderate o Location in [Very Low] then Overall Rating = Low • Service in [High] <ul style="list-style-type: none"> o Location in [High] <ul style="list-style-type: none"> • Sleep Quality in [Very High] then Overall Rating = Very High • Sleep Quality in [High] then Overall Rating = High • Sleep Quality in [Moderate] then Overall Rating = Moderate o Location in [Moderate] <ul style="list-style-type: none"> • Sleep Quality in [Very High] then Overall Rating = Very High • Sleep Quality in [High] then Overall Rating = High • Sleep Quality in [Moderate] then Overall Rating = Moderate o Location in [Very High] then Overall Rating = Very High o Location in [Low] then Overall Rating = Moderate o Location in [Very Low] then Overall Rating = Low • Service in [Moderate] <ul style="list-style-type: none"> o Location in [High] then Overall Rating = High o Location in [Moderate] then Overall Rating = Moderate o Location in [Very High] then Overall Rating = Very High o Location in [Low] then Overall Rating = Low o Location in [Very Low] then Overall Rating = Very Low • Service in [Very Low] then Overall Rating = Very Low

Table 2

Decision tree for Segment 2

Decision tree for Segment 1
<ul style="list-style-type: none"> • Value in [Very High] <ul style="list-style-type: none"> o Sleep Quality in [Very High] <ul style="list-style-type: none"> • Service in [Very High] then Overall Rating = Very High • Service in [High] then Overall Rating = Very High • Service in [Moderate] then Overall Rating = High • Service in [Low] then Overall Rating = Moderate o Sleep Quality in [High] then Overall Rating = High • Value in [High] <ul style="list-style-type: none"> o Service in [Very High] <ul style="list-style-type: none"> • Sleep Quality in [Very High] then Overall Rating = Very High • Sleep Quality in [High] then Overall Rating = High o Service in [High] <ul style="list-style-type: none"> • Sleep Quality in [Very High] then Overall Rating = Very High • Sleep Quality in [High] then Overall Rating = High o Service in [Moderate] then Overall Rating = Moderate o Service in [Low] then Overall Rating = Low • Value in [Moderate] <ul style="list-style-type: none"> o Service in [Very High] <ul style="list-style-type: none"> • Sleep Quality in [Very High] then Overall Rating = Very High • Sleep Quality in [High] then Overall Rating = High o Service in [High] then Overall Rating = High o Service in [Moderate] then Overall Rating = Moderate o Service in [Low] then Overall Rating = Low

Table 3

Decision tree for Segment 3

Decision tree for Segment 3
<ul style="list-style-type: none"> • Cleanliness in [Low] then Overall Rating = Low • Cleanliness in [Moderate] <ul style="list-style-type: none"> o Location in [Very High] then Overall Rating = Very High o Location in [High] <ul style="list-style-type: none"> • Sleep Quality in [Very High] then Overall Rating = Very High • Sleep Quality in [High] then Overall Rating = High o Location in [Moderate] then Overall Rating = Moderate • Cleanliness in [High] <ul style="list-style-type: none"> o Location in [Very High] <ul style="list-style-type: none"> • Sleep Quality in [Very High] then Overall Rating = Very High • Sleep Quality in [High] then Overall Rating = High o Location in [High] then Overall Rating = High o Location in [Moderate] then Overall Rating = Moderate • Cleanliness in [Very High] then Overall Rating = Very High

Table 4
Decision tree for Segment 4

Decision tree for Segment 4
<ul style="list-style-type: none"> • Rooms in [Very High] <ul style="list-style-type: none"> ◦ Sleep Quality in [Very Low] then Overall Rating = Low ◦ Sleep Quality in [Low] then Overall Rating = Low ◦ Sleep Quality in [Moderate] then Overall Rating = High ◦ Sleep Quality in [High] then Overall Rating = Very High ◦ Sleep Quality in [Very High] then Overall Rating = Very High • Rooms in [Moderate] <ul style="list-style-type: none"> ◦ Service in [High] then Overall Rating = Moderate ◦ Service in [Very High] then Overall Rating = Moderate ◦ Service in [Low] then Overall Rating = Moderate ◦ Service in [Moderate] then Overall Rating = Moderate ◦ Service in [Very Low] then Overall Rating = Low • Rooms in [High] <ul style="list-style-type: none"> ◦ Service in [High] <ul style="list-style-type: none"> • Sleep Quality in [Very Low] then Overall Rating = Low • Sleep Quality in [Low] then Overall Rating = Low • Sleep Quality in [Moderate] then Overall Rating = Moderate • Sleep Quality in [High] then Overall Rating = High • Sleep Quality in [Very High] then Overall Rating = Very High ◦ Service in [Very High] <ul style="list-style-type: none"> • Sleep Quality in [Very Low] then Overall Rating = Low • Sleep Quality in [Low] then Overall Rating = Moderate • Sleep Quality in [Moderate] then Overall Rating = High • Sleep Quality in [High] then Overall Rating = High • Sleep Quality in [Very High] then Overall Rating = Very High ◦ Service in [Low] then Overall Rating = High ◦ Service in [Moderate] then Overall Rating = High ◦ Service in [Very Low] then Overall Rating = Low • Rooms in [Very Low] then Overall Rating = Very Low • Rooms in [Low] then Overall Rating = Low

Table 5
Decision tree for Segment 5

Decision tree for Segment 5
<ul style="list-style-type: none"> • Cleanliness in [Very Low] then Overall Rating = Very Low • Cleanliness in [Low] then Overall Rating = Low • Cleanliness in [Moderate] then Overall Rating = Moderate • Cleanliness in [High] <ul style="list-style-type: none"> ◦ Location in [Very High] <ul style="list-style-type: none"> • Sleep Quality in [Low] then Overall Rating = Low • Sleep Quality in [Moderate] then Overall Rating = High • Sleep Quality in [Very Low] then Overall Rating = Very Low • Sleep Quality in [High] then Overall Rating = High ◦ Location in [High] then Overall Rating = High ◦ Location in [Low] then Overall Rating = Moderate ◦ Location in [Moderate] then Overall Rating = Moderate • Cleanliness in [Very High] <ul style="list-style-type: none"> ◦ Sleep Quality in [Low] then Overall Rating = Low ◦ Sleep Quality in [Moderate] then Overall Rating = High ◦ Sleep Quality in [Very Low] then Overall Rating = Low ◦ Sleep Quality in [High] then Overall Rating = Very High

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