

An opportunity identification framework based on Topic Modeling and Sentiment Analysis for muslim-friendly hotels using textual reviews

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Article history:

Received: 2 June 2025

Revised: 18 June 2025

Accepted: 27 June 2025

Published: 30 June 2025

Keywords:

Muslim-friendly

Hotel

Islamic attribute

Text mining

Opportunity algorithm

ABSTRACT

Muslim-friendly hotels still lack consensus on operational standards. The operational standards have been extensively studied theoretically and empirically. However, the previous methods show some drawbacks, such as the credibility of the respondent's answers, bias, subjectivity, and small samples. Customer textual reviews have recently attracted to be utilized to capture the dynamics of customer needs. This present study introduces a framework based on topic modeling, sentiment analysis, and a modified opportunity algorithm applicable to textual data. The framework can be used to identify customer needs, and direction for product or service improvement in which competitors are taken into account. This present study utilized Tripadvisor data. Seventeen Islamic attributes have been identified from textual reviews. The framework has been applied to formulate a service improvement strategy for hotels in Moslem-dominated countries.

DOI:

<https://doi.org/10.31315/opsi.v18i1/14786>

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1. INTRODUCTION

Muslim-friendly tourism is a promising sector to develop. According to [1], the sector is the fastest-growing market segment and should not be ignored by tourism providers. The Global Islamic Economy [2] reported that the global market for Muslim-friendly tourism accounted for 13% of global spending in 2019. Implementing Muslim-friendly tourism has been widely carried out in several Muslim-majority and minority countries [3].

Hotels are becoming one of the main sectors of Muslim-friendly tourism. According to [4], Muslim-friendly hotels' operational standards still lack agreements. Each country defines its operationalization differently [5]. On the other hand, by knowing the operational standards, hotel service providers can formulate

the right strategy to meet the expectations of Muslim customers, which ultimately impacts customer satisfaction [6].

Many studies have attempted to identify attributes in Muslim-friendly hotels theoretically [7]–[12] and empirically [4], [13], [14]. However, operational standards for Muslim-friendly hotels are still inconclusive, as stated in Table 1. These operational standards certainly require the allocation of space, costs, and personnel, yet it is unclear on the actual needs of Muslim customers. In product or service development, customer need analysis naturally becomes the first and critical step [15]. In addition, providers of Muslim-friendly hotels must create offerings that suit their customers' needs (both Muslim and non-Muslim).

Table 1. Operational Standard for Muslim-friendly Hotel

No.	Author	Region	Operational Standard
1.	Din [7]	Malaysia	Prayer mat, quran, prayer beads, qibla direction, no alcohol, separated kitchen utensils, no unmarried couple to check in together, no drug-dealing activities
2.	Hashim et al. [8]	Malaysia	Provide information on mosque and halal food location
3.	Henderson [10]	Timur Tengah	No alcohol, halal foods, quran, prayer mat, arrow indicating the direction of mecca, bed and toilet positioned not facing the direction of Mecca, bidets in bathroom, prayer room, appropriate entertainment, no nightclub or adult television channels, predominant muslim staff, conservative staff dress, separate recreational for men and women, all female floor, guest dress code, Islamic funding
4.	Sahida et al. [11]	Malaysia	Serving halal food and beverages, halal management and operation, design, facilities (separate spa, gym, swimming pool, guest and function rooms for male and female customers), Islamic financing and sharing profit and loss, no interest (riba or usury), Islamic insurance (takaful).
5.	Hayati et al. [9]	Malaysia	Appropriate dress code, hospitality behavior, physical facilities such as serving halal food, no alcohol, providing separate gymnasium, sauna, swimming pool and comfortable praying area, free interest financing mode, obligation of praying zakat, adhere to islamic business principles.
6.	Samori and Sabtu [12]	Malaysia	Have halal certificate, halal logo, qibla indicator, prayer mat, prayer room, no living being symbol, quran, no gambling and prostitution, predominant Muslim workers, appropriate dress code, proper behaviour, zakat, prayer time information, toilet facilities, breaking fast and sahur, no unmarried couple in a room.

However, the previous empirical research utilized conventional methods such as interviews, questionnaires, and focus group discussions. The downsides of these methods are the credibility of the respondent's answers, bias, subjectivity, and the smallness of the sample. With the development of technology, various tourist community platforms, e-commerce, and social media have provided a "place" for customers to give reviews. The availability of abundant and rich data has become a turning point for the research direction. Text-mining has been widely used for many purposes including customer identification [16] and prediction [17]. Several studies related to Muslim-friendly hotels [13] and conventional hotels [18]–[20] have been carried out with text mining as depicted in Table 2. The previous research is limited to identifying attributes and customer satisfaction through sentiment analysis. No research to date discusses the direction for improvement

of Muslim-friendly hotels by considering the importance of each topic, the satisfaction of each topic, and the prioritized direction of improvement.

Table 2. Operational standard for muslim-friendly hotel

Scope	No	Author	Context	Addressed problem	Methods/Data	Region coverage
Muslim-friendly hotel	1	Papastathopoulos [14]	Hotel services for muslim travellers	Exploring which hotel services are important for muslim travellers	Questionnaire ($n = 1.157$)	UAE
	2	Arasli et al. [13]	Muslim friendly hotel	Exploring attributes and the satisfaction of each attribute for muslim friendly hotel	Content analysis; data source: booking.com ($n = 1.250$)	Top 10 Destination based on 2020 Crescent Rating
	3	Pamukcu dan Sariisik [4]	Halal standard for hotel	Exploring guests' expectation regarding halal standards in hotel	Questionnaire ($n=500$)	Turkey
	4	Samori and Sabtu [12]	Halal standard for hotel	Exploring current policies framework relating to halal hotel	Interviews, focus group discussions, and literature review	Malaysia
Conventional hotel	5	Hu et al. [19]	Hotel frontlines' services	Exploring actors, actions, and performances of hotel services	LSA and association rule; data source = Tripadvisor ($n = 115,825$)	China
	6	Handani et al. [18]	Luxury Hotel Services	Exploring which attributes affects customers' satisfaction	Sentiment, descriptive, and regression analysis; data source = Google Travel ($n = 8.441$)	Singapore
	7	Qu et al. [6]	Hotel service and facility	Exploring the relative importance of attribute to satisfy travelers	Questionnaire ($n=402$)	Hong Kong
	8	Prameswari et al. [20]	Hotel service and facility	Exploring hotel service and facility's sentiment	Recursive Neural Tensor Network (RNTN); data source = Tripadvisor	Bali, Indonesia

While previous study provides valuable insights into different aspects of Muslim-friendly hotel services, there is limited integration or comparison across these studies in terms of their scope, methods, and outcomes. In addition, most of the previous studies utilized conventional methods despite the opportunity of abundant data in Internet era. These fragmented findings make it difficult to formulate an operational standard for Muslim-friendly hotels, which highlights the need for a data-driven approach to synthesize customer needs.

In approach to this problem, a customer-centric prioritization of product/service improvement is proposed in this study for Muslim-friendly hotels using textual reviews from online platforms. In this approach, there are four milestones. First, topics (i.e., general and Islamic-specific hotel attributes that customers currently discuss) are identified by topic modeling using textual customer reviews. Second, the

importance degree of each topic is calculated based on the contribution stock that is the output of topic modeling. Third, sentiment analysis assesses each topic's customer satisfaction degree. Fourth, the opportunity score indicating the priority of each topic to be improved is computed using a modified opportunity algorithm in which it has considered other competitors' positions for each topic. This enables providers to determine which hotel service improvements should be prioritized. In this present study, textual reviews from hotels in Moslem-dominated countries were utilized and compared with non-Moslem-dominated countries.

Based on the research gap identified, the following research questions are addressed: (1) What are the key hotel attributes, including both Islamic-specific and general features, that are discussed by customers in Muslim-friendly hotels? (2) How do the importance and satisfaction levels of these attributes differ between Muslim- and non-Muslim-dominated countries? And (3) What are the most urgent service improvement opportunities for Muslim-friendly hotels based on customer textual reviews?

The contributions of the present study are threefold. First, this study introduces a framework to identify customer needs, positioning, and direction for product/service improvements. The approach is applicable to both product and service development. Second, this study formulates the operational standards for Muslim-friendly hotels using customer voice through their textual reviews on online platforms. Third, this study explores the differences between Muslim-dominated and non-Muslim dominated countries in providing services for Muslim-friendly tourism.

2. MATERIALS AND METHODS

The stages of this study, starting from data collection to opportunity analysis, are illustrated in [Figure 1](#). Online reviews were collected from the travel platform TripAdvisor using web data extraction software. TripAdvisor was chosen over other platforms such as Booking.com or Agoda because it provides richer and more descriptive user-generated content. Online reviews were taken from hotels in 9 countries in several cities with dates of stay from January 2017 - August 2022. The 9 hotels were selected based on top-tier rankings on GMTI (Global Muslim Travel Index) 2022 reports. Then, review documents were selected to obtain only halal-related reviews by ensuring the presence of halal keywords: "Muslim", "halal", "alcohol-free", "shariah", "sharia", "private-use", "mixed-gender", "Muslim-friendly", "pray", "prayer", "qibla", and "Islam".

Selected reviews were pre-processed. Data preprocessing consisted of case folding, punctuation removal, non-alphabetic character handling, keeping only nouns, stopwords removal, lemmatization, and tokenization. Pre-processing was conducted separately for topic modeling and sentiment analysis. Thus, the initial dataset used in topic modeling and sentiment analysis was slightly different. Data pre-processing before topic modeling aims to enable topic modeling. In comparison, pre-processing after sentiment analysis aims to obtain keywords included in the topic model only to obtain the satisfaction degree for each topic extracted in topic modeling.

There were two major steps in identifying topics: (1) topic modeling and (2) topic labeling. LDA was modeled using Gensim library in Python. The corpus was transformed to the Term Frequency-Inverse Document Frequency (TF-IDF) with the aim of high-weighting words that often appear in one document but rarely appear in other documents, and low-weighting words with a high frequency in the document but also often appears in other documents.

Hyperparameter in LDA was determined from the optimal result of an experiment. A model with high coherence score, low Jaccard similarity index, and ease of interpretation is selected. Topic coherence is an evaluation method to measure how informative the topic is based on the collection of words generated by the model [20]. It is highly correlated with human evaluation and observed the relevance of the words within the topic [21]. Jaccard similarity is an evaluation method by measuring the similarity index of the words that appear most often (top words) on two topics [22]. Topics were labeled according to top words and then validated by the most representative review documents on the topic.

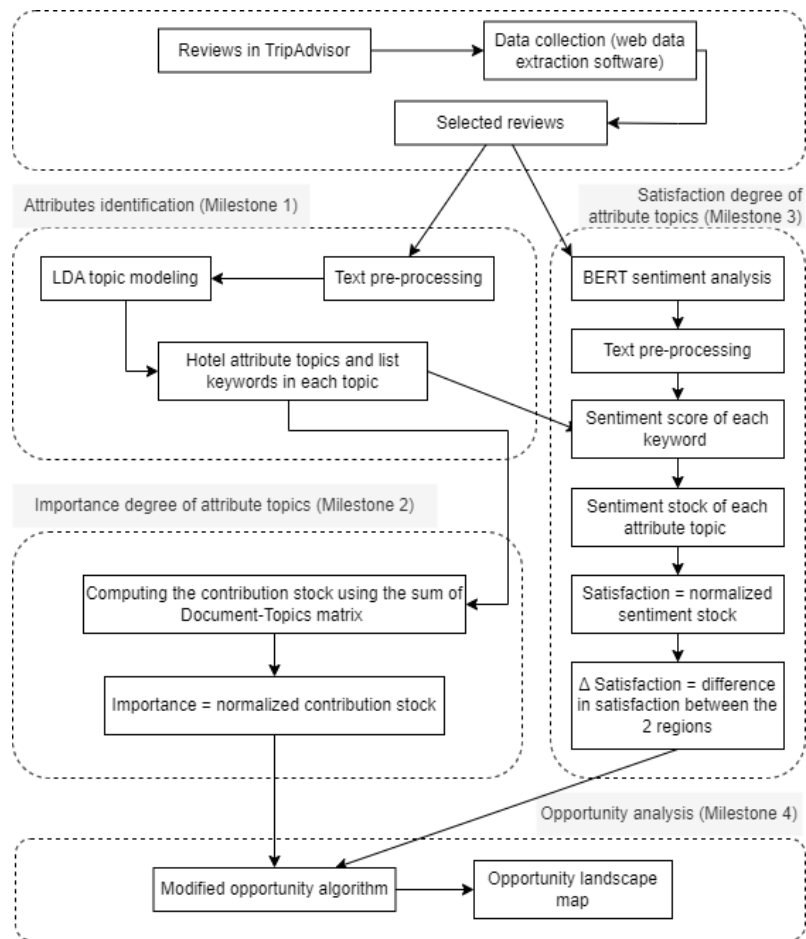


Figure 1. Study method

The importance degree was calculated by how often a topic was discussed by guests [15]. Eq. (2) shows the sum of the contribution stock of each topic (CSt) to all reviews. Summation was carried out on the Document-Topics matrix as illustrated in Figure 2. Contribution stock was then normalized on a scale of 0-10 using Eq. (3) to equate the scale with the satisfaction degree.

$$\text{Opportunity score} = \text{Importance} + \max(\text{Importance} - \text{Satisfaction}, 0) \quad (1)$$

$$CS_t = \sum_{i=0}^{\# \text{ of Documents}} TDMatrix_{t,i}, \text{ where } t = \text{Topic\#} \quad (2)$$

$$\text{Importance}_t = 10 \times \frac{CS_t - CS_{Min}}{CS_{Max} - CS_{Min}} \quad (3)$$

$$\begin{bmatrix} & D_0 & D_1 & D_2 & \dots & D_n \\ \text{Topic}_0 & 0.011 & 0.008 & 0.072 & & \\ \text{Topic}_1 & 0.016 & 0.009 & 0.01 & & \\ \vdots & & & & & \\ \text{Topic}_n & & & \dots & & \ddots \end{bmatrix} \xrightarrow{\text{summation}} \begin{bmatrix} \text{Topic}_0 & CS \\ \text{Topic}_1 & 182.28 \\ \vdots & \vdots \\ \text{Topic}_n & 128.10 \end{bmatrix}$$

Figure 2. Concept of computing the importance degree of topics

There were three steps in computing the satisfaction degree of each topic. First, sentiment analysis was conducted to measure satisfaction in a sentence. Guest satisfaction was measured using Bidirectional Encoder Representation for Transformer (BERT) for sentiment analysis. A review was split into sentences, so the

sentiment was analyzed based on sentences. In this step, sentiment value for each review was obtained. Second, each sentence is pre-processed so that only the words included in the keywords from the topic model were retained. Third, the average sentiment score for each keyword is defined by Eq. (4) and illustrated as shown in Figure 3. This computation was carried out separately between Moslem-dominated countries and from non-Moslem-dominated countries. Last, the satisfaction degree of each topic was computed by Eq. (5) and illustrated in Figure 4. Sentiment stock was then normalized on a scale of 0-10 using Eq. (6) for Moslem-dominated countries and non-Moslem-dominated countries to rationalize the differences in scale between the importance score and satisfaction score. Later, the satisfaction (normalized sentiment stock) of each region is subtracted from each other to obtain Δ satisfaction, which explains satisfaction in a region compared to other region, for the opportunity analysis. Cross-cultural differences are considered non-existent between countries. Thus, the standard of reviewer satisfaction in each country is considered the same.

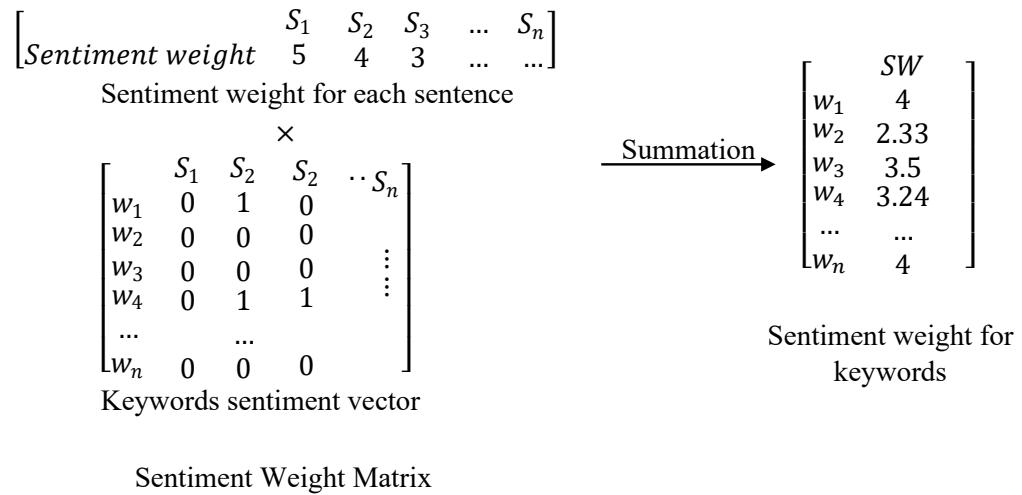


Figure 3. Concept of computing the average sentiment score for each keyword

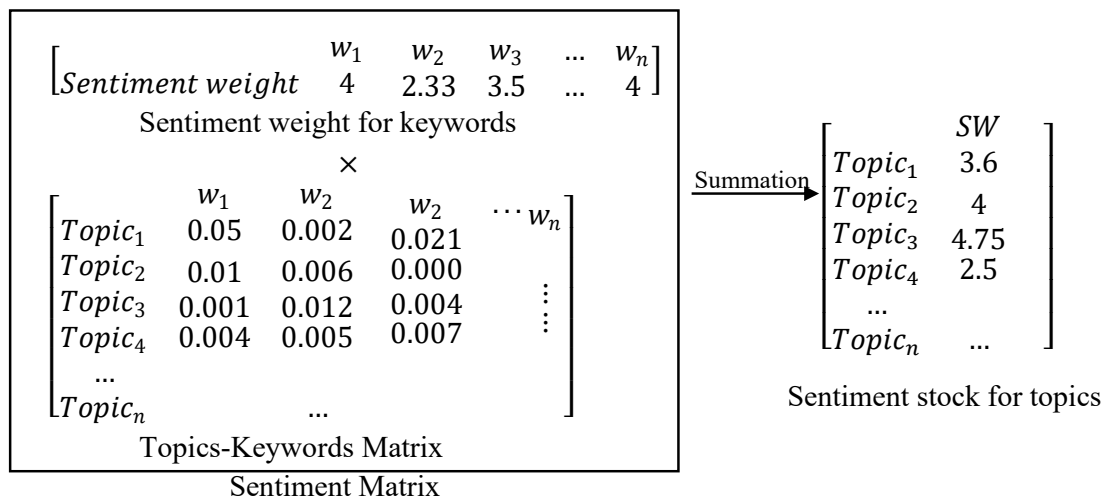


Figure 4. Concept of computing satisfaction degree of topics

$$SW_{Wn} = \frac{\sum_{i=0}^{\#of\ Sentences} SentimentWeightMatrix_{w,s}}{\sum_{i=0}^{\#of\ Sentences} KeywordsSentimentVector_{w,s}} \quad (4)$$

$$SS_t = \sum_{i=0}^{\#of\ Documents} SentimentMatrix_{t,i}, \text{ where } t = Topic\# \quad (5)$$

$$Satisfaction_t = 10 \times \frac{SS_t - SS_{Min}}{SS_{Max} - SS_{Min}} \quad (6)$$

In this study, the satisfaction degree used to define the opportunity score was the difference between the satisfaction degree in Moslem-dominated and non-Moslem-dominated countries. The lower this difference, the worse the satisfaction in Moslem-dominated countries compared to non-Moslem-dominated countries. Therefore, the opportunity for improvement is higher. The opportunity score in this study is modified as stated in Eq. (7). Each topic's position is depicted in the opportunity landscape map. The division of the three areas is limited by the average satisfaction degree and the average importance degree [15].

$$\begin{aligned} \text{Opportunity score} &= \text{Importance} + \max(\text{Importance} \\ &\quad - (\text{Satisfaction Moslem dominated countries} \\ &\quad - \text{Satisfaction non Moslem Countries}), 0) \end{aligned} \quad (7)$$

3. RESULTS AND DISCUSSION

3.1. Data collection and data pre-processing

TripAdvisor online reviews were collected from nine countries: four Moslem-dominated countries (Indonesia, Brunei Darussalam, Malaysia, and Turkey) and five non-Moslem-dominated countries (Thailand, China, England, Japan, and South Korea). The nine countries were chosen to ensure a balanced and meaningful comparison between Muslim-dominated and non-Muslim-dominated regions while maintaining diversity in geography, tourism development, and cultural context. Reviews were collected with the date of stays from January 2017 – August 2022 from 3, 4, and 5-star hotels. Halal-related reviews were manually selected by filtering some keywords. Data was pre-processed and cleaned from duplication. The dataset of 6,292 reviews from 2,023 hotels was obtained. The cleaned reviews description is shown in Table 3. Number of rating from reviewers. The number of reviews before the emergence of Covid-19 (before 2020) is 86%. On TripAdvisor, reviewers can rate the hotel on their reviewers on a scale of 1-5. Based on the rating given by reviewers, most reviews have a rating of 5 as seen in Table 4.

Table 3. Number of rating from reviewers

Rating	Number of reviews	Percentage
1	236	3.75%
2	234	3.72%
3	677	10.76%
4	1,791	28.46%
5	3,354	53.31%
Grand Total	6,292	

Table 4. Topic labels and 10 top words

Topics	Top words
1 Room facilities	Iron, machine, wash, kitchen, board, water_pressure, easy, pressure, iron_board, refrigerator
2 Room ambiance	Home, worker, design, recommend, beautiful, home_home, transit, site, rock, moment
3* Transportation	Subway, changer, money_changer, breeze, check_breeze, subway_station, section, response, ideal, square
4 Activity in the hotel	Love, souvenir, bike, scooter, activity, outside, connect, retreat, happen, rental
5 Prayer mat	mat, prayer_mat, process, concept, Islam, check_process, Ramadhan, operator, policy, answer
6* Hotel view	Nice, mountain, roof, mountain_view, update, rest, detail, pub, attention_detail, sunrise
7* Convenient store	Convenience, convenience_store, store, link, man, good, vicinity, supermarket, address, downside
8 Experience in accommodation	Villa, island, bedroom, culture, partner, garden, boat, worth, sea, sunset

Topics	Top words
9 MICE	event, wedding, decoration, course, memory, pleasure, community, reservation, company, care
10 Variety of breakfast menu	Spread, breakfast_spread, infinity, infinity_pool, ramada, assistance, customer_service, hassle, fast, ease
11* Proximity to tourist attraction	Wise, location_wise, district, stall, decent, layout, upgrade, excellent, hallway, bustle
12 Halal food	Meet, lunch, break, serve, helpful, lunch_dinner, alcohol, fast, chef, waiter
13 Value for money	Mart, value_money, family_mart, opposite, satisfy, beverage, chance, regret, worry, delight
14 Hotel facilities	Environment, apartment, fitness, position, visitor, transfer, surround, spot, overall, airport_transfer
15 Soundproof	Speaker, proof, sound, support, fault, earplug, sound_proof, trouble, cause, tell
16 Executive lounge	Executive, bus, executive_lounge, stop, bus_stop, scenery, hall, switch, expectation, pancake
17 Housekeeping	House_keep, keep, house, front_desk, pray_mat, mosquito, heater, effort, requirement, water_heater
18 TV channel	Channel, river, tv_channel, quarantine, news, sign, disappointment, movie, source, sport
19* Near halal food area	Court, paradise, excellence, food_court, property, railway, dim, exchange, pizza
20 Meal	Dish, negative, dessert, system, club, bungalow, grab, gold, bill, cook
21 Family vacation	Traveler, city_wall, convenient, quarter, muslim_traveller, vacation, gate, masjid, warrior, family_vacation
22* Convenient location	Center, driver, honeymoon, language, city_center, shop_center, taxi_driver, play, hill, tour
23* Historical landmark	Bell, bell_tower, attraction, fashion, tourist, credit, quarter, drum, drum_tower, tourist_attraction
24* Islamic art and architecture	Museum, art, palace, woman, men, art_museum, bazaar, foreigner, sit, vendor
25* Muslim tourism village	Quarter, drum, bell, hostel, bell_drum, renovation, hospitality, tour, tower_quarter, city_wall
26* Religious landmark	Blue, blue_mosque, terrace, leisure, steam, cream, advice, call_prayer, highlight, ice_cream
27 Soundproof	Tourism, stuff, soundproof, crowd, apartment, quiet, polite, action, avoid, shuttle
28 Restaurant in the hotel	Afternoon tea, afternoon, wing, cozy, weekend, interior, party, simple, display, snack

The * denotes topics that the hotel management cannot improve directly

3.2. Topic identification

Topics were identified using Latent Dirichlet Allocation topic modeling with alpha and beta parameters set to 'auto'. It allows the algorithm to learn the priors from the data. The number of rare words occurring in less than 20 documents and the number of common words occurring in more than 5% of the total documents were eliminated to avoid bias. Out of 6,908 unique tokens before elimination, 1,172 unique tokens remained. This model generated 28 topics, including general and Islamic-specific topics.

This setting exhibited the best result evaluated quantitatively and qualitatively. This model generated a coherence score of 0.4038 and a Jaccard index of 0.013. This coherence score is considered acceptable according to the previous literature [23]–[25]. Furthermore, this model is considered to be interpretable based on the top words in each topic, allowing a topic to be manually labeled from the top words. Topic labels and top words formed are shown in Table 5. In addition, the topics are validated using documents with the highest topic contribution and relevant to the topic label. Examples of comments in reviews on each topic are shown in the Table 6.

Table 5. Islamic, general, and destination-related attributes from textual reviews

Topic	Attributes
1 Room facilities	Qibla direction** Holy qur'an** Hand shower bidet** Area for prayer in the room**

Topic	Attributes
3* Transportation	Convenient local transportation Ease of public transportation Fairness of transportation costs Inexpensive travel cost
5 Prayer mat	Prayer mat** Prayer facilities**
11* Proximity to tourist attraction	Hospitable people Security level to the attraction Security when at a tourist attraction Hygiene and cleanliness Friendly employees Beautiful scenery/natural attractions Lack of language barrier Unpolluted environment
12 Halal food	Halal certification**
14 Hotel facilities	Prayer room** Ablution facilities** Swimming pool scheduling** Information about prayer times**
17 Housekeeping	Hotel staff satisfying both muslim and non-muslim guests** Hotel staff responds appropriately to special muslim requirements** Local staff is well aware of halal** High standar of hygiene and cleanliness
19* Near halal food area	Halal food at tourism sites** Halal service information**
23* Historical landmark	Historical/cultural attractions
24* Islamic art and architecture	Unique and novel culture
28 Restaurant in the hotel	Halal menu in hotel's restaurant**

The * denotes topics that the hotel management cannot improve directly; ** denotes keywords associated with Muslim needs

Table 6. Satisfaction degree of topics

Topic ID	Topic Label	Satisfaction Degree					
		Importance degree		Sentiment Stock		Normalized Sentiment Stock (Satisfaction)	
		Contribution Stock	Normalized Contribution Stock	Moslem-dominated Countries	Non-Moslem-dominated Countries	Moslem-dominated Countries	Non-Moslem-dominated Countries
1	Room facilities	275,57	5,69	3,51	3,63	3,10	5,43
2	Room ambience	134,45	0,83	3,63	3,72	5,34	6,96
3	Transportation*)	110,38	0,00	3,35	3,68	0,00	6,36
4	Activity in the hotel	163,24	1,82	3,65	3,73	5,62	7,29
5	Prayer mat	218,63	3,73	3,58	3,63	4,43	5,35
6	Hotel view*)	127,96	0,61	3,68	3,73	6,36	7,13

Topic ID	Topic Label	Importance degree		Satisfaction Degree			
				Sentiment Stock		Normalized Sentiment Stock (Satisfaction)	
		Contribution Stock	Normalized Contribution Stock	Moslem-dominated Countries	Non-Moslem-dominated Countries	Moslem-dominated Countries	Non-Moslem-dominated Countries
7	Convenient store*)	143,47	1,14	3,60	3,66	4,75	5,98
8	Experience in accommodation	400,68	10,00	3,62	3,68	5,20	6,27
9	MICE	184,50	2,55	3,73	3,86	7,26	9,70
10	Variety of breakfast menu	234,30	4,27	3,65	3,72	5,73	6,95
11	Proximity to tourist attraction*)	157,16	1,61	3,62	3,65	5,06	5,66
12	Halal food	230,60	4,14	3,64	3,72	5,60	7,00
13	Value for money	174,33	2,20	3,64	3,77	5,60	7,94
14	Hotel facilities	170,44	2,07	3,59	3,69	4,52	6,38
15	Soundproof	159,29	1,68	3,58	3,55	4,47	3,92
16	Executive lounge	126,31	0,55	3,71	3,77	6,78	8,06
17	Housekeeping	211,23	3,47	3,57	3,62	4,23	5,07
18	TV channel	177,24	2,30	3,46	3,51	2,14	3,09
19	Near halal food area*)	219,28	3,75	3,65	3,66	5,63	5,89
20	Meal	144,98	1,19	3,52	3,62	3,20	5,18
21	Family vacation	214,08	3,57	3,63	3,85	5,40	9,40
22	Convenient location*)	351,51	8,31	3,60	3,65	4,71	5,77
23	Historical landmark*)	191,32	2,79	3,58	3,73	4,40	7,29
24	Islamic art and architecture*)	203,73	3,22	3,62	3,71	5,08	6,91
25	Muslim tourism village*)	183,28	2,51	3,60	3,88	4,81	10,00
26	Religious landmark*)	305,06	6,71	3,63	3,77	5,30	7,90
27	Noise	134,18	0,82	3,56	3,64	4,11	5,47
28	Restaurant in the hotel	170,23	2,06	3,63	3,75	5,31	7,56

The * denotes topics that cannot be improved by the hotel management directly

a. Topic 1: Room facilities

Reviews on this topic mentioned all kinds of room facilities, including sleeping, kitchen, and bathroom facilities. Facilities mentioned: pillow, bed, iron, iron board, washing machine, refrigerator, shower, bathtub, and hair dryer. These reviews discussed the availability of the facilities and the quality of existing facilities.

b. Topic 2: Room ambiance

Reviewers discussed the hotel's ambiance based on their impressions of the hotel. The topic can be expressed through discussions about hotel design, atmosphere, and the reviewers' feelings. Some hotel designs mentioned are classic, cool, cute, and modern. Some of the hotel atmosphere mentioned is serene, has poor environmental credentials, and is homey.

c. Topic 3*: Transportation

This topic mentioned various transportation, such as shuttle buses, trains, taxis, and Tuk Tuk (auto-rickshaws). Reviews on this topic mainly discussed hotel distance to public transportation or how to reach other locations with existing transportation.

- d. Topic 4: Activity in the hotel
Guests shared their experiences of carrying out their activities in the hotel. Various activities can be enjoyed at the hotel, such as breakfast at the hotel restaurant, activities in the pool and gym, or relaxing on the balcony.
- e. Topic 5: Prayer mat
A prayer mat is an item mentioned a lot in reviews on this topic. Many reviewers reviewed the delivery process of getting prayer mats as their requests. Prompt delivery is recommended in this case. If possible, the availability of a prayer mat in the room prior to the guests' arrival is appreciated.
- f. Topic 6*: Hotel view
This topic discussed the hotel's role as lodging for guests. Many reviewers mentioned hotel views. It is preferable for hotels to have a great view, according to some of the reviews on this topic.
- g. Topic 7*: Convenience store
It is preferable for a hotel to be located near a convenience store. This ease the access for guests to buy various necessities such as buying snacks and souvenirs.
- h. Topic 8: Experience in accommodation
The main goal of the hotel is to provide accommodation to guests. Guests often share their experiences in the hotel as accommodation. The experiences included in this topic cover the overall guests' experiences during their stay at the accommodation. The experience of guests when they just arrived and were received by the reception staff, the quality of their sleep, and the quality of their vacation are some of the things they shared. The hotel should be able to provide for the guests' needs so that guests can have a great experience staying at the hotel.
- i. Topic 9: MICE
In general, reviews on this topic mainly discussed the staff's hospitality. However, this topic also appears as a topic that discusses hotels' role in MICE. MICE stands for Meeting, Incentive, Convention, and Exhibition. Hotels usually provide MICE through their banquet facilities. The most frequently held events in hotels are weddings and meetings. Reviews regarding MICE mentioned hotel service in ensuring the event's course and the food quality.
- j. Topic 10: Variety of breakfast menu
Reviewers mentioned the variety of breakfast menus on this topic. It is preferable for guests to have a lot of options for their breakfast.
- k. Topic 11*: Proximity to tourist attraction
Reviews on this topic mentioned the location of the hotel in general. It is preferable for hotel to be located in the center of the city and thus located close to tourist attractions and needs, such as restaurants or tourist spots. In this regard, the hotel should also consider the noise within the hotel if the hotel is located in the middle of the city.
- l. Topic 12: Halal food
Halal food became the main discussion on this topic. The topic is mostly related to the availability of halal food in the hotel and the quality of the food provided.
- m. Topic 13: Value for money
In this topic, reviews mentioned the value for money of the hotel. Reviewers evaluate the hotel by comparing the reasonable price with the facilities and services they received at the hotel.
- n. Topic 14: Hotel facilities
The hotel provides various facilities for guests to enjoy. Reviews on this topic mentioned a lot of hotel facilities, such as the great lobby, bikes for rent, swimming pool, fitness center, etc.
- o. Topic 15: Soundproof
Reviews that can be found on this topic are discussing the soundproofing in the hotel room. Reviewers have complained about the poor soundproofing that makes sounds from outside such as traffic noise and call to prayer can be heard loudly.
- p. Topic 16: Executive lounge
The executive lounge, sometimes called the club lounge, is a relaxing room for elite members or guests who book high-end rooms. Various facilities are provided in this room, such as food, cocktails, coffee makers, etc. Reviewers shared their experience of the service and the quality of the food in the executive lounge.

- q. Topic 17: Housekeeping
Cleanliness is an aspect that concerns the guests and is the responsibility of the housekeeping department. In addition, housekeeping is also responsible for providing guest requests. Therefore, housekeeping is expected to be able to provide the best room service.
- r. Topic 18: TV channel
This topic generally discussed room facilities, but a variety of TV channels specifically discussed on this topic. It is preferable for hotels to provide various TV channels so that guests can watch according to their preferences.
- s. Topic 19*: Near halal food area
The availability of halal food is often a concern for Muslim travelers. Halal food became a topic discussed by the reviewers. In addition, proximity to halal restaurants is a plus for the hotel as mentioned in the review on this topic.
- t. Topic 20: Meal
Reviews on this topic tell about meals in general, mostly tell about the quality of the food in the hotel.
- u. Topic 21: Family vacation
Reviews on this topic mainly discuss the family experience of having a family vacation and staying at the hotel. Therefore, facilities and service that suitable for family were mentioned in this topic.
- v. Topic 22*: Convenient location
It is preferable for a hotel to be located in a convenient location. A location is convenient when the hotel is located near guests' needs. Some essential places preferably close to the hotel are transportation access, tourist attraction, convenience store, shopping center, and restaurants.
- w. Topic 23*: Historical landmark
In this topic, reviewers discussed the historical buildings around the hotel location.
- x. Topic 24*: Islamic art and architecture
Reviewers discussed educational and historical tourist attractions, such as Topkapi Palace museums, Islamic Arts Museum, and Grand Palace.
- y. Topic 25*: Muslim tourism village
This topic discussed a Muslim tourism village where sells halal food and other souvenirs, such as Muslim Quarters in China.
- z. Topic 26*: Religious landmark
This topic discussed tourist attractions around the hotel, especially buildings for Muslim places of worship, such as the Blue Mosque in Turkey.
- aa. Topic 27: Noise
Reviewers discussed room privacy of noise in this topic. Mostly, it discussed the soundproofing in the room. Some of the complaints that can be found on this topic are the poor soundproofing of the rooms so that the noise from the corridor or from the street is heard.
- bb. Topic 28: Restaurant in the hotel
Reviews on this topic mainly discussed the restaurant in the hotel. This topic includes breakfast, afternoon tea, food quality, and restaurant staff's hospitality.

3.3. Identifying islamic attributes from textual reviews

In textual reviews on TripAdvisor, customers usually discourse about not only their experience staying in the hotel but also their overall travel experience in their destinations. In addition, customer reviews include Muslim-specific needs, such as halal food and prayer mat, and general needs applicable to both Muslim and non-Muslim travelers. Hence, the formed topics include Islamic, general, and destination-related attributes. In this section, keywords related to Islamic attributes are manually filtered from textual reviews to formulate an operational standard for Muslim-friendly hotels. The relevance of the Islamic attributes with the identified topics is shown in [Table 7](#).

The Islamic attributes identified from textual reviews include four aspects. First, praying facilities include prayer mat, enough space for praying, holy Qur'an, and qibla direction in hotel rooms. Praying facilities as an Islamic attribute is in accordance with several previous literature which mentioned prayer facilities as an operational standard in Muslim-friendly hotels [4], [7], [10], [12]. In the context of hotel facilities, prayer rooms, ablution facilities, and information about prayer times are required. In addition to prayer facilities, the prayer

room is also an attribute often referred to as operational standards in previous literature [9], [10], [12]. Ablution facilities also need to be considered. It is important to design the spaces for ablution considering the age group with the religious duty of prayer [4]. Praying facilities should also be available in or reachable from tourist sites.

Table 7. Opportunity analysis

Rank	Topic Label	Satisfaction Moslem-dominated Countries	Satisfaction non-Moslem-dominated Countries	Δ Satisfaction	Importance	Opportunity
4	1 Room facilities	3,10	5,43	-2,33	5,69	13,71
24	2 Room ambience	5,34	6,96	-1,63	0,83	3,29
17	3* Transportation	0,00	6,36	-6,36	0,00	6,36
20	4 Activity in the hotel	5,62	7,29	-1,67	1,82	5,31
10	5 Prayer mat	4,43	5,35	-0,92	3,73	8,38
28	6* Hotel view	6,36	7,13	-0,77	0,61	1,98
23	7* Convenient store	4,75	5,98	-1,23	1,14	3,51
1	8 Experience in accommodation	5,20	6,27	-1,08	10,00	21,08
14	9 MICE	7,26	9,70	-2,43	2,55	7,54
7	10 Variety of breakfast menu	5,73	6,95	-1,22	4,27	9,76
22	11* Proximity to tourist attraction	5,06	5,66	-0,60	1,61	3,83
8	12 Halal food	5,60	7,00	-1,40	4,14	9,68
15	13 Value for money	5,60	7,94	-2,34	2,20	6,75
18	14 Hotel facilities	4,52	6,38	-1,86	2,07	6,00
26	15 Soundproof	4,47	3,92	0,55	1,68	2,81
27	16 Executive lounge	6,78	8,06	-1,29	0,55	2,38
12	17 Housekeeping	4,23	5,07	-0,84	3,47	7,79
19	18 TV channel	2,14	3,09	-0,95	2,30	5,55
13	19* Near halal food area	5,63	5,89	-0,26	3,75	7,77
21	20 Meal	3,20	5,18	-1,98	1,19	4,36
5	21 Family vacation	5,40	9,40	-4,00	3,57	11,15
2	22* Convenient location	4,71	5,77	-1,05	8,31	17,67
9	23* Historical landmark	4,40	7,29	-2,89	2,79	8,47
11	24* Islamic art and architecture	5,08	6,91	-1,83	3,22	8,26
6	25* Muslim tourism village	4,81	10,00	-5,19	2,51	10,21
3	26* Religious landmark	5,30	7,90	-2,60	6,71	16,01
25	27 Noise	4,11	5,47	-1,36	0,82	3,00
16	28 Restaurant in the hotel	5,31	7,56	-2,25	2,06	6,37
Mean				-1,85	2,99	

The * denotes topics that the hotel management cannot improve directly

Second is halal food availability in or near hotels and tourist sites. Halal certification that guarantees that foods are served in hotels, near restaurants, and tourist sites is also required. The availability of halal food is the operational standard of Muslim-friendly hotels in several previous literature, but not all of them have particularly discussed halal certificates. The current study supports the studies of Samori and Saturday [12] and Suci et al. [26] which mentions the need for halal certification.

The third is hotel front lines. Hotel staff is expected to satisfy Muslim and non-Muslim guests, respond appropriately to special Muslim requests and be well aware of halal. This attribute is in accordance with the requirements of staff who must ensure to offer services following the halal concept according to [4]. Henderson [10] even mentioned the predominantly Muslim staff as an operational standard for Muslim-friendly hotels.

Fourth is that halal service information is available in hotels and tourist sites. Halal service information includes information about prayer times, information about halal food, location of nearby mosques, and other halal service information. This attribute corresponds to the existing operational standards of halal tourism [4], [8].

Previous studies have proposed extensive lists of operational standards for Muslim-friendly hotels, often encompassing dozens of detailed requirements ranging from facility design to staffing policies. While these comprehensive standards reflect ideal compliance with Islamic principles, they may not be entirely aligned with what customers actually consider important. This study, by directly capturing customer voices through textual reviews, reveals that only a few key aspects—namely prayer facilities, halal food availability, staff responsiveness, and halal service information—are consistently mentioned and valued by guests.

This finding has significant implications. It suggests that hoteliers and policymakers do not need to invest in an overly exhaustive set of features to meet customer expectations. Instead, they can focus their resources on a targeted set of attributes that matter most to Muslim travelers. This customer-centered prioritization can lead to more efficient allocation of space, human resources, and capital investment, without compromising service quality or religious compliance.

3.4. Computing the importance degree of topics

The most and least important topic is Topic 8 "Experience in accommodation" and Topic 3 "Transportation", respectively. The importance degree was determined by how often the topic is discussed. "Experience in accommodation" is the most discussed topic due to the hotel's role as accommodation. Hotels must provide the best accommodation facilities to provide an experience worthy of review by reviewers. Conversely, transportation wasn't discussed much compared to the other. The possibility is that there is nothing extraordinary about transportation that worth mentioned a lot. The importance degree of topics before and after normalization is shown in Table 8 sorted from the highest importance.

Table 8. Importance degree of topics

Topic ID	Topic Label	Contribution Stock	Normalized Contribution Stock (Importance)
8	Topic 8 Experience in accommodation	400,68	10,00
22	Topic 22* Convenient location	351,51	8,31
26	Topic 26* Religious landmark	305,06	6,71
1	Topic 1 Room facilities	275,57	5,69
10	Topic 10 Variety of breakfast menu	234,30	4,27
12	Topic 12 Halal food	230,60	4,14
19	Topic 19* Near halal food area	219,28	3,75
5	Topic 5 Prayer mat	218,63	3,73
21	Topic 21 Family vacation	214,08	3,57
17	Topic 17 Housekeeping	211,23	3,47
24	Topic 24* Islamic art and architecture	203,73	3,22
23	Topic 23* Historical landmark	191,32	2,79
9	Topic 9 MICE	184,50	2,55
25	Topic 25* Muslim tourism village	183,28	2,51
18	Topic 18 TV channel	177,24	2,30
13	Topic 13 Value for money	174,33	2,20

Topic ID	Topic Label	Contribution Stock	Normalized Contribution Stock (Importance)
14	Topic 14 Hotel facilities	170,44	2,07
28	Topic 28 Restaurant in the hotel	170,23	2,06
4	Topic 4 Activity in the hotel	163,24	1,82
15	Topic 15 Soundproof	159,29	1,68
11	Topic 11* Proximity to tourist attraction	157,16	1,61
20	Topic 20 Meal	144,98	1,19
7	Topic 7* Convenient store	143,47	1,14
2	Topic 2 Room ambience	134,45	0,83
27	Topic 27 Noise	134,18	0,82
6	Topic 6* Hotel view	127,96	0,61
16	Topic 16 Executive lounge	126,31	0,55
3	Topic 3* Transportation	110,38	0,00

The * denotes topics that cannot be improved by the hotel management directly

3.5. Computing the satisfaction degree of topics

Satisfaction is computed separately between Moslem-dominated countries and non-Moslem-dominated countries. The satisfaction degree is shown in Table 9. Satisfaction in Moslem-dominated countries is almost the same compared to that in non-Moslem-dominated countries on some attributes, except: Topic 3: Transportation, Topic 21: Family vacation, and Topic 25: Muslim tourism village. Although the satisfaction of the three topics is lower than those of non-Muslim dominated countries, the three topics are not necessarily an improvement direction because the level of importance is not yet considered.

Table 9. Satisfaction degree of topics

Topic ID	Topic Label	Sentiment Stock		Normalized Sentiment Stock (Satisfaction)	
		Moslem-dominated Countries	Non-Moslem-dominated Countries	Moslem-dominated Countries	Non-Moslem-dominated Countries
1	Topic 1 Room facilities	3,51	3,63	3,10	5,43
2	Topic 2 Room ambience	3,63	3,72	5,34	6,96
3	Topic 3* Transportation	3,35	3,68	0,00	6,36
4	Topic 4 Activity in the hotel	3,65	3,73	5,62	7,29
5	Topic 5 Prayer mat	3,58	3,63	4,43	5,35
6	Topic 6* Hotel view	3,68	3,73	6,36	7,13
7	Topic 7* Convenient store	3,60	3,66	4,75	5,98
8	Topic 8 Experience in accommodation	3,62	3,68	5,20	6,27
9	Topic 9 MICE	3,73	3,86	7,26	9,70
10	Topic 10 Variety of breakfast menu	3,65	3,72	5,73	6,95
11	Topic 11* Proximity to tourist attraction	3,62	3,65	5,06	5,66
12	Topic 12 Halal food	3,64	3,72	5,60	7,00
13	Topic 13 Value for money	3,64	3,77	5,60	7,94
14	Topic 14 Hotel facilities	3,59	3,69	4,52	6,38

Topic ID	Topic Label	Sentiment Stock		Normalized Sentiment Stock (Satisfaction)	
		Moslem-dominated Countries	Non-Moslem-dominated Countries	Moslem-dominated Countries	Non-Moslem-dominated Countries
15	Topic 15 Soundproof	3,58	3,55	4,47	3,92
16	Topic 16 Executive lounge	3,71	3,77	6,78	8,06
17	Topic 17 Housekeeping	3,57	3,62	4,23	5,07
18	Topic 18 TV channel	3,46	3,51	2,14	3,09
19	Topic 19* Near halal food area	3,65	3,66	5,63	5,89
20	Topic 20 Meal	3,52	3,62	3,20	5,18
21	Topic 21 Family vacation	3,63	3,85	5,40	9,40
22	Topic 22* Convenient location	3,60	3,65	4,71	5,77
23	Topic 23* Historical landmark	3,58	3,73	4,40	7,29
24	Topic 24* Islamic art and architecture	3,62	3,71	5,08	6,91
25	Topic 25* Muslim tourism village	3,60	3,88	4,81	10,00
26	Topic 26* Religious landmark	3,63	3,77	5,30	7,90
27	Topic 27 Noise	3,56	3,64	4,11	5,47
28	Topic 28 Restaurant in the hotel	3,63	3,75	5,31	7,56

The * denotes topics that cannot be improved by the hotel management directly

3.6. Identifying hotel service opportunities

The result of this study provides information about Muslim-friendly hotel service opportunities in Moslem-dominated countries. Opportunities for improvement are shown to be in underserved areas, i.e., areas with a high importance degree but a low satisfaction degree compared to non-Moslem-dominated countries. The opportunity score calculation is shown in Table 10, and the opportunity landscape map is shown in Figure 5.

Table 10. Opportunity analysis

Rank	Topic Label	Satisfaction Moslem-dominated Countries	Satisfaction non-Moslem-dominated Countries	Δ Satisfaction	Importance	Opportunity
4	Topic 1 Room facilities	3,10	5,43	-2,33	5,69	13,71
24	Topic 2 Room ambience	5,34	6,96	-1,63	0,83	3,29
17	Topic 3* Transportation	0,00	6,36	-6,36	0,00	6,36
20	Topic 4 Activity in the hotel	5,62	7,29	-1,67	1,82	5,31
10	Topic 5 Prayer mat	4,43	5,35	-0,92	3,73	8,38
28	Topic 6* Hotel view	6,36	7,13	-0,77	0,61	1,98
23	Topic 7* Convenient store	4,75	5,98	-1,23	1,14	3,51
1	Topic 8 Experience in accommodation	5,20	6,27	-1,08	10,00	21,08
14	Topic 9 MICE	7,26	9,70	-2,43	2,55	7,54
7	Topic 10 Variety of breakfast menu	5,73	6,95	-1,22	4,27	9,76

Rank	Topic Label	Satisfaction Moslem- dominated Countries	Satisfaction non- Moslem- dominated Countries	Δ Satis- faction	Impor- tance	Oppor- tunity
22	Topic 11* Proximity to tourist attraction	5,06	5,66	-0,60	1,61	3,83
8	Topic 12 Halal food	5,60	7,00	-1,40	4,14	9,68
15	Topic 13 Value for money	5,60	7,94	-2,34	2,20	6,75
18	Topic 14 Hotel facilities	4,52	6,38	-1,86	2,07	6,00
26	Topic 15 Soundproof	4,47	3,92	0,55	1,68	2,81
27	Topic 16 Executive lounge	6,78	8,06	-1,29	0,55	2,38
12	Topic 17 Housekeeping	4,23	5,07	-0,84	3,47	7,79
19	Topic 18 TV channel	2,14	3,09	-0,95	2,30	5,55
13	Topic 19* Near halal food area	5,63	5,89	-0,26	3,75	7,77
21	Topic 20 Meal	3,20	5,18	-1,98	1,19	4,36
5	Topic 21 Family vacation	5,40	9,40	-4,00	3,57	11,15
2	Topic 22* Convenient location	4,71	5,77	-1,05	8,31	17,67
9	Topic 23* Historical landmark	4,40	7,29	-2,89	2,79	8,47
11	Topic 24* Islamic art and architecture	5,08	6,91	-1,83	3,22	8,26
6	Topic 25* Muslim tourism village	4,81	10,00	-5,19	2,51	10,21
3	Topic 26* Religious landmark	5,30	7,90	-2,60	6,71	16,01
25	Topic 27 Noise	4,11	5,47	-1,36	0,82	3,00
16	Topic 28 Restaurant in the hotel	5,31	7,56	-2,25	2,06	6,37
Mean				-1,85	2,99	

The * denotes topics that the hotel management cannot improve directly

There are 4 out of 28 topics in the underserved area. The highest hotel opportunity in Moslem-dominated countries is Topic 8 "Experience in accommodation". It is the most important topic for the guest, but the satisfaction is not much higher than in the non-Moslem-dominated countries. There are things that can be improved to better guest experience in accommodation. Some of complaints were the lights were too dim, the bathroom was small, the lack of quality of sleep due to the call to prayer in the morning, etc. This is in line with the existence of Topic 1 Room facilities which are also in the underserved area. Hotels may improve the room facility to enhance guest experience.

The second highest opportunity is Topic 22 "Convenient location". This topic cannot be directly improved by the hotel management but can be considered in developing a new hotel. Furthermore, it can be used as consideration for infrastructure development so that tourists can get easy access anywhere. The third highest opportunity is Topic 26 "Religious landmark". Muslim travellers consider this topic important. However, Muslim-dominated countries have a lower satisfaction degree on this topic than non-Muslim-dominated countries. Muslim-dominated countries may seize this opportunity to provide or improve religious landmarks. Despite being in an appropriately served area, Topic 25 "Muslim tourism village", also related to tourist attractions, has the second lowest satisfaction degree. It also indicates the urgency of attention to attractions or landmarks related to Muslims.

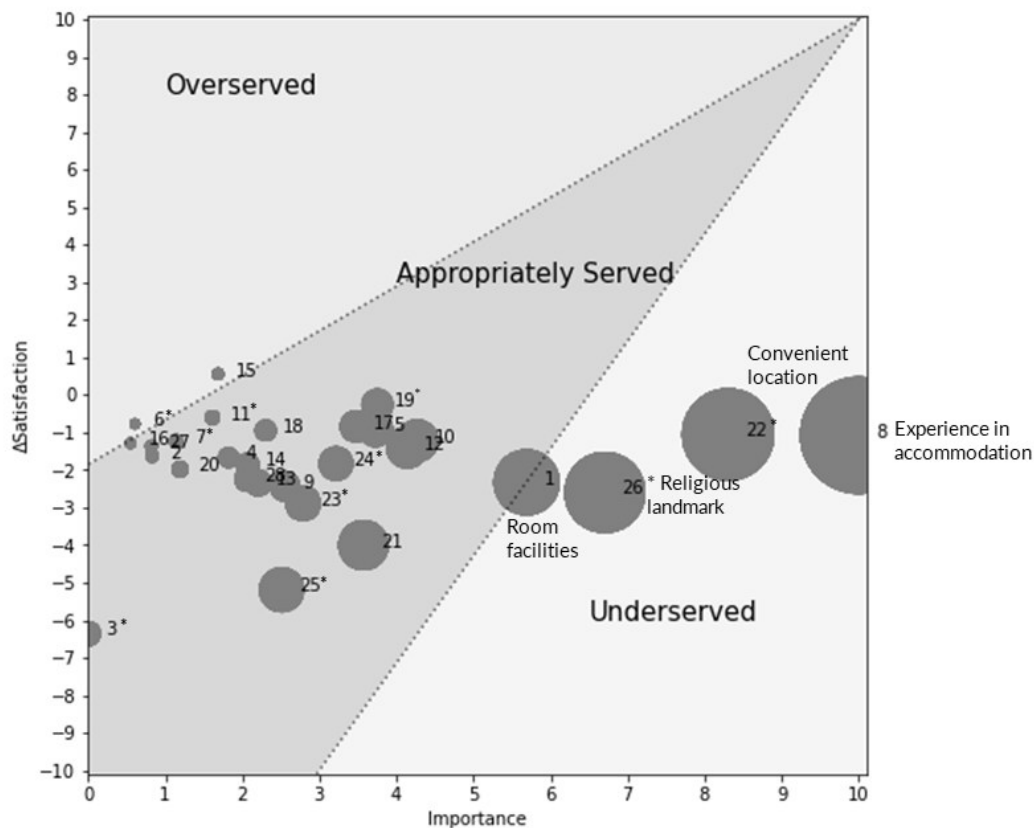


Figure 5. Opportunity landscape map Moslem-dominated countries

The last topic in the underserved area is Topic 1 “Room facilities”. This topic is related to Topic 8 “Experience in accommodation”, where the quality of room facilities can affect the guest experience [27]. Therefore, the hotel must ensure that the room facilities provide all the guest needs with good quality. Other finding in the current study shows that Topic 3 “Transportation” is the least important topic but also has the lowest satisfaction. This may indicate the lack of public transportation in Moslem-dominated countries. The more dissatisfied with public transportation services, the fewer trips one makes using public transportation [28]. Hence, the importance degree is low due to the lack of discussion. The development and improvement of public transportation could support and ease the access for guests to other locations as well as enhance the use of public transportation. This topic may not need to be prioritized as the four topics in the underserved area. However, the low satisfaction degree is worth attention.

Information about Muslim-friendly hotel service opportunities in non-Moslem-dominated countries was also identified to compare service opportunities in the two regions. However, gap satisfaction in the opportunity analysis was obtained from the subtraction of satisfaction degree in non-Moslem-dominated countries with satisfaction degree in Moslem-dominated countries. The opportunity landscape map for non-Moslem-dominated countries is shown in Figure 6.

Topic 8 “Experience in accommodation” and Topic 22 “Convenient location” both appears in the underserved area. The satisfaction degree is higher than in Moslem-dominated countries, but these topics are also prioritized in non-Moslem-dominated countries due to the high importance. Hence, attention to guest experience and infrastructure development for easy access must be considered in non-Moslem and Moslem-dominated countries. In addition to the two aforementioned topics, other topics are in the appropriately served or overserved area due to the higher satisfaction in non-Moslem-dominated countries compared to Muslim-dominated countries.

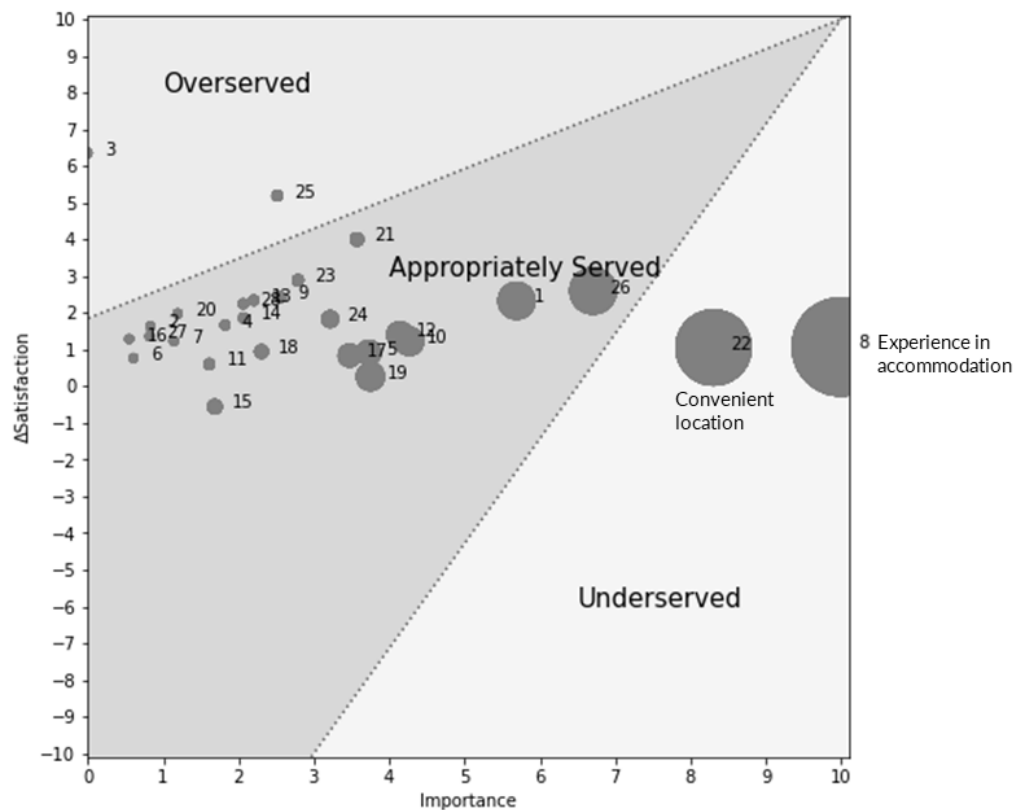


Figure 6. Opportunity landscape map non-Moslem-dominated countries

4. CONCLUSION

This study introduced a framework for capturing customer needs and identifying prioritized product/service improvements in which other competitors are taken into account. By using the framework, this study formulated operational standards for Muslim-friendly hotels based on textual customer reviews from Tripadvisor filtered by halal- or Muslim-specific keywords. From customer textual reviews, 31 attributes were obtained, including general, Islamic, and destination-related attributes. There are four aspects identified for Islamic attributes, which are (1) payer facilities, (2) the availability of halal food, (3) hotel staff awareness of halal and specific Muslim requirements, communication, and responsiveness to Muslim guests, (4) the availability of halal service information. Unlike previous studies that proposed overly extensive operational standards, this study demonstrates that only a limited number of attributes are consistently valued by customers. This highlights the potential for more efficient resource allocation, as hotel managers can prioritize investments in service features that truly impact customer satisfaction, without having to implement every prescribed standard.

A framework consisting of topic modeling, sentiment analysis, and modified opportunity algorithm have been developed to identify topics, provider's position compared to other competitors, and opportunities for service improvement. This framework has been tested to identify room for improvement for hotels in Moslem-dominated countries compared to non-Moslem-dominated countries.

There are 28 topics identified. The most and least important topics are Topic 8 "Experience in accommodation" and Topic 3 "Transportation", respectively. A topic is considered an opportunity in the Moslem-dominated countries when importance is high but has not provided satisfaction compared to non-Moslem-dominated countries. Topics in the underserved area can be prioritized for improvement. There are 4 out of 28 topics identified in the underserved area.

From the results of the opportunity analysis, there are several things that can be given attention for improvement in Moslem-dominated countries, such as infrastructure development for easy access, development of attractions and landmarks, and improvement of room facilities and services to provide the experience in accommodation.

ACKNOWLEDGMENT

This study was fully funded by Bank Indonesia Institute through Research Grant Bank Indonesia Number 24/5/PKS/BINS/2022.

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