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UNDERSTANDING PASSENGER SATISFACTION: TOPIC MODELING OF ONLINE REVIEWS

Yuliani Dwi Lestari[1], Faridatus Saidah[2]

[12]School of Business and Management, Institut Teknologi Bandung

Correspondence:yuliani.dwi@sbm-itb.ac.id

Article Info	Abstract
	This study examined customer satisfaction with three airlines—Garuda Indonesia, Batik Air, and Citilink by analyzing Skytrax customer reviews. Topic modeling based on latent Dirichlet allocation (LDA) was used to categorize 1174 customer reviews from 2024 as having either positive or negative sentiment. The statistical analysis revealed that Garuda Indonesia received the most recommendations, followed by Citilink and Batik Air. Positive review themes included good service and friendly staff, whereas negative sentiment was frequently attributed to delays and poor seat comfort. By identifying these key satisfaction drivers and pain points, this study offers actionable insights for airline service improvement and customer retention strategies. These findings contribute to the growing application of text mining in consumer behavior research and provide practical guidance for airline managers aiming to optimize competitiveness in the aviation industry.

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INTRODUCTION

Customer satisfaction is an important concept in behavioral research, founded on the assumption that organizations must meet consumer needs to achieve profitability and sustainability (Tahanisaz & Shokuhyar S., 2020). It is a complex construct that encompasses a customer's knowledge and experience. In the airline sector, customer satisfaction is measured according to passengers' assessments of their encounters with a particular airline (Murugesan et al., 2024; Tahanisaz & Shokuhyar, 2020). Consequently, it is critical for airlines to understand passenger expectations, as they are constantly compared to airline performance. When passengers receive valuable service quality attributes, they are more likely to report satisfaction (Park, 2015; Pereira et al., 2023).

The aviation industry has undergone numerous changes in recent years, largely due to the global COVID-19 pandemic, which has altered passenger expectations and service delivery paradigms. Passengers are increasingly concerned about the quality of airplane services, especially cleanliness. The pandemic has significantly emphasized the importance of hygiene, safety, and overall service experience, as passengers prioritize their health and well-being while traveling. This shift in expectations aligns with prior research highlighting the importance of service quality in driving customer satisfaction and loyalty in the airline sector (Sezgen et al., 2019; Yao et al., 2015). In Indonesia, the number of passengers traveling by air has also changed. Domestic departures, at 33.514 million in 2020, saw a slight decrease to 30.698 million in 2021, then surged to 52.784 million in 2022, reflecting a strong post-pandemic recovery in domestic air travel (see Table 1). International departures were severely impacted by the pandemic, declining drastically from 3.613 million in 2020 to just 632,000 in 2021 due to travel restrictions, but then increasing to 7.108 million in 2022 when international borders reopened.

Table 1. Number of Passengers on Departure at Indonesian Airports (in thousands)

Departure	Number of Passengers on Departure at Indonesian Airports (in thousand people)		
	2020	**2021**	**2022**
Domestic Flight	33,514	30,698	52,784
International Flight	3,613	632	7108

Source: *BPS* Indonesia 2020–2022

Customer review analysis is widely used for understanding service quality in the airline industry. Studies show that factors such as punctuality, service quality, and comfort are key to customer satisfaction (Bunchongchit & Wattanacharoensil, 2021; Noviantoro & Huang, 2022; Sezgen et al., 2019). However, there is a lack of research specifically focusing on Indonesian airlines. Despite the increasing emphasis on customer experience in the airline industry, there is limited understanding of how to leverage and systematically analyze unstructured online reviews to reveal key drivers of passenger satisfaction and dissatisfaction, particularly in the Indonesian context. Traditional survey-based approaches may overlook spontaneous customer feedback and emerging service issues. Furthermore, there is a lack of methodological clarity about how to utilize topic modeling techniques, such as latent Dirichlet allocation (LDA), to extract meaningful themes from large volumes of textual data. This study aims to address these gaps by identifying dominant themes in online passenger reviews, evaluating the effectiveness of LDA in uncovering patterns in

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customer sentiment, and exploring how these insights can inform practical service improvements for Indonesian airlines.

The aviation industry is highly competitive, and customer satisfaction is crucial for maintaining a strong reputation. Online review platforms like Skytrax offer valuable insights into passengers' experiences, influencing potential new customers. This study focused on online customer reviews sourced from Skytrax for three leading Indonesian airlines—Garuda Indonesia, Batik Air, and Citilink—to identify key factors driving customer satisfaction by applying LDA to the review data. This study contributes to the limited literature on Indonesian airline customer satisfaction by employing machine learning-based text mining to analyze large-scale customer feedback.

METHODOLOGY

We adopted a descriptive–exploratory research design, leveraging text mining to uncover patterns within customer reviews. This approach is well-suited to the study's aim of exploring thematic and sentiment structures in unstructured textual data. Data were sourced from the Air Travel Review website, operated by Skytrax, a global platform for airline consumer ratings. All customer reviews were publicly available on the Skytrax website at the time of data collection. No personally identifiable information was collected or analyzed, and all data handling adhered to ethical research standards regarding the use of publicly accessible online content. The analysis focused on airline customer review data for three airlines-Garuda Indonesia, Batik Air, and Citilink-up to mid-2024, as reported by Skytrax, providing insights into customer satisfaction with and recommendations for these companies (see Table 2). These three airlines were selected due to their prominence in the Indonesian domestic aviation market, their diverse service models (full-service vs. low-cost), and the availability of sufficient customer review data on Skytrax to ensure robust comparative analysis.

Table 2. Data Profile of Indonesia Airline Passengers' Reviews (Garuda Indonesia, Batik Air, and Citilink)

Airline	Total Reviews	Recommended	Not Recommended
Garuda Indonesia	930	815 (87.7%)	115 (12.3%)
Batik Air	179	67 (37.4%)	112 (62.6%)
Citilink	65	46 (70.8%)	19 (29.2%)
Summary of Recommendations	Total Reviews: 1174	Recommended = "Yes": 928	Recommended = "No": 246

Source: Air Travel Review website, run by Skytrax

Data were processed and analyzed using Python, following the procedure illustrated in Figure 1. The flowchart demonstrates our data analysis process for customer reviews extracted from the Skytrax website, with the goal of conducting topic modeling. The process began with data extraction, scraping customer reviews using the Python library BeautifulSoup. Next, the data were pre-processed in preparation for analysis. This included tokenizing the text with Python's NLTK, cleaning the corpus by removing punctuation, numbers, and common stop words (while retaining specific words like "in" and "on"), processing bigrams using gensim, and applying lemmatization to reduce words to their root forms. Part-of-speech (POS) tagging was then performed to extract nouns. Data were then subjected to Term Frequency-Inverse Document Frequency (TF-IDF) filtering, which retained words with high TF-IDF values, indicating their importance in the dataset. After

filtering, LDA topic modeling was applied to identify topics within the reviews. This step involved tuning the LDA model to determine the optimal number of topics and then generating the corresponding topic results. Finally, the results moved to the Interpretation stage, where the identified topics were interpreted to derive further insights. For validation, the coherence score served as the metric to determine the optimal number of LDA topics. Several model iterations were tested, and the configuration with the highest coherence score was selected to ensure topic interpretability and semantic quality.

LDA is a statistical method used to estimate the mixture of words associated with each topic and to determine the mixture of topics that best describe each document (Blei et al., 2003; Silge & Robinson, 2017). Topic modeling using LDA follows the principle that each document represents a collection of topics, and may contain words drawn from several topics in varying proportions (Guo et al, 2017). As an unsupervised machine learning technique, topic modeling identifies groups of similar words in the body of a text. This approach enables the grouping of word clusters based on the similarity of their content across documents, as demonstrated in research conducted by Park et al. (2023).
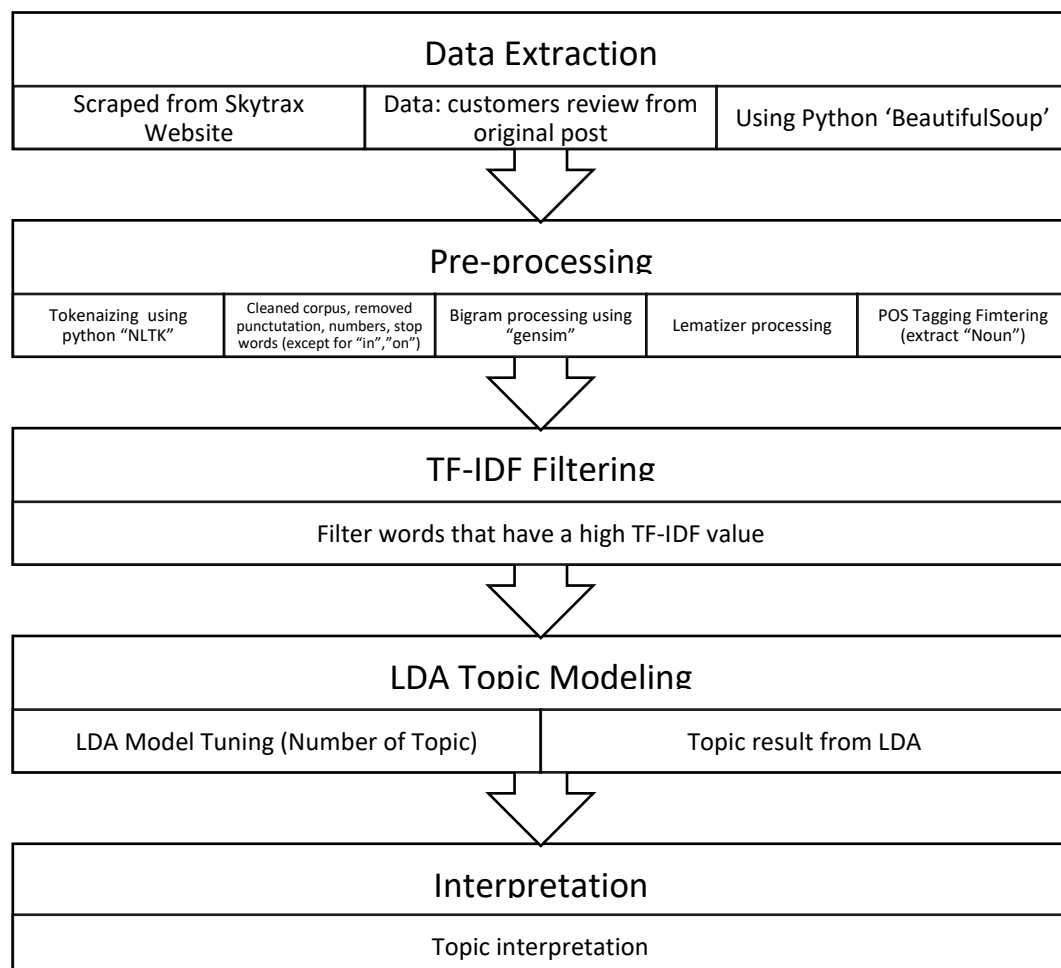

Figure 1. Data Analysis Procedure

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FINDINGS AND DISCUSSION

Descriptive statistics for the 1174 reviews collected from Skytrax revealed the recommendation rates of the three Indonesian airlines (Recommended and Not Recommended, as percentages). Garuda Indonesia has the highest recommendation rate (87.6%), followed by Citilink (70.8%), with Batik Air receiving the lowest recommendation rate (37.4%).

Topic modeling using LDA identified four topics for the "Not Recommended" reviews and six topics for the "Recommended" reviews, with each topic showing at least the top 20 most relevant words. The topic themes were named based on the correlated words.
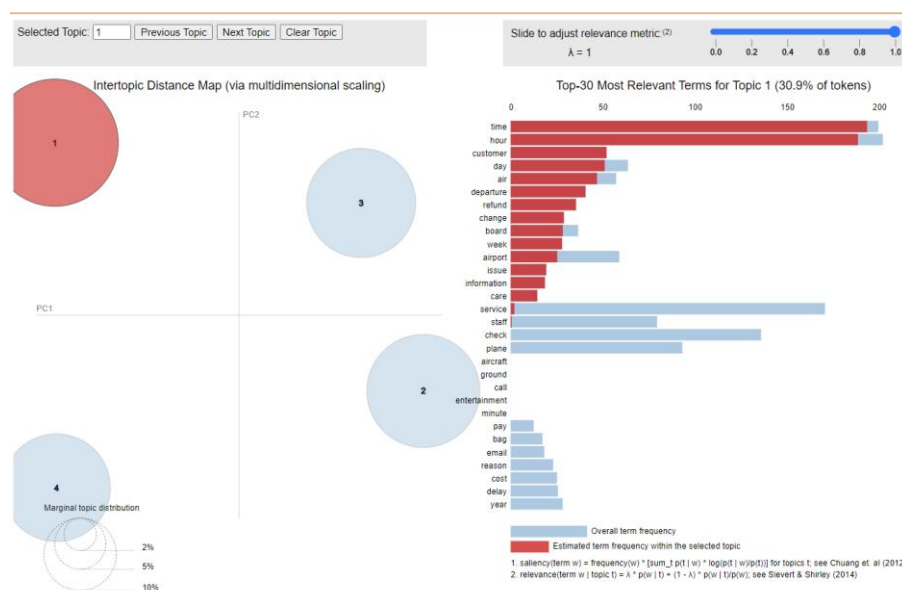

Figure 2. Topic Modeling Visualization based on Latent Dirichlet Allocation (LDA) for Topic 1 of Four Topics

Figure 2 presents a topic modeling visualization based on LDA, a commonly used technique for extracting topics from textual data. The visualization comprises two key parts: an Intertopic Distance Map on the left and the Top 30 Most Relevant Terms for Topic 1 on the right. The Intertopic Distance Map spatially represents topic distinctiveness and indicates the closeness of related themes. The "Top 30 Most Relevant Terms" chart illustrates how the frequency and salience of specific terms reflect dominant themes in customer perceptions. This visualization aims to facilitate understanding of LDA's outputs to support deeper insights into how the technique captures topic relevance and thematic overlaps in airline customer reviews. After topic tuning for nouns, adverbs, and adjectives, four topic lists were identified, with each term categorized according to the words passengers used in their reviews (see Table 2).

Table 2. Topic Themes Identified from Relevant Words in Passengers' "Not Recommended" Reviews. ($n =$ 246; four topics)

Topic No	Topic Themes	Word Recommended = "No": 246 data
1	Operational and Service Efficiency	time, hour, customer, day, air, departure, refund, change, board, week, airport, issue, information, care, service, staff, check, plane, baggage, food, email, economy, cabin, seat, ground, delays, customer service, flight changes
2	Passenger Experience and Service Quality	service, passenger, meal, experience, gate, water, baggage, people, crew, year, way, cost, reason, pay, cabin, staff, airport, plane, issue, hour, time, air, delay, food, refund
3	Class of Service and Onboard Experience	class, plane, food, business, economy, passenger, delay, cabin, bag, staff, service, hour, board, experience, check, return, meal, water, call, email, gate, ground, aircraft, entertainment, seat
4	Ticketing, Seating, and Customer Relations	seat, check, staff, ticket, return, airport, email, way, day, air, time, change, refund, baggage, experience, class, ground, entertainment, gate, reason, business, food, information, call, cabin

Source: Research data, 2025

Table 2 presents the topic themes identified from passengers' "Not Recommended" reviews (246 data points). The table is divided into four topics, each representing a different aspect of the passengers' negative experiences, alongside the words most frequently mentioned within each topic. The first theme, Operational and Service Efficiency, focuses on issues such as delays, customer service, refunds, and flight changes, and includes frequent mentions of time management and service quality. The second theme, Passenger Experience and Service Quality, emphasizes concerns about meal service, baggage handling, crew interactions, and costs, reflecting dissatisfaction with the overall quality of the service. The third theme, Class of Service and Onboard Experience, reveals distinctions between business and economy classes, onboard comfort, staff service, and entertainment options, with frequent mentions of delays and baggage problems. The fourth theme, Ticketing, Seating, and Customer Relations, highlights ticket return issues, seating comfort, refunds, and baggage handling problems, along with concerns regarding the management of customer relations. Collectively, these themes suggest that airlines should address operational efficiency, service quality, class-based experiences, and customer relations to improve overall passenger satisfaction.
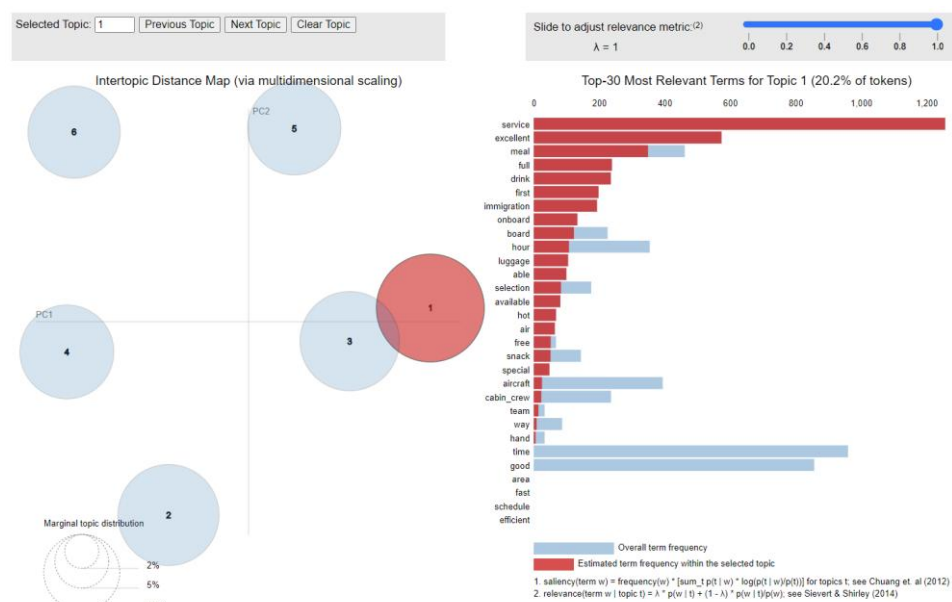
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Figure 3. Topic 1 Identified from the "Recommended" Reviews (n = 928; six topics)

Figure 3 depicts a topic modelling visualization for Topic 6 (one of six topics identified within the "Recommended" reviews). The identified topic theme can be seen in Table 3, which presents the six topic themes identified from reviews in which passengers recommended the airline (928 "Recommended" reviews). The first theme, Onboard Service and In-Flight Experience, highlights positive feedback regarding meal quality, service excellence, and the helpfulness of the cabin crew. The second theme, Check-In and Boarding Process, emphasizes smooth, efficient boarding experiences and quick check-ins. The third theme, Ground and Cabin Crew Support, praises the professionalism and helpfulness of staff, particularly during delays. The fourth theme, Cabin Comfort and Quality of Service, reflects satisfaction with the overall comfort of the cabin, food quality, and attentive service. The fifth theme, Seating, Legroom, and Pricing, addresses passengers' positive views on seating arrangements, legroom, and value for money. Finally, the sixth theme, Entertainment, Cleanliness, and Cabin Environment, highlights appreciation for the entertainment options, cleanliness, and general cabin atmosphere. Generally, passengers who recommended the airline expressed overall satisfaction across multiple aspects of their travel experience, particularly with service quality and comfort.

Table 3. Topic Themes Identified from Relevant Words in Passengers' "Recommended" Reviews (n = 928; six topics)

Topic No	Topic Themes	Word
		Recommended = "Yes" 928 data (6 number of topics)
1	**Onboard Service and In-Flight Experience**	service, excellent, meal, full, drink, first, immigration, onboard, board, hour, luggage, able, selection, available, hot, air, free, snack, special, aircraft, cabin_crew, team, way, hand, time
2	**Check-In and Boarding Process**	time, check_in, aircraft, ok, baggage, minute, quite, domestic, departure, little, process, snack, gate, terminal, good, queue, long, quick, many, boarding, overall, quickly, choice, friendly, trip
3	**Ground and Cabin Crew Support**	staff, great, plane, airport, ground, cabin_crew, hour, late, due, helpful, check_in, board, delay, passenger, year, way, really, time, help, hand, team, minute, quick, sleep, special

4	**Cabin Comfort and Quality of Service**	good, food, new, attentive, cabin, comfortable, overall, selection, pleasant, seat, quality, delicious, friendly, professional, sleep, time, cabin_crew, hour, aircraft, special, system, day, definitely, domestic, hand
5	**Seating, Legroom, and Pricing**	seat, leg, route, crew, economy, definitely, well, trip, passenger, experience, price, meal, better, much, room, back, last, option, ticket, best, late, day, hour, still, long
6	**Entertainment, Cleanliness, and Cabin Environment**	friendly, entertainment, nice, return, clean, movie, attendant, small, choice, system, inflight, bit, short, really, screen, polite, seat, still, smile, helpful, enough, smooth, comfortable, economy, legroom

Source: Research data, 2025

Comparing "Not Recommended" and "Recommended" reviews (Table 4) reveals distinct differences in passenger experiences and priorities. Passengers who did not recommend the airline expressed dissatisfaction with operational efficiency, citing frequent delays, poor customer service, and issues with ticketing, refunds, and seating arrangements. Additionally, they highlighted problems with baggage handling, staff efficiency, and cabin comfort. Conversely, passengers who recommended the airline praised the quality of onboard service, particularly the helpfulness of the cabin crew, meal offerings, and overall in-flight experience. Passengers also appreciated the smooth check-in process, comfortable seating, and cleanliness of the cabin environment. While negative reviews emphasized inefficiencies and service failures, positive reviews focused on attentive service, comfort, and the overall value provided, particularly in terms of crew support and in-flight amenities. This contrast suggests that improving operational efficiency and customer relations could convert dissatisfied customers into airline promoters.

Table 4. Comparison of Passengers' Reviews

Aspect	Passengers' Focus in "Not Recommended" Reviews	Passengers' Focus in "Recommended" Reviews	Common Themes & Network Connections
Focus on Operational Issues	- **Topic 1**: Service, staff, baggage, check, seat, economy, cabin, plane.	- **Topic 2**: Check-in, boarding, gate, terminal, baggage, quick boarding.	- **Common Keywords**: Baggage, check-in, refund, ticket.
	- **Topic 4**: Ticket, refund, baggage, entertainment, ground staff.	- **Topic 3**: Staff, ground crew, boarding, delay, helpful support.	- **Network Cluster**: Central role of staff, check-in processes, and baggage handling.
Focus on In-Flight Service	- **Topic 2**: Service quality, food, delays, crew, meal, experience.	- **Topic 1**: Meals, drinks, cabin crew, snacks, free selection.	- **Common Keywords**: Service, food, cabin, seat.
	- **Topic 3**: Business class, cabin, food, entertainment.	- **Topic 4**: Food, comfort, seat, cabin crew, sleep, selection of services.	- **Network Cluster**: Links between food, comfort, and crew interactions.
Passenger Comfort and Seating	- **Topic 3**: Seat comfort in business vs. economy, legroom, entertainment.	- **Topic 5**: Seat, legroom, economy class, price, comfort, best seat options.	- **Common Keywords**: Seat, cabin, legroom, comfort.
	- **Topic 4**: Seating, ticket changes, refunds, entertainment.	- **Topic 6**: Cleanliness, screen, inflight entertainment, legroom.	- **Network Cluster**: Emphasis on cleanliness, seating arrangements, legroom, and ticket pricing.

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Crew and Customer Support	- **Topic 1**: Staff service, cabin service, operational issues.	- **Topic 3**: Cabin crew support, ground crew handling delays, helpful staff.	- **Common Keywords**: Staff, crew, ground.
	- **Topic 2**: Crew interactions, overall service quality.	- **Topic 6**: Politeness, helpfulness, smooth service, friendliness.	- **Network Cluster**: Strong connections between staff helpfulness, delays, and passenger satisfaction.
Punctuality and Timing Issues	- **Topic 1**: Timing issues (delays, departure, boarding).	- **Topic 2**: Boarding efficiency, quick processes, short delays.	- **Common Keywords**: Time, delay, hour, boarding.
	- **Topic 2**: Delays, hours, time, crew handling delays.	- **Topic 3**: Late flights, delay handling, team support, airport operations.	- **Network Cluster**: Centrality of timeliness, with links to boarding and crew efficiency.

Source: Research data, 2025

Prior studies on airline service quality and customer satisfaction have employed both traditional and computational approaches, offering valuable insights into various satisfaction dimensions. For instance, Hussain et al. (2015), Kos et al (2017), and Farooq et al. (2018) used survey methods to explore service quality and passengers' satisfaction with airlines. Their analysis focused on dimensions such as airline and terminal tangibles, personal services, empathy, and overall airline image, highlighting the importance of both physical and emotional aspects of the travel experience. In contrast, Sezgen et al. (2019) adopted a text-mining approach to analyze global airline reviews collected from TripAdvisor. Their findings underscored the role of soft service attributes such as friendly staff, smooth customer care, seat comfort, and value for money in shaping overall satisfaction. The shift toward computational methods like text mining, as seen in Sezgen et al.'s study, demonstrates the growing importance of analyzing large-scale, unsolicited feedback to complement traditional survey-based research. This methodological evolution not only broadens the scope of measurable service factors but also captures real-time customer sentiment, making it highly relevant for post-pandemic airline service management and digital transformation efforts.

Recent studies have continued to explore customer satisfaction in the airline industry using both traditional surveys and modern data analytics approaches. Lucini et al. (2020) employed a text-mining method to analyze online passenger reviews from Air Travel Review (airlinequality.com), capturing a wide spectrum of satisfaction dimensions These include customer service, flight experience, cabin staff, comfort, delays, luggage handling, and even undefined or emerging topics, highlighting the granularity and richness of unstructured online feedback. Tahanisaz and Shokuhyar (2020) used questionnaire data from the passengers of 13 domestic Iranian airlines to examine flight safety, entertainment quality, crew responsiveness, and access to in-flight amenities such as the internet and electricity. Their study underscores the value of interpersonal service and operational reliability in driving satisfaction. Patel et al. (2022) conducted a sentiment analysis of customer feedback. Noviantoro and Huang (2022) utilized big data analytics, leveraging the U.S. Airline Passenger Satisfaction Dataset to analyze factors such as class of service, check-in efficiency, Wi-Fi, gate location, and delay management, offering insights into how digital services and logistics affect customer experience.

Complementing earlier studies, our comparative review of passenger feedback (presented in Table 4) provides nuanced insights into the divergent themes emphasized in

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"Recommended" versus "Not Recommended" reviews. This table categorizes passenger concerns and commendations across five core dimensions: operational issues, in-flight service, comfort and seating, customer support, and timing. Consistent with the research of Pereira et al. (2023) and Lucini et al. (2020), operational elements such as check-in, baggage handling, and staff performance emerge as central concerns, especially in negative reviews. Conversely, positive reviews highlight quick boarding, terminal experience, and helpful ground staff, aligning with the findings of Noviantoro and Huang (2022), which emphasized ease of boarding and gate location as important factors driving customer satisfaction. Furthermore, consistent with Tahanisaz and Shokuhyar (2020), in-flight services like food quality, crew responsiveness, and cabin comfort were critical satisfaction factors, especially when passengers noted meal options and crew attentiveness in their positive reviews. Comfort and seating-related complaints, especially legroom and entertainment, were consistently reported across both text-mining and questionnaire-based studies. Interestingly, the network clusters shown in Table 4 reinforce the relational dynamics between staff helpfulness, service smoothness, and delay management, reinforcing the findings of Syed et al. (2024) and Sun et al. (2024), who emphasize crew willingness to help and attentiveness.

The persistent prominence of timeliness (delays, boarding processes, and scheduling) across all feedback types supports Patel et al.'s (2022) conclusion about the importance of operational efficiency in shaping passenger perceptions. Furthermore, the study by Farzadnia et al. (2024) highlights the use of topic modeling, specifically LDA, as an effective approach to analyzing airline customer reviews and uncovering key satisfaction themes across different flight classes. Their analysis revealed distinct customer priorities: "passenger care" emerged as the dominant concern in economy class, while "time-related issues" were more frequently mentioned in business and first-class reviews. These findings underscore the varying expectations of passengers by service tier and suggest the strategic importance of tailoring service improvements accordingly. This aligns with our results (presented in Table 4) and those of previous studies, reinforcing the critical role of timeliness, customer service, and class-specific preferences in shaping passenger satisfaction. Thus, our findings strengthen the synthesis of previous literature by clearly distinguishing complaint-driven versus commendation-driven satisfaction attributes while also highlighting the networked service components that influence passenger experiences.

This study's findings reflect the evolving trends of the airline industry in the post-pandemic era. Cleanliness is now central to the overall perception of service quality, alongside long-standing concerns about punctuality, seating comfort, and customer service (Bunchongchit & Wattanacharoensil, 2021; Zahraee et al., 2022). The frequent appearance of keywords such as "clean cabin," "clean seat," and "hygienic environments" in broader discussions on comfort and passenger satisfaction indicates that cleanliness has become a critical pillar of the passenger experience (Rita et al., 2022; Kim et al., 2024; Paraschi et al., 2024). Our results align with the findings of Noviantoro and Huang (2022), suggesting the need for airlines to pay increased attention to external factors, such as hygiene protocols, to ensure a positive travel experience in the post-pandemic era. This study further supports the notion that the airline industry must adapt its service delivery model, integrating hygiene and cleanliness alongside traditional factors like punctuality and

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comfort as core components of enhancing customer loyalty and maintaining a competitive advantage.

CONCLUSION

This study revealed common themes influencing customer feedback: excellent service and staff friendliness influenced positive reviews, while delays and poor seat comfort frequently led to negative reviews. The incorporation of cleanliness and hygiene regulations into the larger service framework is clear evidence that airlines must evolve. To satisfy the needs of today's passengers, they must ensure that every facet of service quality—from comfort to cleanliness—is made a top priority. Understanding the key drivers of customer satisfaction helps airlines improve services and maintain a competitive edge. This study offers practical implications for airline management. The insights derived from the topic modeling of customer reviews can equip airlines with a deeper understanding of real-time passenger concerns and expectations, reducing their reliance on structured surveys alone. In particular, issues related to delays and service recovery processes signal the need for operational adjustments and improved staff training in customer engagement. By understanding the key drivers of customer satisfaction, airlines can enhance their services and maintain a competitive edge.

This study is not without its limitations. We focused solely on data from Skytrax reviews, which may not capture all aspects of customer satisfaction, especially those who do not provide online feedback. The focus on a limited number of flight classes and review sources may restrict the generalizability of findings across different airlines or cultural contexts. Future research could integrate more specific methodological enhancements; for example, combining LDA with sentiment analysis or advanced natural language processing techniques could improve the interpretation of passenger emotions and refine thematic precision. Additionally, broadening the sample to include regional or low-cost carriers and conducting comparative studies across Southeast Asian airline markets would enhance the analytical depth and generalizability of the findings.

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AUTHOR PROFILE

Yuliani Dwi Lestari, PhD.

ORCID ID 0000-0002-4446-1293. Associate Professor, Research interest in sustainable operations management, sustainable tourism, sustainable transportation and energy, halal value chain.

Faridatus Saidah, MSM.

ORCID ID 0000-0002-6720-9461. Research Assistant, Research interest in Sustainable tourism, halal industry development.