

TRANSFORMING TOURIST BEHAVIOR IN THE POST-PANDEMIC ERA: BIG DATA INSIGHTS FROM JAKARTA'S KOTATUA HERITAGE SITE

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Abstract

The COVID-19 pandemic has profoundly reshaped tourist behavior, particularly within urban heritage destinations. This study explores the behavioural transformation of visitors to the Kotatua Jakarta heritage district before and after the pandemic, employing a descriptive quantitative approach grounded in big data analytics. A dataset of 692 user-generated reviews was extracted from multiple digital platforms—Tripadvisor, Google Review, Google Insight, and Traveloka—covering the period from 2016 to 2023. Structured data were analysed using SPSS, while unstructured textual data were processed through natural language processing techniques via RapidMiner and Python libraries. Findings indicate marked shifts in tourist segmentation, travel motivations, attraction preferences, visitation patterns, and spending behaviour. Post-pandemic tourists were predominantly local residents from Greater Jakarta, with Gen Z and Millennials comprising the majority. A transition was observed from educational motivations to light recreational and visual experiences such as photography and sightseeing. Average visit durations decreased, yet revisit intentions increased, while overall expenditure per visitor declined significantly. These trends reflect a growing demand for proximity-based, flexible, and value-conscious travel. The study underscores the imperative for destination management organisations (DMOs) to adopt data-driven strategies that prioritise digital engagement, open-air spatial design, and locally responsive tourism experiences. It further advocates for the sustained integration of big data analytics to support adaptive, inclusive, and sustainable governance of heritage tourism in the evolving post-pandemic context.

Keywords: post-pandemic tourism, tourist behavior, big data analytics, visitor segmentation

A. INTRODUCTION

The Special Capital Region of Jakarta serves as the political, economic, and cultural epicenter of Indonesia. As a rapidly developing metropolitan city, Jakarta is also a major tourism hub, attracting both domestic and international visitors. According to the Central Bureau of Statistics (2023), in 2022 Jakarta accounted for 8.58% of total domestic tourist arrivals and 15.87% of international tourist arrivals, positioning it as one of Indonesia's leading national destinations. Moreover, Jakarta's Gross Regional Domestic Product (GRDP) at constant prices reached IDR 1,953.46 trillion, contributing approximately 16.5% to the national Gross Domestic Product (GDP), thus underscoring Jakarta's strategic role not only as an economic center but also as a primary gateway for Indonesian tourism.

One prominent tourism segment flourishing in Jakarta is heritage-based tourism, which offers educational and historical experiences. Within this context, the Kotatua (Old Town) area holds significant value due to its rich historical and architectural assets, representing colonial legacies alongside distinctive local cultural developments. The presence of three major cultural influences Chinese, Arab, and Coastal Sundanese imbues the area with diverse thematic potential (Angelica, 2023). Heritage tourism plays a strategic role in sustainable tourism development by integrating cultural preservation with economic contribution (Poria et al., 2006; Timothy & Boyd, 2003)

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Despite its promising potential, the area has yet to be fully optimized. Visitor concentrations remain heavily focused on the Fatahillah Square, reflecting a lack of visitor dispersion and weak integration among attractions. This issue indicates insufficient interpretive strategies and poor spatial distribution. From the perspective of the 3A framework attractions, amenities, and accessibility, the Kotatua area already fulfills the essential criteria of a prime destination (Budisetyorini, 2019; Crouch & Ritchie, 1999). With strong attractions, adequate facilities, and easy accessibility, the area should, in theory, be highly competitive in the national tourism landscape.

The development of this destination has become increasingly complex following the outbreak of the COVID-19 pandemic in 2020. The pandemic not only triggered a drastic decline in tourist numbers but also fundamentally transformed traveller behaviour and preferences. Tourists became more cautious, showing a preference for open-air, less crowded destinations that adhere strictly to health protocols. Moreover, the pandemic accelerated the adoption of digital technologies in tourism services, including contactless payments, digital information systems, and touchless services (D. X. F. Fan et al., 2021; Gössling et al., 2021; Khan, 2022).

This behavioral shift demands that destination managers adopt adaptive and responsive approaches in addressing new tourism market dynamics. Understanding the post-pandemic preferences and characteristics of tourists is vital for developing marketing strategies and tourism products that are aligned with these changes. In this regard, an in-depth analysis of market segmentation, travel motivations, and visitor expectations serves as a crucial foundation for enhancing destination competitiveness in a sustainable manner (UNWTO, 2022). As emphasized by Venkatesh, the success of destination management is highly contingent upon the ability to understand and respond to ever-evolving consumer behavior (Venkatesh, 2012).

In light of these dynamic transformations, destination managers in Kotatua must redesign their management approaches holistically. This involves the formulation of consumer-oriented marketing strategies, the development of relevant attractions, and the creation of tourism experiences that are safe, personalized, and meaningful. Therefore, a comprehensive study on post-pandemic tourist behaviour and preferences is essential as a basis for constructing more effective destination governance policies. Such an approach allows development strategies to be aligned with the evolving consumption patterns and expectations of modern tourists (Sangadji, 2014).

This study is conducted in response to the aforementioned urgencies. Its primary objective is to provide a comprehensive understanding of the behavioral transformation of tourists visiting the Kotatua Jakarta Heritage Area in the post-COVID-19 context. Specifically, the research aims to formulate appropriate segmentation, targeting, and positioning strategies aligned with the current market dynamics. Additionally, this study seeks to identify and analyze changes in visitor behavioral profiles, including travel motivations, attraction preferences, modes of interaction with tourism services, and expectations for heritage tourism experiences. The findings are expected to offer strategic insights for destination managers in developing more adaptive, inclusive, and sustainable tourism models in the post-pandemic era.

B. RESEARCH METHOD

Research Design. This research adopts a quantitative descriptive design, aiming to explore and map changes in tourist segmentation and behavior in Jakarta's Kotatua heritage area before and after the Covid-19 pandemic (Creswell, 2014; Sekaran & Bougie, 2016). The descriptive method is widely used in tourism behavior studies to examine patterns and comparative tendencies in large populations (Babbie, 2020). This design is particularly relevant for studies using digital behavioral data, where the objective is to identify shifts in patterns over time (Xiang et al., 2015).

In alignment with current trends in tourism research, the study integrates a big data analytics approach, enabling the extraction of meaningful patterns from unstructured and semi-structured digital user content (Mariani et al., 2018). Big data allows for scalable analysis of online behaviors across platforms and has been used effectively to analyze post-Covid tourist dynamics (Gretzel, Fuchs, et al., 2020; Li et al., 2022).

Data sources and research object. The object of study is the visitor population to the Kotatua Jakarta heritage area, focusing on domestic tourists who have interacted with the destination via digital platforms (BPS, 2023). The dataset includes a total of 692 user-generated records from Tripadvisor, Google Review, Google Insight, and Traveloka, covering the period of 2016 to 2023 (C. Liu, 2021; Zhao, 2017). The sample is divided into 312 pre-pandemic observations (2016–2019) and 380 post-pandemic observations (2021–2023) to enable comparison across temporal periods (Zenker & Kock, 2020). Data include both structured attributes (such as rating, time of visit, reviewer origin) and unstructured content (user comments, keywords, sentiments) commonly utilized in tourism big data research (Marine-Roig & Clavé, 2015).

Data collection technique. The data were collected using automated web scraping, a technique widely applied in tourism studies to extract publicly available information from digital platforms in real time (Lawson, 2017). Tools such as Python scripts and Google Data Extractor were employed to capture reviews, metadata, and sentiment expressions associated with Kotatua Jakarta (Salvador, 2014).

The method allows for the extraction of high-volume, naturally generated user content, which increases ecological validity and reduces social desirability bias typically present in traditional surveys (Gretzel, Sigala, et al., 2020; Xiang et al., 2015). The use of multiple platforms also supports data triangulation, improving reliability and contextual generalizability (Li et al., 2022).

Operationalization of variables. This study focuses on two major constructs: **tourist segmentation** and **tourist behavior**, both of which are operationalized based on established theoretical frameworks in tourism and marketing research. The tourist segmentation construct is developed by referring to classical marketing models that define segmentation according to demographic, geographic, psychographic, and behavioral variables (Kotler & Keller, 2016). In this study, segmentation includes age group, gender, origin (geographic), and motivation—a structure supported by Manrai et al. (2011), who emphasize the role of cultural dimensions and motivation in tourist segmentation.

The tourist behavior construct refers to how tourists interact with the destination before, during, and after travel. It includes behavioral indicators such as activity preference, visit duration, travel timing, expenditure levels, and review sentiment, aligned with models by Kozak & Decrop (2009) and Pearce (2005), which categorize tourist behavior across cognitive, affective, and behavioral domains. To ensure clarity and replicability, Table 1 below details the operational definitions of each variable and its source:

Table 1. Operationalization of Research Variables

Variable	Indicator	Measurement Approach	Source / Reference
Tourist Segmentation	Age Group	Classified by generation (Gen Z, Y, X, etc.)	(Kotler & Keller, 2016; Schiffman & Wisenblit, 2019)
	Gender	Male / Female / Unspecified	(UNWTO, 2022)
	Geographic Origin	Based on city/province (domestic only)	(Li et al., 2022; Manrai, 2011)
	Motivation	Heritage, leisure, culinary, etc.	(Pearce, 2005; Poria, 2006)

Variable	Indicator	Measurement Approach	Source / Reference
Tourist Behavior	Preferred Activities	Categorized from review keywords	(Kozak & Decrop, 2009; Marine-Roig & Clavé, 2015)
	Visit Duration	Time range (e.g., <1hr, 1–3hrs)	(Gretzel, Sigala, et al., 2020; Li et al., 2022a)
	Time of Visit	Morning, afternoon, evening	(BPS, 2023; Fuchs et al., 2014)
	Expenditure Estimate	Derived from platform categories	(Schiffman & Wisenblit, 2019)
	Sentiment / Review Score	Polarity & frequency of keywords	(C. Liu et al., 2021; Marine-Roig & Clavé, 2015)

In Table 1 above, it explains that the sentiment indicator is derived from text mining of user reviews using NLP tools to assess polarity (positive, negative, neutral), a method validated by several studies in tourism data analytics. (Dina, 2020; Mariani et al., 2018). The categorization of motivation, activities, and preferences was adapted from prior typologies of cultural/heritage tourists (Chhabra, 2010; Poria, Butler, et al., 2006), which distinguish between passive spectators and active participants in heritage experiences.

Segmentation variables were adapted from classic demographic-psychographic models (Kotler & Keller, 2016), while behavioral constructs refer to the tourist activity and experience cycle proposed by Kozak and Decrop (2009) and Pearce (2005).

The inclusion of sentiment score as a behavioral proxy reflects trends in data-driven tourism studies, where online expressions are treated as behavioral indicators (C. Liu et al., 2021; Mariani et al., 2018).

Data analysis technique. Quantitative analysis was conducted using SPSS v26 for structured data, while textual analysis was conducted using RapidMiner and Python NLP libraries, such as NLTK and spaCy (Crespo, 2011; Dina, 2020). Descriptive statistics were used to profile tourist segments, while independent sample t-tests were applied to examine significant differences between pre- and post-pandemic variables (Sekaran & Bougie, 2016).

Sentiment analysis was applied using Term Frequency-Inverse Document Frequency (TF-IDF) and polarity scoring, as per standard practice in tourism sentiment research (Li et al., 2022a; Marine-Roig & Clavé, 2015). In addition, Market Basket Analysis using Apriori Algorithm was employed to uncover associative patterns between attributes (e.g., origin–activity–timing) (Y. Liu et al., 2021; Zhao, 2017).

Validity and reliability. Although the data were not obtained through random sampling, their authenticity is ensured through platform verification mechanisms, timestamps, and digital signatures, which have been validated in prior studies as reliable sources (Gretzel, Sigala, et al., 2020; Xiang et al., 2015). Reliability was further enhanced through cross-platform triangulation and manual validation of keyword classification during the preprocessing phase (Li et al., 2022). Content validity was addressed by ensuring variable construction aligned with the literature and widely adopted behavioral frameworks (Kozak & Decrop, 2009; Pearce, 2005).

C. RESULTS AND ANALYSIS

Research Findings

This study applied a descriptive quantitative approach using big data analytics to examine behavioral changes among tourists visiting the Kotatua Jakarta Heritage Area before and after the Covid-19 pandemic. A total of 692 user-generated records were collected from Tripadvisor, Google Review, Traveloka, and Google Insight, comprising 312 records before the pandemic (2016–2019) and 380

records after the pandemic (2021–2023). Structured and unstructured data were processed using SPSS v26 for statistical analysis and Rapid Miner and Python-based natural language processing (NLP) tools for text and sentiment analysis. The following are the major findings (Table 1):

Table 2. Comparison of Tourist Behavior Before and After the Pandemic

Aspect	References	Pre-Pandemic	Post-Pandemic
Visitor Origin	(UNWTO, 2022; Zenker & Kock, 2020)	Majority from outside Jabodetabek (64.42%)	Majority from Jabodetabek (62.37%)
Dominant Age Group	(Kim & Prideaux, 2005)	Gen Z and Millennials (15–44 years)	Gen Z and Millennials (15–44 years)
Main Motivation	(Gretzel, Sigala, et al., 2020)	History and cultural learning	Recreation and open-air activities
Preferred Attractions	(D. X. Fan, 2021)	Fatahillah Square complex	Thematic museums (BI, BNI, Bank Mandiri)
Top Activities	(Khan, 2022)	Educational tours, museum visits	Sightseeing, photography, relaxing outdoors
Visit Timing	(Gössling et al., 2021)	Midday	Late afternoon, weekends
Visit Duration	Pearce (2005)	1–3 hours	≤1 hour (67%)
Repeat Visit Rate	(Pearce, 2005; Schiffman & Wisenblit, 2019)	47%	60%
Average Spending	(Chhabra, 2010)	> IDR 1,000,000 (30% of visitors)	< IDR 200,000 (60% of visitors)
Accommodation Type	(Timothy & Boyd, 2003)	Some overnight stays	Mostly day-trips (non-overnight)

In Table 2 above, it is explained that there has been a shift in tourist segmentation by origin, demographic profile, and tourist motivation, as well as changes in preferred attractions and activities, visit timing, duration, frequency, tourist spending, and accommodation

Shift in tourist segmentation by origin. Prior to the pandemic, 64.42% of visitors originated from outside the Jabodetabek region, while post-pandemic data revealed a reversal, with 62.37% of visitors residing within the Jabodetabek area. This indicates a pivot toward proximity tourism, where short-distance and safer travel options became more desirable during health crises (UNWTO, 2022; Zenker & Kock, 2020).

Demographic profile and tourist motivation. Analysis of data from Google Insight and Traveloka indicated that 81.58% of visitors were from the 15–44 age group (Gen Z and Millennials) both before and after the pandemic. This demographic is known for its digital savviness and strong interest in personalized and flexible travel experiences (Kim & Prideaux, 2005; Liu et al., 2021). A shift in motivational drivers was observed. Before the pandemic, visits were largely motivated by historical and cultural education, whereas after the pandemic, most travelers (60%) were drawn by light recreational activities and outdoor visual experiences, such as sightseeing and photography (Gretzel, Sigala, et al., 2020).

Changes in preferred attractions and activities. Using TF-IDF analysis, it was found that the Fatahillah Square complex was the most frequently mentioned attraction pre-pandemic, while post-pandemic reviews favored thematic museums (e.g., Museum BI, Bank Mandiri, and BNI), suggesting a preference for open and visually engaging spaces (D. X. Fan, 2021; Li et al., 2022). There was also a notable

transition from educational activities (e.g., cultural learning) to lighter experiences such as photography and casual exploration. This aligns with emerging literature that identifies a post-pandemic trend toward comfort, safety, and socially distanced travel behavior (Khan, 2022).

Visit timing, duration, and frequency. Visit timing shifted from midday (pre-pandemic) to late afternoon and weekends (post-pandemic), indicating tourists' desire to avoid peak crowd times and fit tourism into more flexible post-pandemic lifestyles (Gössling et al., 2021). The average duration of visits decreased significantly, with 67% of post-pandemic tourists spending less than 1 hour, compared to 1–3 hours in pre-pandemic data. This reflects increased health-related travel caution and preference for shorter, lower-risk trips (Pearce, 2005). Furthermore, repeat visit frequency increased from 47% to 60%, suggesting stronger loyalty among local visitors—a factor that contributes positively to destination sustainability (Schiffman & Wisenblit, 2019).

Tourist spending and accommodation. Tourist spending dropped substantially. Before the pandemic, 30% of travelers spent more than IDR 1,000,000, while post-pandemic, over 60% spent less than IDR 200,000. This reflects value-seeking behavior often seen during post-crisis recovery periods (Chhabra, 2010). Additionally, most visits became non-overnight (day trips), in line with the increase in local visitors and reduced tourism risk appetite (Timothy & Boyd, 2003).

Discussion

This study reveals significant shifts in tourist behavior in the Kotatua Jakarta Heritage Area before and after the Covid-19 pandemic. These findings are categorized into key segments: visitor origin, demographic profile and motivation, preferences for attractions and activities, visitation patterns, and spending and accommodation behavior. Each segment provides strategic insights for Destination Management Organizations (DMOs) and relevant stakeholders to design targeted interventions for sustainable destination recovery and development (Eddyono et al., 2025; Gretzel, Sigala, et al., 2020).

One of the most notable findings is the shift in visitor origin. Prior to the pandemic, the majority of visitors came from outside the Greater Jakarta area (64.42%). Post-pandemic, however, the majority originated from within Greater Jakarta (62.37%). This phenomenon reflects a growing trend in “proximity tourism,” driven by the demand for safe, affordable, and flexible travel options (UNWTO, 2022; Zenker & Kock, 2020). Similar trends were also reported by Eddyono et al. (2022) in the context of national parks in Indonesia, where domestic tourists replaced international arrivals. In light of this, destination marketing strategies for areas like Kotatua should shift toward localized market segmentation through digital campaigns and incentive-based platforms (Nurdiansyah et al., 2024). Such approaches are shown to be effective in stimulating visits, especially when coupled with vaccine-based travel confidence initiatives (Hakim, Eddyono, & Abdullah, 2022).

The demographic structure of visitors has also changed, with younger generations Gen Z and Millennials (aged 15–44) becoming dominant. This underscores the need for DMOs to adopt experience-based approaches and enhance digitalization across destination management. Furthermore, there is a notable shift in travel motivation, from educational and historical interests toward recreational and visual engagement, particularly photography. This finding aligns with Latief & Eddyono (2023), who emphasized the influence of visual attraction perceptions on visitation motivation. Consequently, the development of technology-based attractions, including augmented reality (AR), gamified historical narratives, and social media integration, becomes increasingly relevant (Eddyono et al., 2025; D. X. F. Fan et al., 2021).

Changes in visitation patterns are also evident. There is an increasing preference for afternoon and weekend visits, along with shorter durations of stay. This behavioral shift necessitates crowd management and time-based visitation scheduling, supported by digital technologies. In this context, the implementation of e-ecotourism through big data approaches—as developed by (Eddyono et al., 2025; Hakim, Eddyono, & Abdullah, 2022) emerges as a strategic solution. Reservation systems, visitor

prediction algorithms, and real-time flow management can prevent overcrowding while enhancing tourist comfort and safety (Y. Liu et al., 2021). Infrastructure adjustments, such as improved nighttime lighting and sensor-based monitoring systems, are also essential to accommodate these new visitation patterns (Gössling et al., 2021).

From an economic standpoint, the increasing dominance of "day-trip" visits and declining tourist expenditures indicate a shift toward value-seeking tourism. This challenges DMOs to design affordable yet high-quality tourism experiences that emphasize local uniqueness. Collaborations with local micro and small enterprises (MSMEs) become crucial for adding value and ensuring inclusive economic benefits (Chhabra, 2010; Timothy & Boyd, 2003). Nurdiansyah et al. (2024) highlighted the importance of stimulus mechanisms based on local goods and services to enhance destination attractiveness, while Eddyono et al. (2022) showed that integrating tourism activities with non-tax state revenue (PNBP) contributes to destination competitiveness, provided that such integration is supported by strong institutional and data-driven frameworks.

Overall, managing heritage destinations like Kotatua Jakarta in the post-pandemic era requires a shift toward digital transformation and data-driven decision-making. The optimization model based on big data, as proposed by Eddyono (2020; 2025), places the integration of visitor data, technological capabilities, and institutional innovation at the core of sustainable destination strategy. Digital platforms for DMOs—as suggested by Gretzel et al. (2020) and demonstrated in study by Hakim et al. (2022), can accelerate responsiveness to tourist dynamics and offer greater flexibility in destination management.

By integrating shifts in tourist behaviour, digital technology implementation, locally oriented product innovation, and evidence-based policymaking, destination management strategies for heritage areas such as Kotatua Jakarta can be steered toward adaptive, inclusive, and globally competitive recovery.

D. CONCLUSION

The behavioral shift of tourists in the Kotatua Jakarta Heritage Area in the post-pandemic period necessitates adaptive strategies by Destination Management Organizations (DMOs) and related stakeholders. The current market is predominantly composed of young local travellers who exhibit a preference for light, flexible, and visually immersive recreational experiences. In response to this shift, destination strategies should prioritize the development of open-air thematic attractions, the enhancement of digital engagement through social media and mobile applications, the adjustment of operational hours aligned with contemporary visitation patterns, and the formulation of budget-friendly travel packages tailored to the needs and purchasing power of this demographic.

Integrating *big data*-driven approaches is crucial in the design and implementation of such strategies. By leveraging data analytics from tourist flows, digital sentiment, spatial mobility, and spending behaviour, DMOs can proactively craft precise, efficient, and personalized interventions. Moreover, big data enables real-time monitoring, predictive modelling of visitor surges, and the systematic evaluation of marketing effectiveness and destination governance. This approach aligns with global post-crisis tourism management trends, which prioritize safety, comfort, and personalized experiences as key determinants for rebuilding tourist trust and ensuring long-term destination sustainability.

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