Comparative Analysis of Chatbot Adoption in Indonesian Provinces and Assess the Future Potential in Tourism Sector: A Literature Review

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ABSTRACT:

This study aims to compare chatbot utilization in Indonesian provinces and assess the future potential in the tourism sector. We examine several pioneering chatbot implementations, including Pariyata in Yogyakarta; Mushi in Malang; as well as the Chatbot Desa Wisata Badung and MELALI in Bali. Results indicate that prototype chatbots built on rule-based AIML (Pariyata) and Dialogflow (Badung, MELALI) achieved high response accuracies when answering destination queries, demonstrating technical feasibility and user acceptance. However, early initiatives such as Mushi suffered from limited functionality and platform maintenance issues, showing the importance of sustainable governance and continuous system updates. Comparative analysis reveals that project with institutional support (universities, provincial government) and clear maintenance plans yield more consistent performance, while those lacking long-term funding face rapid obsolescence. Looking ahead, advanced natural language understanding, AI-driven recommendation engines, and multi-channel deployment (web, mobile, messaging apps) are necessary to enhancing user experience and operational resilience. To fully realize chatbot potential in Indonesian tourism, stakeholders should prioritize scalable cloud-based architectures, integration with smart-city and e-government platforms, and data-driven personalization features that adapt to visitor profiles. By addressing governance, technical, and user-engagement challenges, future chatbot deployments can support post-pandemic recovery, increase tourist satisfaction, and contribute to sustainable regional development.

Index Terms—Chatbot, Tourism, sustainable governance, user experience

I. INTRODUCTION

As the tourism industry enters the era of the Fourth Industrial Revolution, artificial intelligence (AI) has emerged as a transformative force reshaping customer experience, operational efficiency, and strategic decision-making. Chatbots (AI-powered conversational agents) now has an important role in the transformation, offering real-time assistance, personalized recommendations, and automated service interactions across websites, mobile apps, and messaging platforms [1]. From global hotel chains deploying virtual concierges to guide guests, to destination management organizations using chatbots for visitor engagement, the technology has demonstrated strong potential for improving service quality and reducing operational costs [2].

Indonesia's tourism sector has been recognized as a key driver of national economic growth, accounting for over 5 percent of GDP prior to the COVID-19 pandemic and employing millions of workers across its archipelagic provinces [3]. Digital transformation initiatives, such as the National Strategy for Artificial Intelligence 2020–2045, have brought attention to the potential of new technologies to improve visitor experiences, operational efficiency, and sustainable development in tourism [4], [5]. Among these technologies, chatbots and conversational agents have garnered attention for the ability to provide real-time, personalized information and recommendations via familiar messaging platforms, thereby reducing service frictions and extending destination marketing efforts beyond traditional channels [6], [7].

Despite the growing global interest in conversational AI, Indonesia presents a uniquely challenging and promising context. Its demographic dividend, which characterized by a large, tech-savvy youth population, and Bahasa Indonesia's status as a unifying national language offer great place for rapid chatbot deployment and adoption [4]. However, uneven AI literacy, data fragmentation under the One Data Indonesia policy, and the absence of dedicated regulatory frameworks for responsible AI use have created obstacles to widespread uptake [4], [5]. Moreover, pilot projects in various provinces have demonstrated that institutional support and sustainable maintenance plans are critical determinants of long-term success [8], [9].

A number of early adopters, ranging from rule-based systems like "Pariyata" in Yogyakarta [10], [11] to hybrid recommender interfaces such as Bali's MELALI [12], have achieved high accuracy rates in controlled tests, yet few have scaled to multi-channel platforms or integrated with broader smart-city and e-government systems. Comparative studies show that project backed by provincial governments or academic institutions tended to remain operational, while those lacking clear governance quickly became obsolete [9], [13]. This emphasizes the imperative to examine not only technological choices (AIML engines versus cloud-based NLP services) but also the policy environments and funding mechanisms that enable sustainable chatbot ecosystems. This literature review therefore aims to compare and analyze chatbot adoption in Indonesia and assess the future potential in tourism sector. By providing a comprehensive comparative analysis, this study seeks to inform policymakers, developers, and tourism stakeholders on how to use conversational AI as a strategic tool for sustainable and resilient tourism development in Indonesia.

II. METHODOLOGY

The literature-review methodology for this study proceeded in three sequential phases: search and retrieval, screening and selection, and analysis and synthesis. These steps are designed to ensure comprehensiveness, relevance, and rigor in examining chatbot adoption across Indonesian provinces and its future potential in tourism. First, we conducted a systematic search of peer-reviewed journals, conference proceedings, government reports, and reputable industry publications. Electronic databases included Scopus, Web of Science, and Google Scholar, supplemented by targeted searches of national repositories such as the BPPT/BRIN digital archive and the UNESCO AI ethics observatory. Search strings combined keywords and Boolean operators, for example: ("chatbot" OR "conversational agent") AND ("tourism" OR "travel") AND ("Indonesia" OR specific

provinces such as "Yogyakarta" OR "Bali") AND ("implementation" OR "deployment" OR "adoption"). To capture both early-stage pilots and more recent AI-driven recommenders, the timeframe was set from 2018 through 2025. We also found and included relevant policy documents through government websites and professional networks. These documents are Stranas KA 2020–2045, Tourism 5.0, and the provincial smart province masterplans.

In the second phase, retrieved records were screened in two steps. Titles and abstracts were first assessed for relevance to tourism chatbot applications in Indonesia; studies focused solely on non-tourism domains (e.g., e commerce chatbots) were excluded. Full-text screening then applied more stringent inclusion criteria: (1) empirical or case-study data on actual chatbot deployments, (2) clear description of technological architecture or platform, and (3) reported performance metrics or qualitative user/organizational feedback. After de duplication and screening, 56 sources remained for detailed analysis, comprising 22 case studies, 14 comparative/systematic reviews, and 20 policy or framework analyses. Then, the final phase involved thematic coding and comparative synthesis. We extracted key variables like platform technology (e.g., AIML, Dialogflow, custom recommender engines), deployment channel, institutional sponsor, maintenance model, and performance outcomes (accuracy, RMSE, user satisfaction). Simultaneously, we mapped documented strengths, weaknesses, opportunities, and threats against national and provincial policy frameworks, following the SWOT-analysis template used by BPPT (2020). Data were organized into matrices to facilitate cross-case comparison and to identify gaps in platform scalability, governance structures, and integration with smart city and e government systems. Synthesis entailed both quantitative tallies (e.g., frequency of platform types) and qualitative narrative to elucidate how technological and institutional factors coalesce to shape adoption trajectories and future potentials in Indonesian tourism.

III. RESULT AND DISCUSSION

A. SWOT Analysis for Chatbot Adoption in Indonesia

According to Indonesia National Strategy for Artificial Intelligence [4], the SWOT analysis for Chatbot Adoption in Indonesia can be seen in Table 1.

Table 1. SWOT Analysis for Chatbot Adoption in Indonesia

Strengths	**Weaknesses**
• Demographic dividend: A large, young workforce increasingly skilled in IT, computer science, and AI–enables rapid development and deployment of chatbot solutions.	• Low public AI literacy: General awareness of AI and chatbot capabilities remains limited among both consumers and many service-industry workers.
• Growing pool of local talent: Indonesian universities are producing more IT/CS graduates who can build and maintain chatbots.	• Shortage of AI experts: There are still relatively few seasoned AI/chatbot researchers, lecturers, and senior engineers to lead complex projects.
• Unified national language: Bahasa Indonesia provides a common, standardized dataset target for conversational models, reducing the barrier of dialect fragmentation.	• Scarce open datasets: While Bahasa Indonesia is a strength, there is a lack of large, high-quality public corpora (text and speech) for training robust Indonesian-language chatbots.
Opportunities	**Threats**
• Rich, diverse data sources: Indonesia's cultural, geographic, and sectoral diversity (tourism, agriculture,	• Data silos & fragmentation: One-Data Indonesia policy faces "ego-sectoral" data hoarding, limiting access to comprehensive

government) can feed chatbots with unique, localized knowledge.	datasets needed for chatbot intelligence.
• Rapid digital infrastructure growth: Expanding cloud connectivity and mobile penetration facilitate scalable, always-online chatbot services.	• Cybersecurity risks: Inadequate network and data security could undermine trust in chatbots handling personal or transactional information.
• National AI funding & incentives: Government R&D grants (RISPRO, LPDP, Ristek programs) can underwrite chatbot innovation in tourism and beyond.	• Weak regulatory oversight: No dedicated AI regulatory body or standards for responsible chatbot use may lead to misuse, data-privacy breaches, or ethical lapses.
• Smart-city & e-government agendas: Provincial "Smart Province" masterplans and Tourism 5.0 initiatives explicitly call for AI-driven assistants in public services, opening channels for chatbot integration.	• Brain drain & foreign dominance: Local AI startups and talent may be poached by large multinationals or overseas opportunities before chatbot projects mature.

B. Comparative Analysis of Chatbot Implementations

The comparative analysis shows that in terms of technology, platform choices varied. The DIY/Yogyakarta chatbot ("Pariyata") used a rule-based AIML engine [10], whereas the Badung chatbot used a commercial NLP service (Dialogflow) [9]. MELALI appears to use custom algorithms (IMDb weighted rating) with a chatbot interface [12]. Mushi's platform is a web-based chat script [8]. Despite these differences, all functioning systems delivered high response accuracy: Pariyata about 85% [10], Badung 87% (Dharmawan, 2022), and MELALI was verified by a low RMSE (effectively 99+% correct outputs) [12]. This suggests that even relatively simple rule-based bots can achieve high success rates on targeted tourism queries if well-designed.

Institutional support strongly influenced outcomes. Projects backed by universities or government agencies tended to persist. For example, the Badung chatbot was built by academic researchers publishing in a journal, and MELALI is associated with a provincial government initiative. These had clearer funding or mandate for deployment. In contrast, Mushi was a city tourism department pilot that lacked long-term funding or technical upkeep, and ultimately the hosting site went offline. The UII project behind Pariyata received academic support until prototype completion, which may explain its good performance. In short, chatbots with institutional awards and defined maintenance plans outperformed stand-alone pilots: they remained accessible and relevant, whereas those without fell into obsolescence.

Functionally, all these chatbots focused on destination information (what to see and where), rather than transactional services like booking. They answered user queries about locations, and in some cases provided navigation or ratings. None were reported to book hotels or tickets, which remains more complex. The usage channels varied: Pariyata's channel is not specified, Mushi was on a web portal, Badung's is on Telegram, and MELALI use web or mobile. This diversity suggests early-stage experimentation; none was truly multi-channel or deeply integrated into traveler workflows.

A technical point is that NLP sophistication has room to grow. The existing bots largely rely on keyword matching or pattern rules. MELALI's authors emphasize keyword identification, Badung's on intent matching (Dialogflow), and Pariyata on pattern templates. User feedback on

complexity handling is not reported, but systematic research indicates that state-of-the-art chatbots still struggle with nuanced, open-ended questions. As Camilleri and Troise (2023) note, AI chatbots cannot yet replace human agents for complex queries, although efforts are underway to improve their language and contextual abilities [7]. This aligns with the modest scope of the Indonesian examples: they excel at fixed tourist queries (e.g. "Where is the XYZ temple?") but would likely falter at broader travel planning.

Table 2. Comparative Analysis of Chatbot Implementations

Chatbot (Location)	Platform/ Technology	Response Accuracy/ Performance	Institutional Support	Maintenance / Status
Pariyata (Yogyakarta, DIY)	Rule-based (AIML, Graphmaster)	About 85% accuracy on test queries	University-led (UII)	Prototype
Mushi (Malang, East Java)	Web-based chatbot	N/A (project incomplete; limited testing)	City tourism office	Site offline; no active maintenance
Desa Wisata Chatbot (Badung, Bali)	Dialogflow (Google NLP) on Telegram	About 87% accuracy on test inputs	Academic developers	Published prototype; deployed on Telegram
MELALI (Bali Province)	Recommender (IMDb-weighted) + chatbot	RMSE=0.0126 (low error); correct keyword mapping	Bali Provincial government & researchers	Operational system

C. Chatbot based Recommender Systems in Smart Tourism

Chatbot recommender systems represent a convergence of conversational AI and personalized recommendation engines, designed to guide tourists through planning, discovery, and in-destination decision-making. Unlike simple FAQ bots, these systems harness user data (such as stated preferences, past interactions, and contextual signals) to suggest attractions, restaurants, routes, or experiences tailored to each traveler [14], [15]. By embedding recommendation algorithms (e.g., collaborative filtering, content-based matching, or hybrid approaches) within a natural-language interface, they enable users to ask open-ended questions ("What cultural sites are nearby?") and receive curated suggestions that reflect both the user's profile and real-time factors like time of day or crowd levels [14].

In practice, most tourism chatbot recommenders combine an underlying knowledge base of destinations or services with a conversational NLP layer. For example, a rule-based engine (AIML or pattern matching) can map user intents to predefined recommendation modules, while more advanced implementations use machine-learning-driven intent classification (e.g., BERT or Rasa's classifiers) to handle a wider variety of user expressions and languages [16], [17], [18], [19]. Once the intent is identified, the recommender component (often using techniques like TF-IDF cosine similarity or Personalized PageRank) ranks available options and returns the top results in a chat message, sometimes enriched with images, ratings, or interactive buttons for deeper exploration [20], [21].

Empirical studies consistently show that chatbot recommenders can enhance user satisfaction and engagement in tourism contexts. In controlled usability tests, conversational recommenders achieved "liked" ratings from over 85% of participants when suggesting local restaurants or attractions [20], while

recommendation accuracy measured by metrics such as RMSE or precision at K often exceeds 80–90% in domain-specific trials [12]. Users value the immediacy of the chat interface and the personalized nature of the suggestions, reporting higher trust and perceived intelligence compared to static web listings [6], [22].

However, several challenges remain. First, domain coverage is often limited: many systems cannot handle queries outside their curated dataset, leading to "no answer" responses when users ask about less-common destinations or services [21], [23]. Second, the quality of recommendations depends heavily on data breadth and freshness, outdated or sparse datasets yield irrelevant or redundant suggestions [20]. Third, multi-language support and local dialects pose difficulties for NLP accuracy, especially in regions like Indonesia with linguistic diversity [24]. Finally, maintaining and updating both the chatbot's conversational flows and its recommendation database requires sustained institutional support, projects lacking long-term governance often become obsolete despite promising prototypes [8].

Looking ahead, integrating advanced NLU models (e.g., transformer-based architectures), embedding real-time context (weather, events, mobility data), and expanding to multi-modal interfaces (voice, images, AR overlays) will be key to next-generation tourism recommenders [25], [26]. Moreover, embedding chatbots within broader smart-city and e-government platforms can provide richer data streams and more seamless traveler experiences, while robust cloud architectures will ensure scalability during peak tourist seasons. By addressing data, linguistic, and governance challenges, AI-driven chatbots have the potential to become indispensable travel companions that both delight users and drive sustainable tourism growth.

Table 3. Chatbot based Recommender Systems in Smart Tourism

References	Method	Context (Location & Setting)	Key Topic	Key Finding	Challenges
[27]	Exploratory qualitative (Service Design, Grounded Theory; interviews, FGDs)	Tourist pro-environmental behavior – Gili Islands, Indonesia	Chatbots for sustainable tourism (PEB spillover)	Proposed a conceptual chatbot framework to nudge sustainable travel behaviors (PEB); developed two design/adoption models for post-trip sustainable engagement.	Context specificity (unique site), stakeholder coordination (government needed) and unvalidated concept; requires future empirical validation.
[20]	System design (conversational recommender using	Culinary tourism – Bandung, Indonesia (Telegram chatbot)	Culinary tourism chatbot recommender	Chatbot effectively recommended restaurants: usability testing	Limited natural-language understanding: some user inputs not

References	Method	Context (Location & Setting)	Key Topic	Key Finding	Challenges
	Dialogflow NLP, Named Entity Recognition, TF-IDF, cosine similarity)			showed 85.7% of users "liked" its recommendations.	understood, affecting ease-of-use (lower scores on responsiveness and interaction).
[21]	Development of mobile conversational recommender (Personalized PageRank algorithm, explanation facility)	Culinary tourism – Indonesia (mobile app chatbot)	Conversational recommender for culinary tourism	Users reported being "pretty satisfied" with recommendations, but overall accuracy was only ~40%.	Low recommendation accuracy (≈40%) due to limited data and algorithmic performance; requires improving the PageRank model or data coverage.
[24]	Knowledge-based RS with chatbot (Rasa framework, knowledge graph, k-NN)	Museum tourism (cultural heritage) – Jakarta, Indonesia	Museum recommendation via chatbot	The chatbot understood user requests and gave personalized museum suggestions by preferences, but overall system accuracy was moderate.	System performance needs improvement (accuracy not yet sufficient) to be reliable in practice; knowledge-base must be expanded and fine-tuned.
[23]	System implementation (Rule-based Dialogflow chatbot over tourism DB)	Urban tourism – Semarang City, Indonesia	Destination recommendation via chatbot	The Rasa-based chatbot provided expected tourism recommendations and information for Semarang; functional	Implementation was rule-based, limited to known intents; future work may require richer NLU and larger data sources

References	Method	Context (Location & Setting)	Key Topic	Key Finding	Challenges
				(black-box) testing passed as designed.	to cover more queries.
[28]	System implementation (Rasa chatbot on Telegram; intents from local social-media data); user testing (UAT)	Regional tourism – Pekalongan Regency, Indonesia	Local tourism recommender chatbot (WisPekaBot)	Chatbot achieved high user satisfaction: ~94% users found its responses and recommendations accurate and helpful.	Some intent coverage gaps remain; future work calls for adding more intents and refining responses for varied user queries.
[26]	ML-based chatbot (RASA with BERT-based intent classification; Flutter mobile app)	Tourist information – Vietnam (cities like Sapa, Hue)	AI chatbot for tourist recommendations	A BERT-based intent classifier achieved ~90% accuracy and F1-score on Vietnamese tourist queries; integrated in a travel chatbot app giving tailored location/hotel info.	Depends on large labeled data (TWCS dataset); performance may drop for queries outside trained topics; requires periodic retraining with new data.
[25]	System design (multi-agent AI: ASR for Thai/English, VQA for images, Chatbot with LLM)	Travel assistant (multimodal) – Thailand	Multimodal AI travel assistant	Prototype "MAHASA MUT" integrates speech, vision and chat to serve as tourist assistant. It can handle language barriers and offer	Needs improved user interface and extensive evaluation; integrating AI components (speech, image, LLM) is complex; careful design needed for seamless UX.

References	Method	Context (Location & Setting)	Key Topic	Key Finding	Challenges
				personalized route/hotel recommendations.	
[29]	Contextual case study (literature/contextual analysis)	Destination management – Bali, Indonesia (tourism ecosystem)	Chatbots for tourist engagement	Found chatbots can strategically enhance tourist satisfaction and loyalty in Bali, but deployment is uneven. Success depends on linguistic inclusivity and trustful design.	Infrastructural and SME digital-readiness gaps hinder chatbot adoption; cultural alignment (language/multilingual support) is critical for effectiveness.
[30]	Prototype development (Flask-based rule/pattern-matching chatbot)	Tourist info – Kediri City, Indonesia	Tourism information chatbot (Kediri Sido)	The Sido chatbot answered 83.3% of test queries correctly, demonstrating improved information service efficiency.	16.7% of test cases failed, indicating needed improvement; future enhancements include expanding training data and adding AI/NLP to handle more varied questions.
[31]	System development (Dialogflow chatbot on Telegram; black-box testing)	Destination information – Semarang Regency, Indonesia	Tourism information chatbot (Semarang)	Chatbot achieved 100% accuracy in black-box tests (all scripted scenarios answered correctly),	Evaluation was limited to predefined scenarios; real-world conversational variability may reduce performance (no failure

References	Method	Context (Location & Setting)	Key Topic	Key Finding	Challenges
				indicating reliable info provision for Semarang destinations.	observed in narrow tests).
[32]	System development (Dialogflow NLP-based chatbot; black-box & UEQ testing)	Regional tourism – Pati Regency, Indonesia	Tourism info chatbot (Pati tourist info)	Chatbot correctly answered 12 of 13 test questions (92.3% accuracy); user-experience scores (UEQ) were moderately high.	One query failed, suggesting the need to cover rare questions; further refinement of intents and data is required.
[33]	Experimental study (vignette-based between-subjects design; TAM analysis)	Service context – Hotel booking (Germany context)	AI chatbot vs human booking agent	In a simulated booking task, chatbots yielded slightly lower purchase intention than human agents (especially under adverse conditions). Users recognized chatbots but were less inclined to book with them.	Human-like design of chatbots is needed to boost acceptance; current user preferences favor humans for complex booking decisions.

D. Policies Supporting AI in Tourism in Indonesia

Indonesia's National Strategy for Artificial Intelligence 2020–2045, issued in August 2020 under the coordination of BPPT (now BRIN), provides a comprehensive blueprint for integrating AI across all sectors, explicitly including tourism. Stranas KA sets out objectives to use AI to enhance productivity and service quality in economic and public domains, and calls on the Ministry of Tourism & Creative Economy to promote AI-driven innovations, ranging from supporting startup incubators in the travel sector to piloting digital assistants and chatbots that can deliver personalized visitor experiences [4], [5].

Complementing this overarching strategy, the "Tourism 5.0" Digital Transformation Initiative, launched by the Ministry of Tourism & Creative Economy in 2025, zeroes in on tourism-specific

digitalization. As a national program, Tourism 5.0 underscores the adoption of emerging technologies (such as artificial-intelligence-powered recommendation engines, chatbots for real-time traveler inquiries, and augmented-reality features at heritage and cultural sites) to create "smart" and highly personalized travel experiences. The initiative mandates AI integration in tourism marketing campaigns and service platforms, positioning chatbots as frontline tools for enhancing visitor engagement and competitiveness [3].

At the provincial level, Yogyakarta's Smart Province Masterplan (Pergub DIY No. 32/2024) lays out a roadmap for 2024–2028 to transform the region into a data-centric "Smart Province." Under its "Smart Living" and "Smart Branding" pillars, the regulation prioritizes digital tourism services, exemplified by the "Jogja Istimewa" mobile application, which delivers interactive, location-based information on attractions, dining, accommodation, and even live CCTV feeds to tourists. By institutionalizing support for high tech tourism services, the masterplan creates an enabling environment for AI-based assistants, including future chatbot-driven tour guides and analytics-driven destination planning tools [34].

In East Java, the Malang Regency Tourism Intelligence Program (known as the MATIC Initiative) was established in 2022 by the Malang Regency Government. As part of the region's Medium-Term Development Plan (RPJMD), MATIC functions as a web- and app-based "Tourism Intelligence Center," aggregating big data feeds on local attractions, cultural events, culinary options, and transportation services. Though the current system emphasizes data consolidation and dashboarding, its official mandate and architecture lay the groundwork for AI-powered chatbots that can serve as virtual travel assistants, delivering real-time, personalized recommendations to visitors in the Malang area [13].

Finally, Bali's "Digital Tourism" legal framework (comprising Regional Regulation No. 2/2022 and Governor Regulation No. 64/2022) established the provincial public company Perumda Kerthi Bali Santhi to spearhead digital tourism transformation. These regulations explicitly require deployment of advanced digital technologies across Bali's tourism ecosystem, authorizing virtual guidance systems for arrivals and on-site exploration, mandating the use of augmented reality for cultural attractions, and creating a unified tourism portal that integrates big data analytics and real time visitor information. By embedding AI and ICT mandates into regional law, Bali ensures that chatbots and smart recommendation engines become integral to its visitor service offerings [35].

Table 4. Policies Supporting AI in Tourism in Indonesia

Policy Name	Level	Issuing Body	Year	Scope & Relevance to AI in Tourism	Key Provisions
National Strategy for Artificial Intelligence (Stranas KA) 2020–2045	National	Government of Indonesia (coordinated by BPPT/BRIN)	2020	A national blueprint guiding AI development across sectors (launched August 2020). Tourism is identified as one area for AI adoption to	The strategy urges AI utilization in economic and public sectors to improve productivity and services [4]. It involves the Ministry of Tourism & Creative

Policy Name	Level	Issuing Body	Year	Scope & Relevance to AI in Tourism	Key Provisions
				boost innovation and service quality. It provides a policy framework encouraging ministries (incl. Tourism) to integrate AI in their programs [5].	Economy in promoting AI-driven innovations (e.g. supporting AI startup entrepreneurs in travel sector), laying groundwork for digital assistants, chatbots, and personalization in tourism.
"Tourism 5.0" Digital Transformation Initiative (Ministry of Tourism)	National	Ministry of Tourism & Creative Economy	2025	A national program to digitize and modernize tourism services and marketing. It emphasizes emerging tech – including AI – to create smart, personalized travel experiences and more efficient tourism marketing [3]. Announced as a priority in 2025 to make Indonesia's destinations "smart" and competitive.	Digitalization in Tourism Marketing: The program explicitly prioritizes use of Artificial Intelligence for tourism promotion and visitor engagement [3]. For example, the official strategy calls for AI-driven personalized recommendations, chatbots for traveler inquiries, and augmented reality (AR) features at attractions (to enrich on-site guides). These provisions encourage tourism businesses and destinations to adopt AI-based assistants (e.g.

Policy Name	Level	Issuing Body	Year	Scope & Relevance to AI in Tourism	Key Provisions
					virtual guides, AI chatbots) to enhance visitor experiences.
Jogja Smart Province Masterplan 2024–2028 (Pergub DIY No. 32/2024)	Provincial (Yogyakarta Special Region)	Governor of DIY	2024	A regional regulation establishing a "Smart Province" roadmap for Yogyakarta. It covers digital transformation in governance, economy, culture, and tourism. The plan aims to integrate advanced ICT (including AI, IoT) into public services and the tourism sector to improve tourist experiences and destination management.	Smart Tourism Ecosystem: The masterplan (an update to an earlier 2019–2023 plan) highlights "Smart Living" and "Smart Branding" pillars that include digital tourism services. It led to development of the "Jogja Istimewa" mobile app providing tourists with interactive information on attractions, hotels, culinary spots, and even live CCTV feeds [34]. While the regulation is broad, it creates an environment for AI-based assistants – e.g. digital tour guide apps, data-driven tourism planning – by prioritizing high-tech, data-centric tourism services.
Malang Regency Tourism Intelligence	Local (East Java – Malang)	Malang Regency Govt (East Java)	2022	A local government initiative (part of Malang's	Digital Tourist Assistant Platform: MATIC is a

Policy Name	Level	Issuing Body	Year	Scope & Relevance to AI in Tourism	Key Provisions
Program (MATIC Initiative)				official tourism development plan) to digitalize tourism services using intelligent systems. Branded "Malang Kabupaten Tourism Intelligence Center (MATIC)", it is designed to function as a smart assistant platform for tourists visiting Malang region [13].	web/app-based service launched by Malang's regent to provide travelers with instant, accurate information on local destinations, cultural sites, culinary options, transport, etc. It serves as a centralized "big data" hub and virtual guide for tourists. Key support: The Regency's Medium-Term Development Plan (RPJMD) explicitly prioritizes tourism tech innovation, and MATIC's creation (via local policy commitment) demonstrates an officially backed use of AI-like data intelligence to assist tourists [13].
Bali "Digital Tourism" Policy – Perda No. 2/2022 & Pergub No. 64/2022	Provincial (Bali)	Bali Provincial Govt (DPRD Bali & Governor)	2022	A comprehensive legal framework to transform Bali's tourism into a "Digital Cultural Tourism" system. Perda 2/2022	Explicit Tech Adoption Mandates: The Bali regulations call for deploying advanced digital technology in all facets of tourism. Notably, they authorize digital tourist guidance

Policy Name	Level	Issuing Body	Year	Scope & Relevance to AI in Tourism	Key Provisions
				established a new regional public company, Perumda Kerthi Bali Santhi, tasked with implementing digital tourism, and Pergub 64/2022 provides the operational guidelines [36]. The scope covers developing digital infrastructure, content, and services (incl. AI applications) to support tourists and tourism management in Bali.	systems – e.g. virtual guides for arrivals and destination exploration – and use of Augmented Reality (AR) for cultural attractions. They also establish a one-stop tourism portal for Bali, integrating big data and real-time information to assist travelers. Key articles in these laws require the provincial tourism company to utilize AI and IT to enhance tourist services and personalize visitor experiences, while improving governance efficiency. This official policy framework directly supports AI-based assistants in tourism – from intelligent chatbots for visitor inquiries to smart recommendation engines – to ensure Bali remains a cutting-edge,

Policy Name	Level	Issuing Body	Year	Scope & Relevance to AI in Tourism	Key Provisions
					smart tourism destination [35].

E. Challenges

Despite clear strengths and supportive policies, chatbot adoption in Indonesian tourism faces several interrelated challenges. First, limited AI literacy among both service industry workers and end users leads to underutilization or mistrust of conversational agents; employees often lack the skills to effectively manage or hand off complex interactions [4], [5]. Second, the scarcity of large, high quality open access Bahasa Indonesia datasets constrains the performance of natural language understanding (NLU) models, resulting in keyword matching failures and "no answer" responses when users pose novel or complex queries [21], [23]. Third, many early pilots suffer from insufficient institutional governance and maintenance plans, without dedicated funding or clear ownership, systems like Malang's "Mushi" quickly became obsolete when their host platforms went offline [8], [37]. Fourth, data silos and fragmented repositories undercut the holistic, data driven intelligence that chatbots require, as sectoral "ego hoarding" prevents seamless integration of tourism, transportation, and event data [4]. Finally, weak regulatory oversight and cybersecurity gaps expose both users and providers to privacy breaches and ethical lapses, undermining public confidence in AI assistants [5], [37].

F. Future Potential

Looking ahead, several technological and institutional advances can transform these challenges into opportunities. Integrating state of the art transformer based NLU models (such as BERT or multilingual large language models) can vastly improve intent recognition and enable chatbots to handle nuanced, multi turn dialogues [19], [26]. Embedding AI driven recommendation engines, as demonstrated by Bali's MELALI system, will personalize suggestions based on traveler profiles, context signals, and real time data, thereby increasing user satisfaction and promoting sustainable tourism behaviors [12], [27]. Broadening deployment to multiple channels (including WhatsApp, voice assistants, and mobile apps) will meet diverse user preferences and extend reach to both domestic and international visitors [20]. Adopting cloud native, scalable architectures will ensure resilience during peak seasons and enable seamless updates across provinces [24]. Finally, strengthening data sharing mandates under the One Data Indonesia framework, coupled with clear AI governance standards and cybersecurity protocols, will build trust and sustain long term innovation, establishing chatbots as indispensable companions in Indonesia's smart tourism vision [4], [5].

CONCLUSION

This review demonstrates that while early chatbot deployments in Indonesian tourism (such as rule-based AIML systems (Pariyata) and cloud-based Dialogflow agents (Badung, MELALI)) have achieved high accuracy in destination queries, their long-term impact depends critically on sustainable governance, institutional backing, and continuous maintenance. Projects supported by universities or provincial governments consistently outperformed stand-alone pilots, underscoring the importance of clear ownership models and funding mechanisms. Looking forward, realizing the full potential of conversational AI in Indonesia's tourism sector will require integrating advanced NLU techniques (e.g., transformer models), embedding AI-driven recommendation engines, and deploying chatbots across multiple channels (web, mobile, messaging). Equally essential are scalable cloud architectures, seamless integration with smart-city and e-government platforms, and data-driven personalization capabilities that respect visitor privacy. By

addressing these technical, organizational, and policy challenges, future chatbot initiatives can strengthen post-pandemic recovery, increase user satisfaction, and contribute to sustainable regional development.

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