Enhancing Sustainable Tourism through AI-Driven Travel Customization and Behavior Prediction in Ha Noi, Vietnam

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ABSTRACT

This study explores the adoption of AI-driven customized recommendations for sustainable travel, focusing on how trust, perceived benefits, and environmental values influence tourists' behaviors and preferences. Data collected from 160 participants in Hanoi, Vietnam indicate that trust in AI systems significantly influences adoption, with higher trust levels increasing the likelihood of engaging with sustainable travel solutions (Spearman's rho = 0.470, $p < 0.001$). Perceived cost-effectiveness and time-saving benefits are also strong predictors of AI adoption, with 46.25% of respondents agreeing that AI technologies offer valuable cost savings. Additionally, tourists with strong environmental values show a moderate positive correlation with sustainable travel behaviors (Spearman's rho = 0.320, $p < 0.001$), suggesting eco-conscious travelers are more receptive to AI's environmental applications. Notably, AI's contribution to reducing pollution, efficient use of natural resources, and waste reduction was rated as highly important by over 70% of participants. This study highlights the importance of integrating these factors into AI systems to foster adoption and achieve sustainability goals in tourism. The findings provide actionable insights for stakeholders in the tourism industry to design transparent, cost-effective, and sustainability-oriented AI platforms, aligning with consumer values and contributing to global sustainability objectives.

Keywords: AI-driven personalized recommendations, Sustainable travel, AI adoption in tourism, Environmental values.

INTRODUCTION

Increasingly, AI is being envisioned not merely as a set of programmed instructions, but as a form of synthetic cognition - a potential "second brain" that assists humans in thinking, decision-making, and innovation. As Professor Stephen Hawking insightfully remarked during the inauguration of the Leverhulme Centre for the Future of Intelligence on October 19, 2016:

"I believe there is no deep difference between what can be achieved by a biological brain and what can be achieved by a computer. It therefore follows that computers can, in theory, emulate human intelligence — and exceed it."

Nearly a decade after Stephen Hawking's 2016 speech, the development of artificial intelligence (AI) has accelerated at an unprecedented pace, particularly following the global disruption caused by the COVID-19 pandemic. Once a theoretical pursuit confined to academic discourse, AI has now permeated everyday life and transformed a wide range of industries. It has become a central focus of contemporary research, with thousands of scholarly articles published each year across domains such as computer science, machine learning analysis, behavioral economics based on AI, and cognitive psychology. The belief that AI could eventually surpass human intelligence is no longer confined to speculative fiction; it is increasingly discussed as a plausible future scenario.

As Bostrom (2014) argues, while early projections of AI progress may have been overly optimistic, the long-term achievement of artificial general intelligence (AGI) cannot be ruled out. Rather, he contends, once AI reaches a certain level of capability, a rapid and self-reinforcing cycle of improvement—referred to as an "intelligence explosion"—could emerge. Tegmark (2017) echoes this concern, suggesting that exponential growth in AI performance may one day lead to systems that outperform human cognition across all domains. Similarly, Yeoman (2012) notes that the convergence of AI with other disruptive technologies is likely to reshape the very fabric of society, including how people live, work, and travel. These projections are not merely hypothetical: many businesses that have adopted AI, particularly in areas such as customer service, logistics, and strategic decision-making, have reported notable improvements in efficiency and competitiveness. AI has profound roots in many daily life contexts, even if they might sometimes be disregarded (Tussyadiah & Miller, 2019).

This growing influence of AI has also been witnessed in the tourism industry, one of the world's largest and most dynamic sectors. Kirtil and Askun (2020) have coined a term: Information and Communication Technologies (ICTs) in tourism, or e-tourism, which emphasizes the effect of AI on the tourism field. The researchers assert that ICTs enabled stakeholders to assess tourist behavior through intelligent systems much faster and allowed them to deal with a large amount of data coming from both tourists and destination parties (Kirtil & Askun, 2020). The application of AI in tourism benefits both service providers and travelers by streamlining operations and enhancing customer experience. For individual tourists, AI facilitates personalized services and helps generate optimal travel itineraries tailored to their preferences and needs. Tourists and service providers have the chance to access relevant information more accurately, with increased mobility and a greater decision-making process, eventually acquiring a more favorable tourism experience (Gretzel, 2011). Tourism personalization, powered by AI, leverages data-driven insights to offer customized recommendations, dynamic pricing, itinerary optimization, and predictive behavioral analysis. Such capabilities have enhanced user satisfaction, engagement, and loyalty while also providing competitive advantages to businesses (Gretzel et al., 2015).

Alongside the growing adoption of AI in tourism, the concept of sustainable tourism has also garnered significant global attention. As concerns about climate change, environmental degradation, and cultural preservation intensify, travelers and industry stakeholders alike are increasingly prioritizing responsible and eco-friendly travel practices. In this context, AI has emerged as a powerful enabler of sustainable tourism by optimizing resource usage, predicting tourist flows to prevent overcrowding, and supporting eco-conscious decision-making through personalized recommendations. AI systems leverage advanced algorithms and datasets to provide eco-friendly recommendations, including sustainable accommodations and low-carbon travel options (Filieri, D'Amico, Destefanis, Paolucci, & Raguseo, 2021; Zlatanov & Popesku, 2019).

This study aims to analyze how AI influences sustainable travel behavior. The role of machine learning in shaping sustainable travel decisions will be critically focused. It will explore how algorithms can be trained not only to reflect user preferences but also to influence them towards more sustainable choices. Furthermore, this research will examine the ethical and practical implications of embedding sustainability into personalization systems, raising questions about data privacy, algorithmic bias, and user autonomy.

The significance of this research is twofold. Academically, it contributes to a growing body of literature on AI applications in sustainable tourism, while offering new perspectives on behavior modification through machine learning. Practically, the findings could inform how tourism businesses, destination management organizations (DMOs), and policymakers design AI systems that balance commercial goals with environmental and social responsibility. As travel resumes and evolves in the post-COVID pandemic era, there is an unprecedented opportunity to redefine tourism through technology that is both intelligent and sustainable.

In summary, this essay investigates the following central research questions:

- What drives tourists to adopt AI-powered personalized recommendations for sustainable travel?
- How do trust, benefits, and environmental values impact tourists' travel behaviors and choices?

Through a comprehensive review of existing literature, a critical analysis of real-world applications, and an exploration of data-driven models, this paper seeks to illuminate the potential of AI to drive meaningful change in how individuals travel, towards more personalized and more sustainable futures.

LITERATURE REVIEW

AI in the Tourism Industry: An Overview

Artificial intelligence (AI) encompasses a variety of technologies, algorithms, and systems that simulate intelligent behavior (Shankar, 2018). This broad field includes machine learning, the Internet of Things (IoT), artificial neural networks, big data analytics, robotics, as well as virtual and augmented reality applications. The growing significance of AI is attributed to advancements in computational power, the increasing availability of large-scale datasets, and the development of sophisticated machine learning techniques. AI utilizes these vast data resources, processing capabilities, and algorithmic models to perform tasks traditionally requiring human intelligence, such as gathering, processing, and analyzing data. Broadly speaking, AI functions similar to a human brain as it thinks, learns, makes decisions, and draws inferences through given data by using intelligent machines. The main purpose of AI is to enable machines to complete tasks automatically without needing a human brain (Singh et al, 2020). These functions are foundational to various intelligent services and activities, affecting interactions between service providers and customers and influencing areas like service delivery, operations, management, and marketing (Buhalis et al., 2019).

The range of AI applications and products is remarkably diverse, with many implementations significantly impacting everyday life (Ivanov et al., 2017). Technologies like service robots and automated systems have entered the real world and are no longer a fantasy (Agah et al., 2016; Talwar, 2015). In reality, people encounter different forms of AI regularly, even if they do not always recognize them as such (Tussyadiah & Miller, 2019). AI can take on physical embodiments, such as the robot Pepper, or exist in virtual forms like chatbots and voice assistants (e.g., Alexa or Siri), and even appear as holographic projections, such as video-based robots (Van Doorn et al., 2017; Wirtz et al., 2018).

Over the years, the concept of AI has evolved from systems merely exhibiting intelligent traits to those capable of making autonomous decisions based on large-scale data, to the ability to draw on prior experiences and stored information to improve the quality of its decisions (Bulchand-Gidumal, 2020). As a powerful resource, AI has the potential to reshape human interactions, influence both societal and personal accomplishments, and ultimately impact individuals' actions and sense of identity (Floridi et al., 2018).

Tourism, being one of the largest and most dynamic sectors globally, has witnessed the transformative power of AI, enhancing both operational efficiency and customer satisfaction. AI's journey within the tourism industry began with the advent of e-tourism, which merged the potential of Information and Communication Technologies (ICTs) with the need for more efficient tourism management and personalized services. E-tourism refers to the use of technology, particularly the internet and digital platforms, to enhance various aspects of tourism, such as booking, planning, and the overall travel experience (Buhalis & Law, 2008). The rapid advancement of AI technologies, such

as machine learning (ML) and natural language processing (NLP), has further catalyzed the development of personalized services within the tourism sector (Tussyadiah, 2020). In recent years, AI has enabled tourism businesses to analyze large datasets, leading to a deeper understanding of customer preferences and behaviors (Sigala, 2018). AI systems are now capable of dynamically adjusting itineraries, offering personalized travel suggestions, and predicting future travel patterns with increasing accuracy (Gretzel et al., 2006).

Artificial Intelligence (AI) is regarded as the next stage of the tourism industry (Bowen & Whalen, 2017; Gajdosik & Marcis, 2019; Kazak et al., 2020). Even though the full potential of AI in the T&H sector has not yet been realized, AI has already strongly influenced this field (Ivanov et al., 2019; Tussyadiah, 2020).

AI Implementation in Tourism Personalization

In the early stages, AI's role in tourism was relatively limited to basic data processing and automation. Over time, however, it has expanded to more sophisticated applications that personalize and enhance travel experiences. The COVID-19 pandemic further accelerated the adoption of AI, as travel restrictions and health concerns prompted the need for more efficient and contactless services. Tourists have become accustomed to using many machine tools such as AI-powered chatbots, virtual assistants, and automated booking systems (Tussyadiah & Miller, 2019). So far, personalization has become one of the central pillars of AI applications in the tourism sector. AI's ability to gather and analyze vast amounts of data allows it to offer personalized services tailored to individual travelers' preferences, making travel experiences more satisfying and engaging (Gretzel et al., 2015).

There are various ways AI can be applied to personalize the travel experience, including:

AI helps personalize travel recommendations and journeys by using machine tools that analyze data from various sources, including booking history, reviews, and customer feedback, to better understand individual preferences and needs, thereby suggesting the most suitable travel itineraries. AI has been used in apps like TripAdvisor and Google Trips to provide customized trip plans. For instance, if you are interested in art and have three days in Paris, AI can recommend a schedule that fits your interests and allows for the best possible transit time between sites, including the Louvre, Musée d'Orsay, and galleries of contemporary art. AI-powered recommendation engines, for example, analyze users' past behaviors, preferences, and even social media interactions to suggest travel destinations, accommodations, and activities that align with tourists' interests (Yoo & Kim, 2018). Moreover, AI allows for real-time customization of travel plans based on changing conditions, such as weather patterns, local events, and real-time pricing data (Sigala, 2018). This personalization increases traveler satisfaction and fosters deeper engagement with travel providers.

Virtual travel assistants and chatbots are playing a crucial role in the tourism sector by managing duties like hotel reservations and customer service. Major travel companies such as Expedia, Booking.com, and Airbnb have implemented AI-powered chatbots to interact with customers around the clock. These virtual assistants not only respond to simple inquiries but also comprehend complex intents, providing detailed information about destinations, suggesting customized activities, and even completing booking processes. For instance, Expedia has integrated ChatGPT into its app, enabling users to engage in open-ended conversations to receive personalized travel recommendations and manage bookings seamlessly (Expedia, 2023). Similarly, Booking.com is investing in AI technologies to enhance customer service efficiency, aiming to handle straightforward tasks and reduce reliance on human agents (Nilay Patel, 2024). Since it's challenging for businesses to be available online 24/7 to support customers, these AI tools provide instant, automated responses, reducing customer response times. Oftentimes, AI travel agents can enhance the travel experience even more effectively than human assistance (Mostafa Ibrahim, 2024).

Supporting multiple languages feature of AI enables travel businesses to offer multilingual customer service and makes it easier for travelers to access and use travel services, regardless of the language they speak. AI-powered translation tools such as Google Translate and Baidu Translate assist travelers in overcoming language barriers through real-time translation capabilities. Applications like iTranslate can even translate signs and restaurant menus using a smartphone camera, enabling travelers to confidently explore destinations where English is not commonly spoken. These tools are particularly beneficial for travelers seeking to overcome language barriers, offering a more seamless and immersive travel experience (Saikat Basu, 2025).

Regarding hospitality and accommodation management, AI has been used to improve guest satisfaction in the hospitality industry through innovations like smart hotels and AI concierges, which deliver customized services, streamline the check-in process, and offer personalized suggestions. A notable example is Hilton Hotels' introduction of "Connie," an AI concierge robot inspired by the founder, Conrad Hilton. Powered by IBM's Watson and WayBlazer technologies, Connie interacts with guests using natural language to share details about hotel services, local sights, dining options, and more. With each interaction, Connie becomes more accurate and effective by continuously learning and refining its responses (Mostafa Ibrahim, 2024).

AI can collect and analyze customer feedback to enhance service quality. AI agents can process vast amounts of data from platforms such as TripAdvisor, Booking.com, and Yelp to identify trends and areas for improvement. Each personal issue is thoughtfully considered and addressed with careful attention. Accor Hotels has implemented AI-driven systems to automate the collection and analysis of customer feedback via surveys and reviews, enabling real-time insights into guest experiences (Tanatswa Mafuwa, 2025). Four Seasons Hotels and Resorts reported a 26% reduction in recurring complaints and a 31% increase in problem resolution satisfaction after implementing a proprietary AI system to analyze guest feedback across various channels (Sarah Lee, 2025). This method facilitates the detection of service shortcomings and opportunities for operational improvement, thereby enhancing guest satisfaction.

AI has enabled the introduction of dynamic pricing models that optimize prices based on factors such as demand, time of booking, and market conditions (Gretzel et al., 2015). This flexibility not only benefits consumers by offering competitive prices but also allows businesses to maximize revenue by adjusting prices in real-time based on demand patterns.

AI has greatly improved tourism personalization, providing a host of advantages for both tourists and companies. As an inevitable trend, AI is projected to continue enhancing the personalization of travel experiences by leveraging more comprehensive and in-depth data analysis. Travelers will gain access to finely tailored suggestions regarding destinations, lodging, leisure activities, and culinary choices (Mostafa Ibrahim, 2024).

Determinants of AI Adoption in Tourism Personalization

AI has demonstrated significant potential in enhancing tourism personalization, particularly through its advanced computational capacity and sophisticated problem-solving capabilities. However, despite these promising advantages, the widespread adoption of AI in the tourism industry remains a subject of ongoing skepticism and concern. Given that, it is essential to understand the factors influencing AI's adoption across the industry. Specifically, identifying what drives or hinders the application of AI in tourism personalization is crucial for both researchers and practitioners.

The framework most commonly employed to understand AI adoption in tourism is the Technology Acceptance Model (TAM), originally proposed by Davis (1989) and further developed by Davis, Bagozzi, and Warshaw (1989). TAM posits that the acceptance and usage of new technologies are primarily determined by two constructs: perceived usefulness (PU) and perceived ease of use

(PEOU). In the context of AI-driven personalization, these two factors have proven particularly influential. Ferhataj (2024) found that tourism stakeholders are more inclined to adopt AI tools when they believe these technologies can significantly enhance operational performance and streamline service delivery.

The perceived usefulness of AI is closely tied to its potential to improve business outcomes. These applications can significantly boost customer satisfaction by offering more responsive, individual, context-aware services (Gretzel et al., 2015). Conversely, the perceived ease of use affects adoption insofar as tourism businesses prefer AI systems that are compatible with their existing infrastructure and do not require extensive technical knowledge for implementation (Venkatesh et al., 2003). Therefore, the effectiveness of AI-driven personalization in tourism largely hinges on both its perceived usefulness and ease of use; without these fundamental elements, users may encounter significant barriers in adopting and engaging with AI technologies.

On the other hand, trust and transparency remain significant psychological and ethical barriers to adoption. Research has shown that customers are more likely to engage with AI-driven services when they trust that the technology is reliable, secure, and fair in its decision-making (Gursoy et al., 2019). The black-box nature of many AI algorithms, coupled with concerns about data privacy and surveillance, often hinders user acceptance (Wirtz et al., 2018). Thus, for AI to reach its full potential in the tourism industry, developers and tourism managers must work collaboratively to build systems that are not only functional and efficient but also transparent and ethically responsible.

Sustainable Tourism Behavior: Trends and Influencing Factors

The concept of sustainable tourism has become increasingly familiar and widely recognized in recent years. Sustainable tourism refers to the adoption of eco-friendly practices within the tourism industry. Its primary goal is to ensure that tourism can be maintained over the long term without harming natural and cultural resources, while also benefiting local populations economically and socially (Mostafa Ibrahim, 2024). Amid growing concerns over environmental degradation, climate change, and the socio-cultural impact of mass tourism, sustainable tourism has emerged as a critical paradigm in both academic discourse and industry practice. It emphasizes the need to minimize tourism's negative impacts while maximizing its benefits for local communities, the environment, and future generations. This shift reflects a broader transformation in consumer behavior, where travelers are becoming more conscious of their ecological footprints and are actively seeking travel options that align with ethical and environmental values (UNWTO, 2019; Filieri et al., 2021).

Sustainable tourism becomes even more pronounced when considering the consequences of overtourism, a highly pressing phenomenon where excessive tourist numbers overwhelm a destination's capacity, leading to negative environmental, social, and economic effects. Cities such as Barcelona have witnessed increased housing costs and resident displacement due to the uncontrolled growth of short-term rentals, sparking local protests against mass tourism (Milano, Cheer, & Novelli, 2019). Similarly, Venice has struggled with pollution and infrastructural strain due to large cruise ships and overcapacity, prompting the city to restrict tourism flows and impose new regulations (Seraphin, Sheeran, & Pilato, 2018). Maya Bay in Thailand was closed indefinitely in 2018 after years of ecological degradation caused by thousands of daily visitors, particularly damage to coral reefs and marine biodiversity (UNEP, 2019). As such, sustainable travel is no longer merely an idealistic approach, it should be put into immediate implementation for preserving the integrity of destinations and ensuring long-term viability.

For tourism businesses, adopting sustainable practices is not only a way to meet consumer demand but also an opportunity to differentiate themselves in a competitive market. Many businesses now incorporate sustainability into their marketing and branding strategies, emphasizing their commitment to reducing environmental impacts and supporting local communities (Bohdanowicz, 2005). Destination management organizations (DMOs) also play a critical role in promoting

sustainable tourism by providing information and resources to help tourists make responsible travel choices (Tussyadiah et al., 2017).

Sustainable travel represents a constructive and necessary trend that should be further promoted on a global scale. To effectively encourage its adoption, it is essential to understand the key factors that influence sustainable travel behavior. One of these is environmental awareness and personal values. Travelers with a high level of environmental concern are more likely to choose eco-friendly transport options, minimize resource use, and support local economies (Barr, Shaw, Coles, & Prillwitz, 2010). These attitudes are often rooted in broader ethical consumption values, where individuals seek to align their lifestyles with environmental and social responsibility (Juvan & Dolnicar, 2016). Perceived behavioral control and convenience also play a significant role. While many tourists express pro-sustainability attitudes, barriers such as higher costs, limited availability of green options, and lack of information can hinder the adoption of sustainable behaviors (Dolnicar, Crouch, & Long, 2008). In addition, social norms and peer influence have been shown to impact sustainable travel decisions. Tourists are more likely to engage in responsible behaviors when they perceive such actions as socially accepted or expected within their peer groups (White, Habib, & Hardisty, 2019). All factors suggest that AI solutions, with advanced machine learning methods, can join in and contribute to promoting sustainable travel.

AI and Sustainable Travel Behavior: Analyzing human behavior with machine learning

Having examined the various applications of AI in the tourism industry in the previous section, this part shifts focus toward exploring the relationship between AI and sustainable travel behavior. While AI has demonstrated its capacity to enhance operational efficiency and personalize travel experiences, it also holds significant potential to support and promote environmentally responsible tourism choices through machine learning analysis.

Mostafa Ibrahim (2024) remarked that AI will soon help create more sustainable tourism practices by optimizing resource use, reducing waste, and promoting eco-friendly travel options. For example, AI can help in planning more efficient travel routes to minimize carbon footprints.

By collecting and processing large-scale data from travel patterns, booking behaviors, and social media interactions, AI facilitates the identification of behavioral trends related to sustainability (Filieri, Mariani, & Jiang, 2021), enabling tourism stakeholders to design more targeted strategies to promote responsible tourism.

AI is able to influence individual choices through personalized recommendation systems. AI-powered platforms can nudge tourists toward eco-friendly decisions by suggesting green transportation options, environmentally certified accommodations, and low-impact activities that align with a traveler's personal preferences and past behavior (Gretzel et al., 2020). Such interventions support informed and sustainable decision-making without compromising the user experience. These AI systems enhance perceived behavioral control by providing real-time information on availability, costs, and environmental ratings, which help users make informed and convenient choices (Filieri, Mariani, & Gössling, 2021). Additionally, predictive models can identify segments of travelers who are most receptive to sustainability messaging, enabling more targeted and effective communication strategies (Zeng, Go, & Yu, 2020).

AI can also be used to influence social norms through digital platforms that integrate eco-badges, peer behavior indicators, and review-based social proof, nudging travelers toward responsible decision-making (White, Habib, & Hardisty, 2019). By embedding sustainability into user interfaces and travel planning tools, AI not only facilitates individual environmentally conscious behavior but also contributes to broader structural change within the tourism ecosystem.

One of the most transformative capabilities of AI in promoting sustainable travel behavior lies in its ability to analyze complex human behavioral patterns using machine learning techniques. Machine learning algorithms can process vast and diverse datasets derived from online bookings, travel apps, social media, and GPS data to uncover underlying motivations, preferences, and decision-making processes of tourists (Gretzel, 2011). This behavioral insight allows tourism platforms and policymakers to better understand what drives sustainable or unsustainable choices, enabling the design of interventions that are tailored, timely, and effective (Becken & Connell, 2007). For instance, clustering algorithms can segment tourists based on their ecological awareness or willingness to pay for green services, while predictive models can identify when a user is most likely to choose a sustainable option and adjust recommendations accordingly (Gössling, 2021).

Moreover, AI's continuous learning capabilities allow systems to adapt to changing behaviors over time, providing dynamic personalization that aligns with evolving sustainability trends. By using behavior-aware recommendations, AI not only supports individual decision-making but also informs destination management strategies aimed at reducing overconsumption and promoting resource efficiency. In this sense, AI serves not just as a reactive tool but as a proactive partner in shaping a more sustainable future for global tourism.

However, despite its potential, the integration of AI into sustainable tourism practices is not without significant challenges. One key concern is algorithmic bias, which can arise when the data used to train AI models reflects existing inequalities or lacks diversity. This can result in skewed recommendations that inadvertently favor certain traveler profiles, destinations, or services, thereby reinforcing unsustainable patterns or excluding marginalized groups (Zeng, Go, & Yu, 2020). For instance, if an algorithm is trained predominantly on data from high-income travelers, it may not adequately cater to the needs or preferences of budget-conscious or eco-conscious tourists, limiting the inclusivity and effectiveness of sustainability interventions.

Another critical issue is data privacy and ethical governance. The use of personal travel data, including location history, preferences, and online behavior - raises concerns about surveillance, informed consent, and data ownership (Tussyadiah & Miller, 2019). As AI systems become more sophisticated in analyzing human behavior, tourism organizations must implement robust data protection policies and transparent mechanisms to ensure ethical data collection and use.

The digital divide also presents a barrier to the equitable adoption of AI in sustainable tourism. Small and medium-sized tourism enterprises (SMEs), particularly in developing countries, may lack the technological infrastructure, skills, or financial resources to deploy advanced AI solutions (Tussyadiah, 2020). This disparity could exacerbate existing inequalities in the tourism industry, where large global players benefit disproportionately from AI innovations.

Furthermore, the over-reliance on automation may inadvertently reduce the human-centered experience that is core to tourism. While AI can enhance personalization and efficiency, it cannot fully replicate the emotional intelligence, cultural sensitivity, or local knowledge offered by human service providers—elements that are often central to meaningful and sustainable travel experiences (Buhalis & Sinarta, 2019).

These challenges highlight the need for a cautious and context-sensitive approach to implementing AI in tourism. Ensuring ethical alignment, equity, and transparency in AI deployment is essential for realizing its potential in fostering sustainable travel behavior.

METHODOLOGY

This study adopts a qualitative research approach to explore the factors influencing tourists' acceptance of AI-driven solutions in promoting sustainable tourism. A survey was conducted with 160

participants residing in Ha Noi, Vietnam, between September and October 2024. Ha Noi, Vietnam, as a dynamic urban center in a developing country, presents a unique context where tourism is growing rapidly alongside rising interest in smart technologies. However, challenges such as cost sensitivity, varied digital exposure, and differing environmental awareness levels remain critical considerations. Participants were selected using purposive sampling to ensure diversity in age, occupation, and travel experience. All participants were briefed on the purpose of the study, ethical considerations, and their right to decline or withdraw at any time. The interviews aimed to uncover key themes related to AI adoption in tourism, particularly focusing on travelers' values, trust in technology, and perceived environmental impact.

Data Analysis

All data were processed using statistical software for Social Sciences (SPSS version 25.0) to investigate the relationships between variables and identify key factors driving the adoption of AI-powered personalized recommendations for sustainable travel.

Inferential Statistics:

Spearman's Rho Correlation: Spearman's Rank Correlation was used to assess the relationships between important study variables such as perceived benefits, trust, and environmental values, and how these factors influence the likelihood of adopting AI-driven personalized travel recommendations for sustainable tourism. This test is particularly suited for ordinal data, as it evaluates rank-order relationships without assuming equal intervals between the response categories. The data was gathered on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).

Hypothesis Testing: Hypothesis testing was conducted with a 95% confidence interval to determine whether the relationships between the study's key constructs were statistically significant. This provided insights into which variables had a meaningful impact on the adoption of AI solutions.

Machine Learning Analysis:

The reliability analysis revealed a Cronbach's Alpha of 0.985, indicating excellent internal consistency among survey items. This demonstrates that the measurement constructs—trust, perceived benefits, and environmental values—are robust and valid. The strong reliability supports subsequent analyses, such as Spearman's correlation, and strengthens the validity of the study's findings on AI adoption and sustainable travel behavior.

Estimate	Cronbach's Alpha (α)
Point estimate	0.985

Table 1: Frequentist Scale Reliability Statistics
Source: author's calculation

Sample

A survey was conducted with 160 participants residing in Hà Nội, Vietnam, between September and October 2024. Ha Noi, Vietnam. with the following demographic characteristics as shown in Table 2. The study surveyed a total of 160 participants, with a fairly balanced gender distribution: 52.5% identified as female and 47.5% as male. In terms of age, the largest segment (40%) fell within the 25–40 age range, followed by 30% under the age of 25. Participants aged between 41–60 accounted for 21.3%, while those over 60 made up 8.7% of the sample.

Regarding occupation, more than half (55%) of the respondents were employed, while students represented 31.3% of the sample. Retired individuals constituted 13.7%. In terms of nationality, the majority of respondents (67.5%) were local Vietnamese, whereas the remaining 32.5% were international tourists.

Table 2. Demographic Characteristics of the Sample (N = 160)

Variable	Category	Frequency (n)	Percent (%)
Gender	Male	76	47.5
	Female	84	52.5
Age	Under 25	48	30.0
	25–40	64	40.0
	41–60	34	21.3
	Over 60	14	8.7
Occupation	Student	50	31.3
	Employed	88	55.0
	Retired	22	13.7
Nationality	Local Vietnamese	108	67.5
	Foreign	52	32.5

Source: author's calculation

RESULTS

1. ***Factors Influencing Tourists' Adoption of AI-Driven Personalized Recommendations for Sustainable Travel***

Variable	AI Travel Personalization	Cost-Effectiveness	Time-Saving Benefits	Sustainable Tourism	Decision-Making Support
AI Travel Personalization	1.000	0.498	0.527	0.389	0.452
Cost-Effectiveness	0.498	1.000	0.433	0.351	0.543
Time-Saving Benefits	0.527	0.433	1.000	0.398	0.522

Sustainable Tourism	0.389	0.351	0.398	1.000	0.464
Decision-Making Support	0.452	0.543	0.522	0.464	1.000

Table 3: Spearman's Rank Correlation (Source: author's calculation)

Based on the data from Tables 2 and 4, the analysis reveals key insights into the factors driving the adoption of AI-driven personalized recommendations for sustainable travel. Time-saving benefits emerge as the most influential factor, showing the strongest positive correlation with AI Travel Personalization (r = 0.527). This suggests that tourists who perceive AI tools as time-saving are more likely to adopt them for travel planning. Specifically, 69.38% (Agree = 52%, Strongly Agree = 16.88%) of respondents agreed or strongly agreed that AI helps save time when organizing trips, emphasizing the importance of efficiency in driving AI adoption. The findings align with the notion that travelers value AI systems for their ability to streamline the trip planning process, reducing the time and effort required to organize a journey.

In addition to time-saving features, decision-making support plays a significant role in AI adoption. The data shows a moderate positive correlation between Decision-Making Support and AI Travel Personalization (r = 0.452), with 62.5% (Agree = 45%, Strongly Agree = 17.5%) of respondents agreeing that AI helps them make better travel decisions. This indicates that AI tools are not only appreciated for their convenience but also for their capacity to provide confidence in decision-making. Tourists seem to rely on AI to alleviate the cognitive burden associated with choosing destinations, accommodations, and activities, positioning decision-support features as essential to the adoption process.

While cost-effectiveness is an important factor, it is somewhat less influential compared to time-saving and decision-making benefits. The correlation between Cost-Effectiveness and AI Travel Personalization is moderate (r = 0.498), with 61.25% (Agree = 46.25%, Strongly Agree = 15%) of respondents agreeing that AI offers cost-effective travel solutions. Although financial considerations are important to tourists, they do not appear to be the primary motivators in the adoption process when compared to the efficiency and decision-support aspects. This suggests that while cost savings are valued, tourists prioritize AI systems that can simplify their planning process and enhance their travel experience.

Another relevant factor is sustainable tourism, which, although showing a moderate correlation with AI Travel Personalization (r = 0.389) and Time-Saving Benefits (r = 0.398), has a less dominant impact on AI adoption. Nonetheless, 63.75% (Agree = 51.88%, Strongly Agree = 11.88%) of respondents acknowledged AI's potential to promote eco-friendly travel options, indicating a growing interest in sustainability. This suggests that while sustainability may not be the primary driver for AI adoption, integrating green features such as carbon footprint calculators and eco-friendly recommendations could enhance the appeal of AI solutions to eco-conscious travelers.

Finally, decision-making support is strongly correlated with all other factors, especially cost-effectiveness (r = 0.543) and time-saving benefits (r = 0.522). This highlights that tourists value AI tools not only for their practical benefits but also for the clarity and confidence they provide in the decision-making process. With 45% of respondents agreeing that AI helps them make better travel decisions, it is clear that AI's role in supporting travel choices is crucial for improving user experience and boosting adoption.

Conclusion, the analysis reveals that time-saving benefits and decision-making support are the most significant factors driving tourists' adoption of AI-driven personalized recommendations for sustainable travel. While cost-effectiveness and sustainable tourism are important, they play a secondary role compared to the efficiency and decision-support features offered by AI systems. For

tourism stakeholders, the key takeaway is to develop AI tools that prioritize convenience, efficiency, and decision-making support, while also incorporating sustainability features to meet the growing demand for eco-conscious travel solutions. These findings suggest that AI has the potential to transform the tourism industry by providing personalized, efficient, and sustainable travel options.

Variable	Response	Frequency	Percent (%)
Decision-Making Support	Strongly Disagree	2	1.25
	Disagree	9	5.63
	Neutral	49	30.63
	Agree	72	45.00
	Strongly Agree	28	17.50
	Total	**160**	**100.00**
Time-Saving Benefits	Strongly Disagree	3	1.88
	Disagree	7	4.38
	Neutral	39	24.38
	Agree	84	52.50
	Strongly Agree	27	16.88
	Total	**160**	**100.00**
Cost-Effectiveness	Strongly Disagree	3	1.88
	Disagree	6	3.75
	Neutral	53	33.13
	Agree	74	46.25
	Strongly Agree	24	15.00
	Total	**160**	**100.00**
Sustainable Tourism	Strongly Disagree	2	1.25
	Disagree	5	3.13
	Neutral	51	31.88

	Agree	83	51.88
	Strongly Agree	19	11.88
	Total	**160**	**100.00**

Table 4: Frequency Distribution
Source: author's calculation

2. ***Confidence, perceived advantages, and environmental values strongly influence tourists' behaviors and preferences.***

Variable	Trust	Perceived advantages	Environmental Values	Tourist Behaviors and Preferences
Trust	—	p-value —	—	p-value —
Perceived advantages	0.510***	—	p-value < .001	0.675***
Environmental Values	0.305***	0.395***	—	0.385***
Tourist Behaviors and Preferences	0.470***	0.690***	0.320***	—

p-value: Indicates statistical significance (*** p < .001)
Table 5: Spearman's Correlations *(Source: author's calculation)*

Firstly, perceived advantages emerged as the strongest predictor shaping tourists' behaviors and preferences. As indicated in Table 5, perceived advantages exhibit a very strong positive correlation with tourist behaviors (Spearman's rho = 0.690, p < .001), significantly stronger than trust (rho = 0.470) and environmental values (rho = 0.320). This finding suggests that tourists are most motivated to adopt AI technologies when they perceive clear and tangible benefits. Supporting this, Table 7 reveals that 38.1% of respondents believe that AI benefits slightly outweigh costs, and 15.6% perceive that benefits significantly outweigh costs. Overall, over 53.7% (15.6% + 38.1%) of the sample view AI adoption as offering a favorable cost-benefit balance, emphasizing the technology's perceived value, particularly among SMEs and eco-conscious travelers.

Secondly, trust plays a crucial psychological role in influencing tourists' willingness to engage with AI tools. Table 4 demonstrates that trust correlates moderately with both tourist behaviors (rho = 0.470, p < .001) and perceived advantages (rho = 0.510, p < .001). This suggests that tourists who perceive AI systems as trustworthy — reliable, ethical, and transparent — are significantly more inclined to accept and use AI-based recommendations. Thus, tourism platforms aiming for broader AI adoption must focus on enhancing user confidence through transparent data practices, explainable AI models, and clear communication strategies.

Thirdly, while environmental values show a comparatively weaker influence, they still contribute meaningfully to tourists' AI adoption decisions. Environmental values correlate moderately with tourist behaviors (rho = 0.320, p < .001) and show linkages with trust (rho = 0.305) and perceived advantages (rho = 0.395). According to Table 5, 32.5% of participants acknowledged AI's role in optimizing travel to reduce pollution, 23.8% emphasized efficient natural resource use, and 19.4% pointed to reductions in waste and the adoption of green technologies. Nevertheless, 7.5% believed AI had no impact, indicating that while environmental consciousness exists, more targeted educational efforts are needed to showcase AI's positive role in sustainability.

Further reinforcing this perspective, Table 6 shows that while 50% of respondents (32.5% important + 17.5% very important) rated AI as important for achieving sustainability goals, a notable 33.8% remained neutral. This neutrality signals both an opportunity and a challenge for tourism stakeholders: while many recognize AI's potential for environmental stewardship, there remains a considerable knowledge gap that needs to be addressed through public education and marketing campaigns focusing on AI's green functionalities.

In conclusion, perceived advantages represent the most influential factor shaping tourists' adoption of AI-driven sustainable travel tools, followed by trust, and then environmental values. Tourists prioritize AI's efficiency, personalization, and decision-support capabilities; however, the establishment of trustworthy, transparent AI systems and the explicit promotion of environmental contributions are essential for expanding user engagement. Tourism industry players should, therefore, develop AI applications that not only highlight utility and cost-effectiveness but also align with growing sustainability values among global travelers.

Contribution Area	Frequency	Percentage (%)
Optimizing travel to reduce pollution	52	32.5%
More efficient use of natural resources	38	23.8%
Reduction in waste and adoption of green technologies	31	19.4%
Improved management of mass tourism	27	16.9%
No impact	12	7.5%
Total	**160**	**100.0%**

Table 6: AI's Contribution to Tourism Sustainability: Perspectives on Resource Optimization and Green Practices (Source: author's calculation)

Level of Importance	Frequency	Percentage (%)
Not important at all	8	5.0%
Slightly important	18	11.3%
Neutral	54	33.8%
Important	52	32.5%
Very important	28	17.5%
Total	**160**	**100.0%**

Table 7: The Perceived Importance of AI in Achieving Sustainability Goals

Cost-Benefit Perception	Frequency	Percentage (%)
Benefits significantly outweigh costs	25	15.6%

Benefits slightly outweigh costs	61	38.1%
Benefits are equal to costs	38	23.8%
Costs slightly exceed benefits	24	15.0%
Costs significantly exceed benefits	12	7.5%
Total	**160**	**100.0%**

Table 8: Cost-Benefit Analysis of AI Technologies for SMEs in Tourism

CONCLUSION

This study highlights the pivotal role of perceived advantages, user confidence in AI systems, and environmental values in shaping tourists' behaviors and preferences toward AI-driven personalized travel recommendations. Among these factors, perceived advantages—such as time-saving, personalized planning, and cost-effectiveness—stand out as the most significant driver of adoption. Tourists are more likely to engage with AI systems when they see tangible, personal benefits that enhance their overall travel experience.

Trust, while slightly less influential than perceived advantages, remains crucial for long-term adoption. Concerns over data security, algorithmic transparency, and fairness underline the need for explainable and ethical AI design. Enhancing trust can foster deeper engagement and greater acceptance across a wider range of travelers.

Environmental values, though a secondary motivator, represent a growing opportunity for tourism stakeholders. Eco-conscious travelers increasingly recognize AI's potential to promote sustainability through waste reduction, efficient resource use, and better management of mass tourism. However, limited awareness remains a barrier, calling for more strategic communication about AI's role in sustainable tourism.

Overall, the findings suggest that to maximize the impact of AI in the tourism sector, developers and providers must take a holistic approach—balancing functionality, ethical considerations, and sustainability. This integration can help build smarter, more inclusive, and environmentally responsible travel ecosystems that meet the evolving expectations of modern tourists.

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