

Artificial intelligence in tourism management: theoretical underpinnings, empirical tests and the SmartTourAI framework

Wojciech Dyduch

University of Economics in Katowice, Katowice, Poland, and

Anna Brzozowska

Czestochowa University of Technology, Czestochowa, Poland

Abstract

Purpose – The aim of the article is to analyze the potential applications of artificial intelligence (AI) in the tourism sector and to develop a strategic model for AI integration in this industry, called SmartTour. The article focuses on understanding and illustrating specific areas of AI application in tourism while addressing the existing research gap in this field. Additionally, the article presents practical recommendations for managers and decision-makers in the tourism sector, aimed at maximizing the potential of AI to enhance the competitiveness and innovativeness of tourism enterprises.

Design/methodology/approach – To develop the SmartTour model, cross-validation and methodological triangulation. The study was based on case analyses of enterprises already utilizing AI, expert interviews and quantitative data analysis, which allowed for a comprehensive understanding of the researched phenomenon. In-depth semi-structured interviews were conducted with managers of tourism enterprises and customers. Qualitative data were analyzed using NVivo software, while quantitative data were collected from a sample of 200 respondents. The surveys included both closed and open-ended questions, and the data were subjected to statistical analysis using SPSS software. The research sample was purposively selected.

Findings – The study revealed that the Polish tourism sector utilizes AI for process automation, offer personalization and data analysis, enhancing efficiency and competitiveness. The developed SmartTour model integrates AI technologies, such as machine learning, to optimize services and customer experiences. Despite challenges like financial constraints and data security concerns, most companies plan further investments in AI.

Originality/value – The article presents a new perspective on the application of AI in tourism management and proposes a specific model, SmartTour, which has not yet been empirically studied in the context of tourism. It also offers an analysis of the impact of AI on customer satisfaction, contributing to the existing literature that predominantly focuses on theoretical concepts. The research findings provide practical insights for managers, affirming the relevance and originality of the study. While AI in tourism is a growing area of research, the article's focus on developing a comprehensive business model tailored to tourism enterprises is both original and significant.

Keywords Tourism, Management, Artificial intelligence

Paper type Research paper

Impact statement

The introduction of the SmartTour business model into the tourism industry signifies marked progress in the application of advanced artificial intelligence technologies, demonstrating a profound understanding of sectoral needs and a commitment to optimizing operational processes, enhancing customer service quality, and increasing the competitiveness of enterprises. Through the utilization of tools such as machine learning, natural language



processing, image analysis, and process automation, SmartTour offers tourism enterprises substantial opportunities to optimize their operations, personalize offerings for customers, and effectively respond to dynamically evolving market demands. This model not only elevates standards in customer management and operational efficiency but also signals a time of new possibilities for sustainable development in the tourism sector, contributing to value generation for a wide spectrum of stakeholders, including businesses, customers, and local communities.

Introduction

The utilization of artificial intelligence (AI) in the tourism industry is rapidly expanding (Dwivedi, Pandey, Currie, & Micu, 2024). Scholars argue that AI is reshaping the entire sector, particularly in terms of employee engagement, retention, and productivity (Ruel & Njoku, 2021). The swift growth of AI has disrupted the tourism sector, with specific tools like ChatGPT finding various applications among stakeholders in tourism management (Carvalho & Ivanov, 2024). Moreover, consumers in the tourism industry have readily adopted artificial intelligence and robotics in the hospitality and tourism sector (Goel, Kaushik, Sivathanu, Pillai, & Vikas, 2022).

The increasing interest in applying artificial intelligence in tourism has led to the development of various frameworks that consider key factors of the industry where automation and AI can yield potential benefits (Jabeen, Al Zaidi, & Al Dhaheri, 2022). However, there remains a need for a more comprehensive understanding of the areas in tourism management that can benefit from AI applications.

The characteristics of tourism services necessitate simultaneous consumption and production, requiring excellent coordination and smooth flow of information in the value chain. Unlike industrial sectors where the process entails the sequence of designing, manufacturing, and distributing tangible goods, the tourism industry operates on intangible products, leading to the need for intermediaries to convey information, such as travel agencies (Çolak, 2023). A challenge in promoting and selling tourism services lies in the difficulty of consumers evaluating the product before purchase, making it crucial to provide detailed descriptions of offerings and user reviews (Kabus, 2015; Filieri, 2021). The dynamic nature of tourism services is subject to continuous challenges arising from the need to adapt to the changing digital environment and the individualized needs of consumers in terms of content (Samara, Magnisalis, & Peristeras, 2020). In this context, tools based on artificial intelligence, particularly natural language generation systems like ChatGPT, play a significant role, offering innovative solutions to support this sector. The tourism sector faces the challenge of adapting to evolving consumer preferences and the need for personalized tourism experiences, necessitating effective content production and the implementation of automated marketing strategies (Gursoy, Li, & Song, 2023). In this regard, ChatGPT can significantly support tour organizers by improving customer service, optimizing data analysis, and facilitating personalized communication (Stalidis, Karapistolis, & Vafeiadis, 2015). The use of artificial intelligence in the tourism sector, including solutions such as 24/7-operating chatbots, enables easy access to information and personalized recommendations for customers, leading to increased satisfaction and loyalty. For example, the ability to suggest hotels based on flight preference analysis illustrates how AI technology can effectively contribute to optimizing operations in the tourism sector. Through the utilization of advanced text generation algorithms, ChatGPT can play a crucial role in producing content tailored to the specific needs of target audiences (Shin & Kang, 2023). This has the potential to not only revolutionize customer interactions but also significantly reduce operational costs in the industry (Popescu & Zlatanov, 2019). This article aims to present the possibilities of using ChatGPT in the tourism sector, demonstrating how this tool can enrich the offerings of tourism enterprises through an innovative approach to content generation and customer experience personalization. Additionally, based on conducted research, the SmartTour

(Jabeen *et al.*, 2022) business model is presented, which implements advanced artificial intelligence (AI) technologies into the daily procedures of tourism enterprises.

The first section of the paper focuses on a literature review concerning the application of AI in the tourism industry, resulting in the formulation of research questions and hypotheses. The second part describes the research methodology. Based on both qualitative approaches (multi-case study) and quantitative analyses (correlation analysis of survey data), conclusions can be drawn regarding the relationship between AI in tourism and dependent variables such as performance, innovativeness, customer satisfaction, or the possibility of individually tailoring services (Goh, Mok, & Law, 2009). As a result of the research, the SmartTour framework is identified, offering assumptions for the business model of travel agencies utilizing artificial intelligence.

AI in tourism services – literature review

Currently, a significant transformation is occurring in the nature of marketing, where a trend known as e-marketing (Labanauskaitė, Fiore, & Stašys, 2020) is evolving, and it may soon dominate all marketing strategies (Ketter & Avraham, 2021) and activities within the tourism industry. The primary driver of e-marketing's development is the Internet; however, the essence of this approach is not limited merely to online deployment. Rather, e-marketing fundamentally involves the extensive use of digital technologies (Pawlicz, 2012). It is now believed that the most crucial innovation in tourism marketing is its virtualization, which entails the replacement of tangible resources, actual processes, and traditional marketing relationships with their virtual counterparts (Rapacz & Jaremen, 2015, pp. 1346–1354). From the perspective of tourism service providers, e-marketing is viewed as a new tool for promotion and efficient online sales of tourism products, as well as for delivering technological solutions (e.g. offer search engines or reservation systems) to the tourism industry (Kalecińska, 2013). From the consumer's standpoint, e-marketing may provide access to programs, applications, and devices that facilitate communication and access to tourist attractions, and even virtual travel experiences. Without undermining the significance of information technology in today's tourism marketing, Buhalis and Law (2008) identifies areas of its application, including marketing mix, airline operations, hospitality, and tourism area management. Another direction involves creating tourism products based on the virtualization of experiences, emotions, and sensations, which can be accessible through technology for individuals unable to travel for various reasons. E-marketing in tourism also encompasses building relationships and conveying significant information to tourists via the Internet through various activities and communication tools, such as having a website, email marketing, social media presence, messengers, and virtual diaries (Kuczamer-Kłopotowska, 2009). Recently, among these activities, platforms such as Facebook, Twitter, Instagram, and YouTube, as well as online blogs, including those on tourism topics, are becoming a significant factor in shaping opinions. Consequently, contemporary tourism marketing is compelled to rely on the use of the Internet and innovative hardware and software solutions that serve tourists.

In recent years, AI technologies have revolutionized many sectors of the economy, offering innovative solutions that enhance efficiency, service personalization, and customer satisfaction (Maurer, 2021). Despite the tourism industry being a dynamically evolving sector that increasingly integrates modern technologies to improve traveler experiences, conceptual frameworks emerge (Jabeen *et al.*, 2022), yet there is still a lack of comprehensive studies addressing the readiness of both customers and tourism enterprises to accept and implement AI-based solutions. The specificity of the tourism industry, characterized by direct customer contact and the need to tailor offerings to individual needs and expectations, makes the potential for AI utilization enormous (Armutcu, Tan, Amponsah, Parida, & Ramkissoon, 2023). Opportunities such as offer personalization, customer service process optimization, or task automation, however, require not only advanced technology but also understanding and

acceptance by the users of these solutions. Despite emerging studies that address the issue of AI in the tourism industry, there is still a need for more exhaustive and comprehensive research that comprehensively addresses the issue of predispositions to accept the implementation of AI technology in tourism, from both consumer and service provider perspectives. There are individual studies focusing on specific aspects of AI utilization, such as chatbots or recommendation systems, but a cohesive model utilizing the full AI toolkit for the tourism industry has not been proposed yet (Huang, Chao, de la Mora Velasco, Bilgihan, & Wei, 2022).

Currently, the development of AI-generated content is gaining increasing interest and popularity worldwide (Alyasiri, 2024). This applies to users' ability to utilize AI to automatically generate content such as images, texts, and videos that cater to their individual needs (Wu *et al.*, 2023). AI technology has been recognized as one of the most advanced, but it was only with the advent of ChatGPT that its powerful capabilities were publicly revealed. ChatGPT, being a highly advanced AI chatbot, has gained unprecedented attention due to its ability to understand complex and diverse human languages and generate personalized, human-like responses (Lim, 2023; Milmo, 2023). Importantly, it is the first AI user interface that has become widely available to the general public (Lim, 2023). ChatGPT has made significant progress compared to previous chatbots, overcoming limitations associated with personalized responses (Luo, Tong, Fang, & Qu, 2019; Go & Sundar, 2019), content richness (Beran, 2018; Følstad & Skjuve, 2019; Janssen, Grütznier, & Breitner, 2021), and conversation coherence (Chong, Yu, Keeling, & de Ruyter, 2021; Shen *et al.*, 2023). Its unique capabilities make it a valuable tool in various applications and sectors (Shahsavari & Choudhury, 2023). With growing interest in ChatGPT across various sectors of life, recent studies have revealed its potential and challenges in the context of scientific writing (Altmäe, Sola-Leyva, & Salumets, 2023), healthcare sector (Patel & Lam, 2023), education (García-Peñalvo, 2023; Liu & Ma, 2023), smart vehicles (Du *et al.*, 2023), and other areas. These analyses have mainly focused on ChatGPT's applications in specific fields, with little attention paid to individual ChatGPT usage. Currently, its creators at OpenAI have offered ChatGPT as a free and easily accessible tool for individuals without specialized technical knowledge (Editorials, 2023). Furthermore, ChatGPT represents a breakthrough in AI text generation, allowing users to feel the closeness of AI technology in their lives for the first time. However, there is still a shortage of research on ChatGPT acceptance by ordinary users and the factors influencing this acceptance. Our intention is to investigate whether users' interest in ChatGPT corresponds to their actual readiness to accept it and what factors influence this acceptance. Therefore, this study aims to understand users' readiness to accept or reject ChatGPT and the factors shaping these attitudes.

In recent years, there has been dynamic development and application of AI-based devices, which has gained significant prevalence (Duan, Edwards, & Dwivedi, 2019). From robots operating on production lines in the automotive industry to decision support systems in medicine used in hospitals, AI technology has become an integral part of commercial activities in various sectors. Tasks that were previously the domain of humans alone, such as vehicle driving, speech processing, face recognition in photos, large dataset analysis, or conducting internet searches, can now be easily performed by AI devices (Anthes, 2017). Service companies have also begun implementing AI technologies in their production and service delivery processes. For example, in the hospitality sector, Hilton Worldwide uses a robot as a concierge, personalizing guest experiences, providing information, and fulfilling their basic needs (Tavakoli & Mura, 2021). In the aviation industry, airlines use AI devices to respond to travelers' inquiries and improve their travel experiences (West, Clifford, & Atkinson, 2018). AI-driven applications provide personalized recommendations to customers based on the analysis of extensive data sets with multiple variables. This AI-based sales application not only offers quick and accurate personalized suggestions that enhance interactions between the customer and the brand but also allows the company to increase efficiency and operational effectiveness, thereby reducing costs associated with staffing (Kiliçioğlu, Özçelik, & Yöndem, 2023).

As a result of the literature review, a significant research gap was identified, leading to the formulation of key research questions and corresponding hypotheses.

Research questions:

RQ1. How does the application of AI tools in the strategies of tourism companies shape the quality of customer interactions and their level of satisfaction?

RQ2. What are the effects of integrating AI technology in reservation systems and customer service on customer loyalty and retention in the tourism industry?

Research hypotheses:

H1. The application of AI tools in the strategies of tourism companies improves the quality of customer interactions and increases their level of satisfaction.

H2. The integration of AI technologies in reservation systems and customer service leads to increased customer loyalty by enhancing the purchasing processes and support experiences.

Methodology

In response to the growing importance of AI technology in the tourism sector, the following analyses aim to conceptualize an innovative business model called SmartTour. This model predicts the use of advanced AI tools to optimize operations and deliver highly personalized services by tourism enterprises in Poland. In the context of developing this model, a methodology amalgamating qualitative and quantitative techniques was applied. The research goal included identifying ways in which the implementation of advanced AI technologies, such as machine learning, natural language processing (NLP), image analysis, business process automation, and recommendation systems, influences the increase in operational efficiency of tourism enterprises. The study also aimed to determine the specific application of AI and assess the benefits and challenges associated with their adaptation in the context of the Polish tourism market.

In the first stage of the research, a case analysis of enterprises that already incorporate AI technologies in their operations was conducted. This process enabled the identification of best practices and potential barriers associated with their implementation. Subsequently, to obtain more detailed perspectives, a series of in-depth interviews were conducted with key stakeholders, including managers of tourism enterprises and customers. These semi-structured interviews provided valuable insights into experiences, expectations, and opinions regarding the application of AI technology in the tourism industry. Quantitative data analysis accompanied qualitative analysis, including the distribution of online questionnaires to a sample of 200 respondents, representing both tourism enterprises and customers. This hybrid methodology allowed for both quantification of needs, expectations, and satisfaction levels with the implementation of AI technologies and a deeper understanding of the context. Additionally, an analysis of available market data and industry reports was conducted, which served as a quantitative assessment of trends and patterns regarding the use of AI in the tourism industry.

The selection of the research sample was based on criteria such as data availability, willingness to participate in the study, and representativeness for the sector. This sample included tourism enterprises operating in Poland, diversified in terms of size, geographic location, and range of services offered. Such a holistic approach allowed for the acquisition of diverse data relevant for comprehensive analysis of the topic. Qualitative data collected underwent content analysis using NVivo software, facilitating the identification of key themes and patterns. Quantitative data were processed and analyzed using SPSS statistical software, ensuring both quantitative verification of conclusions arising from qualitative research and their statistical underpinning.

As previously mentioned, the study was conducted on a group of 200 respondents, including managers of travel agencies and their clients. The sample was purposively selected based on criteria of availability and representativeness for the tourism sector in Poland. Individuals from various regions of the country were chosen to enhance the generalizability of the results. The sample was also diversified in terms of industry experience, which facilitated the analysis of the impact of artificial intelligence on various aspects of management and customer service.

Two main tools were used for data collection: online surveys and semi-structured interviews. The survey included closed and open-ended questions designed to assess the perceptions and experiences of respondents related to the use of AI in tourism. The questions covered topics such as satisfaction with service automation, offer personalization, and the overall impact of AI on service quality. Semi-structured interviews were conducted to deepen the understanding of specific cases of AI usage, as well as the barriers to its implementation. Quantitative data were processed using SPSS statistical software, where descriptive analysis and Spearman correlation tests were performed. Qualitative data from the interviews underwent content analysis using NVivo software, which facilitated the identification of main themes and patterns. Integration of quantitative and qualitative results was achieved through data triangulation, providing a holistic view of the impact of AI technology in the tourism sector. Participants were informed about the goals of the study and assured of the anonymity and confidentiality of the collected data. Participation in the study was voluntary, and all respondents provided written consent to participate.

The qualitative component involved in-depth interviews with tourism enterprise managers and clients, which were recorded and transcribed. The data analysis was conducted using NVivo software, enabling a systematic approach to identifying, organizing, and interpreting the collected material. The coding process included repeated readings of the transcripts, creating preliminary categories, and then iteratively refining their content; these codes were subsequently verified by two independent researchers, enhancing the validity and reliability of the findings. As part of the conducted interviews, an analysis of dominants was carried out, defined as the most frequently occurring responses among respondents, which were subjected to detailed exploration using qualitative analysis methods. It was assumed that generalization and aggregation of data hold greater methodological and cognitive value than citing individual statements, as this approach allows for the identification of key patterns and relationships. All presented relationships and dependencies were derived from the subjective assessments and interpretations, in line with the adopted research strategy.

Results

The most important descriptive statistics regarding the conducted research are presented in [Table 1](#). The study involved 90 women and 110 men. The average age of the respondents was 36.97 years with a standard deviation of 15.23 years. The average length of employment was 9.95 years, and the average organization size was 99.41 persons. [Table 1](#) provides statistics on satisfaction ratings with the application of AI technology in various areas. Overall satisfaction is at a moderately higher level of 71.12%.

[Table 2](#) presents Spearman's rho correlation coefficients between satisfaction features with AI in the tourism industry and organizational size, organizational climate, age of participants, and work experience.

The strongest positive relationship is observed between organizational size, organizational culture, expectations, needs, satisfaction, and availability. The older the individual, the lower the acceptance of AI solutions ($\rho = -0.513$). Furthermore, the longer the work experience, the greater the expected benefits ($\rho = 0.552$) and the higher the level of user acceptance of AI ($\rho = 0.514$). Additionally, the larger the organization and the stronger its organizational culture, the greater the satisfaction with the use of AI technology in the tourism industry.

Table 1. Descriptive statistics of measured variables in the tourism industry sector

Area	Variable	<i>M</i>	<i>N</i>	<i>SD</i>	<i>MD</i>	<i>S</i>	<i>K</i>
Expectations	Expected benefits (e.g. increase in efficiency, cost reduction)	4.03	200	0.14	4.01	2.95	20.04
	Level of user acceptance	4.01	200	0.11	4.01	0.33	0.06
Needs	Impact on ethics and safety	3.99	200	0.17	3.99	-7.58	87.80
	Level of automation	4.01	200	0.12	4.01	-1.24	6.22
	Technological requirements	3.99	200	0.10	3.99	-0.03	0.06
	Budget	4.01	200	0.11	4.01	1.85	13.09
Satisfaction	Human resources	4.01	200	0.10	4.02	-0.17	-0.47
	Level of goal achievement	3.99	200	0.11	4.00	-0.16	0.05
	User perception	4.00	200	0.10	4.00	0.04	-0.34
Availability	Satisfaction with implementation process	4.01	200	0.09	4.00	-0.12	-0.22
	Quality	4.00	200	0.09	3.99	0.26	0.59
	Quantity	3.99	200	0.10	3.98	0.24	-0.33
	Diversity	3.99	200	0.09	4.00	0.14	-0.24
Metrics	Organization size	99.41	200	9.91	100.01	-0.31	0.10
	Organizational culture	4.01	200	0.10	4.00	-0.15	-0.05
	Age	36.97	200	15.23	37.09	-0.27	-0.13
	Work experience	6.95	200	0.89	6.83	0.17	-0.11
Overall satisfaction with the use of AI technology in the tourism industry		71.12	200	8.11	75	0.11	0.76

Note(s): *M* – mean; *N* – sample size, *SD* – standard deviation; *MD* – median, *S* – skewness; *K* – kurtosis

Source(s): Authors' own elaboration

Table 2. Correlation matrix of Spearman's rho coefficients

Category	Variables	Organization size	Organization culture	Age	Work experience
Expectations	Expected benefits (e.g. increase in efficiency, cost reduction)	0.764*	0.839*	-0.222	0.552*
	Level of user acceptance	0.654*	0.835*	-0.513*	0.514*
Needs	Impact on ethics and safety	0.311	0.767*	-0.355	0.234
	Level of automation	0.798*	0.768*	-0.238	0.497
	Technological requirements	0.818*	0.741*	-0.144	0.266
	Budget	0.673*	0.880*	0.128	0.254
Satisfaction	Human resources	0.236	0.801*	0.269	0.353
	Level of goal achievement	0.767*	0.821*	-0.219	0.291
	User perception	0.728*	0.735*	-0.198	0.235
Availability	Satisfaction with implementation process	0.613*	0.761*	-0.474	0.441
	Quality	0.551*	0.768*	0.241	0.382
	Quantity	0.504*	0.544*	-0.104	0.232
	Diversity	0.520*	0.610*	-0.228	0.156
Overall satisfaction with the use of AI technology in the tourism industry		0.781*	0.761*	0.244	0.211

Note(s): *Statistically significant correlation at $p < 0.05$

Source(s): Authors' own elaboration

In the research on the best predictive model, ARIMA methods, LSTM neural networks, and exponential smoothing were employed.

The best prediction results after applying five-fold cross-validation (Table 3) were obtained for the ARIMA model. The independent variables in each model are Expectations, Needs, and

Table 3. Prediction results of the three compared models

Predictor	Metrics	a	b	c
		ARIMA	LSTM	Exponential smoothing
	MAPE	3.828	3.932	4.882
	RMSE	3.05%	3.45%	3.91%
	R ²	0.876	0.823	0.876

Source(s): Authors' own elaboration

Availability, while the dependent variable is Satisfaction. It is important to note that the cross-validation aimed to build a model that is not overfitted to the data.

Figure 1 presents the forecast of satisfaction with the use of AI using the training set from 2009 to 2023. The forecast is made until 2026. The model fits well with $R^2 = 0.876$, root mean square error $RMSE = 3.025\%$, and mean absolute percentage error $MAPE = 3.828\%$. We observe a rising trend, indicating that by 2026, there could be approximately a 10% increase in satisfaction with the use of AI technology in the tourism industry compared to 2023.

The study revealed that the vast majority of entities operating in the tourism sector in Poland utilize AI technologies to varying degrees. The most commonly adopted tools include reservation systems based on advanced machine learning algorithms and platforms for data analysis and personalized recommendations. Respondents pointed out a wide range of AI applications in various operational aspects, including offer individualization, automation of booking processes and customer service, analysis of diverse market data, and optimization of pricing and marketing strategies. The main benefits of implementing AI technologies in the Polish tourism industry include increased operational efficiency through process automation, improved customer service quality through offer personalization, and deeper understanding of customer needs and preferences through data analysis. The study also identified several key challenges associated with AI implementation, including limited financial and human resources, difficulties with system integration, and concerns about data security and customer privacy. The analysis confirmed that the majority of companies operating in the tourism sector in Poland plan to continue investing in AI-related technologies. Planned steps include expanding existing infrastructure, implementing new solutions, and enhancing employee competencies in the AI field.

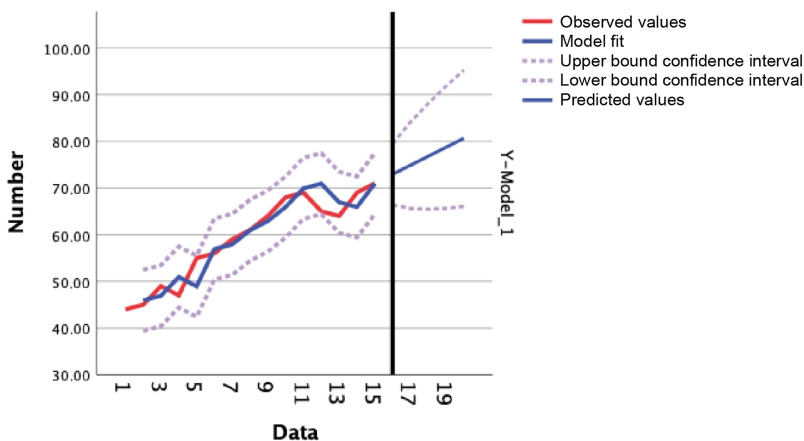


Figure 1. Time series plot of exponential smoothing method for AI satisfaction forecast. Data point 1 represents the year 2009, and data point 19 represents the year 2026. Source: Authors' own elaboration

The study results provide a solid foundation for further exploration and interpretation of the impact of artificial intelligence technologies on the tourism sector in Poland, as well as for developing development strategies based on these findings. This study can also serve as a reference point for future empirical research and inspire other companies interested in leveraging AI technologies in their operations.

Identifying the conceptual framework for tourism management

The results of the research were used to identify the SmartTour business model, which involves the implementation of selected AI technologies to optimize the operational activities of tourism enterprises and provide personalized services to customers. This model is based on the belief that artificial intelligence technologies can significantly contribute to improving operational efficiency, customer service quality, and the competitiveness of tourism enterprises in the market. The integration of various research methods not only helped understand the current state of AI utilization in the tourism sector but also identified potential for future innovations and development within the proposed SmartTour business model (Figure 2). The proposed SmartTour business model integrates advanced artificial intelligence technologies to create an innovative approach in the tourism industry, focusing on personalization and optimization of customer experiences. It uses machine learning to analyze data from various sources, enabling computers to learn from the history of searches, bookings, and customer behavior without the need for direct programming. This allows for the customization of tourism offers, tailoring them to individual user preferences. Machine learning algorithms are also used to predict airfare prices, detect potential fraud in bookings, and adjust offers based on anticipated demand for specific destinations.

Empirical findings from the quantitative survey and in-depth interviews provide a critical analysis of how each AI-powered component (machine learning, image analysis, process automation, NLP and recommendation systems) was identified and improved. Additional analysis of the empirical data enabled the demonstration of the consistency between the theoretical input and the obtained results, with respect to the SmartTour model (Figure 2). In the in-depth interviews conducted with managers and customers, the highest importance was given to solutions based on machine learning and process automation, which is confirmed by high satisfaction rates (over 71% overall satisfaction with the AI implementation). Managers noted a clear improvement in operational efficiency (for example, a 20–30% reduction in booking times), while customers emphasized a better matching of travel offers to individual preferences. The interview results also indicated that the image analysis component enabled quick identification of the most visually appealing aspects of the offer and helped to indicate areas for improvement in terms of spatial aesthetics, which led to increased tourist satisfaction. These observations were particularly evident in larger organizations, which is consistent with the quantitative data (Table 2) showing a significant correlation between company size and expected benefits of AI implementation. At the same time, for smaller companies, NLP-powered process automation (Natural Language Processing) facilitated faster handling of customer queries, which improved retention rates. However, respondents mentioned initial concerns about data security, which partly explains the more cautious approach to integrating these technologies in the smallest entities. To confirm the importance of individual components in the SmartTour model, we also surveyed respondents on the impact of AI on customer satisfaction and organizational performance. The qualitative and quantitative results clearly showed that personalization of offers and reduced turnaround time are key factors supporting positive AI reception, which in turn is combined with machine learning functionalities (price prediction, customization of travel proposals) and automation (instant booking confirmations, automatic notifications). Content analysis of the interviews also helped to explain how the survey results translate into management

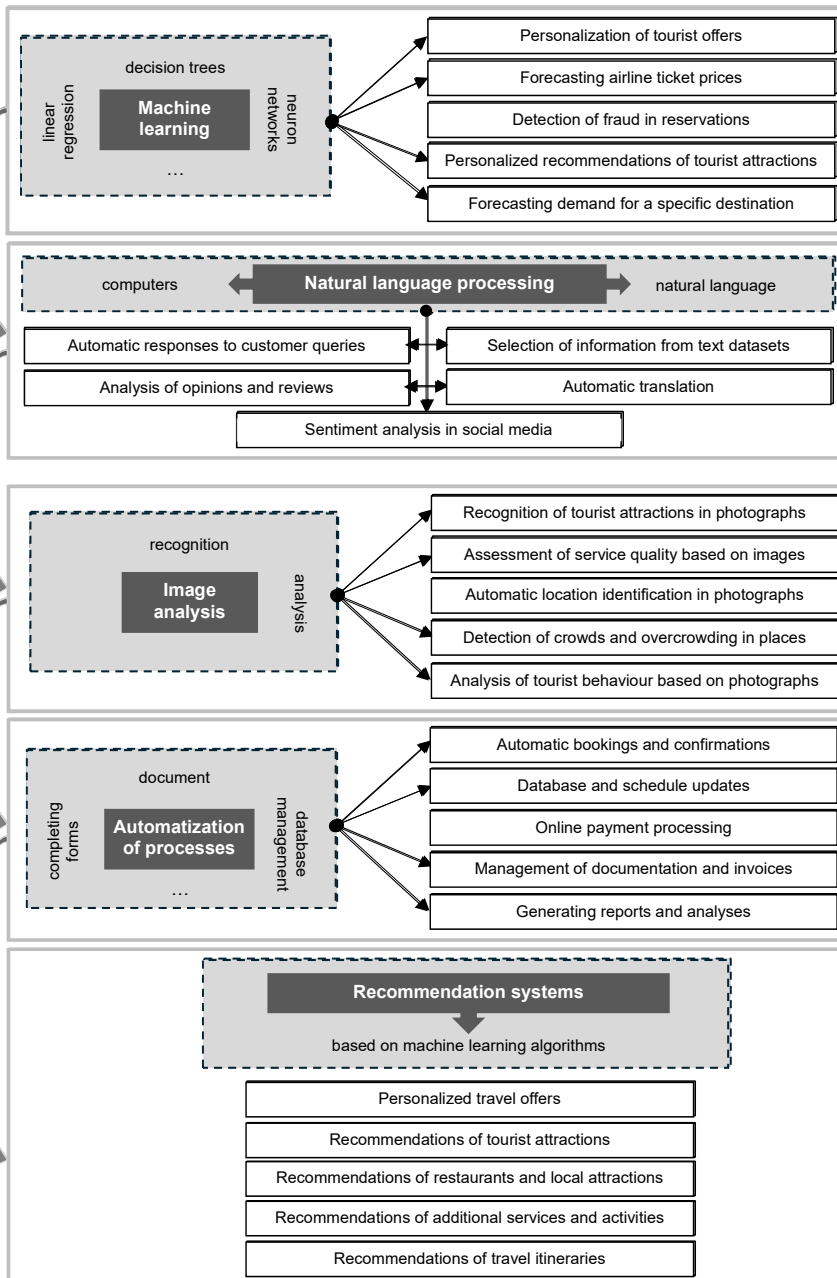


Figure 2. Business model SmartTour. Source: Authors' own elaboration

practices in tourism, in particular how increased satisfaction and optimization of operational processes directly relate to qualitative data on current customer needs (e.g. demand for 24/7 online support). Thus, in contrast to a purely theoretical perspective, the

conclusions drawn from the in-depth interviews clearly confirm that each element of the SmartTour model was identified through analysis of the collected data. Machine learning, NLP, image analysis, process automation and recommendation systems do not represent abstract concepts; rather, they arise directly from the needs and expectations expressed by the study participants.

AI algorithms analyze data from the history of searches, bookings, and behaviors on tourist platforms, enabling the personalization of tourist offers and increasing sales effectiveness by adjusting proposals to individual customer preferences. In the SmartTour model, natural language processing (NLP) is also of great importance, enabling interaction between computers and human language. This technology is used for automatic responses to customer inquiries by chatbots, analysis of opinions and reviews, as well as for selecting key information from large text datasets. As a result, tourism companies can quickly respond to customer needs, improving their experiences and increasing service efficiency. Another element is image analysis, which allows for the recognition of tourist attractions in photos, evaluation of service quality based on images, and automatic identification of locations. This facilitates offer personalization and multimedia resource management, translating into greater attractiveness of tourist proposals. Process automation is another important aspect of the SmartTour model. It increases operational efficiency by automating tasks such as bookings, confirmations, database updates, online payment processing, and document processing. This reduces the time and costs associated with performing routine tasks and minimizes the risk of human errors. SmartTour utilizes recommendation systems based on machine learning algorithms to generate personalized proposals for users. By analyzing customer preferences and behavior, the system can suggest individually tailored travel offers, tourist attractions, restaurants, or additional services, increasing customer satisfaction and translating into higher revenues for tourism industry companies.

The SmartTour business model, defined based on research, constitutes effective utilization of selected tools for the tourism industry to improve operational efficiency, increase competitiveness, and deliver more personalized and satisfying travel experiences to customers. In the context of these carefully considered actions, the imperative of ensuring data security and adhering to ethical norms related to automation and personalized service delivery is emphasized. Own research analysis also encourages reflection on the difficulties associated with integrating artificial intelligence tools with existing information systems in the tourism industry. One of the key challenges is harmonizing modern AI tools with the current IT infrastructure, which is often incompatible or requires significant modifications, thus generating additional costs and delays. Implementing AI tools also entails the risk of breaching data confidentiality and customer privacy, requiring adequate protection measures and full compliance with applicable regulations such as the General Data Protection Regulation (GDPR).

For surveyed entities operating in the tourism industry, investing in AI technologies represents a significant expenditure requiring appropriate financial resources. There is concern that the introduction of AI tools may encounter resistance from both customers, fearing loss of control or the disappearance of personalized services, and from employees, fearing job loss or changes in the way duties are performed. The use of AI technology in the tourism sector also raises a number of ethical issues, including concerns about discrimination against customers from different social groups and the loss of direct contact with customer service. Therefore, making thoughtful decisions and ensuring compliance with company values and societal expectations becomes essential.

It has been noted that to minimize concerns related to the implementation of AI tools in operational management of tourism companies, comprehensive research and analysis are necessary to identify individual needs and capabilities of the company as well as to identify potential threats and challenges. Significant mitigation of potentially negative consequences can be achieved by ensuring transparency in the process of implementing AI tools and engaging both customers and employees through regular communication and the opportunity to express opinions and concerns.

Empirical validation of the SmartTour model from a marketing perspective

The study was based on a combination of qualitative and quantitative approaches, which allowed for a comprehensive analysis of the impact of AI technology implementation on performance, innovation, and customer satisfaction in the tourism industry, particularly in the area of e-marketing. In the initial phase, a case analysis of several tourism enterprises that already integrate AI technologies was conducted, identifying best practices and potential barriers. Subsequently, extensive survey research was carried out among 200 travel agency managers and clients, which facilitated the collection of quantitative data regarding the effectiveness of AI application in marketing strategies. These data were then subjected to statistical analysis, enabling the assessment of correlations between the use of AI tools and changes in key performance indicators and the efficiency of marketing campaigns. The results of the empirical study confirmed that the implementation of the SmartTour model significantly improved customer service quality in the tourism enterprises studied, as well as the effectiveness of e-marketing.

Managers of travel agencies who had implemented AI solutions reported higher satisfaction with process automation and the personalization of marketing offerings. Customers using the services of these companies expressed greater satisfaction with the quality of service and the adaptation of marketing offers to their individual needs. Based on the study results, it is recommended to continuously refine AI algorithms to better tailor marketing offers to the needs and preferences of customers. Furthermore, ensuring transparency and ethical use of personal data in marketing activities is crucial, as it increases customer trust and supports the long-term development of customer relationships.

Discussion

This article significantly enriches the literature on the applications of artificial intelligence (AI) in the management of the tourism sector, particularly through the introduction of the SmartTour model. The discussion of the research results and presented conclusions is crucial for assessing both the potential and limitations of this technology within the tourism context. The article makes a substantial contribution to the literature by thoroughly analyzing the impact of AI on customer interaction quality, satisfaction, loyalty, and retention. Previous studies (e.g. [Buhalis & Law, 2008](#); [Gursoy et al., 2023](#); [Dwivedi et al., 2024](#)) have emphasized the importance of service personalization as a key success factor in the tourism sector. This article empirically confirms that the use of AI and recommendation systems, can significantly enhance customer service and offer personalization.

One of the key contributions of the article is the empirical validation that AI can improve the operational efficiency of tourism enterprises. The results show that AI technologies effectively predict customer satisfaction levels and enable dynamic adaptation of offers to changing market needs. This aligns with the findings of [Jabeen et al. \(2022\)](#), which suggest that automation and data analysis can enhance the effectiveness of marketing efforts in tourism. The methodology used in the study, encompassing a mixed-methods approach, is a strong point of the article as it provides a comprehensive view of AI's impact on tourism management. However, certain aspects may raise concerns. For instance, the choice of a sample size of 200 respondents, although representative, may not fully capture the diversity of the Polish tourism market. Future research should consider a larger sample size and broader geographical diversification to achieve more generalizable results. Additionally, it should be emphasized that the sample size (200 respondents) may limit the generalizability of the obtained results to the diverse tourism market. While this number of study participants provides valuable insights, subsequent research phases should consider expanding the geographical scope and including a larger number of entities from various segments of the industry, which would allow a more comprehensive capture of the multifaceted nature of the tourism sector. Key areas were identified where the implementation of artificial intelligence improves the efficiency of tourism enterprises, although only the main conclusions directly related to the SmartTour model are presented at this stage.

The article fills several critical gaps in the existing literature. Firstly, while earlier studies, such as [Buhalis and Law \(2008\)](#) and [Samara et al. \(2020\)](#), focused mainly on theoretical aspects of AI applications in tourism, this article provides empirical evidence on practical AI applications. Secondly, studies like [Gursoy et al. \(2023\)](#) discussed the general benefits of AI but did not present specific business models integrating AI. The SmartTour model addresses this gap by offering concrete solutions and recommendations for tourism managers. Moreover, existing literature often overlooked aspects related to precise measurement of customer satisfaction and loyalty in the context of AI. This study, through the use of advanced statistical methods and predictive models such as ARIMA and LSTM, provides precise tools for forecasting and analyzing these variables. Thus, the article contributes to a more accurate analysis of how AI affects customer satisfaction, an area previously not extensively examined.

From a practical standpoint, the SmartTour model offers tourism enterprises advanced tools to improve service quality and enhance competitiveness. This is particularly significant in the context of a dynamically changing market and rising customer expectations. Managers should, however, be mindful of the need for continuous monitoring and adjustment of AI strategies to ensure their effectiveness and alignment with market expectations. Despite promising results, certain limitations should be considered. Implementing AI in tourism involves challenges related to system integration and data management. The article points to the need for further research on data security and customer privacy, which are crucial in the context of regulations such as GDPR. Additionally, the article does not fully explore the ethical aspects of AI applications. Although potential benefits such as automation and personalization are discussed, there is a risk that excessive reliance on AI could lead to the dehumanization of customer service and the marginalization of employees. Future research should therefore focus on the sustainable implementation of AI, considering both efficiency and social and ethical aspects.

The article is a valuable contribution to the understanding of AI's role in tourism management. The discussion of the research findings highlights the importance of advanced technologies in improving customer service quality and optimizing processes. Future research should, however, place greater emphasis on ethical and social aspects to ensure the sustainable and responsible implementation of AI in the tourism sector.

Conclusions

Artificial intelligence has recently disrupted tourism management. Consequently, scholars and practitioners are expanding their knowledge on the potential benefits of AI applications in tourism and seeking effective ways to incorporate AI tools. However, there is still a lack of comprehensive research demonstrating the specific areas of AI applications in tourism.

Artificial intelligence offers solutions that can revolutionize tourism marketing management. Its ability to adapt and generate personalized content makes it an invaluable tool for improving customer experience and operational optimization in the tourism industry. It is the cornerstone on which almost all modern business models are based, especially in companies, including those in the tourism sector. Properly selected AI tools support process automation, optimize operations and use data to make more informed business decisions. These tools include various techniques such as machine learning, natural language processing and image analysis, which are used in many operational areas of tourism companies. Models such as ChatGPT, which are part of artificial intelligence, stand out for their ability to generate texts resembling human creativity. Thanks to advanced natural language processing techniques, they analyze user input, which allows for the creation of consistent and relevant answers.

Such innovative solutions have found extensive application not only in content creation but also in tourism marketing management, where immediate and precise responses to frequently asked questions can significantly impact the quality of tourism services provided. In the customer service area, ChatGPT enables the implementation of AI-based systems that offer

instant assistance, responding to a wide range of inquiries related to tourism services. Such support, allowing simultaneous handling of multiple inquiries, is extremely valuable in the context of tourism marketing management, where the efficiency and speed of response are crucial to customer satisfaction. Thanks to ChatGPT's adaptability, personalized recommendations can be generated, which play a significant role in providing tourism services. Analysis of preferences and data entered by users enables the delivery of individually tailored travel proposals, directly improving the quality of customer experiences and their satisfaction with the services offered. ChatGPT's multilingual support opens up new perspectives in global communication, which is crucial in the tourism industry. Real-time translation facilitates interactions between travelers and local tourism service providers who speak different languages, thereby contributing to the improvement of tourism marketing management and increasing the accessibility of services. In the context of travel planning, ChatGPT can assist in designing efficient routes, taking into account individual customer needs, which is extremely important for companies offering tourism services because it allows for the delivery of personalized travel solutions, which directly affects brand perception and customer loyalty. Content generation by ChatGPT, such as attractive descriptions of tourism offers, travel blogs, or promotional materials, becomes an invaluable tool in tourism marketing management. The ability to create engaging content allows for attracting more customers and increasing the number of bookings, which is crucial for success in the tourism industry. Moreover, using ChatGPT to analyze trends and preferences in the tourism industry provides valuable insights that can be used to optimize the offer of tourism services. The acquired information allows for a better understanding of customer needs, which is the foundation of effective tourism marketing management.

The tourism industry with the use of AI reveals both promising opportunities and potential challenges. By integrating artificial intelligence systems, tourism companies can ensure effective communication, reduce costs through automation of routine tasks, and provide real-time data analysis, enabling informed decision-making. Economical content production and improved SEO through content generation optimized for search engines contribute to better positioning of tourism companies in the market. However, there are also weaknesses, such as the risk of AI generating incorrect responses that may confuse customers, and potentially robotic content that may not fully convey human emotions, which is important in customer communication. Additionally, using AI-generated content raises ethical issues such as plagiarism and data privacy, requiring strict control and accountability. Opportunities for the tourism industry with the use of ChatGPT include the development of AI technology, which offers new ways to improve services and expand the offer, expansion into new markets through multilingual support, and the creation of innovative tourism products that increase the competitiveness of companies. These aspects indicate the potential for further growth and innovation in the tourism industry. On the other hand, threats include dependence on technology, which may lead to risks associated with system failures or cyber-attacks, intense technological competition, which requires continuous investments in new solutions, and legal regulations regarding the use of AI and personal data protection, which may affect the way ChatGPT is used in the industry. In the tourism industry with the use of ChatGPT, both the dynamic potential of this technology for the sector and the need for conscious management of the challenges it poses are emphasized. For tourism companies, it will be crucial to balance the benefits of automation and personalization of services with the need to maintain the authenticity of tourism experiences and ethical aspects of using AI technology. However, it should be remembered that ChatGPT represents significant progress in the field of artificial intelligence, offering solutions that can revolutionize tourism marketing management and the quality of tourism services.

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Corresponding author

Anna Brzozowska can be contacted at: annabrzozowska@gmail.com