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INTEGRATING ARTIFICIAL INTELLIGENCE INTO SMART CITY STRATEGIES FOR SUSTAINABLE URBAN TOURISM

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Summary: This paper analyses the role of artificial intelligence in the development of smart city tourism, with particular emphasis on the opportunities and challenges of its application in Serbia. The aim of the study is to examine the direct application of AI in the tourism industry of smart cities, the key barriers to its implementation, and future directions for development. The paper is based on a systematic review of relevant scientific literature, as well as strategic and institutional documents related to the development of smart cities, tourism, and artificial intelligence in Serbia. The results indicate that AI has significant potential in the areas of personalization of tourism services, visitor flow management, smart mobility, cultural heritage preservation, and sustainable resource management. At the same time, the study identifies obstacles related to underdeveloped digital infrastructure, limited data availability, high implementation costs, and insufficiently developed institutional capacities. The successful application of AI in smart city tourism in Serbia requires an integrated, strategic, and sustainable approach, supported by stronger cross-sectoral cooperation and technological modernization.

Key words: Artificial intelligence (AI), Smart cities, Serbia, Sustainable Tourism, Urban planning, AI-driven innovations

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Introduction

The contemporary tourism industry is undergoing a profound transformation driven by the rapid development and integration of digital technologies. Artificial intelligence (AI) plays a particularly important role in this process, as its convergence with smart city systems opens opportunities to redefine the tourism sector toward greater accessibility, stronger personalization, and more sustainable development (Gretzel & Koo, 2021). In this context, AI stands out as one of the most significant technological innovations, as it enables improvements in both user experience and the operational efficiency of smart destinations.

Modern technologies based on natural language processing have significantly transformed the field of customer support in tourism. AI-powered chatbot systems and virtual assistants can respond to user inquiries in real time and providing recommendations tailored to individual needs, thereby achieving a level of personalization that was previously unattainable (Li et al., 2017). Their added value is also reflected in their ability to operate continuously and learn from previous interactions, which contributes to the gradual improvement of the accuracy, relevance, and usefulness of the responses they provide within smart cities (Trisha, 2022).

A significant contribution of AI tools is also evident in the domain of predictive analytics, which represents one of the key areas of contemporary AI application in tourism. Based on the analysis of large data sets, AI systems can predict tourism trends, demand patterns, and consumer behavior regarding the choice of smart cities with a high degree of accuracy. In this regard, the study by Buhalis and Leung (2018) is particularly relevant, as it highlights the transformative potential of artificial intelligence in tourism, especially in terms of strengthening the predictive capacities of smart cities. These authors emphasize that AI enables the integration and processing of diverse data sources to generate operationally and strategically useful insights that can be applied to business planning and the enhancement of user experience. Such capabilities contribute to the optimization of smart cities' tourism offerings and the increase of operational efficiency, which is indirectly reflected in higher levels of user satisfaction and increased profitability of tourism organizations.

Artificial intelligence represents a qualitatively new phase in comparison with traditional ICT tools in the tourism industry of smart cities. Unlike conventional digital systems, which are primarily focused on information processing and transfer, AI possesses the ability to recognize patterns, make autonomous decisions, and adapt to new data (Popović Šević et al., 2025). Therefore, its application in smart city tourism covers a wide range of functions, including chatbots and virtual assistants in customer support, automatic translation, personalized recommendations, automated check-in processes, security monitoring systems, and dynamic pricing (García-Madurga & Grilló-Méndez, 2023). In addition, some authors and reports indicate that AI can also play an important role in enhancing sustainability through the preservation of cultural heritage within smart cities, improvement of quality of life, environmental monitoring, and the assessment of tourist satisfaction (Majid et al., 2023).

However, although the positive effects of AI are frequently emphasized in both the literature and practice, such optimistic approaches often overlook the possible risks, limitations, and trade-offs associated with these technologies. Previous research on the relationship between artificial intelligence and tourism has mainly focused on expected benefits, while the systematic analysis of risks, especially in relation to the sustainable development goals of smart cities, has remained relatively neglected. For this reason, there is a need to consider more carefully not only the developmental potential of AI, but also the negative consequences that its application may have in the context of sustainable tourism development.

This study addresses an important gap in the existing literature by critically examining the multiple impacts of artificial intelligence in smart city tourism in the Republic of Serbia. On the one hand, AI may contribute to the achievement of sustainable development goals, while on the other hand, it may also generate certain risks and challenges. Within this framework, the paper is guided by the following research questions:

RQ1: What are the direct applications of artificial intelligence in the tourism industry of smart cities?

RQ2: What are the barriers to the implementation of artificial intelligence in smart cities?

RQ3: What are the future directions for the use of artificial intelligence in smart cities?

In order to answer these questions, the author relies on a systematic review of the existing scientific literature on the relationship between artificial intelligence and sustainable tourism in smart cities.

Literature review

A smart city represents a process of urban transformation aimed at improving environmental sustainability, quality of life, and inclusive economic development, with technologies embedded in urban infrastructure serving as the key driver of such change (Toli & Murtagh, 2020). At the same time, a smart city constitutes a technologically advanced urban entity capable of monitoring and interpreting the state of its environment and the needs of its population, as well as processing different types of data to generate applied intelligence intended to address urban challenges and enhance the overall functioning of the city (Stübinger & Schneider, 2020). On this basis, the concept of data-driven smart cities has evolved, in which urban data are first collected and then analyzed using advanced models and artificial intelligence techniques (Singh et al., 2020).

In the literature, a smart city is also defined as a concept that connects physical, digital, and human systems within the built environment with the aim of creating a sustainable, prosperous, and inclusive future for the population (Pan et al., 2021). Information and communication technologies play a particularly important role in this process, as they contribute to better resource management, reduced carbon emissions, increased safety of public spaces, and the adaptation of urban services to the needs of contemporary society (Belli et al., 2020). At the same time, one of the fundamental goals of smart cities is to mitigate the environmental, economic, and organizational challenges brought about by urbanization. The smart city model implies a set of interconnected components and technologies that enable the alignment of urban infrastructure with modern information and communication and AI-based solutions. Within this framework, sensors and Internet of Things (IoT) devices play a significant role, being distributed throughout the urban space and used for the continuous collection of real-time data. The data collected in this way are then integrated, processed, and stored in centralized or distributed databases, thereby creating a reliable

basis for analysis and prediction. Building on this technological foundation, smart cities apply advanced urban life management systems which, with the help of data analytics and decision-making algorithms, contribute to traffic flow optimization, signal regulation, congestion mitigation, and the timely provision of information to participants in any type of movement or mobility (Ismaeel et al., 2023).

Smart tourism is, at the same time, an integrated system for combining different types of tourism-related information, including data on tourist attractions, accommodation capacities, restaurants, and transportation. Within this framework, the tourism industry is increasingly using modern technologies and digital communication formats to achieve more efficient and direct interaction with tourists, with smartphone applications standing out as an especially important channel of communication and service delivery. In addition, other advanced technologies are also being applied in the field of smart city tourism, such as virtual reality (VR), augmented reality (AR), extended reality (XR), media art, and the metaverse, with the aim of creating attractive content and enhancing the tourist experience (Gelter et al., 2022). In line with the further development of smart tourism destinations, it is expected that they will establish new standards in the tourism industry by offering innovative solutions tailored to the needs of modern travelers.

Big data analytics plays a central role in the functioning of smart tourism destinations. By analyzing large amounts of data collected from various sources, such as social networks, mobile applications, and IoT devices, tourism managers can gain important insights into visitor behavior, habits, and preferences (Bernardo et al., 2023). Such insights enable more precise planning of tourism offerings, a better understanding of market needs, and the adjustment of services in line with the demands of contemporary tourists.

An important dimension of smart tourism is also smart infrastructure, which includes both physical and digital systems that support the functioning of a smart tourism destination. This infrastructure comprises smart transport networks, energy-efficient facilities, and digital information platforms, thereby contributing to greater efficiency and sustainability of tourism operations. It is particularly significant that the implementation of smart power grids and energy management systems can reduce the negative environmental impact of tourism facilities, further strengthening the sustainable component of tourism development (Flores-Crespo et al., 2022).

Recent research has increasingly focused on the relationship between artificial intelligence, smart tourism, and sustainability. Smart tourism is based on the application of modern information and communication technologies, such as the Internet of Things, big data, and artificial intelligence, to improve destination management and enhance the tourist experience. Within such systems, artificial intelligence plays an important role because it enables the rapid collection, processing, and use of data, as well as more efficient decision-making.

The concept of smart tourism is largely based on the integration of different technological systems. As Tussyadiah (2020) points out, the combination of artificial intelligence, the Internet of Things, and big data constitutes the foundation of smart tourism ecosystems, as it enables the simultaneous improvement of visitor experiences and more efficient, sustainable management of smart destinations. In this sense, modern technologies serve not only to modernize tourism offerings, but also to address the challenges arising from increased tourism pressure.

More broadly, the literature links the application of artificial intelligence with key dimensions of sustainable tourism development. At the conceptual level, as suggested in the studies under consideration (Hossain et al., 2020), AI can contribute to economic sustainability through greater efficiency and profitability, to environmental sustainability through better resource management and the preservation of smart destinations, and to social sustainability through the enhancement of tourist satisfaction and safety. Nevertheless, the application of these technologies must be carefully directed so as not to lead to new problems, such as the deepening of digital inequalities or the reduction of employment opportunities for the local population.

Artificial intelligence plays a significant role in improving sustainability in smart city tourism, particularly through more efficient use of resources and better environmental management. Specifically, AI tools can help reduce energy consumption, waste, and the irrational use of resources in tourism operations. This is especially evident in the hospitality sector, where smart systems such as thermostats and lighting are used to adapt to the habits and preferences of guests to achieve energy savings without compromising the quality of their stay.

Artificial intelligence also has an important strategic role in improving the management of cultural heritage destinations within smart cities and destinations, as it contributes to data-driven decision-making, more efficient use of resources, and improved overall operational performance (Cheng et al., 2025). Particularly important is its ability to process large volumes of data collected from social media, sensors, digital platforms, and historical archives, making it possible to identify visitor behavior patterns, preferences, and ways in which cultural heritage spaces are used. In this way, the development of technologies such as artificial intelligence, virtual reality, and the metaverse is transforming both cultural tourism and heritage protection, creating new opportunities for interaction, greater accessibility, and more sustainable management of cultural resources in smart cities (Alonso Almedia, 2019).

Examples of AI Applications into Smart Cities

The application of artificial intelligence in smart cities can be identified across several interconnected areas, particularly in the domains of smart tourism, destination management, cultural heritage preservation, and sustainable resource management. Based on the analyzed sources, artificial intelligence in smart cities is primarily used for processing large volumes of data to support real-time decision-making, service personalization, resource optimization, and the enhancement of user experience (Yang & Wang, 2023; Gretzel, 2022). One of the most significant applications relates to the personalization of tourism services. AI enables the provision of relevant information for travel planning, recommendations based on tourist behavior and preferences, and the continuous adaptation of services based on user feedback (Aliyah et al., 2023). In this way, visitor satisfaction is improved and the competitiveness of smart tourism destinations is strengthened (Buonincontri & Micera, 2016; Koo et al., 2023).

The management of visitor flows and congestion represents one of the most widely used applications of AI in the sphere of smart cities. In smart cities, Internet of Things sensors can detect the overcrowding of specific sites, while AI systems enable the redirection of tourists to alternative locations through real-time notifications. Such applications contribute to the protection of cultural and natural resources, reduce pressure on the most visited zones, and support more sustainable destination management (Rahmadian et al., 2022). Machine learning algorithms, such as time-series forecasting models

and regression models, are extremely useful in estimating visitor numbers depending on the time of day, weather conditions, holidays, and special events (Xu et al., 2021). Based on such predictions, tourism stakeholders can more easily identify peak visitation periods and introduce appropriate measures accordingly, such as flexible pricing, reservation time-slot allocation, and congestion management (Dašić et al., 2024). Existing research indicates that artificial intelligence contributes to better decision-making by enabling real-time responses to expected visitor movements, which helps reduce excessive pressure on spaces and improves the overall tourist experience (Chien et al., 2022; Pereira et al., 2021).

Artificial intelligence, in combination with virtual reality, also contributes to the preservation and interpretation of cultural heritage by enabling the development of virtual tours and immersive digital experiences. In this way, the need for physical presence at sensitive sites is reduced, which contributes to their preservation (Loureiro et al., 2022). In addition, AI is used for image recognition, 3D reconstruction, documentation, restoration, and automated cataloguing of cultural assets, which is particularly important for sites at risk of damage or disappearance (Buhalis & Karatay, 2022). Furthermore, artificial intelligence is applied in contactless and automated tourism services, such as facial-recognition check-in, voice commands, passenger and baggage tracking, as well as accelerated reception and service procedures. These solutions gained particular importance during the COVID-19 pandemic but have retained long-term value due to their contribution to higher operational efficiency and service quality (Gaur et al., 2021; Ioannidis & Kontis, 2023).

The implementation of AI in the sphere of smart cities also involves the management of sustainability and environmental performance. In hospitality and tourism, AI and big data are used to analyze water and energy consumption, monitor guest behavior patterns, and develop strategies for more efficient resource use while preserving user comfort (Lv et al., 2024). At the level of smart destinations, the analysis of GPS and mobile data enables a better understanding of visitor movements, capacity control, and the application of dynamic space-management measures (Rahmadian et al., 2022).

Contemporary developments also show that AI plays an important role in the growth of immersive and extended tourism experiences, especially through

integration with metaverse technologies, expanded 3D environments, and holographic displays across interconnected devices. Such solutions enable more efficient, personalized, and interactive experiences, whereby the tourism experience extends beyond the spatial and temporal limitations of the smart destination itself (Stankov et al., 2025). These applications confirm that AI represents one of the key instruments for improving efficiency, sustainability, and quality of life in modern smart cities, thereby directly defining the areas of artificial intelligence use in smart cities within the framework of RQ1.

Barriers to the Application of Artificial Intelligence in Smart Cities

When it comes to the obstacles to implementing artificial intelligence in smart cities, it is widely recognized that these barriers are not exclusively technological, but also include governance-related, social, environmental, and organizational challenges (Li et al., 2017). Although artificial intelligence has significant potential to improve smart tourism, resource management, and cultural heritage preservation, its successful application depends on the ability of cities and destinations to respond to the complexity of the relationships among technology, institutions, local communities, and users (Gretzel, 2022). One of the main barriers relates to the complexity of managing sustainable tourism and smart destinations. Contemporary destinations are faced with the need to simultaneously preserve market attractiveness, service quality, cultural heritage, and natural resources, while uncontrolled tourism growth may lead to environmental degradation, the erosion of cultural identity, and the deepening of socio-economic inequalities (Font et al., 2023). In such a context, the implementation of AI does not represent an automatic solution but rather requires the careful alignment of technological innovation with the principles of sustainable development (Rahmadian et al., 2022).

The limitations of conventional governance models, which are often not sufficiently adapted to the complex interrelationships among environmental, social, and economic factors, may also constitute a barrier. Precisely for this reason, the introduction of artificial intelligence may be hindered in the absence of appropriate institutional capacities, strategic frameworks, and governance models capable of supporting its effective and responsible application (Qi & Li, 2022). In other words, the problem lies not only in the

availability of technology, but also in the system's capacity to integrate that technology into existing decision-making processes.

The need for high-quality data and their real-time processing may also create difficulties in the management of smart cities. Smart destinations and AI-supported systems rely heavily on the intensive use of data, sensors, GPS information, mobile data, and user feedback to enable service personalization, congestion management, and more efficient resource allocation (Koo et al., 2023; Rahmadian et al., 2022). However, if the infrastructure for collecting, linking, and analyzing data is not sufficiently developed, the possibilities for applying AI remain limited. This is especially evident in destinations that do not have a high level of technological integration between the public and private sectors.

An additional barrier is reflected in the need for adequate forms of human–technology interaction (Cambra-Fierro et al., 2024). The practice of AI-supported smart tourism must take into account the complexity of the relationship between people and technological systems, while also developing appropriate business models and governance principles. This means that the implementation of AI depends not only on the technical functionality of the system, but also on whether the services are sufficiently understandable, accessible, and acceptable to visitors of smart cities, local residents, institutions, and service providers. Without such alignment, lower levels of acceptance and limited implementation effects may occur (Gretzel, 2022). At the same time, there is a risk that technological development may fail to keep pace with the social and ethical needs of a smart destination, which may create further complexity in addressing these issues. Although AI can contribute to greater efficiency, transparency, and safety, its application may be problematic if insufficient attention is paid to developmental fairness, the preservation of local community authenticity, and the protection of cultural and natural resources (Pagani et al., 2025; Font et al., 2023). This is particularly important in smart cities, where excessive technological orientation may suppress the needs of the local population or place additional pressure on sensitive spaces if governance is inadequate.

Some authors identify dependence on a high level of interconnectivity among different stakeholders as a potential problem in the implementation of AI in smart cities. Smart tourism destinations operate through the interconnection of tourism enterprises, destination management

organizations, technology companies, public institutions, and tourists themselves (Buonincontri & Micera, 2016; Koo et al., 2023). If there is insufficient coordination, data exchange, and a shared strategic approach among these actors, the implementation of AI may remain partial, uncoordinated, and less effective. Mora et al. (2022) further identify the challenge of balancing innovation and sustainability preservation as an important barrier. Although technologies such as virtual reality, the metaverse, holographic displays, and advanced AI systems open new possibilities for the development of immersive tourism experiences, their implementation requires careful consideration of the consequences for the physical space of the destination, mobility patterns, and the long-term development of the community. Without such an approach, technological innovations may remain isolated solutions without making a real contribution to the sustainable development of smart cities.

For all of the above reasons, the successful application of AI in smart cities requires not only technological innovation, but also an integrated, responsible, and long-term sustainable management approach, thereby introducing RQ2, which seeks to identify the potential barriers to the application of artificial intelligence in smart cities.

Future Directions for the Use of Artificial Intelligence in Smart Cities

Regarding the future directions of artificial intelligence use in smart cities, it is generally considered that its development is moving toward ever deeper integration with smart tourism systems, sustainable destination management, cultural heritage preservation, and the enhancement of user experience. Artificial intelligence is no longer viewed merely as a tool for automating individual processes, but as a transformative technology that changes the way cities manage resources, communicate with visitors, and shape the long-term development of urban destinations (Yang & Wang, 2023; Gretzel, 2022).

In the context of the further development of AI in smart cities, much attention is given to the continued improvement of the personalization of tourism and urban services. Smart destinations are increasingly striving to provide services tailored to the individual needs of users, based on data about their preferences, behavior, and experiences. In this sense, artificial intelligence

has the potential to further develop recommendation systems, real-time travel planning, and models of continuous service adaptation, thereby increasing visitor satisfaction and the competitiveness of destinations (Aliyah et al., 2023; Koo et al., 2023). At the same time, further efforts will likely focus on the development of intelligent management of tourist flows and spatial capacities. Research indicates that AI will play an increasingly important role in analyzing visitor movement patterns, predicting congestion, and making decisions on the dynamic redirection of tourists to less crowded locations. This approach is particularly important for smart cities seeking to balance tourism development with the preservation of cultural and natural resources, as well as with the quality of life of the local population (Rahmadian et al., 2022).

When defining future directions, attention is also given to connecting artificial intelligence with virtual reality, augmented reality, and metaverse technologies. According to Stankov et al. (2025), the integration of AI with expanded 3D environments, real-time context analysis, and advanced visual interfaces leads to the creation of more efficient, personalized, and immersive tourism experiences. Such solutions enable the tourism experience to go beyond the boundaries of the physical destination and the visit itself, opening new models of interaction between users, space, and digital content. Another future direction of AI use concerns the preservation, interpretation, and digital transformation of cultural heritage. Artificial intelligence will play an increasingly important role in the development of virtual tours, digital reconstructions, intelligent interpretation systems, and automated documentation of cultural assets. In this way, the accessibility of cultural content is expanded, while pressure on sensitive sites is reduced and their long-term preservation is supported (Loureiro et al., 2022; Buhalis & Karatay, 2022).

In addition, a strengthening of AI application in sustainable resource management and environmental performance can be expected. The analysis of large-scale data on energy and water consumption, as well as user behavior, already enables more efficient strategies for resource conservation in tourism and hospitality, and the future use of such systems will likely become even more advanced and integrated into broader urban governance structures (Lv et al., 2024). In this regard, AI may become an important pillar for aligning tourism development with the principles of sustainability. At the same time, the development of contactless, automated,

and secure services is also evident. Technologies such as facial recognition, voice commands, and automated check-in procedures proved especially important during the COVID-19 pandemic, but their relevance extends far beyond the crisis context. In the future, these solutions are expected to expand further in the direction of greater operational efficiency, safety, and service quality in smart cities and destinations (Gaur et al., 2021; Ioannidis & Kontis, 2023).

The future use of AI applications in the sphere of smart cities also relates to a deeper understanding of user experiences and attitudes through data analysis and large language models. Systems for the analysis of comments, opinions, and semantic patterns can help managers of smart destinations more precisely identify tourist expectations and adjust offerings to their needs. In this way, AI contributes not only to more efficient management, but also to the shaping of more meaningful, relevant, and higher-quality experiences in smart cities (Harisanty et al., 2024). Future developments in the use of artificial intelligence must, however, be directed toward responsible and sustainable models of governance. This means that technological development should not be an end, but part of a broader strategy that takes into account the complexity of the relationship between humans and technology, the needs of local communities in smart cities, the principles of fairness, and the long-term preservation of resources (Gretzel, 2022; Manfreda & Mijač, 2024). For precisely this reason, the further development of AI in smart cities requires an interdisciplinary and strategic approach, thereby summarizing RQ3.

Strategic Application of AI Tools in the Development of Smart Cities in Serbia

The Republic of Serbia is focused on advancing the development of artificial intelligence, relying on the new AI Development Strategy until 2030 and the corresponding Action Plan. In 2022, Serbia joined the Global Partnership on AI, while in 2023 it became a member of the AI Governance Alliance of the World Economic Forum (Naled, 2024).

The field of tourism in Serbia is regulated by the Law on Tourism, the Law on Hospitality, as well as the Tourism Development Strategy for the period 2016–2025. In addition, in 2023 the Government of the Republic of Serbia adopted the Ethical Guidelines for the Development, Application, and Use of

Trustworthy and Responsible Artificial Intelligence. Their purpose is to ensure that scientific and technological progress, especially in the field of AI, proceeds in a way that does not endanger human beings, but rather places them at the center of all processes in which they participate directly or indirectly (Službeni glasnik RS, 2023).

Although developed programs for strengthening urban governance capacities already exist in European Union member states, the countries of Southeast Europe that are not part of the EU, including Serbia, have significantly less experience in this field, as well as weaker access to financial support for testing new approaches and innovations in urban development. In such an environment, the concept of the smart city in these settings emerges not only as a development idea, but also as a matter of adapting to existing institutional and social patterns. In this context, although urban governance has already been affirmed as an important academic and practical field, Serbia remains in the early stages of its development. At the same time, the local context is made even more complex by economic transition, the process of European integration, adaptation to market conditions, and the slower adjustment of institutional capacities and regulations to new challenges (Čolić, 2015). All of this is also influenced by internal development incentives, as well as the values and attitudes of decision-makers and experts involved in development planning. It is a fact that wealthier countries with more developed infrastructure and stronger institutional capacities have greater opportunities to apply technological innovations to achieve sustainable development (Popović et al., 2025).

In recent years, the concept of smart cities in Serbia has been receiving increasing attention and has become more present in public discourse. The state recognizes the construction of digitalized, smart, and safe communities as one of its important development goals, as confirmed by the Strategy for the Development of the Information Society and Information Security in the Republic of Serbia for the period 2021–2026 (Službeni glasnik RS, 2021). A particularly important place among these documents is occupied by the Sustainable Urban Development Strategy of the Republic of Serbia until 2030. Although it does not explicitly introduce the smart city model, the measures it envisages are largely based on the same principles. This can also be seen through the presence of terms such as smart low-carbon city, healthy city, resilience, participatory planning, and other elements of sustainable urban development. In terms of practical implementation, the

activities of certain institutions and projects are particularly important. One example is the focus on developing concrete smart solutions, such as smart parking, electric chargers, and devices for monitoring water quality and consumption. In addition to the technological solutions themselves, attention is also directed toward preparing plans for their introduction into selected local self-governments, as well as transferring experiences to other cities and municipalities in Serbia and the Western Balkans, to encourage the wider adoption of similar models and ensure their long-term sustainability.

In Serbia, smart cities in the full sense of the term do not yet exist, and such development is mostly discussed at the level of planning documents. Contemporary urban planning particularly recognizes medium-sized cities, with up to 500,000 inhabitants, as spaces with the greatest potential for the future development of smart cities, and in Serbia almost the majority of larger settlements belong to this category (Pucar et al., 2016). Nevertheless, the greatest demographic and development pressure is still borne by Belgrade, whose urban area continues to expand, making the balanced development of other cities and regions more difficult and further reinforcing the centralized model of governance.

Among most urban settlements with city status, Belgrade stands out as the largest, while Novi Sad, Niš, and Kragujevac are of particular importance due to their size and strategic role. These cities attract population from rural and smaller environments because they represent the main centers for the development of different urban functions. For example, the following has been implemented in Belgrade: public-space video surveillance, open public transport data, parking sensors and information panels, and smart traffic projects; in Kragujevac and Novi Sad, smart street-lighting systems have been introduced with the aim of reducing energy consumption and increasing lighting efficiency through the use of LED lighting and smart meters. In Smederevo, a pilot project for smart waste management was recently launched, based on the use of sensor-equipped containers, which enables more efficient waste collection and route optimization, while in Pančevo a network for monitoring air quality has been established, providing citizens with real-time pollution data through sensors and digital data-display platforms. These projects show that in Serbia the concept of smart cities is primarily developing through individual initiatives aimed at solving concrete urban problems through the application of modern digital technologies (Bradić-Martinović et al., 2023).

The integration of smart city and smart destination technologies in Serbia represents significant potential for improving efficiency, enhancing visitor experience, and encouraging the sustainable development of tourism. The dimension of smart travel emphasizes the creation of immersive, personalized, and sustainable tourism experiences through digital innovations. In this regard, the improvement of the digital experience can be achieved through the integration of AI tourism assistants, as well as through the application of augmented and virtual reality at cultural and historical sites, such as monuments reflecting the traces of the Roman Empire in Serbia, ancient monuments, and medieval fortresses. In addition, sustainable tourism solutions play an important role in destinations such as Zlatibor, Kopaonik, and the better-known spas in Serbia, where practices of smart waste management, infrastructure for electric vehicles, and energy-efficient accommodation facilities can be developed. Furthermore, the improvement of visitor safety and security is possible through the implementation of smart surveillance systems, emergency response networks, and contactless payment systems, which contributes to a greater sense of security and trust among tourists (Vujko et al., 2025). The application of AI algorithms can contribute to the personalization of tourism services through recommendations for accommodation, gastronomic offerings, and cultural content, based on tourist preferences and previous behavior. Great importance also lies in the use of digital marketing and big data analytics, which enable more precise market targeting, the acquisition of real-time insights into user behavior, and the prediction of tourism demand for more effective tourism development management.

The concept of smart cities, based on modern information and communication technologies, represents one possible response to such challenges. Within this framework, artificial intelligence occupies an important place because it enables the improvement of city governance, traffic systems, energy management, public services, and other key areas. One study in Serbia dealt precisely with the role of artificial intelligence in the development of smart cities, especially from the perspective of state institutions and the possibility that AI solutions may contribute to more efficient governance of urban environments and a better quality of life for citizens (Kresović & Vukmirović, 2025).

In Serbia, the application of artificial intelligence in urban and regional development carries great potential. For example, the use of AI solutions in

traffic management could contribute to the reduction of congestion in larger urban centers. The introduction of predictive traffic models, following the example of solutions applied in London, could reduce delays by as much as 20%, which would simultaneously contribute to lowering carbon emissions and improving air quality in urban environments (Kassens-Noor & Hintze, 2020).

The most recent project, “Towards Smart, Green and Sustainable Cities in Serbia,” included the first local self-governments entering the smart city development program, namely Kragujevac, Pirot, Veliko Gradište, Raška, and Vrnjačka Banja. Through this project, which is being implemented with the support of GIZ, NALED, local self-governments, and private partners, the introduction of new infrastructure is planned, which should enable greater savings, more efficient resource management, and an improved quality of life for citizens (Naled, 2026). Among the concrete solutions, the following stand out: smart management of green areas in Raška, smart parking in Pirot, the development of a smart water-supply network in Kragujevac and Vrnjačka Banja, as well as a smart solar charging station for electric vehicles in Veliko Gradište, which will further intensify tourist flows toward the mentioned smart destinations.

Table 1. Applications, Barriers, and Development Directions of Artificial Intelligence in Smart City Tourism in Serbia

Area of AI Application in Smart Tourism	AI Application / Existing Solutions (RQ1)	Key Barriers to Implementation (RQ2)	Future Directions of Use and Development (RQ3)
<i>Personalization of tourism offerings</i>	AI systems for recommending accommodation, gastronomic content, cultural attractions, and tourist routes based on user preferences	Limited data availability, insufficiently developed digital platforms, and weak interconnection of information systems	Development of integrated platforms for service personalization and more precise profiling of tourism demand
<i>Digital communication</i>	Chatbot systems, virtual assistants,	Insufficient digital infrastructure, limited	Introduction of advanced AI

<i>with tourists</i>	and digital platforms for informing visitors about destinations and services	multilingual support, and a low level of technological equipment in certain destinations	assistants connected to local tourism and public services
<i>Management of tourist flows and congestion</i>	Predictive analytics and AI models for tracking tourist movements, assessing spatial pressure, and managing visitor flows	Lack of sensor infrastructure, absence of integrated databases, and limited application of real-time monitoring	Development of systems for forecasting tourist flows in order to manage space more efficiently and reduce congestion
<i>Smart mobility and destination accessibility</i>	AI support in traffic management, smart parking, digital public transport information, and optimization of tourist routes	Outdated infrastructure, financial constraints, and insufficient integration of transport and tourism systems	Application of intelligent transport systems and sustainable mobility solutions in tourism centers
<i>Immersive and interactive tourism experiences</i>	Application of augmented and virtual reality at cultural and historical sites and in heritage interpretation	High implementation costs, lack of skilled personnel, and limited technological equipment	Expansion of AR and VR content in cultural tourism and its integration with educational and promotional functions
<i>Visitor safety and security</i>	Smart surveillance systems, digital emergency response networks, and contactless payment systems	Privacy protection issues, regulatory limitations, and the costs of establishing security infrastructure	Development of integrated security systems combining surveillance, communication, and digital visitor services
<i>Sustainable resource management in destinations</i>	AI solutions for waste management, water and energy consumption management, as well as infrastructure for electric vehicles	Underdeveloped municipal infrastructure, high initial costs, and limited local capacities	Expansion of sustainable smart solutions in urban, mountain, and spa destinations
<i>Digital marketing and</i>	Big data analytics, monitoring of user	Lack of high-quality and scalable data, as	Development of AI tools for more

<i>tourism demand analytics</i>	behavior, and forecasting of tourism demand	well as limited analytical capacities of tourism organizations	precise market targeting, promotion optimization, and strategic tourism development planning
<i>Institutional governance and the development of smart destinations</i>	Existence of strategic documents, ethical guidelines, and pilot projects in the field of smart cities and AI	Insufficient institutional coordination, slower regulatory adaptation, and pronounced regional disparities	Strengthening cross-sectoral cooperation, improving the regulatory framework, and developing systemic governance models for smart cities

Source: Author

Table 1 indicates that the application of artificial intelligence in smart city tourism can be understood through several interconnected areas, ranging from the personalization of tourism offerings and digital communication with visitors to the management of mobility, resources, and safety. In line with the first research question, it can be observed that AI is already finding practical application through recommendation systems, virtual assistants, predictive models, data analytics, and solutions for the sustainable management of destinations. At the same time, the second research question shows that the most prominent barriers are related to infrastructural limitations, insufficient data availability and integration, high implementation costs, as well as an underdeveloped institutional and regulatory framework. Finally, the answer to the third research question points to the need for the further development of integrated digital platforms, stronger cross-sectoral cooperation, the enhancement of analytical and technological capacities, and the expansion of sustainable AI solutions in tourism destinations. Taken as a whole, the results confirm that artificial intelligence represents significant potential for improving competitiveness, sustainability, and the quality of the tourism experience within smart cities.

From the perspective of tourism development within smart cities, the greatest potential for the application of artificial intelligence tools in Serbia is recognized in the areas of tourism offer personalization, smart navigation, tourist flow management, smart mobility, and the sustainable management

of destinations. It is precisely in these segments that AI solutions can contribute to improving the tourism experience, enabling more efficient urban space management, and strengthening the competitiveness of tourism destinations. At the same time, the successful implementation of these tools depends on the development of digital infrastructure, the availability of data, the strengthening of institutional capacities, and the establishment of an appropriate regulatory framework.

Conclusion

The results of this study show that artificial intelligence has considerable potential to support the development of smart cities and smart tourism destinations in Serbia. Its application is particularly significant in the areas of tourism personalization, digital communication with visitors, tourist-flow management, smart mobility, safety, and sustainable resource management. In these fields, AI can contribute to improving the quality of the tourism experience, increasing the efficiency of urban systems, and strengthening the competitiveness and sustainability of destinations. At the same time, the findings indicate that the broader implementation of AI solutions in Serbia is still limited by infrastructural constraints, insufficient data availability and integration, high implementation costs, and an underdeveloped institutional and regulatory framework. Therefore, the effective strategic use of AI requires not only technological innovation, but also stronger institutional coordination, improved digital capacities, cross-sectoral cooperation, and a clearer governance model for smart city development.

The practical importance of this research lies in highlighting that the future development of smart cities in Serbia should be based on integrated digital platforms, responsible and ethical AI governance, and stronger support for local governments and tourism stakeholders in adopting innovative solutions. In this way, AI can become an important instrument for creating more efficient, sustainable, and user-oriented urban and tourism systems.

Future research should focus on empirical evaluation of specific AI solutions in Serbian cities and tourism destinations, as well as on examining the perceptions of key stakeholders regarding their usefulness, challenges, and long-term developmental effects. Overall, the study confirms that artificial intelligence represents an important strategic resource for the future development of smart cities and tourism in Serbia.

Conflict of interests

The authors declare no conflict of interest.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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