

Smart Solutions in Tourism as an Element of Sustainable Logistics in Urban Areas of Central Pomerania

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Abstract

Tourism in the coastal regions of Central Pomerania plays a key role in socio-economic development and also causes significant seasonal changes that strongly influence the urban logistics system. The increase in tourist traffic flows during peak periods leads to overloading of transport infrastructure and many challenges for residents and tourists alike related to mobility management and transport services. This pressure directly affects the functioning of urban logistics and underscores the need to use modern tools to support the sustainable management of tourist destinations. In this context, smart tourism—understood as the integration of digital technologies, data-driven decision-making, and smart urban solutions—appears as a strategic element of sustainable urban logistics. This article aims to present the conceptual foundations of smart tourism, identify smart tools implemented in selected municipalities of Central Pomerania, and evaluate these tools in relation to improving the efficiency of urban logistics in tourist areas in the studied municipalities. This article combines theoretical considerations on smart tourism and sustainable logistics with the empirical results of a pilot study conducted in six municipalities. The pilot study was conducted using a survey questionnaire based on the SA6 conceptual framework for the analysis of smart tourist destinations. The SA6 conceptual framework refers to six intelligent elements that determine the sophistication of a tourist destination: intelligent attractions, intelligent accessibility, intelligent amenities, intelligent ancillary services, intelligent activities, and intelligent available packages. The pilot results show that intelligent accessibility is the most advanced dimension in the analyzed municipalities. Progress in this area is reflected primarily by the implementation of digital mobility systems, intelligent transport solutions, and real-time information tools that support the flow of tourists and reduce pressure on urban infrastructure. These indicate that local authorities have prioritised mobility-oriented investments, treating them as crucial for managing seasonal congestion and supporting sustainable logistics. The results also highlight the growing importance of integrating smart technologies into local development strategies and identify areas requiring further investment and coordination between stakeholders. The study provides valuable information to local governments, tourism managers, and urban planners seeking to increase regional resilience through smart technologies and provides a basis for expanded research on smart tourism innovations and their role in the sustainable development of coastal urban areas.

Keywords: smart city solutions; sustainable urban logistics; smart mobility; smart tourism destination; urban tourism; digital tools;

1 Introduction

Increasing pressure on cities and local infrastructure systems is driven by tourism, which plays a key role in the socio-economic development of coastal regions. This is especially clear in destinations with strong seasonal tourism patterns, where there is a sharp increase in visitor numbers over short periods (Radlińska, 2018). Cities mainly designed for permanent residents then have to manage much larger crowds, leading to overloaded transport infrastructure, crowded public spaces, and decreased efficiency of urban logistics systems (Kozmiński, Michalska & Mąkosza, 2015). Seasonality remains a constant feature of many tourist destinations and affects both the functioning of the tourism market and the management of urban spaces. During peak times, issues related to mobility, service availability, and flow organization become more prominent, while in the off-season, infrastructure resources are underused (Corluka, 2019). This creates a structural imbalance that hampers efforts toward sustainable development and long-term urban policy planning. The growing demands on urban systems call for the development of tools to better manage tourist flows.

In response to these challenges, the concepts of smart city and smart tourism are gaining increasing importance. The development of digital technologies enables traffic monitoring, real-time data analysis, and more flexible

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management of mobility and urban services (UNCTAD, 2021). Smart tourism, derived from the smart city paradigm, is no longer perceived solely as a tool for improving the tourism experience, but is increasingly treated as an element supporting destination management and the coordination of flows in urban space (European Commission, 2022; Díaz et al., 2023).

Despite the growing body of research on smart tourism, relatively few analyses focus on its operational importance for sustainable urban logistics. Research so far has mainly examined technological aspects or tourists' experiences, but less often the perspective of local government units responsible for managing the destination (Baggio, Micera & Del Chaippa, 2020; Gretzel, 2021). Specifically, there is a lack of empirical studies showing which areas of smart tourism truly support mobility management under strong seasonal pressure. To address this research gap, the article aims to identify and evaluate the role of smart tourism tools used in coastal municipalities in supporting sustainable urban logistics.

The article advances the discussion on the relationship between smart tourism and urban management by integrating the perspective of smart tourism with urban logistics issues. The results highlight which aspects of smart tourism are most critical for managing mobility in tourist destinations and how digital solutions can help create more resilient and sustainable urban systems during seasonal congestion.

Understanding this relationship requires embedding analyses within a conceptual framework that connects the development of smart tourism with the concept of sustainable urban logistics, which serves as the foundation for further theoretical considerations in the next part of the article.

2 Conceptual Foundations

2.1 Smart Tourism – conceptual approach

In recent years, the idea of smart tourism has been widely discussed in the literature as a response to the digital transformation of tourism destinations and the increasing importance of data-driven management in destination governance (Boes, Buhalis & Inversini, 2016).

Smart tourism relies on modern technologies to reshape the tourism industry, boosting efficiency, enhancing public-private collaboration, supporting sustainable growth, and enriching travel experiences (Gajdošík, 2019, Allawi, 2022). It is described as tourism driven by destination activities that facilitate the gathering, analysis, and processing of data from physical infrastructure, social connections, government, and organizational sources. The core of smart tourism is in the interconnected, synchronized, and coordinated use of various technologies that together form systemic “smartness” (Höjer & Wangel, 2015; Gretzel et al., 2015). Advanced computing systems, such as cloud computing, mobile technologies, and the Internet of Things, allow for real-time data collection and transmission (Gretzel et al., 2016). As a result, smart tourism is fundamentally data-centered and relies on continuous information exchange. Beyond its technological aspect, smart tourism is increasingly seen as a systemic and relational phenomenon. It brings together multiple stakeholders—public authorities, tourism businesses, residents, and visitors—into a network that creates value collaboratively (Boes, Buhalis & Inversini, 2016).

From this perspective, the idea of a smart tourism ecosystem becomes especially important. Based on the systemic definition of ecosystems as self-regulating structures of interconnected actors sharing resources and generating mutual value (Vargo & Lusch, 2016), a smart tourism ecosystem can be seen as a dynamic network where stakeholders collaborate through shared data and institutional arrangements. In this article, an integrated smart tourism ecosystem is understood as a data-driven governance framework in which public authorities and private stakeholders exchange and utilize shared information to coordinate mobility, services, and tourism-related activities within the destination (Beverungen, Matzner & Janiesch, 2017).

Previous studies emphasize that smart tourism should be understood not only as technological adoption but as an integrated approach that supports destination management, mobility coordination, and service innovation. The effectiveness of such an ecosystem depends not only on the availability of digital tools but also on the degree of integration of information flows and decision-making processes (Baidal et al., 2023). To implement the concept of smart tourism at the destination level, the analytical framework (SA)6 (Buhalis & Spada, 2000; Tran, Huertas & Moreno, 2017) is applied. This framework builds upon the traditional 6A model of tourism destinations (Buhalis, 2000) and introduces an “intelligent” component across six core dimensions: smart attractions, smart accessibility, smart amenities, smart ancillary services, smart activities, and smart available packages. These dimensions provide a structured way to assess how deeply digital technologies are embedded in destination management and tourism services. Intelligent attractions involve the digital enhancement and personalization of tourism experiences. Smart technologies used in attractions improve visitor engagement and support experience co-creation through interactive content, real-time information, and participatory management approaches. Intelligent accessibility addresses both physical and digital access to the destination and its services. It includes mobility systems, transport connectivity, real-time travel information, and inclusive infrastructure. This dimension is especially important for managing mobility patterns and supporting the spatial and temporal distribution of tourist flows. Intelligent amenities relate to managing natural and built infrastructure, including accommodation and service facilities, with innovative and sustainable solutions. Smart approaches in this area enhance the functionality and overall quality of the destination environment. Intelligent ancillary services include support services strengthened by digital

technologies, such as communication systems, safety-related services, and mechanisms that facilitate interaction between visitors and local communities. These services help improve operational efficiency and user experience. Intelligent activities refer to the smart organization of tourism and leisure activities supported by digital information systems. By providing access to schedules, reservations, and event information, this dimension supports coordination and helps regulate tourist flows, especially in destinations with seasonal peaks. Finally, intelligent available packages involve integrating tourism services into coordinated, digitally supported offers. By combining transport, accommodation, attractions, and complementary services, smart packages enhance service integration and support more cohesive destination management.

The (SA)6 framework is especially helpful in differentiating smart tourism destinations from broader smart city projects. It concentrates specifically on tourism-related functions and allows for the assessment of how digital tools support experience design, mobility management, service delivery, and stakeholder collaboration within the destination.

2.2 Sustainable Urban Logistics in Touristic Areas

The relationship between tourism development and urban logistics has increasingly gained attention from scholars, especially in destinations with strong seasonal fluctuations. The concept of sustainable urban logistics in tourist areas (Sustainable Urban Logistics) is a key part of the Smart City and Smart Tourism paradigm. Its main aim is to optimize the movement of people and goods while lowering environmental pressures and minimizing negative impacts on residents' quality of life. In tourist destinations, urban logistics concerns not only transportation but also the entire city system — including mobility, service availability, public space management, and infrastructure use under varying demand conditions (Dadić, Parčina & Pulić, 2024).

The idea of smart tourism stems from the concept of a smart city. A smart sustainable city is viewed as a system that leverages information and communication technologies to enhance urban services, governance, and competitiveness while considering economic, social, and environmental factors (Gretzel, 2017; United Nations, 2022). The city operates as a network of interconnected sectors, including intelligent transportation systems, tourism, education, and urban infrastructure. This approach has gradually been adopted in the realm of tourist destinations, where the development of digital technologies has enabled the widespread use of intelligent solutions that support managing tourist flow and delivering services to visitors and residents (European Commission, 2022).

One of the most destabilizing factors impacting both the tourism industry and the logistics systems of cities is seasonality. It is persistent and recurring, and efforts to mitigate it often fail (Lee et al., 2008). The seasonal influx of tourists results in uneven utilization of spatial and infrastructure resources. During peak times, transportation becomes overloaded, environmental pressure increases, and public spaces see greater use. Conversely, in the off-season, infrastructure remains underutilized, and regional economies that depend on tourism experience slowdowns. Therefore, seasonality can be seen as a repeating pattern of tourist activity that influences the operation of destinations each year (Corluca, 2019).

During periods of increased traffic, the issue of congestion, which includes both traffic jams and overcrowding of urban areas, becomes especially apparent (Benevolo, Dameri & D'Auria, 2016; United Nations, 2022). Tourist destinations involve many public and private actors, and the line between city residents and tourists often blurs (Gretzel, 2021). As a result, actions aimed at improving the tourism experience also impact other city sectors—such as transportation, security, communication, public services, and resource management. Technologies play a crucial role by enabling the measurement of traffic flows and the redistribution of vehicles to less congested areas (Kachniewska, 2022; Rosario & Dias, 2024).

The development of smart cities using Internet of Things solutions opens new options for managing mobility. Networks of sensors, cameras, and IoT devices enable real-time data collection and analysis, leading to better transportation, enhanced safety, and more efficient use of urban infrastructure (Tripathy et al., 2018; Rosario & Dias, 2024). At the same time, the increasing number of devices and data sources creates technological challenges related to system scalability. During peak tourism times, network congestion, data processing limits, and digital application performance issues can occur, making it harder to keep the smart tourism system running smoothly (Car, Pilepić Stifannich & Šimunić, 2019; Dammak et al., 2020).

In response to these challenges, the concept of smart mobility (smart mobility) is evolving, becoming a key pillar of the Smart City. It involves the use of ICT to optimize traffic flow, enhance traveler safety, and decrease emissions, noise, and congestion (Benevolo, Dameri & D'Auria, 2016). Intelligent transportation systems, urban monitoring, and social data analysis improve the city's ability to adapt to changing traffic conditions and threats (Cheng et al., 2017). Solutions like shared mobility systems, traffic monitoring, and MaaS platforms that integrate public and private transportation help design optimal travel routes, improve last-mile connectivity, and lessen transportation pressure in the busiest areas (UNECE, 2020).

The sustainable aspect of mobility is directly connected to the idea of green logistics. In smart destinations, digital technologies help reduce emissions, manage energy efficiently, develop eco-friendly transportation options, and promote responsible tourism practices. Smart tools, which use real-time data and user participation, influence travel behavior, customize journeys, and support a more sustainable tourism ecosystem. Intelligent transport

systems (ITS) serve as the technological foundation for mobility in this context, integrating transportation infrastructure with management systems and enabling safer, more efficient movement in urban areas (Ma, 2020; Asian Development Bank, 2023).

3 Methods

The study uses an exploratory and diagnostic research design to identify and describe how smart tourism solutions are implemented in selected coastal municipalities in Central Pomerania. Smart tourism development in many destinations remains uneven and is still in the early stages. Therefore, an exploratory approach is appropriate for examining institutional practices and emerging trends.

The empirical research was carried out as a pilot study involving six coastal municipalities ($n = 6$) in the Pomeranian and West Pomeranian regions of Poland. These destinations are known for high seasonal tourism and increased pressure on urban infrastructure during peak times. Local government units were selected as the analysis units because of their coordinating role in tourism development. They are responsible for destination management, digital infrastructure, mobility systems, and public services. Each questionnaire was filled out by a municipal representative in charge of tourism-related activities. Data collection took place in October 2025 using a structured web-based questionnaire. All invited municipalities participated, resulting in a 100% response rate among the chosen pilot sample.

The research instrument was developed by reviewing the literature on smart tourism and destination management. The analytical framework (SA)6 was used to structure the questionnaire and align with established approaches to smart tourism destinations. This framework identifies six interconnected dimensions: intelligent attractions, intelligent accessibility, intelligent amenities, intelligent ancillary services, intelligent activities, and intelligent available packages. Table 1 displays the (SA)6 framework with examples of smart tourism tools included in the survey questionnaire for respondents to choose from.

Table 1. Smart tourism tools assigned to the six dimensions of the (SA)6 framework

SA6 Dimension	Municipality A (Urban)
Intelligent attractions	Info-tourist kiosks, Audio guides / visiting apps, Thematic applications (e.g. botanical, historical), Interactive information boards / QR codes / NFC, Beacons / sensors for monitoring tourist traffic
Intelligent accessibility	Public Wi-Fi in tourist centers or attractions, Traffic / parking management applications, Digital timetables / stops, Tourist information systems available online, Websites with facilities for people with disabilities, Official social media channels of the municipality
Intelligent amenities	Reservation systems, Opinion apps / review portals, CRM systems for managing customer relationships, Sustainable management of resources (e.g. energy, water), Cooperation with tourism platforms
Intelligent ancillary services	Geolocation of medical services (pharmacies, hospitals), Mobile payment systems, Multilingual applications, Ability for the application to report issues, Information about health / medical tourism
Intelligent activities	Event management systems (e.g. Destination Management System), Open access to event data, Platforms for cooperation with local organizers

Intelligent available packages	Apps presenting tourist offers, Digital tourist cards (with transport, discounts), Systems enabling the combination of services (e.g. accommodation + attraction + transport), Initiatives like „invisible hotel'
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Each dimension was operationalized through closed and semi-closed questions. The questions identified the presence or absence of specific digital tools and institutional practices within the municipality. Given the pilot nature of the study and the limited sample size ($n = 6$), the findings should be interpreted as indicative rather than representative.

4 Results

4.1 Smart Tourism Tools in Coastal Municipalities

The identification of smart tourism tools in the analyzed municipalities was summarized in a comparative matrix based on the six dimensions of the (SA)6 framework. Table 2 distinguishes between declared implementation, lack of implementation, and cases in which municipal representatives reported limited knowledge. The summary offers an overview of the scope of smart tourism tools adoption across administrative levels and serves as the foundation for further analysis.

Table 2. Implementation of smart tourism tools across the analysed municipalities in the pilot stu

SA6 Dimension	Municipality A (Urban)	Municipality B (Urban)	Municipality C (Urban-rural)	Municipality D (Rural)	Municipality E (Rural)	Municipality F (Rural)
Intelligent attractions	✓	✓	✓	✓	–	–
Intelligent accessibility	✓	✓	✓	✓	✓	✓
Intelligent amenities	✓	?	✓	✓	?	?
Intelligent ancillary services	–	–	✓	✓	–	✓
Intelligent activities	✓	✓	✓	✓	–	–
Intelligent available packages	–	✓	✓	–	–	✓
Total number of implemented dimensions	4	4	6	5	1	3

✓ - implementation declared;
– - no implementation declared;
? – lack of knowledge declared.

Table 2 shows how smart tourism tools are distributed across the six municipalities analyzed, organized by the (SA)6 framework. Intelligent accessibility is the only dimension present in every municipality, regardless of its administrative category. The other dimensions display a more varied adoption pattern.

The comparison does not show a simple urban–rural divide. Although urban and urban-rural municipalities cover a wider range of SA6 dimensions, some rural municipalities also demonstrate implementation in multiple areas. However, a closer look at the reported tools reveals differences in scope and intensity. In urban units, individual dimensions are often supported by several digital solutions, whereas in rural municipalities, implementation usually relies on a single or a few instruments within a given category.

The least developed aspect in the sample concerns available intelligent packages, which are only found in certain municipalities. Meanwhile, some rural units demonstrate relatively strong engagement in specific areas, especially in accessibility and basic digital communication.

The most common tools used are those for digital communication and accessing information. All municipalities have official websites and utilize social media channels as their main communication platforms. In many cases, these channels are supported by online transport schedules, digital information systems, or public Wi-Fi networks.

Interactive information tools are also available, though less consistently. These include QR codes, NFC-based solutions, themed mobile apps, and digital information kiosks. In some urban areas, more advanced solutions have been reported, such as monitoring systems and sensors that track tourist flows. These tools require greater organizational capacity and technical integration, so they are less common.

Reservation systems and cooperation with digital booking platforms are implemented throughout municipal areas. However, in several municipalities, representatives reported limited knowledge of the digital tools used by private tourism businesses.

4.2 *Intelligent Accessibility as a Key Dimension Supporting Urban Logistics*

The results indicate that intelligent accessibility is the most consistently developed aspect of smart tourism across the analyzed municipalities. Unlike the other SA6 components, this aspect was implemented in all units, regardless of administrative type.

Tools like online transport schedules, real-time info platforms, digital communication channels, and public Wi-Fi improve visitors' access to information. In destinations with strong seasonal changes, providing timely and precise information is crucial for managing traffic and flow. Congestion in coastal towns isn't only caused by physical infrastructure capacity but also by how information is shared and utilized. When tourists get current data on transport timings, parking spaces, or temporary restrictions, they can adjust their behavior more effectively.

Differences between municipalities mainly lie in how deeply they implement systems rather than in what tools are available. Urban areas usually use multiple instruments within the accessibility area, creating a more cohesive information environment. Rural municipalities tend to rely on fewer tools. Still, even limited digital communication systems can help with orientation and reduce uncertainty during high-demand situations.

5 Discussion

Tools for digital communication and information access are relatively affordable and require minimal technical skills, which may explain their widespread use. Smart accessibility, as the most advanced aspect of smart tourism in all analyzed municipalities, shows that mobility-related digital tools have become a key focus of smart initiatives in coastal destinations. Although other facets of smart tourism remain important, their connection to urban logistics seems more indirect compared to mobility-focused solutions. This aligns with previous research highlighting smart mobility and intelligent transport systems as central operational elements of smart destinations and smart city growth.

The lack of knowledge about the digital tools used by private tourism enterprises within the destination does not necessarily mean these tools are absent. Instead, it may suggest limited data exchange between local authorities and private tourism businesses (European Commission, 2022; Díaz et al., 2023). Smart tourism is fundamentally driven by data. Its effectiveness depends on the collection, sharing, and integration of information produced by multiple actors within the destination (UNCTAD, 2021). When data exchanges between the public and private sectors are incomplete, the ability for coordinated management becomes limited. Without systematic access to information on the digital practices adopted by tourism enterprises, local authorities may struggle to monitor visitor flows, develop integrated services, or personalize tourism offers. As a result, decision-making may rely on partial or fragmented information, reducing the effectiveness of strategic planning and operational responses (Baggio et al., 2020). In this way, insufficient data exchange can hinder municipalities' capacity to fully adopt evidence-based management practices. Consequently, the functioning of the smart tourism ecosystem may not fully meet its conceptual expectations, even when individual digital tools are available in the destination. Similar challenges relating to fragmented data exchange and stakeholder coordination have been noted in earlier smart tourism governance studies, emphasizing the importance of integrated information flows for effective destination management.

From an urban logistics perspective, the importance of intelligent accessibility lies in its functional role within the mobility system. These solutions can help distribute tourist flows more evenly across space and time, especially during peak periods (Corluka, 2019; United Nations, 2022; Rosario&Dias, 2024). Although the pilot study does not directly measure changes in traffic volume or emissions, the use of mobility-focused digital tools indicates their potential to enhance the efficiency of current infrastructure. By increasing transparency and enabling better communication, these solutions can improve coordination between authorities and visitors. In this way, intelligent accessibility acts as a practical link between smart tourism development and sustainable urban logistics.

To conclude, the findings suggest that intelligent accessibility is the most tangible link between smart tourism and green urban management in the region studied (Benevolo et al., 2016; United Nations, 2022). It does not eliminate structural capacity constraints, but it can enhance system responsiveness and support more informed operational decisions in destinations that experience seasonal overloads. At the same time, overall development of smart tourism remains uneven across different areas. In practice, digital transformation seems to focus mainly on mobility-related and information-based solutions rather than on fully integrated ecosystem structures (Asian Development Bank, 2023; Rosario&Dias, 2024).

The preliminary nature of the research and the limited number of municipalities analyzed mean that the results should be seen as exploratory. Additional research with a larger sample of destinations is needed to confirm the observed relationships and evaluate the long-term effects of smart tourism tools on sustainable urban logistics outcomes.

6 Conclusions

This article aimed to identify and evaluate the role of smart tourism tools used in coastal municipalities in supporting sustainable urban logistics. Based on a pilot study conducted among six municipalities in the Pomeranian and West Pomeranian Voivodeships using the (SA)6 analytical framework, the research offered an exploratory view of how local governments implement smart solutions within the tourism ecosystem.

The results show that intelligent accessibility is the most important aspect of smart tourism in the studied municipalities. Digital tools focused on mobility, especially those providing real-time information, communication platforms, and transport access, serve as the main connection between smart tourism growth and urban logistics management during seasonal tourism periods.

The findings confirm that smart tourism tools can support sustainable urban logistics not only by enhancing visitor experiences but also by improving the management of tourist flows and boosting the responsiveness of urban systems facing seasonal congestion. In this regard, smart tourism appears as a component of modern urban management instead of just a tourism development strategy. The study emphasizes the importance of integrating digital solutions into local governance and improving data sharing between public authorities and tourism stakeholders. Such coordination can help build more resilient and sustainable urban systems in regions that depend heavily on tourism.

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