THE ROLE OF SMART TOURISM IN A RESILIENT AND MODERN TOURISM INDUSTRY: FIRST RESULTS OF SMART TOURISM ECOSYSTEM MATURITY RESEARCH IN HUNGARY

STUDIA TURISTICA

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ABSTRACT

This study investigates the role of smart tourism in enhancing the resilience and modernization of the tourism industry, focusing on the maturity of smart tourism ecosystems across Hungarian destinations. The research evaluates digital readiness, sustainability, and stakeholder engagement through a detailed destination survey conducted among over 100 settlements with accentuated guest night statistics.

Using a questionnaire aligned with the SmartTourismCapital.eu dimensions—sustainability, digitalization, accessibility, cultural heritage, and creativity—the study identified significant disparities in the adoption of smart tourism practices. Hierarchical clustering and K-means analysis revealed four distinct destination clusters, highlighting key areas of excellence and underperformance. Municipalities with a strong focus on sustainability and cultural heritage emerged as leaders in smart tourism ecosystem maturity, while others showcased potential in leveraging digital tools for competitiveness.

Findings emphasize the importance of tailored strategies for destinations to optimize resource utilization, enhance visitor experiences, and foster local engagement. The research underlines the critical role of data-driven decision-making in supporting sustainable tourism practices, offering practical insights for policymakers and stakeholders aiming to strengthen the tourism industry's resilience and adaptability.

Keywords: Smart tourism. Smart tourism ecosystem maturity. Settlements. Hungary.

INTRODUCTION

Tourism has long been a cornerstone of cultural exchange, economic vitality, and societal development. However, as the industry evolves in response to rapid technological advancements and shifting consumer preferences, the emergence of smart tourism marks a pivotal turning point in its modernization and resilience. Smart tourism, characterized by the integration of digital technologies, data-driven innovations, and sustainable practices, has garnered significant attention worldwide, including in globally renowned tourist destinations (Chen, Li & Huang, 2022). This transformative trend reflects the growing need to enhance resource efficiency, foster competitiveness, and achieve sustainability while improving the overall visitor experience (Csapó, 2024).

At its core, smart tourism endeavours to optimize the management of resources – both natural and human – by leveraging advanced technologies such as the Internet of Things (IoT), big data analytics, artificial intelligence (AI), and smart infrastructure (Gretzel et al., 2015; Iványi, 2022). By bridging technological innovations with the unique demands of tourism, smart tourism ecosystems facilitate seamless interactions among stakeholders, including tourists, service providers, and policymakers. These ecosystems not only enable destinations to adapt to evolving market trends but also empower them to create tailored, meaningful experiences that align with the expectations of modern travellers (Bastidas-Manzano et al., 2021; Csapody & Jászberényi 2024; Femenia-Serra et al., 2022).

This pursuit aligns seamlessly with the European Union‘s tourism policy objectives, which emphasize digital transformation, sustainability, accessibility, and cultural preservation as key pillars for strengthening the tourism industry (European Commission, 2020). In this context, Hungary, with its diverse cultural heritage and burgeoning tourism sector, serves as a compelling case for exploring the maturity of smart tourism ecosystems. Despite the growing body of research on smart tourism globally, studies specifically addressing the maturity and readiness of tourism ecosystems in Hungary remain limited. This gap underscores the need for focused research to evaluate how Hungarian destinations can capitalize on smart tourism to enhance their resilience and modernization.

This study aims to address this gap by investigating the role of smart tourism in fostering a resilient and modern tourism industry, with a specific focus on the maturity of smart tourism ecosystems across Hungarian destinations. Through a comprehensive destination survey encompassing over 100 settlements with high guest night statistics, this research evaluates critical dimensions such as digital readiness, sustainability, and stakeholder engagement. Employing the analytical framework inspired by SmartTourismCapital.eu – encompassing sustainability, digitalization, accessibility, cultural heritage, and creativity – the study identifies significant disparities in the adoption of smart tourism practices across Hungarian destinations (SmartTourismCapital.eu, 2024).

By shedding light on these dynamics, this research not only contributes to the academic discourse on smart tourism but also provides actionable insights for policymakers, stakeholders, and industry practitioners. It underscores the critical role of data-driven decision-making in enabling destinations to navigate contemporary challenges, achieve sustainable growth, and fortify the resilience of the tourism industry. Ultimately, this study seeks to inform strategies that empower Hungarian destinations to thrive in a competitive and rapidly changing global tourism landscape.

LITERATURE REVIEW

Smart tourism constitutes a relatively recent yet extensively explored domain within contemporary tourism research and literature (Villacé-Molinero et al., 2021). An examination of the term „smart tourism“ on various scholarly platforms reveals between 600-750 hits on ScienceDirect and Web of Science (WoS), and 24,900 on Google Scholar. Similarly, the term „smart destination“ yields 132 results on ScienceDirect, and a bit less than 100 on WoS, and 2,980 on Google Scholar. Furthermore, the escalating number of publications focusing on smart tourism literature reviews and Systematic Literature Review (SLR) research, as indexed in reputable journals (Web of Science, Scopus, EconLit with Full

Text, Academic Search Complete), has demonstrated a steady increase since 2010, attesting to the growing scholarly interest in the field (Csapó & Végi, 2023).

It can be asserted that the term ‚smart' has currently become a ubiquitous buzzword, permeating both academic discourse and everyday vernacular, encompassing a broad spectrum of subjects ranging from smart devices (Ghafurian et al., 2023) to smart cities (Fekete, 2023), smart rural development (Szalai & Fabula, 2021), accessibility (Raffay & Gonda, 2020), sustainability (Elkhwesky et al., 2022; Richards, 2023) and smart governing (Zsilincsar, 2008).

Nonetheless, as highlighted by Borges-Tiago et al. (2022), the term „smart tourism" has become pervasive recently in the realms of tourism business, policy, and research. However, we must stress that its definition and conceptualization exhibit considerable variation across related publications. Drawing upon a comprehensive review of existing literature and a substantial number of systematic literature review (SLR) studies within the domain of smart tourism research, it is evident that two overarching perspectives are commonly acknowledged in the comprehension of smart tourism:

1. The genesis of the phenomenon, terminology, and definition of smart tourism can be traced back to the foundational concept of the smart city (Micera et al., 2013).
2. Smart tourism has emerged as a social phenomenon resulting from the convergence of information technology, digitalization, technological advancements, and travel (Liu et al., 2023).

Furthermore, in alignment with the assertions made by Liu et al. (2023), the author of this chapter contends that the notion of smart tourism has undergone evolution and transformation over time, manifesting in diverse contextual frameworks.

To establish a logical and scientifically grounded correlation between sustainability and smart tourism, the author first intends to reference the seminal work on smart tourism conducted by Gretzel et al. (2015). Commencing with a concise overview of the theoretical underpinnings of smart tourism, Gretzel and colleagues highlighted the inherent definitional ambiguity in this domain. They observed that, particularly from the 2010s onward, coinciding with the remarkable surge in digitalization within the tourism sector, the term ‚smart' became ubiquitously applied. The authors contended that the prevailing technologies and novel methodologies for data collection, management, and sharing did not comprehensively encapsulate the essence of the concept. Consequently, Gretzel et al. proposed a definition for smart tourism based on three integral components and layers rooted in information and communication technologies (ICT): smart experience, smart business ecosystem, and smart destinations. According to their definition *„smart tourism is defined as tourism supported by integrated efforts at a destination to collect and aggregate/harness data derived from physical infrastructure, social connections, government/organizational sources and human bodies/minds in combination with the use of advanced technologies to transform that data into on-site experiences and business value-propositions with a clear focus on efficiency, sustainability and experience enrichment.„* (Gretzel et al. 2015)

Taking Gretzel's interpretation as a starting point, there are three main areas (of the system of tourism) to understanding the complexity of smart tourism:

1. from the point of view of the supply region – smart destination;
2. from the point of view of the consumer – smart tourist/smart travel experience;
3. and from the point of view of the service providers' and decision and tourism policy makers' side – smart business ecosystem. To this latter category we suggest including smart governance.

The system relies on data collection, exchange and processing with the complex application of up-to-date technologies in order to create a smart tourism ecosystem (STE). STE is understood by Gretzel et al (2015) as: *"The term smart tourism ecosystem implies first and foremost that its focus is on a shared goal or purpose related to the production and consumption of touristic value, culminating in meaningful touristic experiences."* The authors also highlight that because the above-mentioned, resources are necessary for the survival of the smart tourist ecosystem, economic and environmental sustainability are also intrinsic concerns at the system level.

Smart destinations constitute a fundamental element of smart tourism, defined by the incorporation of sophisticated technological solutions and stakeholder cooperation to improve destination competitiveness, sustainability, and visitor experiences (Buhalis & Amaranggana, 2015; Boes et al. 2016). Utilizing big data, sensor networks, and real-time analytics, smart destinations may better align their services with visitor expectations, manage resources efficiently, and facilitate evidence-based policymaking (Buhalis & Amaranggana, 2015). These locations use advanced digital infrastructures, including smart mobility apps and customized tourist information platforms, facilitating seamless connection and personalized guest engagements. Smart destinations utilize proactive and data-driven strategies to tackle the challenges of contemporary tourism, such as overcrowding and environmental degradation, while simultaneously promoting inclusive and sustainable travel ecosystems by involving local communities and enhancing stakeholder collaboration (Koo et al. 2016; Micera & Crispino, 2017).

The notion of smart destinations transcends mere technological implementation, including wider social, cultural, and economic aspects, hence promoting a comprehensive strategy for tourist management (Gretzel et al., 2015). This necessitates interorganizational synergies in which municipal authorities, service providers, and citizens together formulate policies and projects that emphasize sustainability, accessibility, and cultural preservation (Bastidas-Manzano et al., 2021). Successful smart destinations depend on continual innovation, strong governance frameworks, and sustained stakeholder involvement to remain competitive and resilient in a rapidly changing marketplace, as shown by an expanding body of research (Femenia-Serra et al., 2022). In this framework, destinations utilize intelligent tools for data collection and analysis to enhance resource allocation, track visitor patterns, and provide superior services, thereby strengthening their appeal and adaptability in a progressively digital and sustainability-focused tourism environment.

DATA AND METHODS

The present study is part of a research project examining the possibilities and prospects for the development of smart tourism in domestic (Hungarian) tourism destinations. To this end, we conducted an online questionnaire survey focusing on 11 tourism regions in Hungary. During the research, our primary aim was to identify the role that smart tourism and the creation of smart destinations play in the post-Covid-19 restart and re-planning of tourism, as well as to explore in what form and how the implementation of these concepts could be facilitated in Hungary.

As part of this research an online questionnaire survey was carried out with the assistance of a market research company, which provided an online platform to reach respondents and record their answers. We intended to involve such tourism destinations (settlements and regions) that play a relevant role in the domestic tourism supply, based on their number of guest nights. During sampling, we used a quota-based approach, aiming to ensure that domestic tourism destinations with a minimum annual 50,000 guest nights would appear proportionately in the database in terms of visitor traffic characteristics and geographical distribution. The online data collection period lasted for several weeks in the autumn of 2024. During the online completion, one relevant representative (from local government, tourism organizations, or professional decision-making bodies) per destination participated, each having an overview of the local tourism operation, development plans, as well as existing initiatives related to smart tourism.

For the purposes of the present study, when compiling the questionnaire, we used the four main pillars defined by SmartTourismCapital.eu (2024), which serve as a widely adopted framework in the practice of smart tourism: Sustainability, Digitalization, Cultural heritage and creativity, and Accessibility. During our research, these four pillars were treated as four separate measurement dimensions. As no validated national or international scales were available, we formulated our own statements (items) based on the literature and practical considerations, making sure that sustainability, digitalization, cultural heritage and creativity, as well as accessibility, would each be measurable, comparable, and statistically analyzable. The final item pool created from these statements contained 21 items. Respondents were required to indicate the extent to which the statements in the questionnaire characterized the

tourism destination they represented. The degree of agreement was measured on a five-point Likert scale, where "1" meant that the given statement did not characterize the destination at all, while "5" indicated that it fully characterized the destination. In this way, we ensured that respondents could make more nuanced distinctions regarding the level of development and practices applied in each area.

Following the online questionnaire completion, we performed an initial data cleaning process on the dataset. As the first step of the statistical analysis, we conducted a factor analysis to uncover the underlying structure of the statements we had developed, and to verify whether the four dimensions identified in advance could be measured appropriately in the empirical data. For this purpose, based on data characteristics we used principal component analysis with varimax rotation. Because the conceptual framework of our research defined four main pillars and thus four measurement dimensions, we set the number of factors to four. Step by step, we examined the factor loadings of the items and excluded statements that presented excessively large cross-loadings or low factor loadings. This yielded a clear factor structure from 15 items, which served as the basis for further analyses (Table 1).

Table 1: Factor loadings of the examined four dimensions

Statement	Factor			
	Accessibility	**Digitalisa-tion**	**Sustaina-bility**	**Cultural heritage and creativity**
The situation of accessible tourism in our municipality/destination has improved in recent years.	**0.852**	0.185	0.223	0.087
For the local tourism management, taking accessible tourism into consideration is an important issue.	**0.827**	0.268	0.110	0.225
In our municipality/destination, ensuring equal opportunities for access is a key consideration during tourism development.	**0.814**	0.107	0.138	0.231
Local tourism service providers are prepared to accommodate people with disabilities.	**0.786**	0.137	0.175	0.139
The situation of accessible tourism in our municipality/destination is better than the national average.	**0.698**	0.085	0.370	0.199
Our municipality/destination is digitally accessible (via a website or application), is regularly updated, and provides comprehensive information on transport options, tourist attractions, and services (accommodation, hospitality).	0.139	**0.876**	-0.007	0.005
We regularly analyze our website and/or web application statistics and utilize them in decision-making.	0.136	**0.876**	0.162	0.083
We regularly analyze the officially available digital statistical data on our visitor traffic and use these insights in decision-making.	0.147	**0.809**	0.282	0.140
We utilize the possibilities offered by digital technology in the development of tourist attractions.	0.219	**0.636**	0.303	0.239
During tourism development, we regularly consult with the local population and involve them in the process.	0.095	0.139	**0.765**	0.204
The issue of carbon-neutral tourism has already been placed on our agenda.	0.245	0.132	**0.741**	0.278
We reinvest a portion of the revenue derived from tourism into the comprehensive development of our municipality/destination.	0.376	0.249	**0.652**	-0.085
We take sustainability issues into account when carrying out tourism development.	0.351	0.388	**0.502**	0.210
Our municipality/destination makes use of the creative industries to enhance the tourist experience and improve quality of life.	0.255	0.120	0.226	**0.855**
There are initiatives in our municipality/destination that are linked to creative tourism.	0.283	0.168	0.170	**0.843**

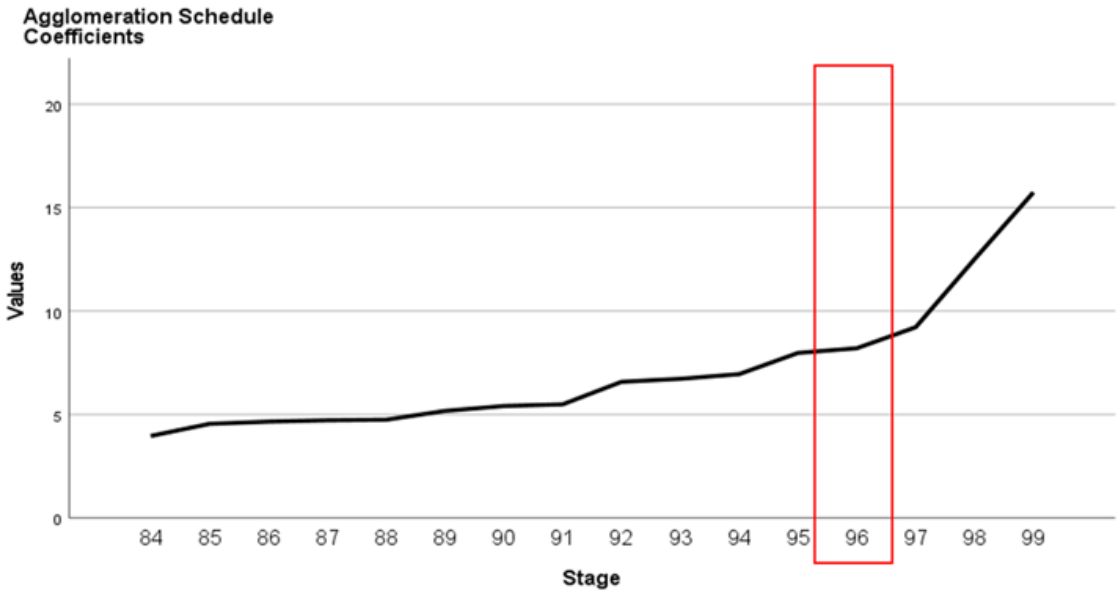
Source: Own edition, 2025.

After the exploratory factor analysis, we assessed the internal consistency of the resulting four factors using Cronbach's alpha. All the Cronbach's alpha values obtained exceeded the recommended minimum of 0.70, meaning the reliability of measurement for the statements within the factors was deemed acceptable (Accessibility Cα=0.909, Digitalization Cα=0.870, Sustainability Cα=0.782, Cultural heritage and creativity Cα=0.861). This confirmed that our four measurement dimensions, structured according to the four pillars, are suitable for revealing the characteristics that are essential to the aim of the study.

To reveal these characteristics, we subsequently conducted a cluster analysis. The purpose of the cluster analysis was to group tourism destinations into homogeneous clusters whose internal characteristics are similar, while significant differences are observed between the clusters. The cluster analysis was carried out in two steps:

1. Hierarchical cluster analysis: First, we used hierarchical clustering to determine the optimal number of clusters. The agglomeration schedule of the coefficients indicated that forming four clusters was the most appropriate solution (Figure 1).
2. K-means cluster analysis: Following the results of the hierarchical clustering, we employed the k-means procedure, creating the predefined four groups. As a result of the k-means clustering, we established the final clusters to be interpreted and further analyzed.

Figure 1: Agglomeration schedule of the coefficients of hierarchical clustering



Source: Own edition, 2025.

To prepare the data and carry out the statistical analyses (factor and cluster analyses, reliability tests), we used IBM SPSS Statistics 28 software. For creating tables and figures, as well as for visualizing detailed data, we employed Microsoft 365 Excel.

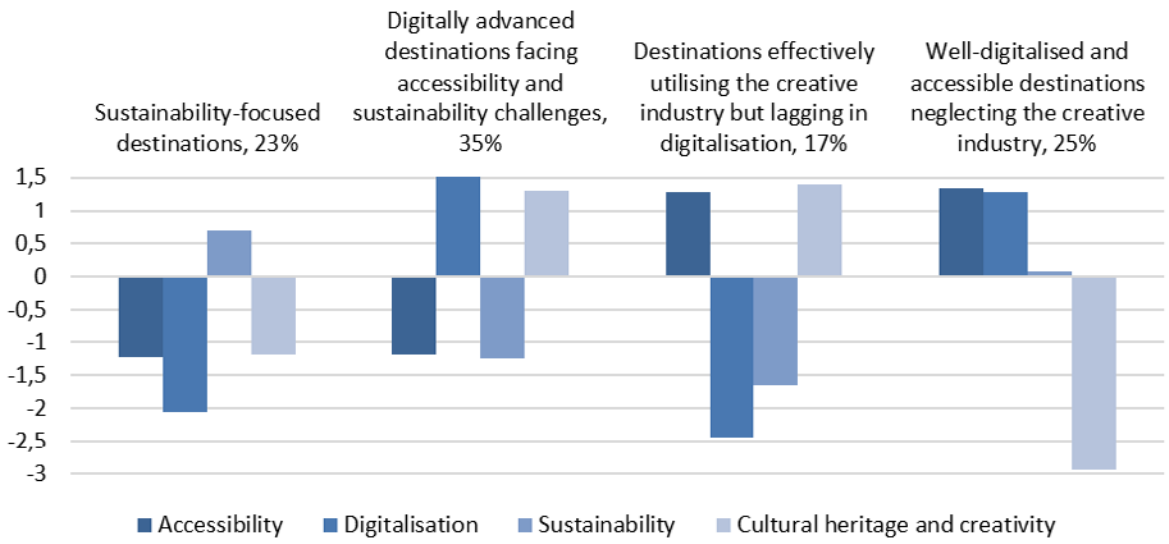
RESULTS AND DISCUSSION

As a result of the K-means cluster analysis, we identified four clearly distinguishable clusters among Hungarian tourism destinations. These clusters exploit the opportunities offered by the four fundamental pillars of smart tourism (accessibility, digitalization, sustainability, cultural heritage and creativity) in different ways and to varying extents. To facilitate interpretation, we have named each identified cluster based on their characteristics. Accordingly, the following groups were formed, where the percentage after the name indicates the proportion of the cluster members within the total sample:

1. Sustainability-focused destinations, 23%
2. Digitally advanced destinations facing accessibility and sustainability challenges, 35%
3. Destinations effectively utilizing the creative industry but lagging in digitalization, 17%
4. Well-digitalized and accessible destinations neglecting the creative industry, 25%

The extent to which each group deviates from the average across the four dimensions can be seen in Figure 2. Below, we present the characteristics of each cluster in detail according to thesedimensions.

Figure 2: Results of the K-means cluster analysis



Source: Own edition, 2025.

Cluster 1: Sustainability-focused destinations (23%) cluster members stand out primarily in the Sustainability dimension (Sustainability: +0.691), suggesting that environmental and social considerations play a key role in their tourism development and daily operations. Examples may include continuous involvement of local residents in planning, reinvesting a certain proportion of tourism revenues into municipal infrastructure development, or placing the issue of carbon neutrality on the agenda. However, the data indicate a significant lag in terms of digitalization (Digitalization: -2.055), and accessibility (Accessibility: -1.233) is also below average. Furthermore, the exploitation of cultural and creative opportunities (Cultural heritage and creativity: -1.188) is at a lower level, meaning that destinations in this cluster primarily build their tourism values around sustainability, while making less use of other aspects of smart tourism.

Cluster 2: Digitally advanced destinations facing accessibility and sustainability challenges (35%), the most populous group, achieve outstanding results in the areas of digitalization (Digitalization: +1.627) and cultural-creative tourism (Cultural heritage and creativity: +1.311). These destinations utilize online tools above the average level for monitoring visitor traffic data, promoting their tourism offerings,

and supporting decision-making. In addition, by leveraging cultural heritage and creative industries, they are able to offer attractive tourism packages and programs. Nevertheless, they exhibit serious shortcomings in accessibility (Accessibility: -1.181) and sustainability (Sustainability: -1.253). Physical and informational accessibility, as well as the integration of environmental and social considerations, do not receive adequate attention, which may hinder the long-term competitiveness and responsible operation of these destinations.

Cluster 3: Destinations effectively utilizing the creative industry but lagging in digitalization (17%) cluster achieves outstanding values in terms of cultural heritage and creativity (Cultural heritage and creativity: +1.398), and also performs above average with regard to accessibility (Accessibility: +1.276). These destinations place great emphasis on creating appropriate infrastructure and services for visitors with disabilities, and on actively involving local arts and creative initiatives in their tourism offerings. In contrast, the level of digitalization (Digitalization: -2.439) is particularly low: websites and other online platforms are less developed, and data analysis and utilization occur infrequently. Sustainability (Sustainability: -1.654) is likewise less prominent, so although cultural programs and accessible solutions may prove attractive in the short term, the lack of commitment to digital and environmental challenges could pose problems in the longer term.

Cluster 4: In the Well-digitalized and accessible destinations neglecting the creative industry (25%) cluster, representatives display strong digitalization (Digitalization: +1.277) and a high level of accessibility (Accessibility: +1.341), indicating that they employ outstanding solutions in both technological and physical accessibility. This may include municipalities or regions where tourism service providers regularly monitor online feedback, use advanced digital platforms, and adopt a comprehensive approach to accessibility (e.g. ramps, special equipment, information systems). However, the emphasis on cultural heritage and creativity (Cultural heritage and creativity: -2.943) is extremely low, meaning local traditions, arts, and other creative industry elements are less evident in their tourism offerings. Their efforts towards sustainability (Sustainability: +0.071) represent an average level, suggesting they are neither particularly advanced nor significantly behind in this area.

CONCLUSION

Based on our results it is evident that Hungarian tourism destinations display significantly different development profiles across the four pillars of smart tourism. The findings highlight that, while certain groups lead the way in strongly upholding sustainability goals, others achieve higher visitor numbers by prioritizing digitalization and creative tourism. At the same time, it is equally clear that accessibility and the inclusion of cultural values often take a back seat or, conversely, destinations built on a cultural foundation may lag in the digital transition. On one hand, this diversity indicates that destinations are proceeding along different paths. On the other hand, it also underscores that an integrated approach, where all four pillars are simultaneously and mutually reinforced rarely comes fully to fruition. However, by drawing on these results, individual clusters can determine their own development priorities and, through targeted measures, better leverage the opportunities offered by smart tourism.

The research findings correspond closely with the initial hypotheses, indicating that Hungarian destinations are progressively adopting smart tourism, albeit with differing developmental characteristics influenced by their strategic priorities and resource distribution. The clustering analysis revealed four distinct categories: sustainability-oriented destinations, digitally advanced destinations facing accessibility and sustainability issues, destinations strong in cultural heritage and creativity yet deficient in digitalization, and well-digitalized and accessible destinations overlooking the creative sector. The clusters support the hypothesis that no single destination has achieved a fully integrated approach across all four pillars of smart tourism. Destinations typically emphasize one or two dimensions while often overlooking others, which indicates varying strategic orientations and limitations in resources.

This study reveals multiple potential directions for future research. Longitudinal studies can monitor the progression of smart tourism maturity over time, providing insights into the effects of policy interventions and evolving market dynamics. Comparative analyses with international destina-

tions may offer benchmarking opportunities and identify best practices. The impact of emerging technologies, including artificial intelligence, blockchain, and virtual reality, on the advancement of smart tourism practices requires additional investigation. Comprehensive case studies of successful clusters may yield replicable strategies for underperforming destinations, promoting wider implementation of smart tourism principles.

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