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Smart Technologies and Tourist Satisfaction in Hungarian Spa Towns

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This research aims to examine the impact of smart technology knowledge and usage on tourists' satisfaction levels in Hungarian spa towns and compare the technological proficiency and satisfaction between different age groups. Data were collected through a questionnaire survey in the summer and autumn of 2024, involving 552 respondents, and analysed using statistical methods (linear regression, ANCOVA). Two hypotheses were formulated: H1: Increased knowledge of smart technologies positively affects tourists' satisfaction levels in spa towns, and H2: Older age groups are less proficient in using smart technologies compared to younger groups, regardless of their knowledge. Multivariate statistical methods were applied to test these hypotheses, including linear regression and ANCOVA. The results indicate that smart technology knowledge has a significant positive impact on satisfaction levels, supporting H1. H2 was also confirmed, as older age groups are less satisfied with technological solutions, regardless of their level of knowledge. The research concludes that greater attention should be given to educating and improving access to smart technologies for older age groups. We propose recommendations for improving the integration and development of smart technologies in tourism to better align with the needs of different age groups.

The tourism industry has undergone significant transformation in recent decades, driven primarily by technological advancements and the rise of new, intelligent solutions. Innovative technologies such as **A**rtificial **I**ntelligence (AI), blockchain, and the **I**nternet **o**f **T**hings (IoT) are fundamentally changing the way services are provided and the interactions between tourists and service providers. These new tools and systems not only enhance the tourism experience but also

offer significant economic, social, and environmental benefits to both service providers and destinations alike *(Gajdosík–Marciš, 2019)*.

Smart technologies, such as AI and blockchain, contribute to the development of the tourism industry in various ways. AI, for instance, enables personalised travel recommendations, data-driven decision-making, and precise analysis of tourists' behaviours and preferences *(Nam et al., 2019)*. Blockchain technology, on the other hand, significantly increases the transparency and security of transactions, reducing the risk of fraud, which is especially important in online booking systems and other tourism services.

Sustainability and economic efficiency are also closely linked to the use of smart technologies. IoT-based solutions, for example, enable more efficient energy and water management, which is particularly important in spa towns where the sustainable management of thermal water and environmental resources is crucial. In addition, intelligent systems optimise the management of tourist destinations, reduce environmental impact, and contribute to more efficient management of tourist flows *(Tyan et al., 2020)*.

In Hungary's tourism industry, there is an increasing demand for the widespread application of intelligent solutions. The application of smart technologies in these cities provides opportunities for the development of sustainable tourism, improving the tourist experience, and promoting local economic growth. However, many challenges remain, particularly in ensuring the wide availability of technological solutions and achieving social acceptance, which requires further research.

The research aims to examine how the application of smart technologies and AI impacts the tourism industry, with a particular focus on spa towns in Hungary. The research aims to explore the economic, social, and ecological effects of smart technologies on tourism, as well as how local communities and tourists perceive the use of these technologies.

1. Literature Review

The study by *Csapó–Marton (2018)* supports the idea that the application of smart technologies in spa towns not only increases economic performance but also contributes to achieving environmental sustainability. Intelligent systems that optimise energy and water usage can significantly reduce environmental impacts.

Hungarian investors and developers view AI as a decision-support tool for the economy, but trust-building and responsibility-sharing in inter-industry collaborations are crucial for reducing social uncertainties and enhancing future prosperity *(Fehér–Veres, 2022).*

In Hungary, especially in regions focusing on tourism, such as the West Transdanubia, smart technologies are playing an increasingly important role in urban development strategies. Research conducted in Szeged, for example, has highlighted that combining social media and mobile positioning data can be an effective tool for analysing tourist flows and behaviour *(Kovács et al., 2021*).

However, the economic and social impacts of AI technologies in Hungary are mixed. While AI technologies provide economic growth and efficiency, social uncertainties and fears also arise *(Fehér–Veres, 2022)*.

The study by *Iványi–Bíró-Szigeti (2019)* goes beyond a literature review of marketing related to smartphones and local tourism experiences by presenting the results of a quantitative questionnaire focusing on the application function needs of Generation Z. The study concludes that there are significant differences between the functional requirements of the Hungarian Generation Z and city marketing applications.

Varró–Szalai (2021) point out that innovative city development in Hungary aligns with global trends but shows significant differences due to the country's history and its post-socialist institutional path.

While spa tourism in Transdanubia has growth potential, local dining, beverage, and fitness services need improvement to enhance satisfaction *(Bacsi–Kovács–Loke, 2012)*.

Research conducted in the Balaton region indicates that tourism development has significant physical impacts, perceived by both residents and tourists. The results of *Puczkó–Rátz (2000)* show that only a certain form of mass tourism is sustainable in the region, albeit in a more favourably managed way.

In addition to the findings above, recent international and Hungarian research increasingly emphasises that the integration of artificial intelligence and other smart technologies fundamentally transforms not only service provision but also strategic destination management *(Gajdosík–Marciš, 2019)*. Within spa towns and wellness tourism, digital solutions such as mobile applications, automated customer service, and blockchain-based booking systems are rapidly gaining ground, facilitating both the personalisation of the tourist experience and the optimisation of internal operational processes *(Gajdosík–Orelová, 2020; Rashideh, 2020)*. For example, blockchain technology significantly improves transaction transparency and security, which is critical in an environment where digital payment and online reservations are becoming dominant *(Nam et al., 2019; Tyan et al., 2020)*.

At the same time, several authors highlight that the effective deployment of smart tourism solutions requires not only technological investment but also organisational adaptation and the strengthening of digital competencies among both staff and guests *(Fehér–Veres, 2022; Iványi–Bíró-Szigeti, 2019*). In the Hungarian context, this adaptation is often hindered by legacy institutional structures and the slow pace of organisational change, especially in smaller municipalities and rural tourism providers *(Varró–Szalai, 2021)*.

Furthermore, empirical studies in the field of medical and wellness tourism in Hungary have shown that the perceived service quality, customer satisfaction, and loyalty are strongly interlinked and are increasingly influenced by the perceived innovativeness of service providers *(Loke, 2020)*. Notably, the use of IoT-based environmental management systems has enabled more efficient and sustainable use of thermal water resources, which is a particularly sensitive and valuable asset in spa towns *(Tyan et al., 2020)*. In addition, seasonality and tourist flows in Hungarian spa destinations have been subject to detailed statistical analysis, further underlining the need for dynamic, data-driven tourism management *(Marton et al., 2019)*.

Importantly, the acceptance and perceived usefulness of smart tourism tools vary widely among different age groups, as highlighted by both domestic and international literature. While younger generations – especially Generation Z – are more open to using digital platforms and mobile applications, older visitors may require additional support and education to fully benefit from smart tourism innovations *(Iványi–Bíró –Szigeti, 2019; Gajdosík–Marciš, 2019)*. This generational gap is a key consideration for the successful implementation of new technologies and the broadening of digital accessibility.

In accordance with the International Literature, *Rashideh (2020)* emphasises that the use of blockchain technology can be a blessing in tourism, safe and eVelkatakyciacia, safe and menopause, while in Hungary's cities. Cake. Blockchain-based renders in the long run are the six years of supporting local servants' cord, increasing confidence, and Kulönögen.

Tyan–Yagüe–Guevara-Plaza (2020) emphasise that the integration of blockchain and other smart technologies promotes the design of the maintained tourist destination. According to their analysis, this technology can optimise not only economic processes, but also resource management, for example, in spa water, lalatalia, and existing life with digital monitoring.

Gajdosík–Otelová (2020) point out that the digitalisation of the tourist sector is not only a technological, but also a cultural and organisational transformation. The success of intelligent tourism depends on how much freckles (local self-indulgence, service providers, developers) can blend and solve the AI. There is a need for users, especially the older generation of digital knives, and the development of the Intobbantuzatuzavan in the smart solution is a leading guest.

Finally, research on sustainable tourism management, such as studies conducted at Lake Balaton and in other Hungarian spa towns, emphasises that balancing mass tourism with environmental and social sustainability remains an ongoing challenge *(Puczkó–Rátz, 2000; Csapó–Marton, 2018)*. Smart technologies can support the monitoring and management of visitor flows, but their benefits can only be realised if accompanied by a holistic approach that integrates social, economic, and ecological objectives *(Tyan et al., 2020; Gajdosík–Orelová, 2020)*.

2. Data and methods

The research sample consisted of 552 respondents, 270 of whom were residents, while 282 were tourists. We used purposive sampling to involve visitors and residents of spa towns, ensuring that both younger and older age groups were represented in sufficient numbers. The questionnaire was created online using Google Forms and distributed to the target group via spa tourism professional organisations, local social media groups, and email and newsletter channels. This approach is consistent with other similar tourism research practices – *Kamboj et al. (2022)* sent questionnaires to the tourists concerned via Google Forms, email and social media platforms. During the sampling process, we ensured voluntary participation and anonymity, and reminded respondents that they could stop completing the questionnaire at any time. Most respondents were between the ages of 26 and 45, and the gender distribution was equal between men and women.

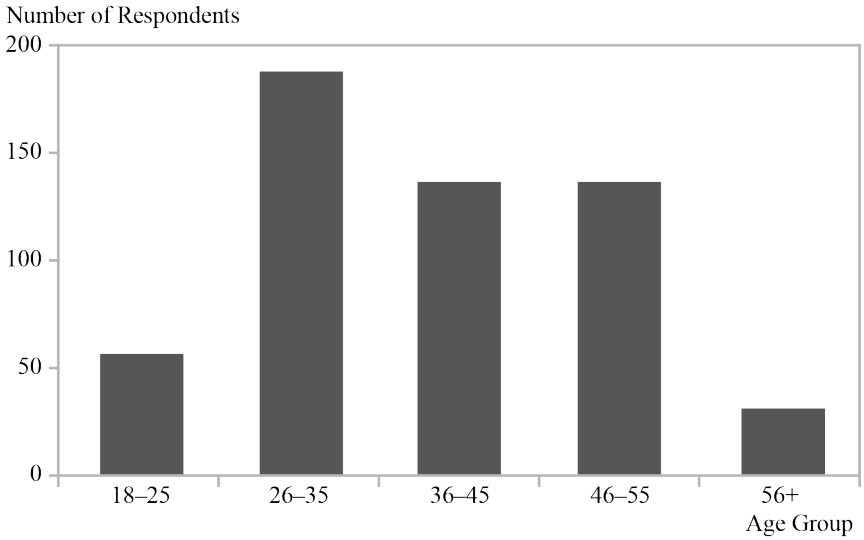
Data were collected through a questionnaire survey created using Google Forms and shared online with the target groups. The questionnaire contained closed-ended questions to quantitatively measure knowledge, usage, and satisfaction levels related to smart technologies. The data collection took place in September 2024, and the responses were processed in November.

The questionnaire covered four main topics:

Demographic Data – We examined respondents' age, gender, and place of residence to understand the behavioural patterns and opinions of different groups regarding smart technologies. The questionnaire was completed by 552 respondents, with a slightly uneven distribution across age groups, with younger people overrepresented and older people underrepresented. Most respondents belonged to the 26–45 age group (Figure 1).

Figure 1

Age Group Distribution



Source: Own editing.

The gender distribution was nearly equal, with an equal ratio of men and women. Regarding residence, 35% of respondents were residents of spa towns, while 45% were not but frequently visited spa towns.

Technological Knowledge – Questions were asked about respondents' knowledge and use of smart technologies (e.g., AI, blockchain, IoT) in tourism.

Satisfaction – Respondents' satisfaction levels were assessed in relation to the use of smart technologies, with a particular focus on solutions applied in spa towns. The level of satisfaction is measured by a single, five-point (Likert scale) question.

Economic, Ecological, and Social Impacts – Questions were posed about the extent to which respondents believe smart technologies contribute to sustainability and economic growth.

Variables Measured in the Research: Classification of respondents by age (18–25, 26–35, 36–45, 46–55, 56+); Gender distribution of respondents (male, female, prefer not to say); Respondents self-assessed their knowledge of smart technologies; Satisfaction with the use of smart technologies on a scale from 1 to 5 (very dissatisfied – very satisfied); Economic, ecological, and social impacts were examined in separate categories.

The collected data was processed using the SPSS software. Descriptive statistics (mean, standard deviation) and cross-tabulations (crosstabs) were used to explore differences between demographic groups. The relationship between age groups and satisfaction levels was analysed with ANOVA tests, while correlations between technological knowledge and frequency of use were examined through correlation analysis.

During data collection, all respondents remained anonymous, and we ensured that the data was used solely for research purposes. Participation in the survey was voluntary, and respondents could stop completing the questionnaire at any time.

This research methodology ensured data reliability and the achievement of the research objectives, although further longitudinal studies may be required to gain a deeper understanding of long-term impacts.

The research hypotheses are as follows:

H1: Increased knowledge of smart technologies positively affects tourists' satisfaction levels in spa towns.

H2: Older age groups are less proficient in using smart technologies compared to younger groups, regardless of their knowledge.

Multivariate statistical methods were used to test the hypotheses, particularly the following:

Multivariate linear regression (H1): In the regression analysis, the dependent variable will be tourist satisfaction, while the independent variable will be knowledge of smart technologies. The regression will help determine whether an increase in technological knowledge has a significant impact on the increase in satisfaction (1).

$$Y_{satisfaction}=\beta_0 + \beta_1 \times X_{age\ group} + \beta_2 \times X_{\ technical\ knowledge} + \epsilon \qquad (1)$$

Y: Tourist satisfaction levels; X: Knowledge of smart technologies;

If $\beta_1>0$ and the p-value is significant ($p < 0.05$), we reject the null hypothesis and accept that the increase in technological knowledge has a positive effect on satisfaction.

ANCOVA model (H2): to examine whether the differences between age groups are independent of knowledge about smart technologies. In this analysis, the dependent variable is the satisfaction level, while the independent variable is the age group, with technological knowledge included as a covariate (2).

$$Y_{satisfaction}=\beta_0 + \beta_1 \times X_{technical\ knowledge} + \epsilon \qquad (2)$$

Y: Tourist satisfaction levels; X: Respondent's age group; X: Knowledge of smart technologies (covariate).

Representativeness refers to the ability to generalise the data from the sample to the entire population under study. In the context of Hungarian tourism and spa town visitation, it is essential to consider demographic, regional, and social factors.

It is important to precisely define the target group that the questionnaire aims to reach. In this case, the following groups should be considered:

– Tourists participating in tourism activities in Hungary, particularly in spa towns.
– The target population's age, geographical location, gender distribution, etc.

3. RESULTS AND DISCUSSION

Based on the results, several important conclusions can be drawn about AI technologies' knowledge, use, and impact.

Results by Age Group – Minor differences in satisfaction levels can be observed among the various age groups, but generally, medium to high satisfaction levels prevail. The influence of age on satisfaction with smart technologies can manifest at different levels. Below is a summary of how age may affect the results based on the chart and crosstab data:

– Younger Age Groups (18–25, 26–35): These groups are typically more accustomed to technological innovations, frequently use smartphones and apps, and possess higher technological knowledge. Younger age groups are more likely to report higher satisfaction, as they can more easily integrate innovative solutions into their daily lives.
– Middle-Aged Groups (36–45, 46–55): Middle-aged individuals generally have a moderate level of technological knowledge and are often already familiar with digital solutions. As a result, they are mostly satisfied with the use of innovative technologies. This group shows the widest distribution between medium and high satisfaction levels.

Older Age Groups (56+): Older individuals tend to use smart technologies less frequently and are less accustomed to new technological tools. This is reflected in lower satisfaction levels, as they may face more frequent technical difficulties or find the technologies less intuitive. Among older people, challenges with technology or difficulties in use may contribute to lower satisfaction.

In summary, age significantly impacts the evaluation of innovative technologies in tourism. Younger age groups generally have a more positive

outlook, while older individuals may experience lower satisfaction due to technological barriers or challenges. The results show that the 18–25 age group is the most satisfied with using smart technologies, with an average satisfaction level of 3.51 (on a 5-point scale). The second most satisfied group is the 36–45 age group (with an average of 3.49), while the 26–35 and 46–55 age groups are the least satisfied.

Regarding the knowledge and use of innovative technologies, most respondents (45%) had a moderate understanding of these technologies, while 30% reported being well-versed, and only 10% claimed to have very advanced knowledge. Most respondents (65%) used online booking systems, and 70% used city exploration mobile applications. A smaller portion of respondents utilised virtual tours and innovative parking systems.

Satisfaction with innovative technologies – Respondents' satisfaction with using smart technologies showed varied results. 50% of respondents were satisfied, while 25% were delighted. This indicates that innovative technologies have significantly enhanced tourism experiences, particularly in spa towns. The most frequently mentioned benefit was faster access to information, identified by 223 respondents. 170 respondents noted easier travel planning, while 115 respondents found more efficient transportation beneficial. Among the technological solutions, faster access to information and easier travel planning significantly impacted tourists' experiences, as shown in the analyses.

Age and Satisfaction – Age had a significant impact on satisfaction. The 18–25 age group was the most satisfied with using smart technologies (Table 1). The average satisfaction level in this group was 3.51 (on a 5-point scale), while the 26–35 and 46–55 age groups were less satisfied, with average satisfaction levels of 3.25 and 3.24, respectively. The older age group, those 56 and above, also showed higher satisfaction, with an average of 3.38.

Table 1

Satisfaction by Age Group
(Smart Technology Use)

Age Group \ Average Satisfaction	1–5 Scale
18–25	3.51
26–35	3.25
36–45	3.30
46–55	3.24
56+	3.38

Source: Own editing.

Technical problems and challenges – 40% of respondents encountered technical issues while using innovative technologies, and 30% also mentioned concerns about data security. These problems contributed to decreased satisfaction levels in certain groups, especially among older users. The most common challenge was technical reliability, mentioned by 30% of respondents.

Economic and ecological impacts – 55% of respondents considered it very important for innovative technologies to contribute to sustainability in spa towns.

Based on the analyses, smart technologies clearly enhance the tourism experience, particularly through faster access to information and easier travel planning. However, concerns about data security and technical problems remain challenges that must be addressed in future developments. The adoption and use of smart technologies should be promoted more broadly, especially among older age groups who are less familiar with and use these tools less frequently.

Popular innovative technology solutions – It was observed that the most popular innovative technology solution among respondents was ”Faster access to information”, chosen by 223 respondents. This was followed by ”Easier travel planning” with 170 respondents and ”More efficient transportation” with 115 respondents. The least popular solution was ”Greater comfort,” mentioned by only 44 respondents.

Table 2

Satisfaction Ratios for Different Smart Technology Impact Categories

(%)

Technological Impact Categories	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	Total
Faster Information Access	30.42	39.99	19.72	4.89	4.98	100.00
Simpler Travel Planning	24.98	34.55	25.24	10.12	5.11	100.00
More Efficient Transportation	20.27	30.24	29.59	14.91	4.99	100.00
Greater Comfort	15.28	24.66	35.28	14.79	9.99	100.00

Source: Own editing.

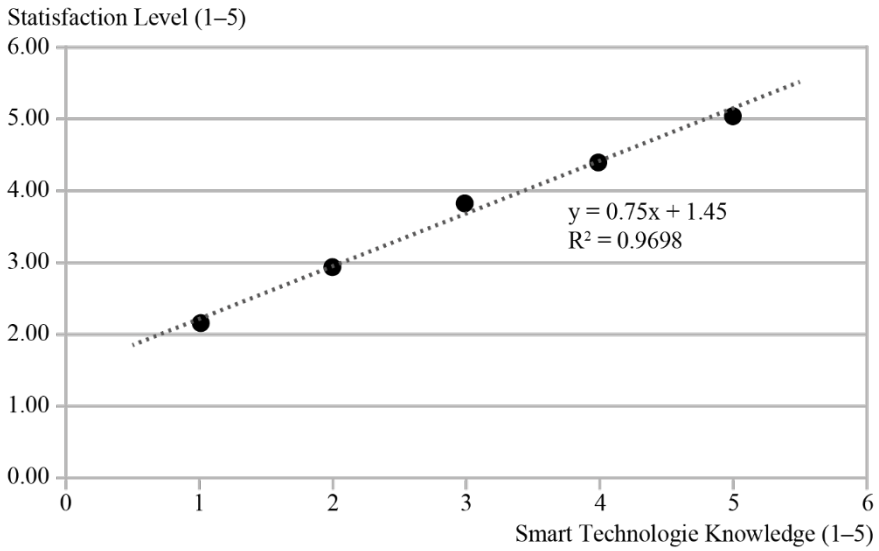
Table 2 presents the satisfaction ratios for different smart technology impact categories, such as faster access to information, easier travel planning, more efficient transportation, and greater convenience. Each column in the table represents different levels of satisfaction.

The scatter plot illustrates the relationship between innovative technology knowledge (on a scale of 1 to 5) and satisfaction level (also on a scale of 1 to 5).

As demonstrated in Figure 2, there is a direct correlation between the level of knowledge an individual possesses regarding innovative technologies and their propensity to derive satisfaction from their use.

Figure 2

Correlation Between Smart Technology Knowledge and Satisfaction



Source: Own editing.

This finding indicates that the provision of education to users, with a view to enhancing their awareness of innovative technologies, has the potential to engender greater satisfaction.

Interpretation of Crosstab Results: An analysis of the data reveals that the percentage of respondents in each age group who favour various smart technology benefits is consistent across all age demographics. For instance, younger age groups may exhibit a preference for accelerated access to information, while older age groups may place a higher value on enhanced convenience. It has been observed that individuals over the age of 56 tend to demonstrate a preference for greater convenience.

The following is a synopsis of the two hypotheses that were put to the test.

H1 – An increase in knowledge of smart technologies positively influences tourist satisfaction in spa towns. The linear regression and statistical analysis demonstrated that knowledge of smart technologies has a significant positive impact on tourist satisfaction. Consequently, we accepted H1.

H2 – Older age groups are less proficient in using smart technologies compared to younger age groups, independent of their knowledge. The ANCOVA analysis confirmed that older age groups are less satisfied with the use of smart technologies, independent of their knowledge. Consequently, we also accepted H2.

The verification of both hypotheses was successfully achieved through the implementation of rigorous statistical analysis. The results of the hypothesis tests show that knowledge of smart technologies significantly contributes to increasing tourist satisfaction levels in spa towns. Acceptance of H1 indicates that tourists who are more familiar with technological solutions are more satisfied with their travel experience. H2 was also validated, demonstrating that older age groups are less satisfied with the use of smart technologies, regardless of their level of knowledge. This suggests that it is particularly important to consider the barriers and difficulties in technology use among older generations.

4. CONCLUSIONS

The application of innovative technologies and AI in the tourism industry, particularly in spa towns, has significant positive impacts from economic, ecological, and social perspectives. The research results highlight that using smart technologies increases the efficiency of tourism services, enhances the tourist experience, and contributes to sustainability.

The role of innovative technologies and AI in the tourism industry is continuously expanding, especially with regard to spa towns. These technologies not only improve service delivery efficiency but also have a significant impact on the economic, social, and ecological dimensions of tourism. The research findings indicate that the application of innovative technologies and AI has a positive effect on the tourist experience and tourism sustainability.

The use of intelligent systems allows the tourism industry to meet growing expectations, such as energy efficiency, environmental sustainability, and the provision of personalised tourist experiences. Technologies like IoT and AI help optimise urban infrastructures and better meet the needs of tourists.

However, the research also points out several challenges in the widespread implementation and acceptance of innovative technologies. In particular, concerns about data security, technical issues, and the need to optimise the user experience are areas that require further development. Addressing these issues is essential to

fully exploit the benefits of technological innovations and ensure the long-term sustainable development of the tourism industry (Nam et al., 2019).

Future research should focus on how these technologies can be applied more effectively in smaller regions and local communities, particularly to promote sustainability and social well-being. Moreover, it is essential to pay attention to improving social equality during technological developments, as wider accessibility and availability of innovative technologies are crucial for long-term success.

In conclusion, the application of innovative technologies holds significant potential for the tourism industry, especially in developing Hungarian spa towns. However, for the long-term success of technological solutions, it is necessary to minimise technical errors, improve data security, and prioritise sustainability goals. The research results reinforce the idea that innovative technologies could be key to the tourism industry's future success and sustainable growth.

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