2026 Volume XXVI(1): 5-20
DOI: 10.25142/aak.2026.001

Integrating Cultural Heritage with Modern Technologies within Technological Innovations in Tourism

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Abstract: This article explores the impact of modern technology on the transformation of tourism, linking historical and cultural aspects with digital innovations. The development of mobile apps, social media and digital marketing is making it easier for tourists to plan their trips and increase interactivity with destinations. Technologies such as virtual and augmented reality, artificial intelligence and IoT are contributing to the personalisation of experiences and the preservation of cultural heritage. The study uses literature analysis and applies SWOT analysis to assess the impact of digitalisation on tourism, assigning factors a probability of impact score on a scale of 1-5. The conclusion highlights the importance of combining traditional and modern technologies to preserve cultural heritage and prepare for future challenges and opportunities in tourism.

Keywords: AI, history, modern technologies, SWOT analysis, tourism.

JEL classification: Z30, Z39, M31

Introduction

The integration of technology in the travel industry has precipitated a paradigm shift in the way tourists plan, book and experience their trips. Contemporary technologies, including mobile applications, social media and digital marketing, have taken on a pivotal role in promoting tourist destinations and supporting trip planning and booking. Recent research further confirms that digitalisation has become a central driver of innovation in tourism, particularly through artificial intelligence (AI), immersive technologies and smart systems that increasingly influence visitor behaviour and destination competitiveness (Xiang 2022, Mariani & Baggio 2022).

Against this background, the present article examines how modern technological innovations contribute to the interpretation, preservation and communication of cultural heritage within tourism, thereby strengthening the link between past and present.

The historical context of tourism is deeply intertwined with the annals of human history, dating back to the earliest days of travel for purposes such as trade, religion, exploration and governance. The Industrial Revolution of the 19th century marked a significant milestone, introducing railways, steamships and other transportation innovations that enabled mass tourism. Understanding this evolution is essential, as current digital technologies represent another transformative milestone—comparable in significance to industrial mechanisation—by reshaping how cultural heritage is accessed, interpreted and experienced (Timothy 2018, Tilden 2008).

Over recent decades, the integration of cultural heritage with digital tools has expanded rapidly. In the 1990s, with the expansion of the Internet, destinations and cultural institutions began digitising information about historical monuments to provide wider public access. The 2000s saw the emergence of mobile applications and multimedia guides, offering audio-visual content and interactive maps. These early developments laid the foundation for today's "digital heritage ecosystems", characterised by 3D digitisation, virtual reconstructions, online archives and open-access platforms (Champion 2021).

During the 2010s, virtual and augmented reality (VR/AR) became increasingly prominent. Cultural organisations introduced virtual tours, reconstructed destroyed heritage sites and developed immersive storytelling tools. VR/AR now serves as a core component of digital heritage interpretation, enabling users to visualise historical events and sites that are inaccessible, endangered or no longer extant (Bekele et al. 2021).

More recently, the fields of artificial intelligence (AI) and machine learning have provided additional opportunities by enabling personalised content delivery and supporting advanced heritage management. AI facilitates automated interpretation, recognition of cultural artefacts, personalised cultural itineraries, predictive conservation and large-scale analysis of heritage collections (Pasikowska-Schnass 2023). Chatbots and virtual assistants support visitors with on-demand contextual information, while 3D scanning and digital archiving expand access to cultural artefacts globally.

In the contemporary digital environment, the Internet of Things (IoT), blockchain technologies and smart systems are also becoming integral to cultural tourism. Smart museum systems adjust content, lighting and navigation according to visitor behaviour. Blockchain ensures security and authentication of digital cultural assets. These technologies collectively demonstrate how modern tourism increasingly relies on the connection between cultural heritage and technological innovation, which constitutes the central focus of this study.

Despite the growing body of research on artificial intelligence, smart tourism and digital heritage, existing studies typically focus on individual technologies or specific tourism applications. Limited attention has been devoted to an integrated assessment of how multiple digital technologies jointly contribute to cultural heritage preservation, interpretation and visitor experience. Furthermore, previous studies rarely combine a systematic literature review with a strategic evaluation framework capable of identifying both benefits and risks of technological integration. This study addresses this research gap by synthesising recent evidence on AI, VR/AR, IoT and digital heritage technologies and evaluating their implications through a structured SWOT-based analytical framework.

1 Theoretical background

In the context of the global professional arena, there is a plethora of research outputs that concentrate on the application of artificial intelligence in the tourism industry. The authors Buhalis and Law (2008) are particularly relevant in this context, as they analyse the progressive development of information technology in tourism management. However, their study reflects the state of digital transformation more than a decade ago and does not address recent advancements in AI, immersive technologies, or digital heritage. Therefore, in accordance with current research trends, this paper builds further on later studies focusing specifically on intelligent systems, digital heritage interpretation and smart tourism ecosystems (Gretzel et al. 2015, Koo et al. 2021, Mariani & Baggio 2022).

Gretzel and Fesenmaier's (2000) study examined the influence of persuasive technologies on online tourist behaviour; however, recent literature expands this perspective by highlighting the role of AI-driven recommendation systems, predictive analytics and machine learning in shaping tourist decision-making (Li et al. 2018, Tussyadiah 2020, Huang et al. 2022). These new approaches enable a deeper understanding of visitor motivation and behaviour, particularly in contexts involving cultural heritage attractions.

Tsiotsou and Ratten (2010) examined the role of technology in destination marketing. While their findings remain relevant, contemporary scholarship demonstrates that destination marketing has shifted toward AI-enhanced systems, multimodal content, augmented storytelling and the use of digital twins in cultural sites (Neuhofer et al. 2021, Lv et al. 2022). These technologies support cultural interpretation, visitor engagement and heritage accessibility in new ways.

Jakubíková (2012) and Kotíková (2013) provide an overview of ICT and tourism marketing; however, their texts do not explicitly address artificial intelligence or data-driven technological innovations, and therefore cannot be used as evidence for AI-based applications in tourism. For this reason, they are referenced only as historical background to the evolution of ICT but are replaced by up-to-date studies when discussing AI, VR/AR or smart tourism systems. Current literature highlights the integration of AI in CRM systems, semantic search, automated content generation and personalised digital interpretation of cultural heritage (Huang et al. 2022, Chansanam et al. 2023).

Bethapudi (2013) examined the impact of ICT on tourism efficiency, productivity and customer relationship management. Although informative, this perspective is extended in recent studies addressing how digital technologies support heritage preservation through 3D scanning, digital archiving and virtual reconstructions (Champion 2021, Bekele et al. 2021). These technologies have become essential in safeguarding intangible and tangible heritage while improving access for domestic and international visitors.

Goeldner and Ritchie (2014) identified trends in digitalisation and automation; meanwhile, recent advancements emphasise the emergence of “smart heritage environments”, which combine IoT, context-aware systems and AI-powered analytics to support real-time personalisation (Novera et al. 2022).

Similarly, the applications of AI in the tourism and hospitality sector - previously discussed by Lee and Moselle (2018) - have expanded toward autonomous service robots, conversational AI, hyper-personalisation, biometric technologies, predictive maintenance and AI-enhanced cultural exhibitions (Ivanov & Webster 2020, Tussyadiah & Park 2018, Xiang 2022).

Finally, Suleyman (2023) addresses broader societal implications of AI and emerging technologies. His perspective is relevant for understanding systemic risks and ethical considerations in applying AI in cultural tourism, especially in contexts involving data protection, algorithmic transparency and responsible use of predictive or generative models.

In summary, the contemporary theoretical foundation of this article is built primarily on recent literature addressing AI, VR/AR, IoT, digital heritage, and smart tourism systems (2018–2024), thus ensuring alignment with the article’s focus on integrating cultural heritage with modern technologies. These publications collectively reflect technological, ethical and methodological

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DOI: 10.25142/aak.2026.001

developments relevant to tourism digitalisation and cultural heritage enhancement in the digital age.

An important dimension that distinguishes cultural tourism from other forms of tourism is the preservation of cultural heritage. Contemporary digital technologies are not only marketing or visitor-management tools; they increasingly function as instruments for heritage conservation. Technologies such as 3D scanning, digital twins, virtual reconstruction and AI-supported archiving contribute to documenting endangered monuments, preserving intangible cultural heritage and facilitating long-term access to cultural resources. Consequently, the role of technology extends beyond tourism development and directly supports the safeguarding of cultural heritage for future generations

2 Aim, material and methodology

The aim of this study is to examine how technological innovations—particularly artificial intelligence (AI), virtual and augmented reality (VR/AR), the Internet of Things (IoT), and digital heritage tools—support the preservation, interpretation and accessibility of cultural heritage within contemporary tourism. The research further aims to identify key opportunities and challenges associated with the technological integration of cultural heritage and to evaluate these factors using a structured analytical approach.

To achieve this aim, the study focuses on two main research questions:

1. How do modern digital technologies contribute to the interpretation, presentation and preservation of cultural heritage in tourism?
2. What are the dominant strengths, weaknesses, opportunities and threats (SWOT) associated with the technological integration of cultural heritage, as reported in the current academic literature?

The material for this study consists of peer-reviewed academic publications, industry reports, and empirical studies published between 2018 and 2024, with an emphasis on AI applications in tourism, VR/AR in cultural heritage, digital archiving, smart tourism systems and emerging technological risks.

Older studies (e.g., pre-2010 ICT literature) were used only for contextual or historical framing and were not applied as evidence for AI-driven innovations.

The dataset includes:

- recent systematic reviews of AI in tourism (Xiang 2022, Mariani & Baggio 2022),
- studies on VR/AR in cultural heritage (Bekele et al. 2021, Champion 2021),
- research on smart tourism ecosystems (Koo et al. 2021, Neuhofer et al. 2021),
- studies addressing ethics, risks and governance of emerging technologies (Themistocleous et al. 2023, Suleyman 2023).

The methodological approach is based on qualitative content analysis and structured analytical modelling. The study follows three main methodological steps:

Step 1: Literature Collection and Screening

A systematic search was conducted in Web of Science, Scopus, ScienceDirect and Google Scholar, using keywords such as:

- *cultural heritage*,
- *tourism*,

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- *artificial intelligence,*
- *VR/AR,*
- *digital heritage,*
- *smart tourism,*
- *IoT,*
- *technology adoption.*

The search process followed predefined inclusion and exclusion criteria. Publications were screened according to their relevance to cultural heritage, tourism technologies and digital innovation. Only studies directly addressing technological applications in tourism or digital heritage were retained for further analysis. A total of 31 peer-reviewed publications meeting the predefined inclusion criteria were included in the final qualitative analysis.

Step 2: Qualitative Content Analysis
The collected publications were analysed using thematic coding, following the procedures proposed by Mayring (2019).
The coding process identified four recurring themes in the reviewed literature: (1) technological support for cultural heritage interpretation, (2) personalisation of visitor experiences, (3) risks related to artificial intelligence and data management, and (4) sustainability and digital preservation. These themes subsequently served as the basis for the SWOT framework, including:

- technological potential for heritage interpretation,
- personalisation of visitor experience,
- risks associated with AI and data management,
- sustainability and digital preservation.

These themes served as input for constructing the SWOT framework.

Step 3: Construction of the SWOT Analysis
Based on the coded qualitative data, a structured SWOT analysis was developed. Each factor (strength, weakness, opportunity, threat) was:

- identified directly from published findings,
- classified according to thematic relevance,
- assigned a probability-of-impact score (1–5).

The scoring followed a consensus approach based on frequency and emphasis in the literature, consistent with methods used in strategic tourism analysis (Evans 2024, Lv et al. 2022). Higher scores were assigned to factors repeatedly highlighted across multiple contemporary sources. The impact scale was interpreted as follows: 1 = very low relevance or occurrence in the literature; 2 = low relevance; 3 = moderate relevance; 4 = high relevance; and 5 = very high relevance. Scores were assigned according to the frequency with which a factor appeared in the reviewed literature and the importance attributed to it by the respective authors. To improve analytical consistency, the classification of factors into SWOT categories was independently reviewed by all three authors. Any disagreements regarding categorisation or impact assessment were resolved through discussion until consensus was reached. This procedure reduced subjective bias and increased the reliability of the analytical framework.

This methodological approach enables the creation of an evidence-based strategic assessment of how modern technologies transform cultural heritage tourism, and a transparent and replicable analytical process.

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3 Results

The results of the analysis are based on the qualitative thematic coding of contemporary academic literature published between 2018 and 2024, as described in the methodology section. The SWOT framework therefore reflects only those factors that were repeatedly emphasised in the reviewed studies and are directly related to the integration of cultural heritage with modern technologies. This approach ensures transparency, replicability and alignment with the aim of the study.

The SWOT analysis identifies the key strengths, weaknesses, opportunities and threats associated with the technological integration of cultural heritage into tourism. Each factor was substantiated by at least two independent scholarly sources and evaluated on a 1–5 probability-of-impact scale, reflecting the frequency and significance assigned to it in the literature (Lv et al. 2022, Xiang 2022). Table 1 summarises the results.

Table 1: Analysis of the use of AI in tourism based on literature

Strengths	**Weaknesses**
Increase efficiency and productivity (5) - automation of processes (check-in, reservations, CRM systems) reduces costs and saves time.	**Technology barrier and digital divide** (3) - not all users are able to use AI and ICT tools effectively. Varying levels of digital skills among users can limit the accessibility and effectiveness of implemented technologies.
Personalisation of services and innovative experiences (5) - the use of AI enables the creation of accurate and personalised offers, while also integrating historical and cultural contexts, leading to higher customer satisfaction.	**Loss of human contact** (4) - the transition to digital services can reduce personal interaction between customers and service providers but can also negatively impact customer service and experience.
Virtual and augmented reality - an innovative blend of history and modern technology (4) - allows customers to explore destinations and hotels in advance, increasing their motivation to buy. – digital tools allow the fusion of historical authenticity with a modern customer experience, which increases the attractiveness of destinations.	**Ethical issues and privacy** (5) - AI analyses large amounts of data, which brings risks related to data protection and ethical standards
Improving destination marketing and management (4) - social media and AI-driven advertising increase the effectiveness of promotions and lead to better targeting of communication strategies.	**Risk of dependence on technology** (4) - excessive digitisation can lead to excessive automation and reduced quality of interaction. It can also lead to dehumanisation of services and dependence on digital systems, which can be problematic during outages or changes in technology.
Opportunities	**Threats**
Continuing developments in AI and ICT (5) - new technologies are opening up new opportunities and improvements in personalisation and efficiency and the creation of innovative experiences. – virtual travel as an alternative for disabled or environmentally conscious tourists.	**Cybersecurity** (5) - the growing number of data leaks and cyber threats in the travel industry. – risk of cyber-attacks and data leaks can reduce customer confidence and lead to financial damage.
Sustainability and green technologies (4) - integrating green solutions and optimising resources contributes to responsible travel, long-term sustainability and minimises waste.	**Rapid obsolescence of technology** (4) - continuous development requires high investment in system upgrades, putting a strain on entities' budgets.
Robotics and Automation (4) - increasing the efficiency of operations in the hotel and related services industry.	**Regulation and legislation** (4) - stricter privacy rules, ethical aspects of AI use and regulation of AI may affect its use and speed of implementation.
Growing interest in cultural and historical experiences. (4) – the trend towards authenticity and unique cultural experiences is increasing the demand for integrated historical and modern offerings.	**Dominance of large platforms** (3) - smaller entities in the travel industry may struggle to compete with the tech giants.

Source: own processing

Strengths

The literature consistently highlights several strengths arising from the implementation of digital technologies in cultural tourism:

- **Enhanced efficiency and productivity (score 5):** Automation of reservations, visitor flow management and digital information systems reduces operational costs and increases the responsiveness of cultural institutions (Neuhofer et al. 2021).

- **High level of personalisation (score 5):** AI-driven systems can tailor recommendations to visitor interests and learning preferences, which significantly improves user engagement and satisfaction (Mariani & Baggio 2022).
- **VR/AR-enabled interpretation of cultural heritage (score 4):** Immersive technologies provide deeper understanding, accessibility and emotional engagement with historical sites, including those that are endangered or inaccessible (Bekele et al. 2021).
- **Improved destination marketing (score 4):** AI-enhanced marketing tools allow cultural destinations to reach specific audiences more effectively through personalised messaging and data-driven campaigns (Koo et al. 2021).

These strengths collectively indicate that technological integration has the potential to substantially enrich cultural tourism experiences, while simultaneously enhancing institutional efficiency.

Weaknesses

Despite the benefits, the literature identifies several limitations:

- **Technological barriers and digital divide (score 3):** Not all visitors possess the digital literacy needed to engage with advanced technologies, which may reduce inclusivity (Tussyadiah 2020).
- **Reduced human interaction (score 4):** Over-reliance on automated services risks diminishing personal contact, which remains crucial in cultural interpretation and heritage education (Ivanov & Webster 2020).
- **Ethical and privacy issues (score 5):** AI systems require significant amounts of personal data, raising concerns over security, transparency and compliance with regulatory frameworks such as GDPR (Themistocleous et al. 2023).
- **Dependence on technologies (score 4):** Cultural institutions may become reliant on technological infrastructures that require continuous maintenance and may fail without adequate resources (Evans 2024).

These weaknesses highlight the need for balanced implementation strategies that combine technological efficiency with human elements and strong ethical safeguards.

Opportunities

The analysis reveals several significant opportunities driven by ongoing technological development:

- **Advances in AI and ICT (score 5):** Continued progress in natural language processing, recommender systems and digital heritage reconstruction opens new possibilities for immersive interpretation and visitor engagement (Xiang 2022).
- **Virtual tourism and accessibility (score 4):** VR-based experiences offer alternative modes of access for individuals with disabilities and for heritage sites where overtourism threatens conservation (Champion 2021).
- **Sustainability and green technologies (score 4):** AI-enabled optimisation of resource consumption and energy-efficient digital tools can help cultural sites reduce their environmental footprint (Li & Zhong 2022).
- **Rising demand for authentic cultural experiences (score 4):** Growing interest in cultural identity and heritage-based experiences increases the relevance of digital heritage tools (Timothy 2018).

These opportunities demonstrate that technological innovations can enhance both sustainability and the global visibility of cultural heritage.

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Threats

However, the literature also identifies several external risks:

- **Cybersecurity threats (score 5):** Digital heritage archives and AI-driven systems are vulnerable to cyberattacks, which may compromise sensitive cultural and personal data (Themistocleous et al. 2023).
- **Rapid technological obsolescence (score 4):** Fast-paced development requires continuous updates and investments, which may burden small institutions with limited budgets (Evans 2024).
- **Regulatory and ethical constraints (score 4):** Increasingly strict global regulations governing AI, data processing and digital heritage may slow or restrict technological deployment in tourism (Suleyman 2023).
- **Dominance of large platforms (score 3):** Global technology providers may outperform smaller cultural institutions, influencing visibility and competitiveness within digital tourism ecosystems (Mariani & Baggio 2022).

These threats indicate that strategic planning, governance frameworks and investment policies are essential to ensure responsible technological development in cultural tourism.

To better understand the overall impact of the individual factors, it is useful to summarise the results of the analysis in a so-called plus-minus matrix, which divides the factors into positive and negative and calculates their cumulative scores, see Table 2.

Table 2: Plus-minus matrix

Category	Total score	Note
Positive factors		
Strengths	5 + 5 + 4 + 4 = 18	Efficiency, personalisation and innovative combination of history and modern technology.
Opportunities	5 + 4 + 4 + 4 = 17	Technological developments and the growing interest in authentic cultural experiences.
Total (Plus)	35	
Negative factors		
Weaknesses	3 + 4 + 5 + 4 = 16	Technological barrier, loss of personal contact, ethical and security issues.
Threats	5 + 4 + 4 + 3 = 16	Cybersecurity, rapid technology obsolescence, legislation and competitive pressure.
Total (Minus)	32	
Total assessment	35 – 32 = +3	Slightly positive overall effect but indicating the need to focus on risk mitigation.

Source: own processing

4 Discussion

The findings confirm the growing importance of digital technologies in cultural heritage tourism and are consistent with previous studies highlighting the transformative role of AI, immersive technologies and smart tourism ecosystems (Xiang 2022, Mariani & Baggio 2022). In particular, the strong positive evaluation of personalisation and operational efficiency supports earlier conclusions regarding the strategic value of AI-enabled visitor management systems.

At the same time, the results reveal a significant tension between technological innovation and cultural authenticity. While VR/AR and AI-based interpretation can improve accessibility and visitor engagement, excessive reliance on digital mediation may weaken direct engagement with heritage resources. This finding corresponds with concerns expressed by Timothy (2018) regarding the preservation of authentic cultural experiences.

The SWOT analysis further demonstrates that cybersecurity and ethical governance represent the most significant challenges for future implementation. This suggests that technological innovation alone is insufficient and must be accompanied by appropriate governance structures, regulatory compliance and institutional capabilities.

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Overall, the study contributes to the literature by providing an integrated evaluation of technological opportunities and risks in cultural heritage tourism, thereby extending previous research that typically focuses on individual technologies rather than their combined impact.

A particularly important finding concerns the dual role of technology in cultural tourism. While most studies emphasise its contribution to visitor experience and destination competitiveness, the reviewed literature demonstrates that technological innovation increasingly serves a conservation function. Digital preservation technologies enable the creation of permanent records of monuments, artefacts and cultural practices that may otherwise be lost. This shifts the role of technology from a supporting tourism tool toward a strategic instrument of cultural heritage management. Consequently, future research should evaluate not only the economic and experiential benefits of digitalisation but also its contribution to long-term heritage sustainability.

The SWOT analysis and plus-minus matrix presented here offer a comprehensive overview of the internal and external factors influencing the sector, while facilitating the identification of intervention areas to mitigate risk. The resulting net score of +3 indicates that, with meticulous management of threats and vulnerabilities, there is an opportunity to achieve a favourable effect of digitalisation in contemporary tourism.

The following aspects of the impact of digitalisation in tourism were identified as a result of the SWOT analysis and the determination of the probability of occurrence of the aforementioned factors.

The advent of digitisation and the utilisation of artificial intelligence (AI) have precipitated a fundamental transformation within the tourism sector. While these measures confer numerous advantages, they concomitantly engender novel challenges. The subsequent analysis will utilise a scale of 1-5 to evaluate the key factors affecting the segment, with 5 representing the highest level of likelihood and 1 the lowest.

A primary benefit of digitalisation is an enhancement in efficiency and productivity (5). The automation of processes, including online check-in, reservations, and customer relationship management (CRM), has been demonstrated to result in substantial cost reductions and enhanced service efficiency. Another pivotal factor pertains to the personalisation of services and innovative experiences (5), which facilitates a more targeted offer according to customer preferences, thereby enhancing customer satisfaction.

The advent of virtual and augmented reality technologies has engendered a paradigm shift in the way potential customers navigate their decision-making process. These technologies empower consumers to explore destinations and hotels in advance, thereby facilitating informed decision-making. Notwithstanding the attendant advantages of this technology, its implementation is contingent upon the factors of availability and investment. The enhancement of destination marketing and management (4) is a notable strength, wherein the utilisation of AI-driven advertising and data analytics has been observed to optimise promotional initiatives and enhance the precision of campaign targeting.

Notwithstanding the numerous advantages attendant upon digitalisation, there are concomitant disadvantages. The technological barrier (3) is one such factor that must be considered. It is important to note that not all users possess the ability to utilise modern AI and ICT tools effectively. This can result in their exclusion from certain services. The loss of human contact

is also a significant issue (4). The transition to fully digital services has the potential to diminish personal interaction, which may present a disadvantage for specific customer groups.

A further significant vulnerability pertains to ethical considerations and privacy issues (5). The processing of vast quantities of personal data by AI systems has the potential to heighten the risk of privacy breaches, thus necessitating the implementation of more stringent regulatory frameworks. A concomitant risk pertains to technology dependency (4), wherein the excessive automation of processes can result in diminished quality of service and reliance on digital instruments.

The future of digitalisation in tourism offers significant potential. The ongoing advancements in technology (specifically, artificial intelligence) and digitisation (5) are facilitating enhanced personalisation and automation, thereby optimising service efficiency. The increasing demand for authenticity and unique cultural experiences (4) has led to a growing interest in integrated historical and modern offers. The significance of sustainability and green technologies is increasing (4). The utilisation of artificial intelligence has the potential to assist in the reduction of energy consumption and the optimisation of resources, a development that is congruent with prevailing environmental trends. Another step towards efficiency is robotics and automation (4), which is gaining ground in the hotel and tourism industry. Even though a certain degree of human intervention remains a prerequisite for certain services, technological solutions have the potential to engender substantial reductions in operating costs.

Digitalisation is not without its risks. The most significant challenge is that of cybersecurity (5), given the increasing number of data leaks and cyberattacks, which pose a substantial risk to companies and customers. The rapid obsolescence of technology (4) signifies that companies must continually invest in updates to avoid rendering their systems obsolete.

Another potential threat is the tightening of regulations and legislation in the area of data protection and the use of AI. It is submitted that the implementation of new technologies may be subject to limitations because of the aforementioned regulations. Finally, the issue of market dominance by large platforms (3) must be addressed. The ability of technology giants to exercise market control can create significant challenges for smaller players in the travel industry, hindering their ability to compete effectively.

5 Challenges of Technological Integration

The integration of modern technologies into the tourism sector, and particularly into cultural heritage management, presents several complex challenges that must be addressed to ensure responsible and sustainable implementation. Although digital tools offer significant benefits, their adoption requires careful consideration of ethical, organisational, technical and social dimensions (Themistocleous et al. 2023). The following section summarises the key challenges identified in recent academic literature.

5.1 Data Protection and Ethical Governance

The protection of visitor data represents one of the primary challenges in the implementation of digital technologies. Cultural institutions increasingly rely on AI-driven systems, mobile applications and sensor-based technologies, all of which collect large quantities of personal data. Ensuring compliance with the General Data Protection Regulation (GDPR) and other international standards is essential, particularly when processing sensitive behavioural or biometric data used in personalised cultural experiences (Tussyadiah 2020). Ethical governance

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frameworks are therefore necessary to prevent algorithmic bias, ensure transparency of AI-based decisions and safeguard the integrity of cultural content.

5.2 Cybersecurity Risks

As cultural heritage is increasingly digitised and stored in cloud systems or online repositories, cybersecurity becomes a significant concern. Digitised artefacts, 3D models, VR reconstructions and archival databases are vulnerable to hacking, data manipulation and ransomware attacks (Themistocleous et al. 2023). Such risks not only compromise institutional operations but can also threaten the authenticity and integrity of cultural data. Effective cybersecurity protocols—including encryption, intrusion detection systems and staff training—are essential safeguards.

5.3 Technological Literacy and Staff Capacities

Despite advances in digital tools, many cultural organisations face barriers in terms of staff competencies and digital literacy. Implementing AI systems, immersive technologies or IoT infrastructures requires specialised knowledge that may be limited in smaller institutions or underfunded heritage sites (Evans 2024). Professional training, capacity-building initiatives and long-term organisational support are therefore crucial to ensure that digital technologies are used effectively and sustainably.

5.4 Financial and Operational Constraints

The rapid pace of technological development presents financial challenges for many heritage institutions. Advanced tools such as VR/AR, 3D scanning, AI-driven analytics and smart museum systems require substantial initial investment as well as continuous maintenance and updates (Li & Zhong 2022). Without adequate funding, organisations may face difficulties keeping systems up to date, which can lead to technological fragmentation, inefficient workflows and decreased visitor satisfaction.

5.5 Preservation of Authenticity

While digital tools can enhance heritage interpretation, there is an ongoing scholarly debate about the potential loss of authenticity caused by excessive digital mediation (Timothy 2018). VR reconstructions and AI-generated narratives may unintentionally distort historical accuracy if not developed in collaboration with experts in history, archaeology or cultural studies. Ensuring factual accuracy and cultural sensitivity is therefore imperative when designing digital heritage experiences.

5.6 Overreliance on Technology

A further challenge is the risk of excessive reliance on digital systems. Technical failures, software incompatibilities or power outages can disrupt visitor experiences and institutional operations, particularly when traditional interpretive methods have been replaced by digital-only solutions (Lv et al. 2022). Balanced integration that maintains a combination of human interaction and technological support is therefore recommended.

Overall, the challenges of technological integration relate to ethical considerations, cybersecurity vulnerabilities, limited institutional capacities, financial constraints and the preservation of cultural authenticity. Addressing these challenges requires strategic planning, investment in human capital, continuous governance oversight and the adoption of robust cybersecurity systems. Only by mitigating these risks can modern technologies effectively support the preservation and interpretation of cultural heritage in tourism.

6 Recommendations for Tourism Businesses

Based on the findings of the literature review and the SWOT analysis, several strategic recommendations can be proposed to support the effective and responsible integration of modern technologies into cultural tourism. These recommendations emphasise the need for balanced digital innovation, ethical governance and long-term institutional capacity-building, all of which are critical for enhancing cultural heritage interpretation and visitor experience.

6.1 Strengthen Digital and Cybersecurity Infrastructure

Given the high probability of cybersecurity threats identified in the SWOT analysis, tourism organisations and cultural institutions should prioritise investment in secure digital infrastructures, including encryption, multi-factor authentication, data anonymisation and the regular auditing of digital systems.

Implementing comprehensive cybersecurity strategies not only ensures compliance with regulatory frameworks such as GDPR but also protects valuable digitised heritage assets and visitor data (Themistocleous et al. 2023).

6.2 Invest in Staff Training and Digital Competence Development

Successful technological transformation requires employees who are capable of using advanced digital tools, especially AI, VR/AR and IoT. Tourism businesses should therefore implement continuous professional training programmes focused on digital literacy, visitor experience design and the ethical use of artificial intelligence (Evans 2024). Strengthening human capital enhances institutional resilience and supports the long-term sustainability of technological innovation.

6.3 Ensure the Ethical and Responsible Use of AI

As AI becomes increasingly integrated into cultural heritage interpretation, organisations must develop and implement ethical guidelines for the use of AI in visitor recommendations, automated translations and digital heritage reconstructions. Transparency, explainability and fairness should be prioritised to avoid algorithmic bias and ensure that AI-generated content does not distort historical accuracy (Tussyadiah 2020).

6.4 Combine Human Expertise with Technological Tools

The SWOT analysis revealed that excessive digitalisation may lead to reduced personal contact and potential losses in cultural authenticity. Tourism organisations should therefore adopt hybrid models that combine human-led interpretation with digital support tools. For example, VR/AR experiences can enhance guided tours rather than replace them, ensuring that cultural narratives remain accurate, educational and emotionally engaging.

6.5 Support Sustainable and Energy-Efficient Digitalisation

Modern technologies offer opportunities to promote sustainability, for example through energy-efficient IoT systems, smart lighting or AI-driven resource optimisation. Cultural sites should integrate green technologies and evaluate the environmental impact of new digital infrastructures (Li & Zhong 2022). Such practices contribute to both operational efficiency and cultural heritage preservation.

6.6 Develop Inclusive and Accessible Digital Experiences

Digital heritage tools should be inclusive and designed with accessibility in mind. VR tourism, audio-guided pathways, AI-assisted navigation and multilingual content can significantly improve access for seniors, persons with disabilities and international visitors (Champion

2021). Ensuring inclusivity strengthens the social value of cultural heritage and broadens audience reach.

6.7 Establish Partnerships and Collaborative Innovation Ecosystems

To address financial and operational constraints, tourism businesses should collaborate with universities, technology providers, museums and governmental bodies. These partnerships support the development of shared digital platforms, open-access heritage archives and joint grant-funded innovation projects. Such cooperation enhances technological capacity and reduces financial barriers for smaller cultural institutions.

Overall, the recommendations emphasise the need for secure, ethical, sustainable and inclusive technological integration that supports both cultural heritage preservation and improved visitor experiences. Strategic planning, investment in human capital and cross-sector collaboration are essential for ensuring that modern technologies contribute meaningfully to the long-term vitality of cultural tourism.

Conclusion

The study provides explicit answers to both research questions. Regarding the first research question, the analysis demonstrates that AI, VR/AR, IoT and digital heritage technologies significantly enhance the interpretation, accessibility and preservation of cultural heritage through personalisation, immersive experiences and digital conservation tools. Regarding the second research question, the SWOT analysis identified personalisation, efficiency and innovative heritage presentation as the dominant strengths, while cybersecurity risks, ethical concerns and technological dependence emerged as the most significant weaknesses and threats.

The findings of this study demonstrate that the integration of modern technologies into cultural tourism offers significant potential for enhancing both the preservation and interpretation of cultural heritage. Based on the qualitative analysis of recent academic literature (2018–2024), it is evident that artificial intelligence, VR/AR, IoT systems and digital archiving technologies play an increasingly important role in improving accessibility, personalisation and visitor engagement. These technologies contribute not only to operational efficiency but also to the development of new modes of cultural storytelling, interactive learning and heritage reconstruction.

At the same time, the results highlight several critical risks and limitations, including concerns related to data protection, cybersecurity vulnerabilities, technological dependency, ethical governance of AI systems and the need to preserve cultural authenticity. The SWOT analysis confirms that although the overall impact of technological integration is positive, its benefits can only be realised if institutions actively address the challenges associated with digital transformation. This includes implementing secure digital infrastructures, investing in staff competencies and ensuring compliance with ethical and regulatory frameworks.

Rather than predicting a specific future trajectory for tourism, the findings suggest that the ongoing development of AI and digital heritage technologies creates opportunities for cultural institutions and tourism organisations to adopt more innovative, sustainable and inclusive approaches. These opportunities are supported by growing visitor interest in authentic cultural experiences and by the global expansion of digital cultural resources.

The study also highlights the need for balanced integration, where digital tools complement, rather than replace, traditional interpretive methods. Maintaining human expertise in heritage interpretation remains essential for ensuring the accuracy, integrity and emotional resonance of cultural narratives. Furthermore, strategic collaboration among technology providers, cultural institutions, policymakers and academic researchers is necessary to ensure responsible development and long-term sustainability.

In conclusion, technological innovations have the capacity to significantly enhance cultural heritage tourism when applied thoughtfully and responsibly. Their successful implementation depends on ethical governance, robust digital infrastructure, inclusive design and well-trained personnel. If these conditions are met, the integration of cultural heritage with modern technologies can support both heritage preservation and enriched visitor experiences, contributing to a more resilient and forward-looking tourism sector.

From a theoretical perspective, the study contributes to the literature by integrating insights from digital heritage research, smart tourism studies and AI adoption literature into a single analytical framework. The proposed SWOT-based synthesis offers a structured approach for evaluating technological transformation in cultural tourism and may serve as a foundation for future empirical investigations.

The study further demonstrates that technological innovation should not be viewed solely as a mechanism for improving tourism services. Equally important is its contribution to heritage preservation through digital documentation, virtual reconstruction and intelligent archiving systems. This conservation dimension represents one of the most significant long-term benefits of technological integration and may become increasingly important as cultural heritage sites face environmental, economic and social pressures. Future research should therefore investigate how digital preservation strategies influence the sustainability and resilience of cultural heritage destinations over time.

Limitations

This study has several limitations. First, it is based exclusively on secondary data obtained from published literature and therefore does not include primary empirical evidence. Second, the SWOT analysis relies on qualitative interpretation and literature-derived scoring, which may involve a degree of subjectivity despite the structured evaluation process. Future studies should complement the present findings through empirical research involving tourism practitioners, cultural institutions and visitors in order to validate the identified opportunities and risks.

Acknowledgement

This paper was supported by the Czech Republic Ministry of Education, Youth and Sports within the Institutional Support for the Long-term Development of a Research Organization in 2025.

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