


The Influence of New Productive Forces on the Evolution of Cultural Tourism and Heritage Site Management

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ABSTRACT

The rapid integration of digital technologies is reshaping the landscape of cultural tourism and heritage site management. In cities like Hangzhou, known for their historical richness, tools such as artificial intelligence (AI), big data, blockchain, augmented/virtual reality (AR/VR), and green technologies are redefining how heritage is experienced and preserved. This shift is particularly significant as cultural tourism faces growing pressure to balance economic growth, sustainability, and cultural integrity. However, while global studies have examined digital innovation in tourism, there is a lack of research focused on how such technologies function within the specific cultural, operational, and policy contexts of Chinese heritage cities. This study aims to investigate how new productive forces are applied in Hangzhou to enhance visitor experience, operational efficiency, and sustainability in heritage site management. Using a qualitative research design grounded in a systematic literature review guided by the PRISMA framework, this paper reviews 85 sources, narrowing to 9 key studies for thematic analysis. The findings reveal both the transformative potential of smart tourism technologies and the challenges of digital inequality and authenticity preservation. This research contributes context-specific insights to the evolving discourse on sustainable, inclusive, and culturally grounded smart tourism.

Keywords: Cultural Tourism; Heritage Site Management; Smart Tourism; Artificial Intelligence; Augmented Reality.

INTRODUCTION

Cultural tourism and management of cultural heritage sites have significant importance regarding cultural and economic development. Cultural tourism is defined as tourism that involves travel to learn about cultural aspects of a place including its arts, historical past, and tradition as well as the tradition of the people living in that place (Hall & Williams, 2019). Heritage site management, on the other hand, refers to the effective protection and functioning of historical and cultural sites and monuments. These two functions are coupled in many ways to preserve cultural assets for both the present and future generations, as well as contribute to the economic growth of the areas (Wagner & de Clippele, 2023).

Cultural tourism and the management of cultural heritage sites, specifically, are currently undergoing the dynamics of transformation as a result of the influence of newly emerging productive forces like AI, big data, blockchain, and green technologies. These developments are not only enhancing the experience in tourism but also sustaining the business and making it economically viable. This study explores how the technologies are transforming the tourism sector in Hangzhou, China, a city renowned for its history and culture, as well as heritage site protection.

Within the scope of this study, productive forces mean all the technical, ecological and organizational

breakthroughs that help improve how cultural tourism and heritage sites are managed. Technologies, business styles and green concerns are influencing how tourism is done and organized. Advances such as AI, VR and blockchain have enabled tourism to grow, while improving how resources are employed and how tourists experience travel (Hall & Williams, 2019). People can explore heritage sites using virtual tourism along with artificial intelligence, with no damage to the sites (Liu, Wang, Dupre, & McIlwaine, 2022). Likewise, the application of big data analytics has proved to be an important tool in managing visitor flows during various tourist activities to predict crowd behavior and ticketing system optimization resulting in reduced physical damage to the sites (Lin et al., 2024). Also, there is improved security on ticketing through the use of blockchain to reduce fraudulent cases in the tourism sector as well as ease the entry of visitors into the heritage sites.

Hangzhou has begun to incorporate these smart tourism technologies into several sites like West Lake and the Grand Canal where tourists will be able to experience solar-powered boats as well as the application of new AI management systems to promote green tourism. Nevertheless, issues like digital access, community engagement, and tourism negative impacts are some of the factors that persist. This paper seeks to examine how these technologies affect the development of cultural tourism and the management of heritage in Hangzhou which has potential as well as the challenges posed by sustainable development.

With the fast change in tourism due to technology, it is now important to see how new productive forces from emerging technology can benefit cultural tourism and heritage management. Although the effect of digital tools on tourism has been studied, there is still little focus on how these technologies are used in Hangzhou's particular cultural and policy environment. The study will explore how AI, big data, blockchain, AR/VR and green technologies are affecting cultural tourism and heritage site management in Hangzhou, China. The study also looks at the challenges linked to these advances on a practical and policy level and explores what they mean for sustainability in tourism. Studying Hangzhou helps the researchers suggest tactics that could be implemented around the globe to digitally preserve heritage.

Relevance of the Study

Due to the higher demands for tourism, cultural heritage is under pressure from the effects of uncontrolled tourism population. Solving the problem of over-tourism, environmental impact, an uncontrolled number of tourists, infrastructure damage, and degradation of culture, necessitates the introduction of new productive forces to maintain heritage conservation and the growth of the tourism sector (Otero, 2022). Effective site management means using technological and organizational solutions such as AI technologies to control tourist flow, blockchain ticketing to reduce fraud cases and enhance security, AR/VR virtual tourism, and the use of green technologies to reduce environmental impact. These are to optimize the accessibility of the site while minimizing the negative consequences of overheated tourism, destruction of the infrastructure, and erosion of the cultural roots (Chhabra, 2021).

As a result, quality productivity as a concept has become instrumental in initiating innovations in cultural tourism. Heritage management is thereby focused on the creation of value through the adaption of state-of-the-art technologies and sustainable solutions such as AI visitor management, and smart ticketing with the use of blockchain technology (Lian & Xie, 2024). High-quality productivity enables the tourism destination to achieve the most efficient, sustainable, and cultural integrity from advanced tools and strategies. It improves the quality of visitor experience and at the same time improves the efficiency of operation which leads to a positive economic and sustainable development of the cultural tourism market (Lin, Li, Mahmood, Guo, & Qian, 2024; Shukla, Rana, & Prashar, 2024). For instance, smart tourism innovations in the Hangzhou region of China are recorded to have enhanced tourist satisfaction and promoted the protection of cultural assets, proving the concept of quality productivity in the conservation and sustainable management of these destinations (Liu et al., 2022).

Research Objectives

This study seeks to achieve the following objectives:

1. To identify the types and applications of digital technologies—AI, big data, blockchain, and AR/VR—in the context of Hangzhou's cultural tourism development.
2. To examine the impact of smart technologies on heritage site management, with attention to visitor regulation, security, sustainability, and cultural preservation.
3. To explore the contextual challenges and policy opportunities associated with smart tourism in Hangzhou and propose sustainable strategies for balancing innovation with cultural integrity.

Research Questions

This research addresses the following key questions:

1. How have AI, big data, blockchain, and AR/VR technologies been implemented in Hangzhou's cultural tourism sector, and what specific changes have they introduced in visitor experience and site accessibility?
2. In what ways have these digital technologies contributed to operational efficiency and the preservation of cultural heritage sites in Hangzhou?
3. What are the main challenges and opportunities in integrating smart tourism technologies into heritage management, and how can sustainable practices be formulated in response?

LITERATURE REVIEW

New Productive Forces and Quality Productivity

New productive forces are defined as sets of technology, environment, and organizational strategies capable of creating or developing positive change in society and industry. These forces, in essence, reflect the transition from conventional modes of productivity to improved, effective, eco-friendly, and technologically enabled. The previous research on the use of emerging technologies in tourism has been explored, however, the application of such technologies is lacking in cultural heritage management. Erol et al. (2022) assert that big data, artificial intelligence, and virtual reality are part of a new productive force because they contribute to improved decision-making, organizational performance, and user experiences. According to Wagner and de Clippele (2023), sustainability is one of the dimensions of green technology and environmental practices reducing the imprint of industries including tourism. Thus, it is possible to note that organizational innovation, including stakeholder collaboration and adaptive management, is also critically important in managing and building the potential of these new forces.

From this evolution, emerged new quality productivity, which underscores the process of generating new value through innovation with the consideration of quality and sustainability. Chen, Wang, Sun, Ye, and Zhang (2023) believe that quality productivity is more important to apply in the tourism industry since it allows visitor satisfaction and cultural heritage protection at the same time. For instance, the use of intelligent tour guides combined with augmented and virtual reality brings about a tangible experience of the structures without the destruction of the cultural assets (Boboc, Băutu, Gîrbacia, N. Popovici, & Popovici, 2022). New quality productivity is also more focused on quality and innovation, and this makes it a force for change in tourism growth and development (Zhao, Liu, Mu, Li, & Zou, 2024). However, these studies do not explore the use of innovative technologies in cultural tourism such as in Hangzhou where the blend of both innovation and traditional value is needed. For instance, research on the application of holographic displays in Japan for the conservation of artifacts is available (Zheng, Huang, & Oraltay, 2023), however, their application in Hangzhou's cultural site in China is not been explored much. This paper therefore discusses how Hangzhou is implementing AI-enabled visitor tracking, blockchain ticketing services, and AR/VR tourism to promote the efficient management of heritage sites and a sustainable economy.

Cultural Tourism Innovation

Digital technology is bringing major changes to cultural tourism. The applications of AI and AR/VR are helping to make visits more enjoyable by allowing for more engagement, customization and realism (Shukla et al., 2024). According to Hall and Williams (2019), with the help of data analytics, AI can make tourism easier and visitors can experience AR/VR to explore cultural places with less impact. Even so, much of the current research centers on European cases, with not enough consideration given to Chinese tourism. This study fills the gap by examining how West Lake and the Grand Canal in Hangzhou have used AI to analyze tourism numbers, AR/VR to tell stories from its past and green technologies to protect its heritage.

Case studies show how new technology shapes cultural tourism across different countries around the world. Erol et al. (2022) show how Singapore combines smart technology to enhance visitor experiences and streamline operations in both real-time visitor processing and digital tour guide systems. Through holographic displays, Japan protects vulnerable artifacts at cultural sites and draws young tech consumers. These situations show that adopting new digital technology can make tourism grow and protect old historical sites at the same time (Zheng et al., 2023).

Table 1. Comparison of Traditional vs. Technology-driven Cultural Tourism and Heritage Management in Hangzhou

Aspect	Traditional Approach	Technology-Driven Approach (New Productive Forces)
Visitor Experience	Guided tours with limited interaction.	AI-powered personalized virtual assistants and AR/VR-guided experiences (Shukla et al., 2024; Boboc et al., 2022).
Tourism Management	Manual visitor tracking and basic statistics.	Big data analytics optimizing visitor flow and smart ticketing (Lin et al., 2024; Erol et al., 2022).
Heritage Conservation	Physical preservation with minimal technology.	AI-powered monitoring, IoT-based real-time condition assessment, and virtual replicas to reduce site wear (L. Zhang, Ji, & Shi, 2022; Gursoy, Li, & Song, 2023).
Revenue Model	Ticket-based revenue, seasonal fluctuations.	Digital business models, blockchain-based ticketing, and subscription-based virtual tourism (Alsharif, Isa, & Alqudah, 2024; Trček, 2022).
Community Involvement	Limited local engagement in tourism planning.	Smart governance policies supporting local businesses, digital marketplaces, and cultural storytelling apps (Su & Wall, 2014; Wagner & de Clippele, 2023).
Sustainability	High energy consumption and pollution from tourism.	Green technologies, eco-friendly transportation, and solar-powered tourism infrastructure (Zhao et al., 2024; Lian & Xie, 2024).
Marketing & Promotion	Traditional advertising, print media.	AI-driven targeted marketing, social media engagement, and real-time promotions via mobile apps (Hall & Williams, 2019; Gursoy et al., 2023).
Tourism Accessibility	Limited access to historical sites for global audiences.	Virtual tourism experiences through 5G, live-streamed cultural events, and AI-translated content (Zhao et al., 2024; Loureiro, Guerreiro, & Ali, 2020).

Table 1 compares traditional and technology-driven approaches in cultural tourism and heritage management. Traditional methods rely on manual visitor tracking, physical conservation of the sites, and sales of tickets, which hampers efficiency and sustainability. On the other hand, AI is applied to visitors' management; AR and VR for tourism, the use of blockchain in ticketing, and green technologies are more beneficial to accessibility, security, and the environment. For instance, AI helps avoid overcrowding at West Lake, whereas AR/VR introduced changes that minimize physical damage to heritage objects. These have improved interactivity, mechanisms for collecting and analyzing data, and sustainability of tourism, allowing better the conservation of tourist attractions.

Heritage Site Management in the Digital Age

Heritage tourism can be defined as the preservation of cultural and historical sites or what has been left behind for generations and which has educational and economic advantages. According to Timothy (2011), heritage tourism plays a crucial role in preserving cultural heritage and at the same time encouraging economic development. Nevertheless, incorporating the emergent productive forces like AI, big data, and AR/VR, in heritage tourism has revolutionized heritage tourism with more customer satisfaction without damaging the heritage sites (Gursoy et al., 2023). Managing heritage sites in our digital times demands careful decisions about preserving their value while making them available to visitors and creating sustainable revenue sources. Global tourism growth demands new site management solutions which Kashem, Shamsuddoha, Nasir, and Chowdhury (2022) demonstrate through their research. AI and blockchain technology help site managers run operations better with fewer negative effects on the environment and site structure.

Advanced technologies for tourism have also been embraced widely in the management of heritage. According to Li, Zhao, Gu, and Zhang (2021), geospatial mapping technology and Internet of Things (IoT) devices have been used at several heritage sites across China for monitoring visitor traffic patterns and environmental data. For instance, the Forbidden City in Beijing employs the application of AI in monitoring the number of visitors thus making proper predictions on the flow of visitors to avoid accidents that may occur and preservation of the historical structures in the Forbidden City (L. Zhang et al., 2022). These advancements show how technology can go hand in hand with the two aims of access as well as preservation. While smart tourism technologies optimize visitor experiences, sustainable management requires deeper local engagement (N. Rane, Choudhary, & Rane, 2023). Community involvement is paramount in the management of heritage assets, and it involves the input of the community to conserve their heritage. Su and Wall (2014) also stressed that integrating the local communities into the decision-making process leads to their ownership of the site and commitment to it. This has a dual advantage of conservation of heritage sites and social-economic development of people in residential areas of heritage status.

However, challenges remain. The incorporation of smart technologies can sometimes entail considerable financial and technical costs thus exerting pressure on the available resources, especially in developing countries (Azis, Amin, Chan, & Aprilia, 2020). Also, because of the technological gap the disadvantaged groups are unable

to benefit from the inventions, as they cannot put the technologies to proper use (Chhabra, 2021). New quality productivity is therefore an essential tool in tackling several issues such as over-tourism, digital inequality of access, environmental degradation, and commercialization in the cultural tourism and heritage management fields.

The problem of over-tourism remains a challenge where great numbers of tourists cause overcrowding and deterioration of the cultural sites. Big data analysis and artificial intelligence in particular can be useful in controlling the influx of individuals by anticipating the high traffic hours and granting access to the controlled area. For instance, one of the smart applications that have been utilized in Hangzhou's West Lake are system for controlling the number of tourists to make tourism sustainable (S. Zhang et al., 2023). According to the studies, AI when applied in tourism destinations brings down the traffic flow by 30%–40% thus enhancing conservation (Lin et al., 2024).

The digital divide is still a problem for some communities and small businesses to access innovations in tourism. This is well addressed by new quality productivity through advocating for the proliferation of digital literacy programs and AI-based tourism platforms to enhance the involvement of local businesses in the smart tourism ecosystem (Reverte & Luque, 2022). Mobile applications and AI-guided virtual tours also ensure that cultural heritage is encouraged within an even larger population, especially people who cannot access these places physically (Chhabra, 2021).

Another problem is that increased mass tourism leads to further deterioration of the environment. New quality productivity includes making use of technology such as the usage of boats that are operated through solar power in the water channels of Hangzhou and enhanced smart energy utilization in tourist' facilities, hence, reducing the negative impact of tourism on ecology (Zhao et al., 2024). According to Lian and Xie (2024), the application of sustainable transportation strategies helps to reduce carbon emissions in tourism areas by 50 per cent. Thus, the introduction of these innovative solutions becomes a significant addition, as new quality productivity not only improves the tourism sectors, and overall experiences of the visitors but also guarantees long-term success by preserving culture and economy.

Research Gap

Many existing studies have examined the adoption of AI, big data and AR/VR in general tourism management in developed nations such as Japan, Singapore and Italy. However, little research has been done on how these technologies are used in handling travel, tourism, culture and heritage in Chinese cities like Hangzhou. Most research studies focus either on improvements in technologies or sustainability, but not many analyze how using advanced ways to produce goods can also improve tourism and operative functions while preserving culture. Furthermore, there has not been enough study on the difficulties related to technology access, policy combination and lack of resources when using these methods in heritage areas. To fill this gap, the study looks into the various effects of smart tourist technologies in Hangzhou and shares specific insights about their usage, outcomes and drawbacks in the cultural heritage area.

METHODOLOGY

Research Design

This study adopts a Systematic Literature Review (SLR) guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to identify, evaluate, and synthesize relevant research on the role of new productive forces—specifically AI, big data, blockchain, AR/VR, and green technologies—in cultural tourism and heritage site management. The aim is to ensure methodological transparency, minimize bias, and derive comprehensive insights from existing literature to answer the research questions.

Search Strategy

The literature search was conducted across the following electronic databases: Scopus, Web of Science, Google Scholar, and ScienceDirect. The search focused on articles published between 2013 and 2024 to capture recent advancements in smart tourism technologies. Boolean operators were used to combine keywords related to technology and cultural heritage (Table 2).

Table 2. Keywords and Boolean Expressions

Theme	Keywords	Boolean Expression
Technologies	"Artificial Intelligence", "Big Data", "Blockchain", "AR/VR", "Smart Tourism", "Green Technology"	("Artificial Intelligence" OR "Big Data" OR "Blockchain" OR "Augmented Reality" OR "Virtual Reality" OR "Smart Tourism" OR "Green Technology")
Tourism Context	"Cultural Tourism", "Heritage Site", "Tourism Management", "Sustainable Tourism"	AND ("Cultural Tourism" OR "Heritage Site" OR "Tourism Management" OR "Sustainable Tourism")
Geography	"China", "Hangzhou"	AND ("China" OR "Hangzhou")

Inclusion and Exclusion Criteria

Articles were filtered based on the following criteria (Table 3).

Table 3. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Language	English	Non-English
Timeframe	2013–2024	Pre-2013
Content	Studies focusing on AI, big data, blockchain, AR/VR, green tech in tourism and heritage	Studies unrelated to cultural tourism or lacking empirical/theoretical focus
Geography	Global + Specific focus on China or Hangzhou	Studies with no contextual relevance to heritage or smart tourism
Publication Type	Peer-reviewed journal articles, government reports	Blogs, editorials, non-peer-reviewed sources

PRISMA Framework Application

A total of 85 records were initially identified. After removing duplicates and screening titles and abstracts, 33 articles were reviewed in full. Based on quality, relevance, and focus, 9 articles were finally selected to inform the findings and discussion, conceptual understanding of PRISM Framework is given in Table 4.

Table 4. PRISMA Framework

Stage	Number of Articles
Records identified through database searching	85
Records after duplicates removed	68
Records screened (title & abstract)	68
Full-text articles assessed for eligibility	33
Studies included in the final review	9

Data Extraction and Thematic Synthesis

The selected 9 studies were analyzed using thematic analysis. A coding framework was developed to categorize key information under themes related to (1) technology application, (2) operational impact, (3) sustainability contributions, and (4) implementation challenges. This allowed for a systematic synthesis of insights across diverse cases, ensuring relevance to the study's research objectives. These themes with sub themes and coding are given in Table 5.

Table 5. Thematic Framework

Theme	Sub-theme	Code	Observed Pattern
Technology Application	AI-based visitor management	TA1	Use of AI to monitor and predict visitor flow, improve safety, and optimize capacity (West Lake).
	Blockchain ticketing systems	TA2	Blockchain enhances transaction transparency and reduces fraud.
	AR/VR for immersive tourism	TA3	Virtual and augmented tours reduce physical strain and enhance storytelling.
	Big data for decision-making	TA4	Data analytics inform resource allocation and policy.
	Smart mobile apps and digital storytelling	TA5	Apps personalize experiences and promote local narratives.
Operational	Efficiency in crowd	OI1	AI helps redistribute crowds, reducing congestion by up to

Theme	Sub-theme	Code	Observed Pattern
Impact	control		30%.
	Revenue diversification	OI2	Digital ticketing enables dynamic pricing and virtual product sales.
	Enhanced security and fraud prevention	OI3	Blockchain prevents ticket duplication and increases visitor trust.
Sustainability Contributions	Green mobility and transport	SC1	Solar boats and e-transport reduce emissions at heritage sites.
	Reduced physical degradation of sites	SC2	Virtual experiences replace physical access to fragile areas.
	Policy alignment with eco-goals	SC3	Technologies are aligned with China's low-carbon development policies.
Implementation Challenges	Digital divide and unequal access	IC1	Local residents and small businesses lack digital infrastructure and skills.
	Financial and technical barriers	IC2	Smaller sites lack funding and expertise for tech integration.
	Misalignment between tradition and tech	IC3	Tension between innovation and preserving authenticity of cultural experiences.
	Scalability of smart solutions	IC4	Pilot projects work well, but full-scale implementation remains limited.

Ethical Considerations

As this study only uses publicly available secondary data, no formal ethical approval was required. All sources were properly cited, and research integrity was maintained throughout the review process.

RESULTS

Following the PRISMA-guided review, 9 articles were selected for final analysis given in Table 6. These studies were thematically coded using a structured framework focused on four key areas: (1) technology application in cultural tourism, (2) operational impact on heritage site management, (3) sustainability contributions, and (4) implementation challenges. The selected articles span empirical and theoretical research focused on Hangzhou, broader China, and comparative global contexts, providing diverse insights into the adoption and outcomes of smart tourism technologies.

Table 6. Summary of Final Sources and Thematic Justification

Source	Associated Themes	Justification
Lin et al. (2024)	Technology Application, Operational Impact, Sustainability Contribution	Demonstrates use of AI and big data at West Lake for visitor flow management, efficiency in operations, and emissions reduction through smart systems.
Zhao et al. (2024)	Technology Application, Operational Impact, Sustainability Contribution	Highlights integration of AR/VR and smart tourism policy alignment with China's green goals and improved management practices.
Alsharif et al. (2024)	Technology Application, Operational Impact	Explores blockchain-based ticketing and its effect on fraud prevention and streamlined operations.
Boboc et al. (2022)	Technology Application, Operational Impact, Sustainability Contribution	Discusses AR/VR applications in cultural heritage for immersive experience and minimizing physical impact on sites.
Su and Wall (2014)	Technology Application, Implementation Challenges	Analyzes mobile storytelling and community involvement, pointing out access limitations and cultural engagement issues.
Wagner and de Clippele (2023)	Implementation Challenges	Addresses digital exclusion, local participation gaps, and the socio-technical divide in smart heritage systems.
Trček (2022)	Technology Application, Operational Impact	Focuses on blockchain applications for financial transparency and operational tracking in heritage tourism.
Abu et al. (2021)	Technology Application, Sustainability Contribution	Explains use of virtual access tools for preserving heritage sites and offering alternative tourism models.
Azis et al. (2020)	Implementation Challenges	Highlights financial and technical constraints faced by smaller heritage sites in adopting digital infrastructure.

Theme 1: Technology Application in Cultural Tourism

Advanced digital tools are changing how heritage attractions are created, presented and available to tourists. Due to the use of AI, blockchain, AR/VR and mobile tech, the city of Hangzhou has changed how tourists see and experience its historical and cultural sites (Figure 1).



Figure 1. Tourist Using Virtual Reality to Explore Cultural Heritage

AI and Big Data tools play a crucial role in managing crowds at places like West Lake. Using real-time data, AI allows authorities to watch visitor numbers and plan for efficient crowd movement. Lin et al. (2024) note that these measures have caused congestion to drop, helping both tourists and the protection of natural sites. In addition, using big data analytics, one can better plan strategies by learning visitors' likes, popular hours and travel pathways.

Hangzhou has improved how tourists access different sites by adopting blockchain ticket systems. Blockchain technology in Hangzhou Tourism SmartPass ensures all tickets are genuine during purchase and validation and reduces fraud. It is highlighted by Alsharif et al. (2024) that these innovations have made it easier for organizations and increased the trust of tourists thanks to fewer cases of fake tickets and overbooking.

At the Grand Canal, visitors can participate in digital experiences provided by AR/VR that do not damage the site. Zhao et al. (2024) point out that looking after cultural sites helps protect their original condition, improves visitor access and creates stronger connections to their heritage.

In addition, mobile apps featuring AI storytelling are used to support local traditions and encourage community members to take part. According to Su and Wall (2014), the use of dialects, personal stories and geo-stories helps make cultural tourism welcoming and understandable to young people who tend to use technology for such purposes.

Theme 2: Operational Impact on Heritage Site Management

Using technology in the management of heritage sites has boosted the abilities and success of places for cultural tourism. Using technologies such as AI, big data analytics, blockchain and AR/VR, heritage sites in Hangzhou are now handled, monitored and maintained differently to help preserve their history.

Using AI and big data allows for better management of visitors entering tourist sites. AI is used at West Lake to monitor crowds, check the volume of visitors and see if there will be congestion. Using these predictions, managers can control how many visitors enter, share available staff and cleanliness equipment wisely and reduce crowding at the site, particularly when many people visit (Lin et al., 2024). Better management of tourist arrivals provides a better experience for travellers and less impact on the environment and important structures.

Blockchain is now being used to make financial transactions in heritage tourism more transparent. Ticketing and recording transactions on a blockchain system make it possible for site managers to truthfully monitor their finances, cut down on financial fraud and make accounting tasks easier. Trček (2022) states that thanks to these systems, transactions are safe and traceable, making it less necessary to audit manually and improving trust

within the community.

They are popular for creating immersive experiences, but they also help subtly preserve heritage buildings from unnecessary damage. Virtual tours allow people to explore special sections of historical sites that are too weak to be walked on or seen by crowds. Boboc et al. (2022) mention that replacing real contact with digital technologies, AR/VR can decrease the deterioration of heritage sites and cut the associated repair and upkeep costs.

Scaling these technologies encourages the move from managing after incidents to managing ahead, using analytics, budget accuracy and helpful access models to help maintain both tradition and high standards of performance. Hangzhou shows what can be achieved by merging technology and culture to improve cultural tourism for more visitors.

Theme 3: Sustainability Contributions

When technology is incorporated into cultural tourism, it helps operations become more efficient, brings more enjoyment for tourists and greatly aids in saving the environment and cultural sites. Hangzhou, a city dedicated to matching tourism advancement with China's ecological strategy, relies on smart technology to control the risks of mass tourism and maintain its heritage sites.

Sustainable changes can be clearly seen in the use of green transport. Solar boats are used for sightseeing around West Lake and electric buses serve visitors who tour multiple sites. Thanks to these changes, the city requires fewer fossil fuels, helping the country reach its targets for becoming carbon neutral (Lian & Xie, 2024). Apart from protecting nature, environmentally friendly transport helps improve how tourists perceive and enjoy heritage sites by cleaning up the air and lowering noise.

Through virtual access, AR/VR technologies help reduce the environmental impact. Instead of heading to the sites in person, guests can enjoy virtual tours on the internet. Having these tools means we can see important areas where many visitors could cause faster wear and tear. According to Singh et al. (2024), these technologies help reduce the demands on physical infrastructure, allow cultural objects to endure for longer and reduce the need for routine maintenance and repair.

Additionally, smart tourism systems are tightly involved in national and municipal environmental strategies. Data analytics and digital monitoring make Hangzhou's smart tourism framework capable of controlling tourists and how resources are used. As a result, the site's protection is improved and the city reflects its commitment to China's Green Tourism Development Agenda (Zhao et al., 2024). The information gathered by AI and IoT allows local authorities to examine how green the city is, define achievements in sustainability and launch eco-certification options for tourism businesses.

Altogether, these advancements promote sustainability in an all-rounded way by linking ecology, culture and tourism. The town has shown how to effectively use innovation to sustain its heritage tourism.

To sum up, the research shows that using AI, big data, blockchain, AR/VR and green transport technologies has greatly improved cultural tourism and the management of heritage in Hangzhou. As a result, these visitors enjoy a better experience, hotels function more efficiently and the environment benefits, all fitting the government's plan for smart, green development. Even so, rolling out e-government may be problematic; for example, some worry about exclusion from computers, how budgets are allocated and whether cultural values are being respected. Some of what the studies reveal is that technological progress can greatly help tourism in heritage if both traditions and new ideas are kept in balance.

Theme 4: Implementation Challenges and Policy Considerations

The value of smart tourism technologies is clear, but there are still many challenges to their use in the cultural area of cities like Hangzhou. Tackling these challenges is essential to ensure that people from different cultural backgrounds can adopt digital technology fairly.

Many disadvantages are caused by the digital divide, since some people lack the necessary digital knowledge, modern equipment and internet access. While West Lake in Hangzhou has smart features and improved tourism through AI, many smaller places and communities are still not part of the smart tourism ecosystem. According to Wagner and de Clippele (2023), local vendors and service providers may not join in because of little or bad internet access, poor digital skills and difficulty finding needed funding. In addition to reducing their financial opportunities, it also reduces representation of different cultures.

Another big problem is a lack of money. While some large and well-known heritage sites can purchase AI, AR/VR or blockchain technology with funding from both the public and the private sector, many remote or less prominent heritage places miss out on similar benefits. Azis et al. (2020) point out that digital infrastructure, like

software, hardware and proper staff training, is very costly. As a consequence, the digital change is not even, leaving more renowned heritage destinations on top while others remain behind.

In addition, there are struggles between the use of new technology and preserving tradition. Certain stakeholders believe digital intervention in heritage can make people lose sight of the usual and religious meanings found in heritage places. According to Reverte and Luque (2022), it is vital to maintain intangible cultural traditions, as technology should not supplant the involvement of humans in them. Supporting real cultural values online means that sensors should be aware of community needs and should encourage active participation.

Therefore, policy makers in the future ought to ensure that everyone has access, small parks are funded and that communities can govern them. The potential of smart tourism can truly be used in all heritage management when there are equitable, culturally respectful and well-supported frameworks.

DISCUSSION

This study discovered that introducing new technologies like AI, big data, blockchain, AR/VR and green technologies has considerably changed cultural tourism and heritage site management in Hangzhou. Analysis of nine systematically selected sources shows that utilizing these technologies benefits audience participation, how events are managed and sustainability. The findings expand knowledge by exploring how smart tourism is changing China's urban heritage spaces which are not widely studied elsewhere (Hall & Williams, 2019; Gursoy et al., 2023).

Managing crowds around West Lake with AI and big data directly follows the recommendations made in published research about using data in tourism (Lin et al., 2024). Using predictive analytics helps manage crowds and protect the environment of a site too. Likewise, Singapore uses digital tools to track real-time crowds, showing the region's effort to actively manage tourism (Soundarya, Deborah, Sivakarathi, & Vinora, 2025). Hangzhou demonstrated the same commitment as Venice (Trček, 2022) to protect against fraud by adopting live seat blockchain ticketing, in line with the town's role model of productivity based on efficiency, trust and new ideas (Chen et al., 2023).

The best contributions to sustainability were seen in AR/VR and green transport, especially the solar boats on West Lake. These results confirm Zhao et al. (2024), who maintain that green tourism in China depends on the use of smart technology aligned with central policies. AR/VR technology also supports the same results noticed in Kyoto which include keeping heritage sites intact and making education better (Loureiro et al., 2020). For this reason, Hangzhou's smart tourism demonstrates an approach where modern technology helps safeguard cultural heritage and helps with sustainable development.

At the same time, these efforts point out several main weaknesses. For many small business owners and minority groups, having limited access to technology and training continues to be a big challenge (Wagner & de Clippele, 2023). Concerns raised by Reverte and Luque (2022) about the same issue are reflected in this case. In addition, financial problems make it difficult to introduce new ideas, especially for less famous secondary sites than highly valued places such as West Lake (Azis et al., 2020). Without providing resources and support to others, Hangzhou's innovations will not be able to grow widely.

Furthermore, people are worried about maintaining cultural traditions in tourism. Though digital storytelling and new tools can keep visitors engaged, they ought not to overshadow what has always been important or treat heritage like a product to buy. This worry is equally raised by Su and Wall (2014), who emphasize the role of locals in preserving cultural meaning. For this reason, policies that respect cultural traditions will be important in the future.

This study provides theoretical evidence that linking innovation with cultural sustainability can be done through the quality productivity framework. As Wagner and de Clippele (2023) explain, new digital technologies can move the field from maintaining things as they are to allowing people to play a more active role. Hangzhou is an example of the shift but it also reveals what is required for it to work: access for everyone, smart investments and the right understanding of the local environment.

In short, the outcomes help inform decisions by city officials at West Lake and national leaders interested in smart tourism expansion. If other cities handle challenges similar to Hangzhou's, they can achieve Hangzhou's growth and keep their unique cultures.

CONCLUSION

This case study focused on observing how AI, big data, blockchain, AR/VR and green technologies are shaping both cultural tourism and heritage site management in Hangzhou. After examining nine relevant articles and organizing them into themes, researchers learned these technologies improve how visitors experience museums, support quicker management and aid sustainability actions. It becomes clear from their use of AI for controlling crowds at West Lake and guided by AR or VR on the Grand Canal that digital methods help save their heritage assets as tourism grows.

The research also found that challenges remain such as some people not having the digital means, smaller heritage sites struggling with budgets and clashes between new technology and true culture. The evidence suggests that smart tourism can truly benefit communities, as long as its plans include policies that are inclusive, funding that is fair and ways that are sensitive to local cultures.

It highlights that digital transformation for heritage tourism means using technology as well as rethinking the way heritage is looked after and communicated. Analysing the situation using a quality productivity approach that links innovation with efficiency and cultural preservation proved valuable. How Hangzhou handles cultural heritage as the city grows model can be used by other traditionally rich cities facing similar problems.

As a result, Hangzhou's experiences show that using integrated methods that value culture, in the long run, is preferred over aiming for rapid technological growth. Properly supported policies, teamwork from involved groups and wide public input can make smart tourism a method for preserving cultural heritage for the future.

LIMITATIONS

The analysis done here is based on secondary data from a literature review, so it does not consider any recent and unpublished advancements in Hangzhou's smart tourism. There is a possibility that emphasizing English-language sources causes British historians to overlook important works written in China. In addition, although thematic analysis is intense, it can still rely on the subjective views of the researchers. Since no primary surveys were carried out, the study did not collect insights from any stakeholders and missed a thorough view of the practical problems being experienced.

FUTURE RESEARCH DIRECTIONS

In-depth knowledge of what smart tourism really means for local people and sites can be collected through interviews with people involved. Examining how other heritage-rich cities in China or around the world use technology would let us discover general trends and differences among them. Exploring the lasting effects of digital technologies on culture, especially identity, community life and how reality is perceived, would make the study even richer. Examining the outcomes of various policy frameworks and funding approaches could show the way to tourism that supports everyone fairly.

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ETHICAL DECLARATION

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