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MAPPING TECHNOLOGY ADOPTION IN FESTIVALS: AN INTEGRATIVE REVIEW OF APPLICATIONS, BENEFITS, AND BARRIERS

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ABSTRACT

This integrative review synthesises research on technology adoption in festival contexts by examining technology applications, stakeholder benefits, and implementation barriers, while identifying key research gaps and future directions. Despite the increasing integration of digital technologies in festivals, existing studies remain fragmented across contexts, technologies, and outcomes, limiting a comprehensive understanding of how technology contributes to festival performance and stakeholder value creation. Literature published between 2017 and 2025 was identified primarily through Google Scholar and expanded using backward and forward snowballing, resulting in a dataset of 59 articles. A thematic synthesis approach was applied to organise findings into three core dimensions: technology types, stakeholder benefits, and adoption barriers. The findings reveal that technology adoption spans eleven categories, ranging from immersive tools such as augmented reality and metaverse applications to operational and strategic systems including artificial intelligence, data analytics, and platform-based technologies. While prior studies often emphasise experiential technologies, the review highlights the critical role of less visible technologies in supporting coordination, decision-making, and operational efficiency. Technology adoption generates benefits across multiple stakeholders, including enhanced visitor experience, expanded reach, improved marketing effectiveness, and increased organisational resilience. However, these benefits are context-dependent and influenced by stakeholder roles, capability, and festival characteristics. Adoption is further constrained by interrelated challenges, including capability limitations, resource constraints,

governance concerns, and experience-design issues in hybrid and virtual environments. Overall, this study provides a structured and analytical synthesis to support more strategic, context-aware, and responsible technology adoption in festival management.

Keywords: Festival, Technology adoption, Digital transformation, Event management, Implementation barriers, Integrative Review

INTRODUCTION

Festivals are among the most frequently staged events worldwide, serving as platforms for celebrating arts, traditions, cultural identities, and the heritage of host destinations (Huszka et al., 2024; Edison & Raj, 2024). Embedded within specific local, social, and historical contexts, festivals function not only as cultural expressions (Garg & Modi, 2025), but also as social phenomena that sustain collective identity, community continuity, and shared meaning (Falassi, 1987; Sadler, 1969; Ismail et al., 2025).

Beyond their cultural and social roles, festivals are increasingly recognised as complex, high-density service environments that require effective coordination, communication, and real-time decision-making, particularly in digitally mediated environments. Festivals are also widely acknowledged as significant tourism products that contribute to destination attractiveness, cultural preservation, and community development (Edison & Raj, 2024; Lopes & Hiray, 2024; Kadayat & Upadhyay, 2024; Solano-Barliza et al., 2024). They provide experiential settings that enhance visitor satisfaction, strengthen destination image, and encourage revisit intention (Adekuajo et al., 2023; Borlido & Kastenholz, 2023; Mulyono & Rolando, 2024; Northover et al., 2024; Sharma & Srivastav, 2024), while supporting socio-economic development through stakeholder participation and local engagement (Nosike et al., 2024; Sánchez Herrera et al., 2024; Weinstein-Tagrina, 2022).

At the same time, the increasing scale and multi-stakeholder nature of festivals introduce significant operational challenges. Large crowds, dense visitor flows, and time-sensitive service delivery create demands related to coordination, safety, and behavioural risk management (Menchenko & Javed, 2023; Santamarina et al., 2024). These conditions require adaptive management approaches that can respond to dynamic environments while maintaining the cultural and experiential integrity of festivals (Edison & Raj, 2024; Papoutsis, 2023).

In response to these challenges, the rapid advancement of digital technologies has begun to transform how festivals are planned, delivered, and experienced (Garg & Modi, 2025; Osman, 2022). This transformation reflects a broader shift towards digitalisation in the event and tourism industries, where technology is increasingly used to enhance operational efficiency, visitor engagement, and strategic decision-making. Technological and data-driven solutions are now being explored to support planning, monitoring, risk mitigation, and communication processes without undermining the cultural and social meanings that festivals represent (Papoutsis, 2023; Ryan et al., 2020).

Overall, while festivals continue to contribute to tourism development and community engagement, their increasing operational complexity and evolving stakeholder demands have intensified the need for more efficient, adaptive, and technology-enabled management approaches.

Technologies in Festival Contexts

In recent years, the growing integration of technology into festival has driven a major shift in how festivals and events are designed, delivered, and experienced (Garg & Modi, 2025). In festival context, technology refers to a range of digital tools and data-enable systems used to support the design, promotion, operation, and evaluation of festival experiences (Osman, 2022).

These technologies can enhance festival development by improving real-time coordination, visitor engagement (Ngernyuang & Ying Wu, 2020), service delivery, safety management, and operational planning. Given the temporary, high-density, and logistically intensive nature of festivals, technology adoption has the potential to address persistent managerial challenges related to crowd management, experience design (Garg & Modi, 2025), and resource optimization (Papoutsis, 2023).

Technology also plays a strategic role in festival marketing and communication (Ngernyuang & Ying Wu, 2020). Digital platforms enable organisers to extend festival visibility beyond on-site audiences, strengthen destination branding (Garg & Modi, 2025) and facilitate ongoing interaction with communities before, during, and after the event (Ngernyuang & Ying Wu, 2020).

At the same time, technology adoption may intensify managerial and socio-cultural tensions, as organisers must balance innovation with tradition while navigating constraints such as cost, data availability, technical capability, and privacy or ethical concerns (Papoutsis, 2023).

Despite these advancements, research on technology adoption in festival contexts remains fragmented and uneven. Existing studies often focus on specific technologies, isolated outcomes, or particular festival settings, resulting in a lack of integrated understanding of technology applications, stakeholder benefits, and implementation challenges across the broader festival landscape.

This fragmentation limits the ability to systematically understand how technology contributes to festival performance, stakeholder value creation, and long-term sustainability.

Accordingly, this narrative review synthesises existing studies on technology adoption in festivals to clarify what has been implemented, what benefits have been reported, and what challenges or barriers continue to shape adoption decisions.

This study contributes by moving beyond fragmented discussions to provide a structured synthesis of technology applications, stakeholder benefits, and implementation barriers in festival contexts, thereby offering clearer insights for both research and practice.

Responding to recent calls for further research on festivals and emerging digital technologies (Iskender et al., 2024), and earlier suggestions to strengthen understanding of digital applications in event delivery (Ryan et al., 2020), this review also develops a future research agenda to support the evolving needs of both scholars and practitioners in festival management (Lopes & Hiray, 2024).

To directly address the identified gaps, this study focuses on synthesising evidence related to technology applications, stakeholder benefits, adoption barriers, and future research directions in festival–technology research.

Accordingly, this study addresses the following research questions (RQs):

RQ1: What types of technologies have been adopted in festival contexts?

RQ2: What benefits of technology adoption are reported for festival organisers, attendees, and other stakeholders?

RQ3: What challenges and barriers influence the adoption and implementation of technologies in festivals?

RQ4: What research gaps and future directions emerge from existing festival-technology studies?

METHODOLOGY

This section outlines the integrative review process undertaken by the authors. Following Whittemore and Knafl (2005), the integrative review comprised five stages: problem identification, literature search, data evaluation, data analysis, and presentation of findings. Each stage was conducted systematically and documented transparently to enhance the validity and trustworthiness of the review, ensuring that the findings are credible and can inform both future research and festival management practice (Ghosh & Choudhury, 2025).

This study adopts an integrative review approach, which allows for the inclusion and synthesis of qualitative, quantitative, mixed-method, and theoretical studies, thereby providing richer and more comprehensive insights than single-method reviews (Dela & Gross, 2017; Oermann & Knafl, 2021). By integrative findings across diverse methodological approaches, this approach enables deeper understanding and stronger explanatory power in addressing complex research questions (Ghosh & Choudhury, 2025; Snyder, 2019). It is therefore particularly suitable for examining complex phenomenon such as technology adoption in festival context for building a strong research foundation (Dela & Gross, 2017; Oermann & Knafl, 2021). Consistent with Whittemore and Knafl (2005), the integrative approach also holds strong potential to support evidence-based understanding of the issues discussed in this study.

Importantly, this study is explicitly positioned as an integrative review rather than a purely narrative review, as it follows a structured, multi-stage process of literature identification, evaluation, analysis, and synthesis. This positioning is also reflected in the Introduction section to ensure consistency across the manuscript.

Problem identification

The review was initiated to address the fragmented nature of festival-technology research. Although digital tools are increasingly applied in festival contexts, existing studies remain dispersed across festival types and disciplines, with uneven attention to stakeholder benefits, implementation barriers, and governance concerns. Accordingly, this integrative review synthesises empirical and theoretical literature to consolidate evidence on: (i) technologies adopted in festivals, (ii) reported benefits for key stakeholders, (iii) challenges and barriers influencing adoption and implementation, and (iv) research gaps and future directions.

Literature Search

Relevant literature was identified primarily through Google Scholar, complemented by backward and forward snowballing techniques. According to Köhler et al., (2025), snowballing expands a literature base by examining both the references cited in selected articles (backward snowballing) and newer articles that cite them (forward snowballing). This iterative process enabled the identification of relevant studies across disciplines related to festivals, events, tourism, and technology adoption. The use of snowballing was also informed by Shalihah (2024), who applied this technique in a review article.

Google Scholar was selected as the primary search platform because it supports the identification of a wider range of relevant studies, particularly in interdisciplinary or emerging areas where important work may be missed if only traditional, discipline-specific databases were used (Martín-Martín et al., 2018). The breadth of Google Scholar also aligns with the integrative review approach, which seeks to synthesize evidence across diverse study designs, theoretical perspectives, and disciplinary boundaries (Dela & Gross, 2017).

Data Evaluation

To ensure coherence and relevance, studies were selected using the following criteria:

- The study addresses festivals, events, or closely related tourism contexts.
- The study discusses technology adoption, application, or implications relevant to event or festival settings.
- The study contributes conceptually or empirically to understanding adoption drivers, outcomes, challenges, or governance issues.

In addition, studies were assessed for relevance, conceptual contribution, and alignment with the research objectives to ensure consistency in the selection process.

Unlike systematic literature review, which requires rigid inclusion and exclusion rules and detailed record-keeping procedures, integrative reviews allow for more flexible selection when the objective is conceptual and interpretive synthesis (Ghosh & Choudhury, 2025). Accordingly, no restrictions were imposed on methodological design. Studies were included as long as they were relevant and contributed to answering the research questions. The final dataset comprised 59 articles for analysis and synthesis.

Data Analysis and Synthesis

The 59 selected articles were analysed using a thematic and comparative synthesis approach. Key information relevant to the research questions was extracted and organised into matrix table. This approach was informed by prior studies that use structured extraction and synthesis procedures (Goyanes et al., 2025; Nguyen-Trung, 2025).

The coding process followed an iterative thematic analysis procedure, where initial codes were generated based on recurring concepts in the literature. These codes were then grouped into broader categories and refined into higher-order themes aligned with the study objectives, namely technology types, stakeholder benefits, and adoption challenges. A thematic framework was developed to guide the analysis, ensuring consistency in how findings from different studies were compared and synthesised. ChatGPT was used as a supporting tool to assist with initial thematic organisation and pattern identification (Turobov et al., 2024). To ensure accuracy and validity, the extracted themes and interpretations were subsequently cross-checked by the authors against the original articles.

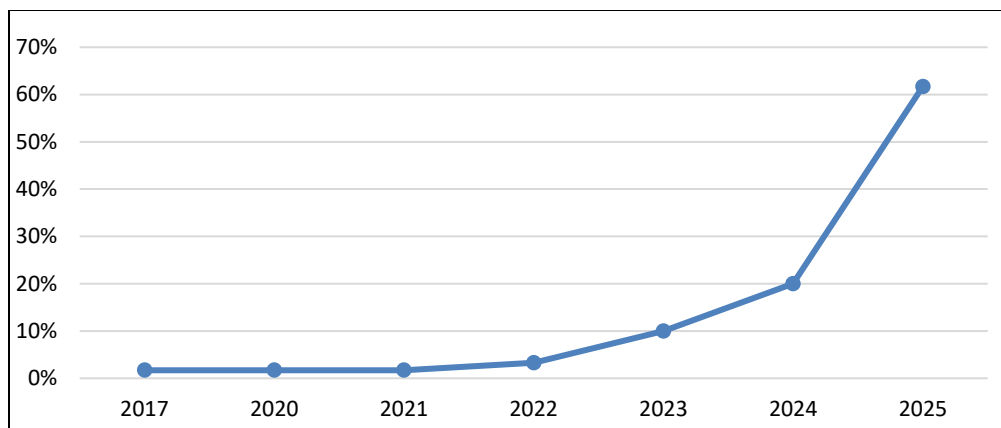
To enhance trustworthiness, multiple strategies were applied, including iterative comparison across studies, validation of themes against original sources, and careful interpretation to minimise bias. This process ensured that the findings reflect a consistent and credible synthesis of the literature. Through iterative comparison and abstraction, recurring themes and patterns were identified and integrated to develop a structured understanding of technology adoption in festival contexts. Instead of combining the results statistically, the review brought together key evidence to answer the research questions and develop broader insights that go beyond any single study.

FINDINGS AND DISCUSSION

The reviewed literature spans 2017–2025 and shows a strong concentration in recent years. As illustrated in Figure 1, publications increased sharply from 2023 onward, with the majority of included studies published in 2024–2025, indicating rapidly growing scholarly attention to technology adoption in festival contexts. This surge suggests that technology adoption in festivals is not only an emerging research area but also reflects broader industry shifts toward digital transformation, particularly in response to recent disruptions such as the COVID-19 pandemic and the increasing demand for hybrid and digitally mediated event experiences.

Figure 1

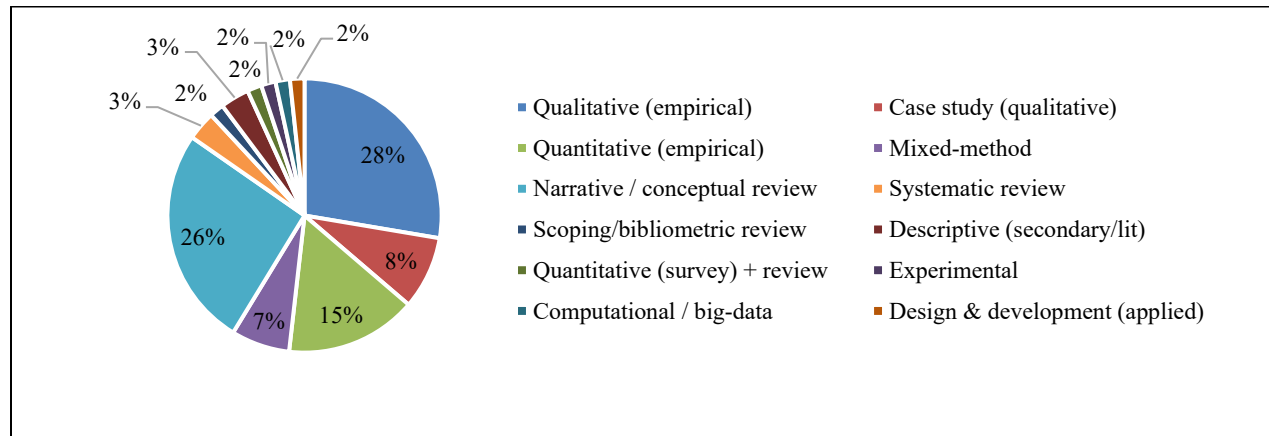
Publication Trend of Included Studies by Year (%)



In addition to publication trends, the included studies demonstrate substantial methodological diversity. Figure 2 summarises the methodological distribution, showing that the evidence base comprises a mix of qualitative studies, quantitative studies, mixed-method research, and multiple forms of review papers. This diversity aligns with the nature of an integrative review, which allows evidence to be drawn from different research designs to generate richer synthesis and deeper explanatory insights than single-method reviews (Ghosh & Choudhury, 2025; Snyder, 2019). The diversity of methodological approaches also indicates that the field is still evolving, with no dominant research paradigm, which may explain the variation in findings and the lack of consistent theoretical grounding across studies.

Figure 2

Methodological Distribution of Included Studies

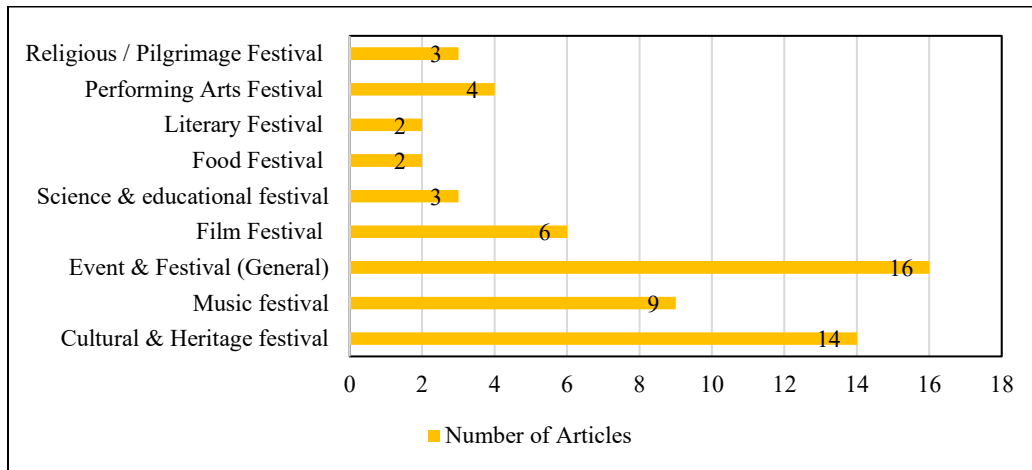


Beyond publication trends and methodological patterns, the review also examined the festival settings in which technology adoption has been studied. Figure 3 presents the distribution of festival types represented in the dataset. The largest share of studies was coded as “events & festivals (general)” ($n = 16$). This category captures studies that discuss technology adoption at the level of event management practice such as visitor information systems, digital marketing and platform use, analytics, and operational technologies without anchoring the analysis to a specific festival type or named festival. The prominence of this category suggests that a substantial portion of the literature remains technology-led and cross-context, aiming to generate transferable insights across multiple event settings rather than focusing on context-specific dynamics.

Among festival-specific contexts, cultural and heritage festivals form the most frequently examined category ($n = 14$), followed by music festivals ($n = 9$) and film festivals ($n = 6$). This pattern indicates that research attention is concentrated in settings where experience design, cultural representation, and visitor engagement are central, and where digital tools are commonly used to support interpretation, communication, and delivery. In contrast, fewer studies were identified in food festivals ($n = 2$) and literary festivals ($n = 2$), with relatively modest coverage of science and educational festivals ($n = 3$), religious/pilgrimage festivals ($n = 3$), and performing arts festivals ($n = 4$). Overall, the distribution highlights opportunities for future research to examine how adoption drivers, outcomes, and barriers may differ across a wider range of festival types with distinct visitor motivations, operational structures, and stakeholder dynamics.

Figure 3

Distribution of Festival Types in Technology Adoption Studies ($n = 59$)



This uneven distribution suggests that current knowledge on technology adoption may be biased toward experience-intensive festival contexts, such as cultural and music festivals, while underexploring other festival types with different operational characteristics. As a result, findings related to adoption drivers, benefits, and barriers may not be fully transferable across all festival contexts.

Types of technologies have been adopted in festival contexts?

Based on Table 1, technology adoption in festival contexts spans eleven categories: AI (artificial intelligence) and ML (machine learning), accessibility technologies, augmented reality (AR), chatbots/conversational agents, digital documentation and learning tools, digital marketing and e-commerce tools, hybrid/phygital technologies, metaverse/virtual worlds, social media and user-generated content (UGC) platforms, web platforms/festival apps, and broader ICT/digital transformation tools. These categories indicate that festival technology adoption extends beyond immersive visitor experiences and increasingly includes communication platforms, marketing infrastructures, operational systems, accessibility supports, and digital tools for cultural documentation and learning.

Table 1

Mapping of technology types and festival contexts in the reviewed studies

Technology type	Festival contexts where applied	Functions of technology in festival contexts	Key Sources
AI / ML (incl. generative)	Cultural/heritage festivals; Music festivals; Traditional cultural festivals	• Personalise experiences • Support decision-making (e.g., sustainability/operations) • Generate/curate digital content	Neuhofer et al. (2021); Rabia (2024); Lopes et al. (2025); Tian (2025)
Accessibility technologies	Music festivals/events; Events/festivals (general)	• Real-time sign-language translation at music concerts and festivals • Improves accessibility for deaf and hard-of-hearing audiences	Papatsimouli & Sarigiannidis (2023); Lee & Jenifer (2025); Adekujajo et al. (2023)

Augmented reality (AR)	Science/educational festivals; Music events	- through assistive communication support • Enriches learning and engagement through immersive, interactive overlays • Used to communicate educational and sustainability messages	Tom Dieck et al. (2017); Lee et al. (2025)
Chatbots / conversational agents	Events/festivals (general)	• Provides automated information and guidance while enabling human-like interaction with festival visitors.	Benaddi & Ouaddi (2024); Neuhofer et al. (2021)
Digital documentation & learning tools	Cultural/heritage festivals; Literary festivals; Language/cultural programmes	• Apps, virtual tours, and digital archives support cultural learning, interpretation, and language revitalisation in cultural and literary events.	Huszka et al. (2024); Firmansyah et al. (2025)
Digital marketing / e-commerce	Cultural/heritage festivals; Cultural/creative-economy festivals; Film festivals	• Supports cultural preservation and education via digital archives, learning apps, and virtual content. • Expands reach and market access through digital marketing and e-commerce (e.g., UMKM/student festival bazaars). • Strengthens film-festival promotion using AI and data analytics. • Enables tea e-commerce promotion through live-streaming collaborations.	Xie & Nallaluthan (2024); Ernawati et al. (2025); Rabia (2024); Kumari & Thakur (2023)
Hybrid / phygital technologies	Hybrid festivals; Cultural festivals	• Extends participation by integrating onsite and online festival experiences. • Expands audiences and improves accessibility.	Georgoula et al. (2025); Marinakou & Mathew (2025); Maniou et al. (2025)
Metaverse / virtual worlds	Virtual/digital festivals	• Creates immersive virtual environments that simulate presence and enable remote participation through enhanced realism (e.g., Decentraland-style festivals).	Iqbal & Campbell (2023); Nazirullah et al. (2025); Green (2025)
Social media & UGC platforms	Film festivals; Music festivals/events; Cultural festivals;	• Amplifies festival visibility, engagement, and community interaction via social sharing and UGC (e.g., WhatsApp/Telegram/Instagram	Kumari & Thakur (2023); Aliakbari (2023); Liu & Hou (2025); Pearson et al. (2025); Puccia et al.

	Traditional celebrations	campaigns, influencer live sessions, and photo/video contests).	(2025); Heidl (2025); Tsaltsabilla et al. (2025)
Web platforms / festival apps	Shrine/religious festivals; Events/festivals (general)	• Supports festival management, information delivery, and visitor navigation, including personalised access and ticketing (e.g., Shrine Festival Support Web Application)	Ide et al. (2025); Chen & Yu (2024)
Unspecified general ICT	Music festival, Film festival, Cultural/heritage, Culinary/food, Performing arts, Events/festivals (general)	• Broad ICT and digital transformation improve festival planning, promotion, and operations by modernising design, marketing, communication, and service delivery (e.g., digital programming during lockdowns and online promotion for culinary festivals).	Adekuajo et al. (2023); Aktepe & Demirci (2024); Belenioti (2022); Hatidah et al. (2025)

Overall, as mapped in Table 1, the functions reported across these technology types can be synthesised into seven themes: experience enhancement and immersion; information, communication and visitor support; accessibility and inclusion; marketing, visibility and audience engagement; operations, management and decision support; cultural documentation, preservation and learning; and participation extension and continuity (hybrid/virtual delivery). These functions are not limited to experience enhancement alone; they also support accessibility, operational coordination, cultural interpretation, and continuity/resilience-related capabilities that are closely linked to perceived value and satisfaction in festival experiences (Jalilvand & Ghasemi, 2024). Importantly, the findings indicate a shift from technology being used primarily for experience enhancement toward a broader role in operational management, communication, and strategic decision-making. While immersive technologies such as AR and metaverse applications are frequently highlighted, other technologies such as data analytics, AI, and platform-based systems play a more critical role in enabling coordination, efficiency, and scalability. This suggests a mismatch between research attention and practical utility, where highly visible technologies receive more focus despite operational technologies being more central to festival performance.

Benefits of technology adoption in festival contexts

The reviewed studies indicate that technology adoption in festivals benefits multiple stakeholder groups, including attendees, organisers, destination management organisations (DMOs), communities, public agencies/authorities, sponsors, and cultural institutions (Table 2). For attendees, immersive technologies such as Augmented Reality (AR), Virtual Reality (VR), and metaverse-based applications enhance experience quality by increasing engagement, enjoyment, and memorability (Tom Dieck et al., 2017; Neuhofer et al., 2021). Beyond the on-site experience, digital exposure through social media and online platforms strengthens destination image and branding, increasing visibility for host destinations (Chen & Yu, 2024; Islamy, 2025; Liu & Hou, 2025; Pearson et al., 2025).

The review also highlights substantial benefits for festival organisers. Hybrid, virtual, and digitally mediated formats expand audience reach beyond physical venues and enable participation continuity (Georgoula et al., 2025; Green, 2025; Islamy, 2025; Marinakou & Mathew, 2025). In addition, social media, User Generated Content (UGC), influencer campaigns, and short-form video enhance marketing effectiveness by improving visibility and engagement (Kumari & Thakur, 2023; Liu & Hou, 2025; Pearson et al., 2025; Puccia et al., 2025). Importantly, emerging tools such as AI, analytics, and event technologies support operational efficiency and real-time decision-making by strengthening coordination, information quality, and logistics management. Technology-led platforms also support festival management and sustainability practices by enabling continuity and more systematic planning (Ide et al., 2025; Lee et al., 2025; Maniou et al., 2025). Finally, multiple studies emphasise the resilience function of technology adoption: digital, virtual, and hybrid delivery helps festivals continue during disruptions such as mobility restrictions and crisis periods (Aliakbari, 2023; Banerji, 2025; Belenioti, 2022; Green, 2025).

Table 2

Stakeholder Benefits of Technology Adoption in Festival Contexts

Stakeholder	Benefit theme	What the studies report	Key Sources
Attendees	Better experience quality (immersive + memorable)	AR, VR, metaverse and immersive previews enhance engagement, enjoyment, and memorability through interactive and experiential design.	Tom Dieck et al. (2017); Neuhofer et al. (2021); Iqbal & Campbell (2023); Sjukriana et al. (2025); Nazirullah et al. (2025)
	Convenience + personalisation	AI-enabled platforms and festival apps provide tailored information, personalised recommendations, immersive previews, and seamless ticketing/decision-making.	(Neuhofer et al., 2021); (Lopes et al., 2025); (Nazirullah et al., 2025)
	Accessibility & inclusion	Accessibility technologies (e.g., real-time sign-language translation, accessible online information) reduce participation barriers for people with disabilities.	Papatsimouli & Sarigiannidis (2023); Lee & Jenifer (2025); Adekuajo et al. (2023)
	Community & belonging	Social media platforms and online communities extend communities, identity formation, and social connection before, during, and after festivals.	Heidl (2025); Tsaltsabilla et al. (2025); Obamwonyi (2025)
	Learning & cultural understanding	Digital archives, learning apps, AR content, and media-based storytelling enhance cultural interpretation, heritage learning, and meaning-making.	Tom Dieck et al. (2017); Huszka et al. (2024); Casini et al. (2025)
Organisers	Audience expansion & reach	Digital media, hybrid formats, and virtual delivery extend reach beyond physical venues and attract new audience segments.	Islamy (2025); Georgoula et al. (2025); Marinakou & Mathew (2025); Green (2025)

Destinations / DMOs	Marketing effectiveness & engagement	Social media, UGC, influencer campaigns, and short-form video increase engagement, visibility, and promotional effectiveness.	Pearson et al. (2025); Liu & Hou (2025); Puccia et al. (2025); Kumari & Thakur (2023)
	Operational efficiency & decision support	AI tools, data analytics, and event technologies improve information quality, logistics, coordination, and real-time decision-making.	Neuhofer et al. (2021); Lopes et al. (2025); Sjukriana et al. (2025); Aktepe & Demirci (2024)
	Festival management & sustainability	Web platforms, apps, and technology-led sustainability tools support management by non-technical users, continuity, and sustainable practices.	Ide et al. (2025); Lee et al. (2025); Maniou et al. (2025)
	Resilience & continuity during disruption	Digital, virtual, and hybrid formats enable festivals to continue during crises (e.g., COVID-19, lockdowns, mobility restrictions).	Belenioti (2022); Aliakbari & (2023); Banerji (2025); Green (2025)
	City image, branding & tourism promotion	Digital exposure via social media, UGC, and online platforms strengthens destination branding, international visibility, and tourism promotion.	Liu & Hou (2025); Islamy (2025); Pearson et al. (2025); Chen & Yu (2024)
Communities	Cultural heritage documentation & youth engagement	Digital storytelling, social platforms, webtoons, and documentation tools preserve heritage and engage youth in cultural expression.	Tsatsabilla et al. (2025); Kumari & Thakur (2023); Firmansyah et al. (2025); Guo et al. (2025)
Public agencies	Public safety & crowd management	Social media analytics and geotagged data support crowd monitoring, emergency detection, and situational awareness.	Duan et al. (2020)
Public agencies / Religious authorities	Health, safety & crowd control in mass gatherings	Wearables and smart devices (e.g., smart bracelets) support health monitoring, crowd control, and communication in large-scale events.	Maddah et al. (2025)
Sponsors / Cultural institutions	Science communication & public engagement	Film, digital media, and festival screenings act as boundary spaces connecting experts, institutions, and the public.	Casini et al. (2025)

Overall, the reported benefits suggest that technology adoption in festivals delivers both experiential and instrumental value: it enhances immersion and personalisation while also strengthening accessibility, marketing reach, operational decision-making, safety management, and continuity during disruptions. Collectively, these outcomes position technology as a strategic enabler of visitor satisfaction, inclusive participation, organisational effectiveness, and festival resilience. However, the reported benefits are not uniform across contexts. While many studies emphasise experiential value for attendees, others highlight

operational and strategic value for organisers and stakeholders. This variation suggests that perceived benefits are contingent on stakeholder roles, festival type, and level of technological integration. From a theoretical perspective, this aligns with technology adoption perspectives that emphasise perceived usefulness as a context-dependent construct rather than a universal outcome.

Challenges and barriers influencing the adoption and implementation of technologies in festivals

Despite the benefits of technologies discussed in the previous section, Table 3 shows that barriers to festival technology adoption across the reviewed studies can be grouped into four clusters: (i) people and capability, (ii) access, cost, and resourcing constraints, (iii) governance issues (Trust, privacy, ethics), and (iv) experience-design challenges.

People and capability emerged as a prominent barrier. The adoption of advanced technologies (e.g., AI/ML, metaverse, AR/VR, and data analytics) depends on digital readiness, staff competence, and organisational capacity to implement and maintain systems (Lopes et al., 2025; Nazirullah et al., 2025; Sjukriana et al., 2025; Aktepe & Demirci, 2024). Where these capabilities are limited, technology investments may not deliver their intended value. Limited manpower and insufficient expertise to execute digital communication and platform management also hinder festival organisations from staying up to date with technological developments and sustaining ongoing maintenance.

Access, cost, and resourcing constraints were also frequently reported. For example, Ernawati et al. (2025) found that limited access, cost, and resources were key barriers to technology adoption at the Rimpu Mantika Festival (Bima, West Nusa Tenggara). In addition, funding instability can restrict long-term integration and upgrading of digital systems. Maniou et al. (2025) reported that many festival organizations face unstable funding when maintaining and integrating new technologies. This challenge is intensified by the rapid pace of digital innovation, which increases complexity as organizations must manage multiple platforms, large volumes of data, and rapidly shifting online trends (Garg & Modi, 2025).

Challenges related to experience design were particularly evident in hybrid and technology-mediated festival formats. Georgoula et al. (2025) and Marinakou and Mathew (2025) noted that designing technology-enabled experiences is difficult, especially when festivals are delivered in hybrid modes that must engage both on-site and online audiences. Delivering a coherent experience across physical and virtual settings requires intentional design, as online participation should not be treated as a simple broadcast or perceived as “second best” (Maniou et al., 2025). Another challenge involves ensuring equitable access and meaningful inclusion for online participants, as their sense of inclusion strongly shapes engagement and overall experience (Tsaltsabilla et al., 2025; Lee & Jenifer, 2025; Ernawati et al., 2025).

Table 3

Challenges and barriers influencing technology adoption and implementation in festivals

Barrier cluster	Challenge theme	What the studies report	Example sources
People & capability	Skills / capability readiness	Adoption of advanced technologies (AI/ML, metaverse, AR/VR, data analytics) depends on digital readiness, staff competence, and organisational	Lopes et al. (2025); Nazirullah et al. (2025); Sjukriana et

	Human resource constraints	capability to implement and maintain systems. Limited manpower and expertise constrain digital communication, optimisation, and sustained technology adoption, especially in smaller or volunteer-led festivals.	al. (2025); Aktepe & Demirci (2024) Ernawati et al. (2025); Maniou et al. (2025)
	Non-technical maintenance capability	Festival apps/platforms may not be sustainable if organisers cannot update, troubleshoot, or manage them without technical support; usability and maintainability become critical.	Ide et al. (2025)
Access, cost & resources	Limited access & weak follow-through	Adoption can be constrained by limited access to tools/ infrastructure and weak continuation after events (e.g., limited follow-up or incubation). Accessibility initiatives require consultation, time, and resources; implementation involves trade-offs, competing priorities, and organisational capacity constraints.	Ernawati et al. (2025) Lee & Jenifer (2025)
	Resourcing constraints for inclusion	Festivals may face unstable funding and competitive pressures, limiting long-term digital transformation and continued hybrid/online innovation.	Maniou et al. (2025); Casini et al. (2025)
	Funding instability / sustainability pressures		
Trust, privacy, ethics & governance	Privacy, ethics & resistance	AI, metaverse, and data-driven systems can raise privacy and ethical concerns and trigger resistance; adoption requires governance and clear value justification. Benefits depend on reliable systems and high-quality information; trust becomes a condition for adoption, particularly where AI shapes recommendations or decisions.	Nazirullah et al. (2025); Sjukriana et al. (2025); Lopes et al. (2025)
	Trust / reliability of AI and data	Digital marketing and platform-based engagement raise compliance issues (e.g., advertising ethics, platform rules), shaping how campaigns can be designed and targeted.	Lopes et al. (2025); Neuhofer et al. (2021)
	Regulatory / legal concerns		Pearson et al. (2025)
Experience design	Hybrid experience design difficulty	Delivering a coherent experience across on-site and online audiences is challenging; online engagement must be intentionally designed rather than treated as a simple broadcast.	Georgoula et al. (2025); Marinakou & Mathew (2025)
	Preference for physical experience	Hybrid/online formats expand access, but many audiences still prefer in-person festivals; digital formats must add distinctive value to avoid being perceived as “second best.”	Georgoula et al. (2025); Maniou et al. (2025)

Authenticity & meaning risks	Digital mediation can commodify culture, blur meaning/authenticity, and alter ritual participation; virtual formats require negotiation of liveness and mediated aesthetics.	Tsalsabilla et al. (2025); Banerji (2025); Obamwonyi (2025)
Digital divide / unequal participation	Online participation can reproduce inequalities through uneven access, skills gaps, and exclusion of groups with limited connectivity or digital literacy.	Tsalsabilla et al. (2025); Lee & Jenifer (2025); Ernawati et al. (2025)

The findings also reveal that these barriers are interrelated rather than independent. For example, limited organisational capability often exacerbates challenges related to technology implementation, while governance issues such as privacy and trust can influence user acceptance and overall effectiveness. In addition, tensions between innovation and authenticity highlight the unique complexity of festival contexts, where technological advancement must be balanced with cultural meaning and experiential integrity.

Research gaps and future directions emerge from existing festival-technology studies

The fourth objective of this study is to identify gaps in the existing literature. Despite the growing number of festivals–technology publications, our content analysis of 59 articles identifies eleven key gaps, grouped into academic and practical (industry) gaps. From an academic perspective, the gaps relate mainly to limited theorisation and uneven evidence. Technology is often discussed as a supporting tool, rather than as something that can shape festival meaning, cultural representation, and governance (Tsalsabilla et al., 2025; Banerji, 2025; Obamwonyi, 2025). In addition, hybrid and virtual festivals are frequently promoted for expanding reach, yet the specific design features that create a “live” and engaging festival experience remain under-tested (Georgoula et al., 2025; Marinakou & Mathew, 2025; Maniou et al., 2025).

Measures of festival impact also vary widely, with limited consistency in capturing festival-specific outcomes beyond satisfaction or intention (Lopes et al., 2025; Pearson et al., 2025). Accessibility is commonly framed in terms of provision, with less attention to equitable quality of participation across festival touchpoints (Lee & Jenifer, 2025). Finally, there is still limited work that tracks technology adoption across multiple festival editions and addresses AI-related issues such as trust, transparency, consent, and fairness in festival settings (Ernawati et al., 2025; Maniou et al., 2025; Nazirullah et al., 2025; Sjukriana et al., 2025; Lopes et al., 2025). Table 4 not only highlights the academic gaps, but also summarises clear future research directions from this review, including suitable theories, stronger research designs, and key outcomes to evaluate for more rigorous festival technology research.

Table 4

Academic research gaps and future research directions

Academic Research gap	Future research directions
Technology is often seen as a tool to help, not something that can change what a festival means or who has influence (e.g., how culture is shown, who controls the story online).	Explore who controls festival messages online, how culture is presented on platforms, and how digital tools change participation and cultural ownership.
Hybrid/virtual festivals are often described as increasing reach, but it is unclear what makes online participation feel “alive” and engaging like being there in person.	Test which features create strong engagement: live sessions, interaction, co-creation, behind-the-scenes access, AR at the venue, good moderation, and community activities.
Festival success is often measured using general things like satisfaction, while festival-specific outcomes are not measured consistently (e.g., sense of belonging, cultural learning, crowd comfort, queue stress, return visits, quality of online sharing).	Use a clear set of festival outcome measures; combine online data (posts, views, retention) with on-site feedback (short experience check-ins, crowd comfort, service and queue experience).
Accessibility is often treated as providing facilities or information, but less attention is given to whether disabled attendees get equal quality of experience across ticketing, information, wayfinding, programmes, and digital content.	Design and evaluate accessibility with disabled attendees; check outcomes like participation quality, safety, satisfaction, and inclusion, across festival types and on-site vs online modes.
There is limited work that tracks technology use across several festival editions, so it is unclear what keeps working over time as organisers and audiences learn.	Follow festivals across editions; compare before/after changes, try small tests (e.g., message or ticketing changes), and document what improves and what does not.
Limited long-term and causal insight; it remains unclear what works across multiple festival editions.	Use pre/post designs across editions, A/B tests (e.g., messaging/ticketing), phased feature rollouts, and stakeholder interviews.
AI is mentioned for personalisation and operations, but questions remain about trust, transparency, consent, and fairness, and how AI shapes what people see and do at festivals.	Test what makes people trust AI: clear explanations, consent, user control, and good data. Check how AI recommendations and automated messages affect behaviour and fairness perceptions.

Table 5 below highlights several practical gaps in using technology for festivals. It shows that implementation details are often unclear, technology use may not continue across festival editions, and hybrid delivery can increase workload and operational risk. The table also points to weak guidance on platform ethics and compliance, as well as the risk of excluding some participants due to poor connectivity, limited devices, or low digital skills. Overall, it recommends simple steps such as keeping clear implementation records, planning for continuity, using a hybrid playbook, setting basic governance rules, and offering low-data or offline options to support inclusion.

Table 5*Key research gaps and future directions in festival–technology studies*

Practical gap	Future research / practice directions
Tech work is often not explained clearly (cost, vendor choice, training, maintenance work, system problems, how it connects to ticketing/access, and what was checked after the event).	Write a simple “how we did it” record: budget range, training plan, who maintains the system, common problems and fixes, how systems connect (ticketing–content–operations), data handling plan, and a short post-event review.
Festival technology may be used for one edition, then stops because there is no long-term plan, stable funding, or clear ownership.	Make a continuity plan: handover notes, standard steps (SOPs), clear roles, partner support, and a basic funding plan. Check progress 3–12 months later and again at the next edition.
Hybrid festivals add extra workload because the on-site and online parts run at the same time. This increases pressure on staff, content, moderation, and incident response.	Prepare a hybrid playbook: staffing plan, content plan, moderation plan, accessibility plan, and a basic crisis plan. Define a “minimum hybrid” option for small teams.
Clear guidance is often missing for platform ethics and rules (privacy, youth exposure, influencer behaviour, moderation, content ownership, and compliance).	Create simple rules and checklists: consent and privacy steps, youth protection rules, influencer guidelines, moderation rules, content rights, crisis steps, and compliance checks.
Some people can be left out because of weak internet, limited devices, or low digital skills, especially for ticketing, information, and online participation.	Offer low-data options, offline alternatives, on-site help, and easy-to-access content formats. Track where people drop off and improve those points.

Taken together, these gaps indicate that festival–technology research remains fragmented across conceptual, methodological, and practical dimensions. This fragmentation limits the development of cumulative knowledge and highlights the need for more integrative, theory-informed, and longitudinal research to better understand the long-term implications of technology adoption in festival contexts.

CONCLUSION AND IMPLICATIONS

This study provides an integrative synthesis of research on technology adoption in festival contexts, drawing on literature published between 2017 and 2025. By organising the findings into three core dimensions—technology types, stakeholder benefits, and adoption barriers, the study offers a structured understanding of a previously fragmented research area.

The findings show that technology adoption in festivals extends beyond experiential enhancement to include communication, operational coordination, decision-making, and continuity during disruptions. While immersive technologies such as AR and metaverse applications are widely highlighted, the review reveals that less visible tools such as data analytics, AI, and platform-based systems play a more critical

role in enabling efficiency and scalability in festival operations. At the same time, the analysis highlights important variations and tensions across studies. Although technology is frequently associated with enhanced experience quality, increased accessibility, and expanded reach, its effectiveness is highly context-dependent. Conflicting findings are particularly evident in hybrid and virtual festival formats, where expanded participation is often accompanied by challenges related to engagement quality, authenticity, and experience design. These patterns suggest that technology adoption in festivals is shaped not only by functional considerations but also by organisational capability, resource availability, and socio-cultural dynamics.

From a theoretical perspective, the findings suggest that technology adoption in festival contexts cannot be fully explained by traditional models focusing solely on perceived usefulness or ease of use. Instead, adoption is influenced by a broader set of factors, including governance considerations, stakeholder interactions, and cultural meaning. This highlights the need for future research to adopt more integrative and context-sensitive approaches that capture the multi-dimensional nature of technology adoption in festival settings. From a practical perspective, the study underscores the importance of strategic and context-aware technology adoption. Festival organisers should prioritise alignment between technological tools and event objectives, invest in organisational capabilities, and adopt intentional design approaches for hybrid and digital experiences. In addition, attention to governance issues such as privacy, trust, and platform management is essential to ensure sustainable and responsible technology use.

Finally, the study identifies key gaps in current research, including limited theoretical integration, inconsistent measurement of festival-specific outcomes, and a lack of longitudinal and cross-context studies. Addressing these gaps will be critical for advancing both academic understanding and practical application of technology in festivals. Overall, this study contributes by moving beyond descriptive accounts to provide a structured, analytical, and practice-oriented synthesis of festival–technology research, offering a foundation for future inquiry and evidence-based decision-making in festival management.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHOR CONTRIBUTION STATEMENT

Ramely, A. conceptualized, designed, and wrote the paper. Zakaria, H. M. contributed to the analysis of stakeholder benefits, while Mokhtar, M. F. investigated implementation barriers and adoption challenges. Kamarudin, L. M. contributed to the research design and methodology, assisted in interpreting the findings, critically reviewed the manuscript, and approved the final version.

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