



JOURNAL OF TOURISM, SUSTAINABILITY AND WELL-BEING

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Local Communities Don't Walk the Greens: The Case of Portugal and Spain (Andaluzia)

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The **Journal of Tourism, Sustainability and Well-being (JTSW)** is an international open-access academic journal in the tourism field that publishes high-quality, refereed articles that advance science widely available so that tourism can serve the society, enhance a sustainable development of the destinations, and positively impact the well-being of stakeholders.

JTSW offers itself a multidisciplinary and all-inclusive bridge between theoretical and practical aspects of tourism and the emerging interdisciplinary aspects that can revolutionise the tourism and hospitality industries. While the JTSW maintains its traditional focus on original research, both conceptual and empirical, that clearly contributes to the theoretical development of the tourism field, it also has a far more inclusive and broadened scope to keep up with the new problems that challenge academics and practitioners working in private, public and non-profit organisations globally. JTSW encourages research based on a variety of methods, qualitative and/or quantitative, based on rigorous theoretical reasoning and supported by a strong methodology. Criteria for evaluation include significance in contributing new knowledge, conceptual quality, appropriate methodology, technical competence (of theoretical argument and/or data analysis), and clarity of exposition.

JTSW promotes research on a broad range of topics that explore major trends in the study of relationships between tourism, sustainable development of destinations and well-being of tourism-related stakeholders. Contributions can be from all disciplinary perspectives, with interdisciplinary approaches especially welcomed as far as they apply to the tourism research field. All policy, planning and management aspects of tourism are also encouraged.

The journal is published as a quarterly international review in open access, mainly composed of thematic special issues. The publishing schedule is the last working day of March, June, September and December. Any interested scholar can submit a proposal for the guest-edition of a special issue to the Editor-in-Chief. The proposal should follow the guidelines provided in the Guide for Guest Editors. Each article must follow the publication rules as in the Author Guidelines. The Guest-Editors and the Editor-in-Chief are responsible for the implementation of a double-blind review process. This method ensures that the author(s) and the reviewers remain anonymous to guarantee a fair and impartial review of the submitted manuscripts.

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The Editorial Board gathers world-renowned experts in different scientific areas, with a striving balance in geographic and gender diversity.

EDITORIAL

The third issue of JTSW in 2026 brings together four contributions that examine how technological transformation, environmental pressures, and community engagement are reshaping tourism development and well-being. The first article reviews the growing role of emerging technologies in smart tourism events, highlighting their potential to enhance visitor experiences, accessibility, sustainability, and real-time decision-making, while also identifying important conceptual and ethical challenges. The second contribution addresses the transition towards Industry 5.0 in tourism, emphasizing the need to combine technological innovation with human-centred service, organizational learning, and adaptability. The third study demonstrates the value of integrating economic, social, and mobility data to better understand how environmental crises influence tourist behaviour and destination resilience. Finally, the fourth contribution examines the barriers that may limit local participation in tourism-related leisure activities and highlights the relevance of perceptions, accessibility, and social interaction for well-being and community inclusion. Together, these studies underline the importance of more integrated approaches to tourism development that connect digital innovation, environmental resilience, inclusive participation, and human well-being.

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A Systematic Review of Event Technologies in the context of Smart Tourism: Trends and Future Directions

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ABSTRACT

This study presents a systematic review of the integration of emerging digital technologies in smart tourism events, with the purpose of understanding how technological innovation is transforming event design, management and visitor experience. The review examines peer-reviewed journal articles and conference proceedings published between 2014 and 2024 and indexed in the Scopus and Web of Science databases. The analysis was conducted using the Bibliometrix package in the R environment, while descriptive and thematic analyses were performed with the Statistical Package for the Social Sciences. The findings show that several technological domains, including Artificial Intelligence, the Internet of Things, Big Data analytics and immersive technologies, are driving significant advances in the development of smart tourism events. These technologies support improvements in personalisation, behavioural analysis, sustainability, accessibility and real-time decision making. The review also reveals conceptual fragmentation, geographical imbalance, limited theoretical integration and the need for greater attention to ethical, accessibility and sustainability issues. Overall, this study contributes to consolidating the theoretical foundations of smart events and identifies promising directions for future research and innovation within technology-enhanced tourism event ecosystems.

KEYWORDS

Smart Tourism, Emerging Technologies, Artificial Intelligence, Event Management, Smart Technologies, Systematic Review.

ARTICLE HISTORY

Received 23 November 2025 Accepted 9 March 2026

1. Introduction

Over the past decade, the tourism sector has increasingly adopted digital technologies to enhance visitor experiences, improve management processes and support sustainable development (Buhalis & Amarangana, 2013; Gretzel et al., 2015; Backman, 2018; Jovicic, 2019; Pencarelli, 2020; Wael et al., 2023). Within this broader digital transformation, events and festivals represent a particularly relevant context because they are temporary, experience-intensive and data-rich tourism settings (Getz, 2008, 2010; Gursoy & Kendall, 2006; Getz & Andersson, 2009; Tuck & Xinyi, 2023). They bring together visitors, infrastructures, services and multiple stakeholders within limited spatial and temporal boundaries, generating specific challenges related to crowd management, personalisation, safety, accessibility, sustainability and real-time decision-making (Ryan et al., 2020; Revilla et al., 2023). In this context, smart technologies can support visitor management, logistics, environmental monitoring and experience design, while also contributing to destination competitiveness and local value creation (Lee, 2023; Getz & Page, 2024).

Smart Tourism provides a useful framework for understanding this transformation. It explains how advanced technologies and data-driven systems can connect infrastructures, organisations and users to improve tourism experiences, management efficiency and sustainability (Gretzel et al., 2015). Smart Tourism is therefore understood as a data-driven approach that uses emerging technologies, such as the Internet of Things (IoT), Artificial Intelligence (AI) and Big Data Analytics, to improve tourism management and enhance the tourist experience (Kontogianni & Alepis, 2022; Stroumpoulis et al., 2022; Aliyah et al., 2023; Liu & Niu, 2024; Suanpang & Pothipassa, 2024).

In this study, emerging technologies are defined as digital tools, infrastructures and data-driven systems whose application in tourism and event contexts is recent, rapidly evolving or still under consolidation. These technologies support automation, connectivity, personalisation, immersive experiences, real-time monitoring, predictive analytics and digital interaction (Rotolo et al., 2015). The term does not imply that such technologies are necessarily novel at a global level; rather, it reflects the fact that their application within event and festival contexts remains evolving, unevenly adopted and, in many cases, insufficiently consolidated in the academic literature. This conceptualisation provides the basis for the analytical classification developed in this review, which organises the identified technologies into eight domains: AI and Data Analytics, Connectivity and Sensing, Platforms and Digital Engagement, Immersive Technologies, Crowd and Operational Management, Blockchain, Security and Biometrics, and Cloud and Digital Infrastructure Services.

This perspective is relevant across different tourism contexts aimed at enhancing experiences, optimising resource management and promoting sustainability (Ferrás et al., 2020). Within this broader ecosystem, smart cities are especially important because they provide the urban infrastructure, digital connectivity and data-driven management systems that support many tourism practices and large-scale visitor experiences (Khan et al., 2017; Um & Chung, 2021). In this manuscript, smart cities are not considered a subcategory of Smart Tourism, but rather a related urban and infrastructural context in which Smart Tourism practices, including smart events, may be embedded.

Despite the growing relevance of event tourism as a research area, there remains a significant gap in the literature concerning the application of emerging technologies in events and festivals. Celuch (2021) examined the role of Information and Communication Technologies (ICTs) in event management and their potential contribution to sustainability, identifying future research areas such as virtual events, Artificial Intelligence, Big Data Analytics and Augmented or Virtual Reality. Building on Celuch's (2021) review, the present investigation advances and broadens this research trajectory by embedding event technologies specifically within the Smart Tourism ecosystem. Smart events are operationally defined as planned event experiences embedded within tourism or destination ecosystems in which digital technologies, data infrastructures and stakeholder interactions are intentionally used to enhance visitor experience, event management, sustainability, safety, accessibility and destination value creation (Cimbaljević et al., 2021). This definition emphasises that smart events are not defined merely by the presence of technology, but by the integration of technology into the broader socio-technical system of tourism, destination management and visitor experience.

In light of this gap, this paper analyses the concept of Smart Event in the context of Smart Tourism. The aim is to identify and analyse trends, emerging technologies and research directions associated with smart events, including festivals, within the broader context of Smart Tourism. More specifically, this study addresses the following research question: “How have emerging technologies applied to events and festivals evolved within the context of Smart Tourism?” The theoretical contribution of this review lies in consolidating the fragmented notion of smart events within the broader Smart Tourism ecosystem. Rather than treating event technologies as isolated managerial tools, this study conceptualises them as part of a wider socio-technical system involving digital infrastructures, data flows, event organisers, destination stakeholders and visitors. Furthermore, this review provides a practical perspective for event planners, destination managers and marketing professionals by identifying strategies to enhance the impact of events in the context of Smart Tourism. This includes the possibility of incorporating emerging technologies, fostering sustainability and maximising economic and social return while applying current trends in tourism.

To achieve the objective of the study, a systematic literature review methodology was used. The following sections describe the methodology applied in this review. Afterwards, a systematic analysis related to the use of emerging technologies in events within the framework of Smart Tourism is presented. Next, the most commonly used technologies in events are discussed. Then, possible future research directions in terms of theories, sustainability and management strategies are proposed. Finally, the conclusion addresses the theoretical and practical implications for planning and managing smart events. In addition, the review develops an integrative conceptual framework that positions smart events as socio-technical ecosystems embedded within the broader Smart Tourism environment.

2. Methodology

2.1 Review Design and Search Strategy

To conduct a literature review, a systematic methodology is utilized to locate, select, and evaluate pertinent studies on the given topic, with the aim of providing a comprehensive understanding of the current state of knowledge (Bandara et al., 2015; Fisch & Block, 2018; Xiao & Watson, 2019). This review followed a two-stage methodological approach. The first phase entailed the identification, close reading and comprehensive understanding of relevant academic sources. The second phase involved a systematic analysis of the selected articles, conducted using SPSS and Biblioshiny powered by R Studio.

The selected databases were Web of Science (WoS) and Scopus (Birkle et al., 2020; Pranckutė, 2021). The data collection process took place between September 2024 and October 2024. To mitigate potential bias in the study selection, the following inclusion criteria were established: (1) The studies included in this review were from 2014 to September 2024 and had to directly contribute to the stated research objective, excluding those with a primary focus outside it. (2) Only articles and Conference Proceedings indexed in CORE and written in English were selected. (3) The selected studies either focused directly on the application of emerging technologies in events, festivals, event management or event tourism, or provided transferable Smart Tourism technology patterns relevant to visitor experience, event management, sustainability, accessibility, real-time decision-making or data-driven tourism contexts. Studies addressing other characteristics not related to events or aspects unrelated to information technology or digitization were excluded.

All selected studies met all three criteria. Additionally, all studies included in the review were read and evaluated for their alignment with the research objective.

The search strategy was organised into two complementary routes (Table 1). The first route, referred to as the direct event route, was designed to identify the core corpus of studies explicitly addressing events, festivals, and event-related technologies in smart contexts. The truncated term “Event*” was used to capture both singular and plural forms, including “event” and “events”.

The second route, referred to as the contextual Smart Tourism route, was designed as a supplementary robustness check to identify potentially transferable insights that may not have emerged through

event-specific search terms alone. Since smart events are conceptually connected to the broader smart tourism literature, this route initially retrieved a wider body of studies. However, these records were not incorporated automatically into the final sample. Instead, each paper was screened to verify whether it explicitly referred to events or whether its technological mechanisms, managerial implications or conclusions could be meaningfully transferred to smart event contexts. This explains the reduction from a broad contextual pool to a smaller final subset and ensures that the robustness check expanded the sensitivity of the search without diluting the event-specific focus of the review. The construction of the groups involved the use of the 'AND' operator to combine the key concepts.

The search logic was designed to reflect the three conceptual components of the research question: the Smart Tourism context, the event-based object of study and the technological focus of the review. First, "Smart Tourism" and "Smart Cities" were used to situate events within broader smart tourism and digitally enabled destination environments. Second, "Event*", "Festival", "Event Management" and "Crowd Management" were included to capture planned events, festivals and operational event-management issues. Third, technology-related terms such as "Artificial Intelligence", "Blockchain", "Internet of Things", "Virtual Reality", "Platform", "Big Data", "Gamification" and "Augmented Reality" were used as gateway terms to retrieve studies addressing key emerging technologies discussed in the Smart Tourism literature. These search terms were not intended to predetermine the final technology domains. Rather, the eight technology domains presented later in Table 7 were derived from the coding and synthesis of the technologies identified in the selected studies. Records retrieved through broader terms were retained only when they explicitly addressed events or provided transferable technological, managerial or infrastructural insights relevant to smart event contexts.

Table 1. Search Strings

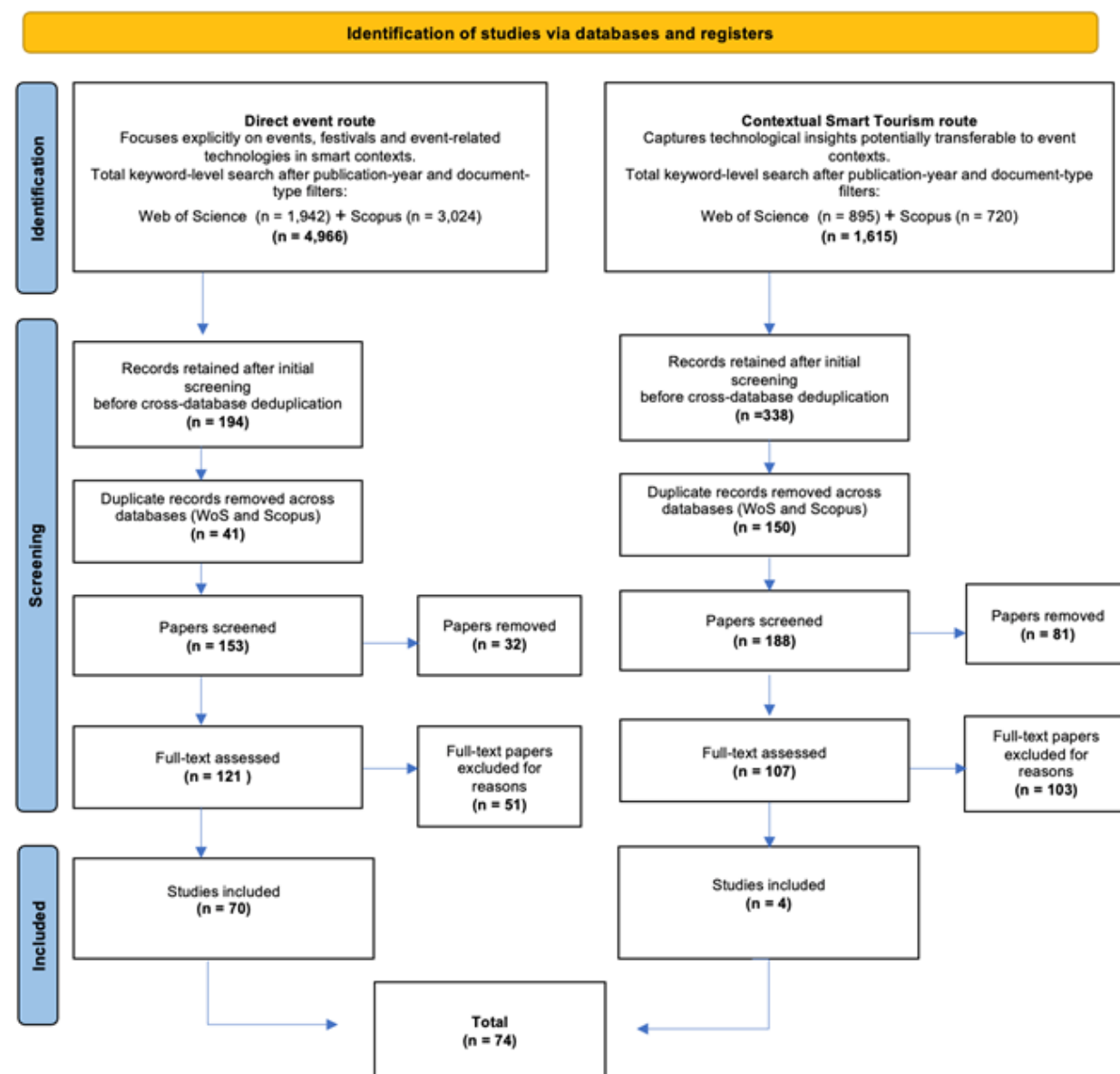
Direct Event Route
"Smart Tourism" AND "Event*"
"Smart Tourism" AND "Festival"
"Smart Cities" AND "Event*"
"Crowd Management"
"Event Management" AND "Artificial Intelligence"
"Event Management" AND "Blockchain"
"Event Management" AND "Internet of Things"
"Event Management" AND "Virtual Reality"
"Event Management" AND "Platform"
"Event Management" AND "Big Data"
"Event Management" AND "Gamification"
"Event Management" AND "Augmented Reality"
Contextual Smart Tourism Route
"Smart Tourism" AND "Artificial Intelligence"
"Smart Tourism" AND "Blockchain"
"Smart Tourism" AND "Internet of Things"
"Smart Tourism" AND "Virtual Reality"
"Smart Tourism" AND "Platform"
"Smart Tourism" AND "Big Data"
"Smart Tourism" AND "Augmented Reality"
"Smart Tourism" AND "Gamification"

Source: Own Elaboration

2.2 Data Extraction, Coding and Analysis

Following this two-route search strategy, and after applying the publication-year and document-type filters in Web of Science and Scopus, the searches produced 6,581 raw keyword-level results: 4,966 from the Direct Event Route and 1,615 from the Contextual Smart Tourism Route (Figure 1). After title, abstract and keyword screening, together with search-string deduplication, 532 records were retained: 194 from the Direct Event Route and 338 from the Contextual Smart Tourism Route. Cross-database deduplication between Web of Science and Scopus removed 191 duplicate records, leaving 341 papers screened: 153 from the Direct Event Route and 188 from the Contextual Smart Tourism Route. Of these, 113 papers were removed during screening, and 228 full-text papers were assessed for eligibility. After full-text assessment, 154 papers were excluded for not meeting the inclusion criteria: 51 from the Direct Event Route and 103 from the Contextual Smart Tourism Route. To strengthen the reliability of the eligibility process, all records proposed for exclusion at the full-text stage were cross-checked by a second reviewer. The final sample consisted of 74 studies: 70 from the Direct Event Route and 4 from the Contextual Smart Tourism Route. The reporting structure follows the PRISMA flow logic (Page et al., 2021), with minor adaptations to reflect the two-route search strategy and the preliminary filtering stage.

Figure 1. Literature Search Overview



The articles were exclusively drawn from journals indexed in reputable bibliometric databases, such as the Journal Citation Report and Scimago Journal Rank, to ensure the quality of the sampled articles.

Quality control was addressed at the source-selection level by including peer-reviewed journal articles indexed in Web of Science and Scopus and conference proceedings indexed in CORE. In addition, each selected study was coded according to its method, theoretical model, hypotheses and main variables. However, no formal critical appraisal tool was applied to score the methodological quality of each individual study, as the objective of the review was to provide a systematic mapping and bibliometric synthesis of the field rather than a risk-of-bias assessment or meta-analysis.

The inclusion of Conference Proceedings in this systematic review is justified by their role in disseminating cutting-edge research on emerging technologies, particularly in the domains of information technology and Smart Tourism. According to CORE (Fekete et al., 2021), conference papers capture key trends, present innovative studies prior to journal publication, and demonstrate rigorous methodologies at relevant academic conferences. Incorporating these sources ensures a comprehensive and current analysis of the technological impact on events and festivals in the context of Smart Tourism.

To ensure consistency in the coding process, studies were classified according to their methodological approach, theoretical basis and technological domain. Methodological approaches were grouped into quantitative, qualitative and mixed-methods studies. For the theoretical dimension, the specific theory, model or conceptual framework used in each article was recorded, together with a brief description of its purpose or contribution. Technologies were grouped into eight domains: AI and Data Analytics, Connectivity and Sensing, Platforms and Digital Engagement, Immersive Technologies, Crowd and Operational Management, Blockchain, Security and Biometrics, and Cloud and Digital Infrastructure Services, specifying their general contribution to smart events. When the methodology, theory or variables were not explicitly stated, classification was based on observable elements such as research design, data collection, analytical technique, technology examined and stated contribution.

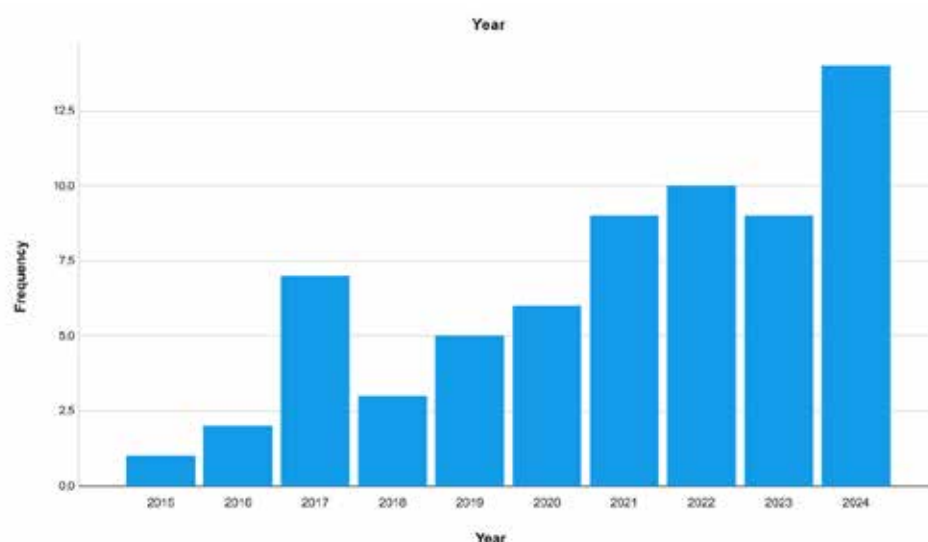
3. Findings

This section presents the results which are organized as follows: (1) Analysis of the temporal evolution of scientific production, (2) Examination of the most influential sources, countries, methodological contributions and main research areas, (3) Identification of key emerging event technologies, (4) Thematic structure analysis, (5) Reconceptualising Smart Events as Socio-Technical Ecosystems: The SESTIM Model, (6) Findings from Contextual Smart Tourism route.

3.1 Analysis of the temporal evolution of scientific production

In order to ensure that this review is grounded in pertinent research, the authors include an overview of the publication timelines encompassed in the study. Studies published over the past ten years were included. This temporal dimension is crucial for understanding the evolution of research in Smart Tourism in events and festivals, revealing trends in research focus, the emergence of new themes, and shifts in methodological approaches that might otherwise remain hidden, thus providing a valuable perspective on the development of the field.

Figure 2 shows the integration of Smart Tourism technologies in events. The increasing academic interest in the field can be attributed to the rising significance of Smart technologies in providing tourism consumers and service providers with relevant information, improved decision-making capabilities, enhanced mobility, real-time awareness, and high-quality and personalized tourism experiences in large-scale events (Gretzel, 2011; Luxford & Dickinson, 2015).

Figure 2. Number of Publications Per Year

Source: Own Elaboration

3.2 Examination of the Most Influential Sources, Countries, Methodological Contributions and Main Research Areas

Table 2 presents the most recurrent publication sources in the final sample. The analysis shows that the literature is distributed across a broad range of journals, although a small group of sources concentrates a higher number of contributions. Event Management is the most represented source, with 6 publications, accounting for 9.09% of the sample. It is followed by the Journal of Hospitality and Tourism Technology with 5 publications (7.58%) and the Journal of Convention & Event Tourism, with 4 publications (6.06% respectively).

A second group of journals contributed 2 publications each (3.03%), including the Asia Pacific Journal of Tourism Research, Information Processing & Management, Journal of Internet Services and Applications, International Journal of Event and Festival Management, Sensors, and the Journal of Sensors. The remaining sources contributed one publication each (1.52%), indicating a highly dispersed publication landscape.

Overall, these results suggest that research on smart technologies in events is not concentrated in a single disciplinary outlet. Instead, it is published across event management, tourism, hospitality, information systems, engineering, sensor technologies and sustainability-related journals. This distribution reinforces the interdisciplinary nature of the field, where smart event research emerges at the intersection of tourism studies, event management and technology-oriented disciplines.

Table 2. Identified Journals

Journal title	Count	Share (%)
Event Management	6	9.09%
Journal of Hospitality and Tourism Technology	5	7.58%
Journal of Convention & Event Tourism	4	6.06%
International Journal of Event and Festival Management	3	4.55%
Asia Pacific Journal of Tourism Research	2	3.03%
Information Processing & Management	2	3.03%
Journal of Internet Services and Applications	2	3.03%
Journal of Sensors	2	3.03%
Sensors	2	3.03%

Sustainability	2	3.03%
Asia Transactions on Intelligent Systems and Technologies	1	1.52%
Asian Journal of Pharmaceutical and Clinical Research	1	1.52%
Automatic Control and Computer Sciences	1	1.52%
Case Studies in Fire Safety	1	1.52%
Computer Communications	1	1.52%
Diabetologia	1	1.52%
Digital Image and Video Processing	1	1.52%
Expert Systems with Applications	1	1.52%
Frontiers in Ecology and Evolution	1	1.52%
Frontiers in Psychology	1	1.52%
Future Generation Computer Systems	1	1.52%
Future Internet	1	1.52%
IEEE Access	1	1.52%
IEEE Open Journal of the Communications Society	1	1.52%
IEEE Technical Digest	1	1.52%
International Journal of Consumer Studies	1	1.52%
International Journal of Contemporary Hospitality Management	1	1.52%
International Journal of Healthcare Analysis and Applications	1	1.52%
International Journal of Hospitality Management	1	1.52%
International Journal of Information Technology	1	1.52%
International Journal of Intelligent Systems and Applications in Engineering	1	1.52%
ISPRS International Journal of Geo-Information	1	1.52%
Journal of Ambient Intelligence and Smart Environments	1	1.52%
Journal of Engineering and Applied Sciences	1	1.52%
Journal of Engineering Research	1	1.52%
Journal of Engineering Science and Technology	1	1.52%
Mobile Information Systems	1	1.52%
Multimedia Tools and Applications	1	1.52%
PLOS One	1	1.52%
Polish Journal of Management Studies	1	1.52%
Quality and Quantity	1	1.52%
Sports	1	1.52%
Tourism Management Perspectives	1	1.52%
Tourism Review	1	1.52%
Tsinghua Science and Technology	1	1.52%
Wireless Personal Communications	1	1.52%
Total	66	100.00%

Source: Own Elaboration

The temporal analysis (Figure 3) further supports the significance of Event Management, demonstrating its consistent publication output from 2017 to 2024, thus illustrating its enduring influence in the field. Other journals, such as the Journal of Convention and Event Tourism and the Journal of Hospitality and

Beyond examining the temporal characteristics of scientific production in terms of countries and sources, it is crucial to examine the methodological characteristics of the reviewed studies. This approach enables the identification of not only the evolution of academic interest, but also the nature of the knowledge generated around the incorporation of smart technologies in events. Table 3 shows the research methodologies used. The trend supports the need for meaningful integration between quantitative and qualitative approaches for a more comprehensive development of the field (Provenzano & Baggio, 2019).

Table 3. Research Methodologies

Method	Count	Share (%)
Quantitative study	51	68.92
Mixed study	14	18.92
Qualitative study	9	12.16
Total	74	100.00

Source: Own Elaboration

Table 4 presents the conference proceedings included in the review and their corresponding CORE/ICORE classification. The proceedings included in the sample are mainly associated with IEEE and international technology-oriented conferences. In terms of CORE/ICORE classification, several venues are ranked B, indicating good and well-regarded conferences within their field, while others are ranked C, indicating recognised conferences that meet academic quality standards. One proceeding is classified as Unranked, meaning that no formal ranking decision has been assigned. Therefore, the inclusion of these proceedings complements the journal-based evidence by capturing recent, applied and technically oriented contributions that are relevant for understanding the technological foundations of smart events within the broader Smart Tourism ecosystem.

Table 4. Identified Conference Proceedings

Source	ICORE Source	ICORE Rank
2018 IEEE international conference on big data (big data)	CORE2023	B
34th Australasian Conference on Information Systems, ACIS 2023	CORE2018	Australasian
ICC 2020 - 2020 IEEE international conference on communications (ICC)	CORE2018	B
16th ACS/IEEE International Conference on Computer Systems and Applications, AICCSA 2019	CORE2023	C
Proceedings of 2016 IEEE 18th international conference on high performance computing and communications; IEEE 14th international conference on smart city; IEEE 2nd international conference on data science and systems (hpcc/smartcity/dss)	CORE2023	C
14th international conference on mobile systems and pervasive computing (mobispc 2017) / 12th international conference on future networks and communications (fnc 2017) / affiliated workshops	CORE2023	Unranked
20th IEEE International Wireless Communications and Mobile Computing Conference, IWCMC 2024	CORE2023	B
IEEE International Conference on Advanced Learning Technologies	CORE2023	B

Source: Own Elaboration

It has also been analysed whether the studies adopt a theoretical or empirical approach in order to understand the orientation and applicability of research in this field. In this regard, 66 articles (89.19%) were found to be empirical and 8 (10.81%) theoretical. The predominance of empirical studies indicates a practical orientation in the research related to the application of Smart technologies in events and festivals.

This analysis also examined the extent to which the reviewed studies have developed theoretical models, as this allows for an evaluation of the level of conceptual development and the contributions to the

theoretical advancement regarding the application of Smart technologies in events. The analysis reveals that 53 articles (71.62%) develop a theoretical model and 21 (28.38%) do not. A strong theoretical framework helps identify the research design and the evaluation of the problem, offering clarity on how the study has been assembled and allowing the theory to be tested, measured, and potentially extended (Grant & Osanloo, 2015).

The proportion of studies that include explicit hypotheses as 20 (27,03%). This examination enables the differentiation between studies focused on validating theoretical relationships through experimental or statistical methods, and those of a more exploratory or descriptive nature.

In addition to identifying whether studies developed theoretical models or hypotheses, the review also examined the theoretical frameworks and conceptual approaches employed in the selected literature (Table 5).

Table 5. Theoretical Frameworks

Theory	Theoretical contribution to event technology research	Source
Agglomeration Theory	Explains how spatial concentration and clustering of event-related activities can generate regional, economic or industry-level effects around events.	Hlee & Lee (2023)
Anthropomorphism Theory	Explains how human-like features attributed to AI agents, robots or digital assistants may influence visitor trust, interaction and experience.	Lu et al. (2024)
Complex Event Processing (CEP) Framework	Supports the real-time detection and processing of large data streams, enabling rapid identification of patterns, incidents or crowd-related situations.	Kousiouris et al. (2018), Roriz Junior et al. (2019)
Consumer Perceived Value Theory	Explains how visitors evaluate the benefits, costs and experiential value of event technologies or digital event services.	Gallarza et al. (2023)
Destination Image Theory	Explains how technologies and event experiences contribute to shaping perceptions of destinations before, during or after an event.	Chang (2022), M & P (2024)
Digital Maturity Framework	Assesses the extent to which users, organisations or destinations are prepared to adopt and use digital technologies.	Marín Díaz et al. (2023)
Experience Co-Creation Theory	Explains how value and experience are jointly created by visitors, organisers, technologies and destination stakeholders.	Bossey, A (2020), Cimbaljevic et al. (2021)
Halo Effect Theory	Explains how positive perceptions of an event or technology can transfer to broader evaluations of the destination or nation image.	Kim et al. (2022)
Information Systems Success Model	Assesses system quality, information quality, service quality, user satisfaction and intention to use digital systems.	Anand et al. (2022), Kim (2024)
IoT/Sensor-Based System Model	Explains how connected devices, sensors and networked infrastructures collect and transmit real-time data for monitoring and management.	Carrino et al. (2016), Elbery & Zorba (2020), Mu (2022), Sabbioni et al. (2022), Silva-Pedroza et al. (2017), Zhang et al. (2021)
Mindfulness Theory	Explains how attentive awareness and mindful experiences may influence visitor wellbeing, engagement and responses to AI-enabled or technology-mediated services.	Wang & Uysal (2024)
Monitor And Acceptance Theory (MAT)	Explains how users monitor and accept new technologies, especially when these technologies affect event attendance, mobility or service use.	Wang et al. (2024)
Open Innovation Theory	Explains how innovation emerges through collaboration among organisations, stakeholders, users and external knowledge sources.	Gusakov et al. (2020), Kubler et al. (2017)
STIRPAT Model	Models the environmental impact of population, affluence and technology, often used for sustainability and carbon-emission analysis.	Zhang (2023)

Satisfaction Transfer Theory	Explains how satisfaction from one experience or technological service can transfer to broader evaluations such as destination or national image.	Kim et al. (2022)
Smart Tourism Technology Experience Framework	Explains how smart tourism technologies shape tourist experience, perceived usefulness, satisfaction and behavioural responses.	Chang (2022), M & P (2024)
Social Technology / Social Media Affordance Framework	Explains how social media and digital communication affordances enable interaction, engagement, information sharing and community formation.	De Maio et al. (2023), Hur et al. (2022), Iványi (2021), Liu et al. (2020), Margolies & Strub (2021), Ozturk et al. (2021)
Stimulus-Organism-Response (S-O-R) Theory	Explains how technological stimuli influence internal visitor responses and subsequent behavioural intentions.	Kim & Jung (2022)
Technology Acceptance Model (TAM)	Explains technology use through perceived usefulness, perceived ease of use, attitude and behavioural intention.	Lei & Ngan (2024), Marín Díaz et al. (2023), Norfolk & Regan (2020), Tsai et al. (2022)
Technology Continuance / Behavioural Intention Framework	Explains why users continue using a technology after initial adoption, often through satisfaction, perceived value and intention.	Nguyen et al. (2019)
Uses And Gratifications Theory	Explains how users actively choose technologies or media to satisfy informational, social, entertainment or experiential needs.	Dieck et al. (2021), Wreford et al.(2019)
Agent-Based Modelling Framework	Models the behaviour and interaction of individual agents to simulate collective dynamics such as crowd movement or evacuation.	Trivedi et al. (2024)
Big-Data Analytics Framework	Uses large-scale data processing to identify patterns, trends, behaviour and managerial insights.	Akbarpour et al. (2020)
Blockchain/Platform Architecture Model	Explains the design of decentralised or platform-based systems that support transparency, security and digital transactions.	Luo & Zhou (2021)
Computational/Predictive Analytics Model	Uses algorithms, predictive models or machine learning to forecast behaviours, flows, sentiment or operational conditions.	Hsieh et al. (2023), Jiang et al. (2022), Song et al. (2024), Sui (2024), Wan et al. (2021)
Interpretative Phenomenological Framework	Explores how individuals make sense of lived experiences in depth and from their own perspective.	Bustard et al. (2019)
Ontology-Based Modelling Framework	Represents concepts, relationships and rules within a domain to support structured system design and knowledge management.	Rajesh Kanna et al. (2017)
Reinforcement-Learning Model	Uses learning agents that optimise decisions through rewards and feedback in dynamic environments.	Tariq et al. (2024)
System Architecture/ Framework	Describes the technical architecture, components and data flows of a digital system, platform or service.	Chen & Zhao (2021), Devine et al. (2024), Franke et al. (2017), Hussein & Mohamed (2023), Koukopoulos & Koukopoulos (2017), Koukopoulos et al. (2018), Pereira et al. (2015), Wang & Binstin (2021), Zhang & Liu (2024)
Technology-Enabled Crowd Management Framework	Explains how digital technologies support monitoring, prediction, regulation and optimisation of crowd movement.	Yamin (2019)

Source: Own Elaboration

The synthesis of theoretical frameworks presented in Table 5 identifies three distinct thematic clusters within the scholarly literature. The first, and most prominent, cluster centers on adoption and behavioral perspectives, incorporating paradigms such as the Technology Acceptance Model, behavioral intention, continuance, perceived value, satisfaction, and stimulus-response theories. While these frameworks are instrumental in elucidating the drivers of user acceptance, adoption, and ongoing interaction with smart technologies, they often concentrate on individual-level perceptions and behavioral outcomes, frequently overlooking wider systematic dynamics.

Second, a significant research stream focuses on experience- and value-oriented paradigms, drawing on constructs such as experience co-creation, destination image, mindfulness, uses and gratifications, and consumer value. These frameworks extend the analytical scope by elucidating the mechanisms through which smart technologies influence visitor engagement, perceived value, and broader destination-related outcomes. Nevertheless, these perspectives often function in isolation, frequently lacking integration with the technological and operational infrastructures essential to facilitating smart event experiences.

Third, studies centered on systemic and operational frameworks, utilizing technologies such as IoT, predictive analytics, and platform architectures, prioritize real-time data capture, monitoring, safety, and mobility. While essential for operational decision-making, these models frequently develop independently of tourism, experience, and governance theories.

Collectively, these patterns suggest that smart event research has evolved through parallel, loosely connected theoretical streams. Although adoption, experience, and infrastructure-oriented approaches explain distinct dimensions of the field, they rarely provide an integrated view of how technologies, organizational capabilities, stakeholder interactions, and visitor experiences function in concert. This fragmentation underscores the necessity for the integrative socio-technical framework proposed in this review.

Additionally, Table 6 examines the articles that utilize or provide open data, enabling an assessment of the transparency, replicability, and potential for reuse of the research findings in future studies. The use of open data promotes greater research transparency, allowing other researchers and practitioners to validate and build upon existing results (Numajiri & Hayashi, 2024).

Table 6. Use of Open Data

Authors	Date	Title
Zhang et al.	2021	Optimization of Sports Event Management System Based on Wireless Sensor Network
Jiang et al	2022	Predicting Citywide Crowd Dynamics at Big Events: A Deep Learning System
Mu	2022	Digitalization and Information Management Mechanism of Sports Events Based on Cooperative Sensing Model of Multisensor Nodes
Peckover et al.	2022	Implementation of Congestion-Related Controls Improves Runner Density, Flow Rate, Perceived Safety, and Satisfaction during an Australian Running Event
Zhang	2023	Artificial intelligence carbon neutrality strategy in sports event management based on STIRPAT-GRU and transfer learning
Sui	2024	AI approach on identifying change in public sentiment for major events: Dubai Expo 2020
Ul Abideen Tariq et al.	2024	Reinforcement Learning for Resilient Aerial-IRS Assisted Wireless Communications Networks in the Presence of Multiple Jammers
Song et al.	2024	Graph Attention Informer for Long-Term Traffic Flow Prediction under the Impact of Sports Events
Roriz Junior et al.	2019	DG2CEP: a near real-time on-line algorithm for detecting spatial clusters large data streams through complex event processing

Source: Own Elaboration

The distribution of research areas across the 74 studies reveals a clearly multidisciplinary and socio-technical profile. The most represented area is Social Sciences – Other Topics, with 22 publications (29.73%), followed by Computer Science; Telecommunications with 5 publications (6.76%). Several areas account for 4 publications each (5.41%): Computer Science, Computer Science; Engineering, and Social Sciences – Other Topics; Business & Economics. Other relevant combined categories include Computer Science; Information Science & Library Science and Social Sciences – Other Topics; Computer Science, each with 3 publications (4.05%). A group of areas accounts for 2 publications each (2.70%), including Computer Science; Education & Educational Research, Computer Science; Engineering; Operations Research & Management Science, Computer Science; Social Sciences – Other Topics, Engineering; Instruments & Instrumentation, Engineering; Telecommunications, and Telecommunications. The remaining areas each contribute 1 publication (1.35%). Overall, these results show that smart event research is not concentrated in a single disciplinary field, but frequently combines social sciences, tourism and event management,

business, computer science, engineering and telecommunications, reflecting the socio-technical nature of the field.

3.3 Identification of Key Emerging Event Technologies

The analysis of the 74 studies identified 231 technology mentions, which were grouped into broader technological domains (Table 7). The most prominent domain is AI, Data Analytics and Computational Intelligence, including artificial intelligence, machine learning, deep learning, neural networks, big data analytics, NLP and predictive analytics. These technologies support prediction, automation, personalisation, decision-making, optimisation, crowd forecasting and content analysis in smart event contexts (Akbarpour et al., 2020; Wan et al., 2021; Zhang et al., 2021; Hur et al., 2022; Sui, 2024; Wang & Uysal, 2024; Wang et al., 2024; Lu et al., 2024).

Other relevant domains include Immersive Technologies, such as virtual reality, augmented reality, mixed reality, 360-degree video and metaverse applications, which enhance visitor experience and digital engagement (Dieck et al., 2021; Hur et al., 2022; Devine et al., 2024); Connectivity and Sensing Technologies, including IoT, wireless sensor networks, GPS, RFID, NFC, wearables and UAVs, which enable real-time monitoring, tracking and safety (Bustard et al., 2019; Sugawara et al., 2022; Mu, 2022); and Mobile Applications and Digital Platforms, which support engagement, information access and service delivery (Kang & Jwa, 2018; Kim et al., 2022). Additional technologies include Location-Based Services (Carrino et al., 2016; Jiang et al., 2022), Cloud Computing and APIs (Li et al., 2017; Kubler et al., 2017), and Crowd and Operational Management Systems (Ronchi et al., 2016; Peckover et al., 2022). Overall, the results suggest a progression from foundational digital technologies to AI-driven, immersive and real-time smart event infrastructures.

Table 7. Identified Technologies

Technological domains	Count	Share (%)	Technologies	Contribution to Smart Events
AI, Data Analytics, Computational Intelligence and Robotics	69	29.87%	Artificial Intelligence (AI); Data and big data analytics; Recommendation, prediction, segmentation and personalisation analytics; Neural networks and advanced AI architectures; Computer vision and image/video processing; Learning and optimisation processes; Machine Learning (ML); Deep Learning models; NLP, text mining and sentiment analysis; Analytical modelling frameworks.	Prediction, automation, recommendation, personalisation, sentiment analysis, decision-making, optimisation and data-driven evaluation.
Connectivity, Sensing and Location Technologies	36	15.58%	Internet of Things (IoT); GPS, geolocation and LBS systems; Wireless and sensor-based networks; RFID, NFC and smart event systems; Sensors and wireless sensor networks; UAVs and intelligent systems infrastructures; Wearables.	Real-time monitoring, mobile tracking, connectivity, mobility management, environmental awareness and attendee/location data capture.
Platforms, Mobile Applications, Digital Engagement, Social Media and Communication Technologies, Streaming, Digital Services	44	19.05%	Mobile applications and smart tourism mobile technologies; E-ticketing and data information and digital management tools; Digital platforms, co-creation and data-sharing tools; Additional mobility platforms.	Digital service delivery, mobile access, attendee interaction, engagement, co-creation, information access and platform-based event experience.

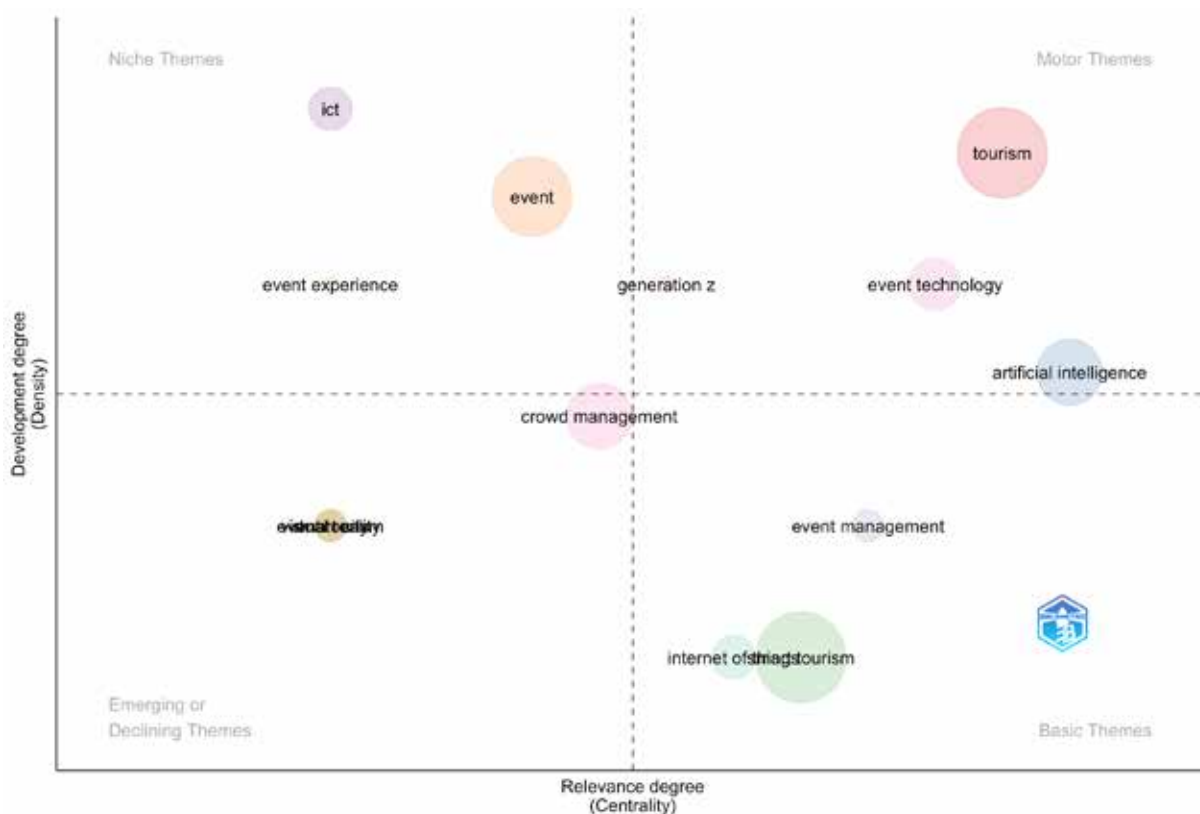
Immersive and Virtual Experience Technologies	26	11.26%	Virtual Reality (VR), 360-degree video and IMEs; Augmented Reality (AR); Mixed Reality; Metaverse and virtual platforms.	Immersive experience, virtual attendance, augmented interaction, experiential engagement and digital event participation.
Crowd, Safety and Operational Management Systems	22	9.52%	Simulation, evacuation, scheduling and mobility optimisation; Decision support, CEP and real-time operational analytics; Crowd management systems and algorithms; Spatial clustering, density analysis and digital detection; Operational planning and mobility systems.	Crowd flows, flow optimisation, congestion reduction, evacuation planning, operational control and risk management.
Blockchain and Decentralized Technologies	6	2.60%	Blockchain, DLT and decentralized platforms	Trust, transparency, traceability, decentralized coordination, smart contracts and secure data/service exchange.
Security, Biometrics and Identity Technologies	3	1.30%	Biometrics and facial recognition	Identity verification, access control, safety, security monitoring and attendee risk management.
Cloud, APIs, Digital Infrastructure Services, Service systems, Smart cities	25	10.82%	Cloud, edge, fog and server computing; APIs and open data interfaces; Microservice, service integration and information systems.	Interoperability, scalable service delivery, data exchange, cloud/edge processing, API-based integration and event information management.
Total	231	100%		

Source: Own Elaboration

The 74 studies produced 231 technology mentions, showing that multiple technologies frequently appear within the same study. This reflects a pattern of technological convergence, where mobile applications, location-based services, IoT, AI, Big Data analytics and crowd management systems are often combined within smart event research.

3.4 Thematic Structure Analysis

A thematic mapping strategy (Figure 5) was employed to investigate the strategic placement and evolution of the subjects within the research domain. The analysis was performed using 100 author's keywords and a minimum cluster frequency of 5 per thousand documents. The thematic map is structured based on two dimensions: centrality, which measures a theme's structural importance within the research, and density, which reflects the theme's internal development.

Figure 5. Thematic Mapping Strategy

Source: Own Elaboration

The thematic mapping strategy delineates a distinct hierarchical organization of research domains, categorized by their respective stages of maturation and academic salience. Within the upper-right quadrant, 'motor themes' such as tourism, artificial intelligence, and event technology are prominent, characterized by robust internal consistency and substantial influence within the scholarly discourse. These motor themes provide a direct response to the research question concerning how emerging technologies applied to events and festivals have evolved within the Smart Tourism context. Their position indicates that the field has moved from isolated technological applications towards a more central research agenda in which smart technologies are increasingly connected to tourism experience, event innovation, and data-driven management. Conversely, the upper-left quadrant encompasses 'niche themes,' including information and communication technologies, tourism studies, and event studies. These themes, despite demonstrating considerable development, exhibit limited integration with the wider thematic landscape. The lower-right quadrant identifies 'basic themes,' comprising the Internet of Things, event management, and tourism management-related concepts. These represent domains of significant relevance that are currently nascent in their development, thereby presenting substantial opportunities for further scholarly inquiry. In relation to the research question, these basic themes suggest that key operational and managerial dimensions remain central to the evolution of smart event research, although they still require further conceptual and empirical consolidation. Lastly, the lower-left quadrant consolidates 'emerging or declining themes,' such as crowd management, Generation Z, sustainability, and event design. These topics manifest both low thematic density and low centrality, potentially indicating either nascent conceptualizations or diminished scholarly focus. However, their position also points directly to future research directions, as these topics are highly relevant for safety, inclusiveness, environmental responsibility, and visitor-centred experience design. Collectively, the analysis underscores a research paradigm progressively influenced by technological advancements, presenting extensive avenues for conceptual refine-

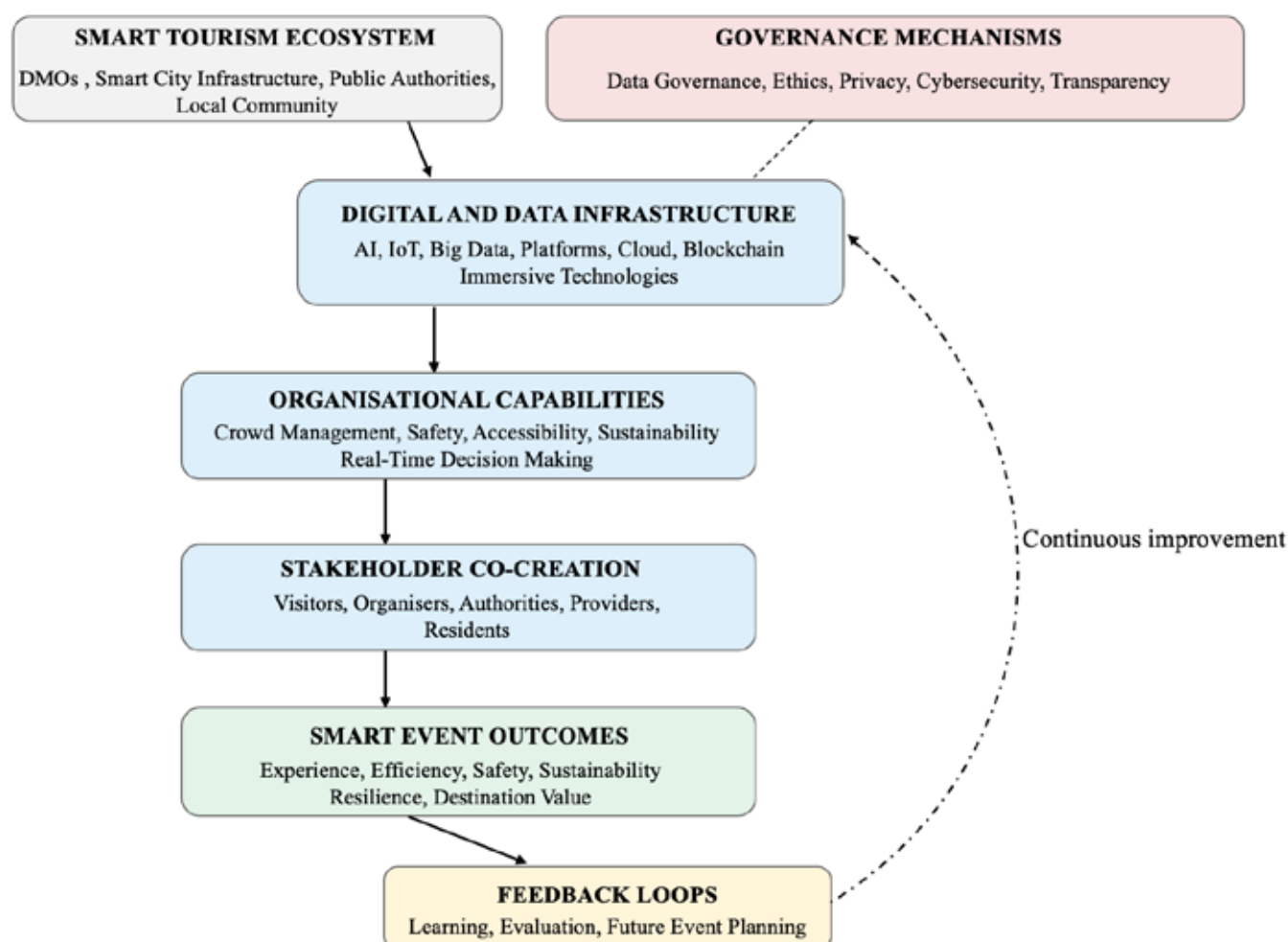
ment and empirical investigation. Therefore, the thematic structure confirms that the field has evolved through technological expansion, but future research should move towards more integrated approaches linking technological innovation with sustainability, accessibility, stakeholder value, and visitor-centred event design.

3.5 Reconceptualising Smart Events as Socio-Technical Ecosystems: The SESTIM Model

The preceding analysis underscores three critical observations. Primarily, smart event scholarship remains characterized by significant fragmentation, with research often compartmentalized into discrete domains such as technology adoption, visitor experience, and digital infrastructure. Furthermore, prevailing studies frequently address technological, managerial, and experiential dimensions in isolation, failing to account for their inherent interdependencies. Finally, despite rapid technological advancements, the literature lacks an integrative framework that elucidates how digital infrastructures, organizational capabilities, stakeholder interactions, and governance mechanisms collectively synergize to generate event-related outcomes.

To address this gap, this study proposes the Smart Event Socio-Technical Integration Model (SESTIM) (Figure 6). This model conceptualizes smart events as data-intensive socio-technical ecosystems embedded within broader Smart Tourism environments. Shifting from a narrow focus on technology adoption, SESTIM explains value generation through the synergy between digital infrastructures, organizational capabilities, governance, and stakeholder co-creation.

Figure 6. Smart Event Socio-Technical Integration Model (SESTIM)



The first component, digital and data infrastructure, comprises technologies such as AI, Big Data analytics, the Internet of Things, cloud computing, and blockchain, which facilitate data acquisition, connectivity, and real-time intelligence across the event lifecycle. The second component pertains to organizational and operational capabilities. Recognizing that technological implementation does not inherently ensure smart outcomes, this dimension highlights the necessity for organizers and stakeholders to translate digital resources into strategic managerial actions, including crowd management, mobility, personalization, accessibility, sustainability, and real-time decision-making.

The second component refers to organisational and operational capabilities. Technologies alone do not generate smart outcomes unless event organisers and destination stakeholders possess the capacity to transform digital resources into managerial action. These capabilities include crowd management, mobility coordination, personalisation, accessibility management, sustainability monitoring, safety control and real-time decision-making.

The third component comprises stakeholder interaction and value co-creation. Smart events involve continuous interactions among attendees, organisers, destination management organisations, public authorities, technology providers, residents and local businesses. Value is therefore co-created through the dynamic exchange of information, experiences and resources among both human and technological actors.

The fourth component relates to governance mechanisms, which regulate and legitimise the operation of smart event ecosystems. Governance encompasses issues such as data protection, cybersecurity, interoperability, ethical use of Artificial Intelligence, transparency, accessibility and institutional coordination. Within the model, governance acts as a cross-cutting mechanism that shapes the effectiveness of technological and organisational processes.

The final component concerns smart event outcomes, including enhanced visitor experiences, operational efficiency, safety, sustainability, resilience and destination value creation. These outcomes are not treated as static end points. Instead, they generate feedback loops that contribute to organisational learning, post-event evaluation and the continuous improvement of future events.

The proposed model contributes to the literature by integrating three previously siloed research streams: technology adoption, experience-oriented value creation, and infrastructure-focused operational frameworks. By synthesizing these perspectives, SESTIM provides a comprehensive explanation of smart events as socio-technical systems, where technologies, organizations, stakeholders, and destination environments continuously interact to generate value.

3.6 Findings from Contextual Smart Tourism Route

The Contextual Smart Tourism Route contributed four studies to the final sample. These papers were not included merely because they addressed smart tourism in general, but because the full-text screening confirmed that they contained explicit references to events or event-related tourism contexts and offered transferable insights for the study of smart events. Their inclusion therefore strengthens the review by showing how technological mechanisms developed in smart tourism and smart destination research can also inform event settings (Table 8).

The retained studies highlight four main contributions for smart event research: blockchain-based trust and transparency, open innovation and stakeholder co-creation, digital maturity-based personalisation, and integrated service architectures. These findings are relevant because smart events can be understood as temporary, data-intensive and experience-oriented ecosystems in which multiple actors, services and technologies need to be coordinated in real time.

Table 8. Contextual Smart Tourism Route Findings

Source	Title	Current relevance to events	Replicable patterns for smart events
Luo & Zhou (2021)	BlockTour: A blockchain-based smart tourism platform	The study refers to events as part of the smart tourism service ecosystem, where digital platforms can support trusted interactions between tourists and service providers.	Blockchain-based event ticketing; smart-contract payments; anti-fraud access control; multi-stakeholder event platform governance; tokenised or NFT-based event passes.
Gusakov et al. (2020)	Mechanisms to Support Open Innovation in Smart Tourism Destinations: Managerial Perspective and Implications	The paper connects open innovation in smart tourism destinations with event-related activities and stakeholder collaboration.	Event hackathons; living labs for festival innovation; open APIs for event services; data-sharing agreements among DMOs, organisers and venues; attendee or stakeholder co-creation platforms.
Marín Díaz et al. (2023)	Smart Cities and Citizen Adoption: Exploring Tourist Digital Maturity for Personalizing Recommendations	The study refers to event-related recommendation contexts within smart cities and smart tourism environments.	Digital maturity profiling during event registration; personalised recommendations for sessions, routes, attractions or services; maturity-adaptive event apps; targeted communication for different attendee profiles; accessibility-oriented digital support.
Sabbioni et al. (2022)	An Architecture for Service Integration to Fully Support Novel Personalized Smart Tourism Offerings	The paper includes events and activities within the broader set of smart tourism services that can be integrated into personalised tourism offerings.	Microservice-based smart event ecosystems; integration of ticketing, mobility, accommodation, navigation and scheduling; real-time personalised event itineraries; cross-event interoperability.

Source: Own Elaboration

Overall, the contextual route shows that relevant smart event insights can emerge from studies that are not exclusively event-centred but that explicitly acknowledge events within broader smart tourism ecosystems. These four studies expand the review by identifying technological mechanisms that can support event management, personalisation, stakeholder coordination and digital service integration. Thus, the contextual route does not dilute the event focus of the review; rather, it complements the direct event route by capturing event-relevant contributions embedded in the wider smart tourism literature.

4. Conclusion

This analysis elucidates the transformative impact of emerging technologies on smart tourism events, revealing how digital innovation is reshaping event design, management and experiential value. Artificial Intelligence emerges as a pivotal technological facilitator, supporting a wide range of applications that span from personalised service delivery and operational optimisation to enhanced decision-making and the creation of immersive experiential environments. Alongside Artificial Intelligence, the Internet of Things, Big Data analytics and immersive technologies further contribute to the development of dynamic, responsive and data-driven event ecosystems capable of adapting to visitor needs in real time.

Furthermore, the continuous expansion of scholarly discourse in recent years not only signifies intensifying academic interest in smart tourism but also highlights a progressive shift in research priorities toward understanding and improving the attendee experience. This growing emphasis on experience reflects a broader transition in tourism research, where value creation, personalisation and technological mediation are increasingly central to theoretical and managerial debates. Consequently, events are positioned as critical arenas for examining the complex interplay between technological advancement, visitor behaviour, perceived value and destination competitiveness.

The reviewed studies suggest that smart events are evolving from isolated technology-enhanced experiences towards integrated socio-technical systems. These systems combine data infrastructures, digital platforms, sensing technologies, immersive tools and managerial capabilities to support visitor experience, operational efficiency, safety, sustainability and destination value creation.

4.1 Implications

4.1.1 Theoretical Implications

This review primarily contributes to the field by addressing the conceptual fragmentation prevalent in smart event technology literature. Empirical evidence confirms the field's multidisciplinary character, which integrates perspectives from social sciences, tourism and event management, computer science, engineering, telecommunications, and business studies. Yet, this expansion has inadvertently fostered siloed theoretical streams. Specifically, adoption and behavioral theories explore technology acceptance and usage intentions; value- and experience-oriented approaches examine engagement, co-creation, and outcomes; and infrastructural frameworks focus on data acquisition, platform architecture, and operational management. Despite their utility, these perspectives lack a unified, overarching explanatory framework. This theoretical dispersion reflects a broader trend where rapid industry advancements frequently outpace the development of foundational models, necessitating the integration of adapted frameworks from disparate disciplines (Unson et al., 2023; Dubinsky, 2023; Chen et al., 2025).

The analysis responds to this gap by conceptualising smart events as socio-technical ecosystems embedded within the broader Smart Tourism environment. This perspective aligns with recent conceptual work that emphasises the layered and socio-technical complexity of AI-powered Smart Tourism systems (Koo et al., 2025). Extending this logic to event and festival settings, the proposed framework integrates digital infrastructures, organisational capabilities, stakeholder interactions, governance mechanisms and visitor experiences into one conceptual model. In doing so, the study moves beyond technology-centric interpretations of smart events and provides a more holistic understanding of how technologies, actors and destination contexts interact before, during and after events (Aktepe & Demirci, 2024).

This research advances the theoretical consolidation of smart event scholarship through three primary contributions. First, it reconceptualizes smart events, shifting the focus from mere technological adoption toward an understanding of these phenomena as dynamic systems characterized by data, governance, experience, and value co-creation. Second, the study bridges fragmented intellectual streams across Smart Tourism, event management, visitor experience, digital innovation, sustainability, and governance. Finally, it establishes a conceptual foundation that enables future research to move beyond technology acceptance, allowing for a more nuanced investigation of how these tools shape perceived value, satisfaction, engagement, accessibility, safety, environmental responsibility, and destination-event outcomes. Consequently, this synthesis addresses the urgent need for robust theoretical and methodological lenses to navigate the disruptive technological shifts currently redefining event management (Choi et al., 2023; Gursoy et al., 2023; Urul & Holmes, 2025).

4.1.2 Practical Implications

From a managerial perspective, these findings offer critical strategic guidance for event organizers, destination management organizations, technology providers, and public authorities engaged in the conceptualization and administration of smart events. The results advocate for a departure from managing such events through siloed technological applications, recommending instead the implementation of holistic digital ecosystems that synthesize data, platforms, stakeholder interests, and decision-making mechanisms.

For event organisers, the review highlights the importance of integrating ticketing systems, mobile applications, access-control technologies, crowd-monitoring tools, real-time dashboards and post-event analytics. These systems can support safer mobility flows, personalised communication with attendees, more efficient resource allocation, improved accessibility services and faster operational responses during the event. For example, real-time crowd data can help identify congestion points, adapt entrance flows, modify security deployment or send targeted notifications to visitors through event apps.

For destination management organisations, smart events provide valuable opportunities to connect event data with broader destination strategies. Information on visitor flows, mobility patterns, accommodation demand, satisfaction, spending behaviour and social media sentiment can help destinations improve transport planning, reduce congestion, coordinate local services and evaluate the contribution of

events to destination competitiveness. In this sense, events can function as temporary but highly data-intensive environments that support smart destination management.

For technology providers, the findings underline the importance of interoperability, scalability and user-centred design. Smart event solutions should be able to integrate with existing systems such as ticketing platforms, transport services, accommodation providers, navigation tools, payment systems and destination apps. Open APIs, cloud-based infrastructures, microservices and common data standards can facilitate coordination among organisers, venues, public authorities and tourism stakeholders.

For public authorities, the review points to the need for clear governance, safety and ethical protocols. As smart events increasingly rely on location tracking, biometric systems, artificial intelligence, recommendation engines and real-time data processing, public authorities and organisers should establish safeguards for privacy, informed consent, cybersecurity, algorithmic transparency and responsible data use. They should also coordinate emergency planning, crowd safety, environmental monitoring, accessibility requirements and sustainability measures to ensure that smart events generate public value beyond operational efficiency.

Given the increasing dependence of smart events on data-intensive technologies, practical implementation also requires ethical governance mechanisms. Event organisers, destination managers, technology providers and public authorities should define clear protocols for data collection, storage, sharing and deletion. These protocols should include transparent consent procedures, cybersecurity safeguards, algorithmic accountability, bias monitoring and measures to prevent digital exclusion. This means ensuring that personalised services and automated decision-making systems remain understandable, inclusive and accessible to different visitor profiles, including attendees with disabilities or reduced access to digital devices.

The contextual Smart Tourism route reinforces these implications by showing that blockchain-based trust, open innovation, digital maturity segmentation and service integration architectures can be transferred from smart tourism and smart destination research to smart event contexts. In practical terms, this means that smart events can benefit from blockchain-based ticketing and anti-fraud access control, co-creation platforms involving attendees and stakeholders, personalised recommendations based on visitor profiles, and integrated service architectures connecting mobility, accommodation, navigation, scheduling and event participation. These applications can help smart events enhance visitor experience, sustainability, resilience, accessibility and long-term destination value.

4.1.3 Ethical and societal considerations

The analysis concurrently emphasizes the critical necessity of addressing ethical and societal considerations, such as data privacy, digital accessibility, and the equitable distribution of smart technology benefits (Gretzel et al., 2015). As smart events increasingly rely on data collection, location tracking, biometrics, artificial intelligence and personalised recommendation systems, practitioners must ensure transparent data governance, informed consent, privacy protection and cybersecurity safeguards. Smart event strategies should also address accessibility and equity, ensuring that technological innovation does not exclude attendees with limited digital skills, disabilities, economic constraints or reduced access to digital devices. Ethical implementation should therefore be considered a central condition for the sustainable development of smart events, rather than a secondary managerial concern. Collectively, these implications affirm the strategic significance of smart technologies in shaping the evolutionary trajectory of events within the broader Smart Tourism ecosystem.

4.2 Limitations and Future Research Directions

This systematic review, while providing valuable insights into the integration of emerging technologies within the Smart Tourism event context, is subject to several limitations that may have influenced its findings. The search strategy was confined to Scopus and Web of Science, encompassing only English-language studies published between 2014 and 2024. This restrictive approach may have inadvertently omitted pertinent research from other linguistic backgrounds, regional databases, or earlier foundational scholarship. Furthermore, the review exclusively considered peer-reviewed journal articles and CORE-indexed

conference proceedings, thereby excluding industry reports and practitioner literature, which often serve as primary sources for technological innovation. The underrepresentation of specific event typologies and geographical regions also curtails the generalizability of the findings. In addition, this review adopts a broad treatment of event types. Although this approach allowed the review to capture the diversity of the field, future research should distinguish more clearly between mega-events, cultural festivals, music festivals, sports events, conferences and smaller local events, as technological needs, adoption patterns and impacts may vary substantially across these contexts.

A further limitation concerns the absence of a formal study-level quality appraisal. Although source-level quality control was applied by selecting studies indexed in Web of Science, Scopus and CORE-ranked conference proceedings, the methodological robustness of each individual study was not assessed through a formal critical appraisal tool. Consequently, the findings should be interpreted as a structured mapping of technologies, themes, theoretical approaches and research gaps, rather than as weighted evidence of methodological quality, causal effects or intervention effectiveness. Future reviews could complement this mapping approach with formal appraisal criteria to assess the strength and reliability of the empirical evidence in greater depth.

Based on the findings, future research should advance in several directions. First, further conceptual work is needed to define smart events more precisely and distinguish them from related concepts such as digital events, technology-enhanced events, smart tourism destinations and smart cities. Second, future studies should examine technological convergence more deeply, analysing how AI, Big Data, IoT, mobile applications, immersive technologies, blockchain, service platforms and crowd management systems interact within integrated event ecosystems. Third, more attention should be paid to technologies that remain less visible in the reviewed literature, such as augmented reality, mixed reality, gamification, robotics and metaverse-related applications.

Fourth, future research should adopt more stakeholder-centred approaches, considering the perspectives of attendees, event organisers, destination managers, public authorities, local communities and technology providers. Fifth, the field would benefit from more longitudinal, comparative and mixed-method studies, since much of the existing evidence remains empirical, quantitative and cross-sectional. Finally, sustainability, accessibility and ethical governance should become central research priorities. Future studies should examine how smart event technologies affect privacy, algorithmic bias, digital inclusion, environmental impact, community value and responsible destination development. Taken together, these directions suggest that smart event research should move from descriptive mapping towards more integrated, comparative and socially responsible approaches.

Highlights of the Study

- Artificial Intelligence, Internet of Things, Big Data analytics and immersive technologies emerge as key drivers of smart tourism event innovation.
- Event technologies enhance personalisation, behavioural analysis, sustainability, accessibility and real-time decision making across the planning and delivery of tourism events.
- Smart event scholarship remains fragmented and geographically uneven, with limited theoretical integration and insufficient attention to ethical, accessibility and sustainability issues.
- The study proposes SESTIM, integrating digital infrastructures, organizational capabilities, governance and stakeholder co-creation to explain value generation within smart event ecosystems.

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REFERENCES

- Aktepe, B., & Demirci, B. (2024). Emerging technologies in the event industry. *Worldwide Hospitality and Tourism Themes*, 16(4), 498-518. DOI: <https://doi.org/10.1108/WHATT-06-2024-0124>.
- Akbarpour, N., Haranaki, M. K., Mehrani, H., Gharibnavaz, N., & Sharif, M. A. (2020). A Design of Strategic Real-Time Marketing Model in Smart Cities Based on the Internet of Things in the Fourth Industrial Revolution. *International Journal of Nonlinear Analysis And Applications*, 11, 339-349. <https://doi.org/10.22075/ijnaa.2020.4607>
- Aldailami, A. H., & Mohamed, R. (2023). Feasibility study for developing an event prioritizing system using CMSs. *International Journal of Intelligent Systems and Applications in Engineering*, 11(1s), 30-45.
- Aliyah, Lukita, C., Pangilinan, G. A., Chakim, M. H. R., & Saputra, D. B. (2023). Examining the Impact of Artificial Intelligence and Internet of Things on Smart Tourism Destinations: A Comprehensive Study. *APTISI Transactions on Technopreneurship*, 5(2), 12-22. <https://doi.org/10.34306/att.v5i2sp.332>
- Anand, K., Arya, V., Suresh, S., & Sharma, A. (2022). Quality Dimensions of Augmented Reality-based Mobile Apps for Smart-Tourism and its Impact on Customer Satisfaction & Reuse Intention. *Tourism Planning And Development*. <https://doi.org/10.1080/21568316.2022.2137577>
- Backman, K. F. (2018). Event Management Research: The Focus Today and in the Future. *Tourism Management Perspectives*, 25, 169-171. DOI: <https://doi.org/10.1016/j.tmp.2017.12.004>.
- Bandara, W., Furtmueller, E., Gorbacheva, E., Miskon, S., & Beekhuyzen, J. (2015). Achieving Rigor in Literature Reviews: Insights from Qualitative Data Analysis and Tool-Support. *Communications of the Association for Information Systems*, 37(1). <https://doi.org/10.17705/1CAIS.03708>
- Birkle, C., Pendlebury, D. A., Schnell, J., & Adams, J. (2020). Web of Science as a data source for research on scientific and scholarly activity. *Quantitative Science Studies*, 1(1), 363-376. https://doi.org/10.1162/qss_a_00018
- Bossey, A. (2020). Accessibility all areas? UK live music industry perceptions of current practice and Information and Communication Technology improvements to accessibility for music festival attendees who are deaf or disabled. *International Journal of Event and Festival Management*. <https://doi.org/10.1108/IJEFM-03-2019-0022>
- Buhalis, D., & Amaranggana, A. (2013). Smart Tourism Destinations. *Information and Communication Technologies in Tourism 2014*, 553-564. https://doi.org/10.1007/978-3-319-03973-2_40
- Bustard, J. R. T., Bolan, P., Devine, A., & Hutchinson, K. (2019). The emerging smart event experience: an interpretative phenomenological analysis. *Tourism Review*. <https://doi.org/10.1108/TR-10-2017-0156>
- Carrino, F., Mugellini, E., Abou Khaled, O., Ouerhani, N., & Ehrensberger, J. (2016). iNUI: Internet of Things for Urban Innovation. *Future Internet*, 8(2), Article 18. <https://doi.org/10.3390/fi8020018>
- Celuch, K. (2021a). Event technology for potential sustainable practices: A bibliometric review and research agenda. *International Journal of Event and Festival Management*, 12(3), 314-330. <https://doi.org/10.1108/IJEFM-08-2020-0051>
- Chang, S. (2022). Can smart tourism technology enhance destination image? The case of the 2018 Taichung World Flora Exposition. *Journal of Hospitality and Tourism Technology*, 13(4), 590-607. <https://doi.org/10.1108/JHTT-07-2020-0182>
- Chen, S., & Zhao, G. (2021). High-Performance Server-Based Live Streaming Transmission Optimization for Sports Events in Smart Cities. *Mobile Information Systems*, Article 9958703. <https://doi.org/10.1155/2021/9958703>
- Choi, M., Choi, Y., Nosrati, S., Hailu, T. B., & Kim, S. (2023). Psychological dynamics in the metaverse: evaluating perceived values, attitude, and behavioral intention in metaverse events. *Journal of Travel and Tourism Marketing*, 40(7), 602-618, DOI: <https://doi.org/10.1080/10548408.2023.2276435>.
- Cimbaljević, M., Stankov, U., Demirović, D., & Pavluković, V. (2021). Nice and smart: Creating a smarter festival—the study of EXIT (Novi Sad, Serbia). *Asia Pacific Journal of Tourism Research*, 26(4), 415-427. <https://doi.org/10.1080/10941665.2019.1596139>
- De Maio, A., Fersini, E., Messina, E., Santoro, F., & Violi, A. (2023). Exploiting social data for tourism management: The SMARTCAL project. *Quality & Quantity*, 57(3), 307-319. <https://doi.org/10.1007/s11135-020-01049-8>
- Devine, A., Devine, F., & Burns, A. (2024). An Examination of the Virtual Event Experience of Cyclists Competing on Zwift. *Event Management*, 28(1), 151-167. <https://doi.org/10.3727/152599523X16907613842110>
- Diaz, G. M., Salvador, J. L. G., & Hernandez, J. J. G. (2023). Smart Cities and Citizen Adoption: Exploring Tourist Digital Maturity for Personalizing Recommendations. *Electronics*, 12(16), Article 3395. <https://doi.org/10.3390/electronics12163395>
- Dieck, M. C. T., Dieck, D. T., & Jung, T. (2021). Exploring usability and gratifications for virtual reality applications at festivals. *Event Management*, 25(6), 585-599. <https://doi.org/10.3727/152599521X16106577965152>
- Dubinsky, Y. (2023). Nation branding, country image, and the scope of sport-tech diplomacy: lessons from the case of the Tokyo 2020 Olympic Games. *Journal of Global Sport Management*. <https://doi.org/10.1080/24704067.2023.2226155>.
- Elbery, A., Hassanein, H. S., & Zorba, N. (2020). Vehicular Crowd Management: An IoT-Based Departure Control and Navigation System. *IEEE International Conference on Communications*. <https://doi.org/10.1109/ICC40277.2020.9148635>
- Fekete, A., Grundy, J., Garcia De La Banda, M., Winikoff, M., Sadiq, S., & Padgham, L. (2021). CORE rankings uses. *ICORE Conference Portal*.

- Ferras, X., Louise Hitchen, E., Tarrats-Pons, E., & Arimany Serrat, N. (2020). Smart Tourism Empowered by Artificial Intelligence: The Case of Lanzarote. *Journal of Cases on Information Technology*, 22(1), 1-13. <https://doi.org/10.4018/JCIT.2020010101>
- Fisch, C., & Block, J. (2018). Six tips for your (systematic) literature review in business and management research. *Management Review Quarterly*, 68(2), 103-106. <https://doi.org/10.1007/s11301-018-0142-x>
- Franke, T., Poxrucker, A., Bahle, G., & Lukowicz, P. (2016). Trace driven simulation model for city scale crowd movements. *2016 IEEE 18th International Conference on High Performance Computing and Communications; IEEE 14th International Conference on Smart City; IEEE 2nd International Conference on Data Science and Systems*, 1341-1348. <https://doi.org/10.1109/HPCC-SmartCity-DSS.2016.0190>
- Gajdosik, T., & Marcis, M. (2019). Artificial Intelligence Tools for Smart Tourism Development. R. Silhavy (Ed.), *Artificial Intelligence Methods in Intelligent Algorithms* (Vol. 985, pp. 392-402). https://doi.org/10.1007/978-3-030-19810-7_39
- Gallarza, M. G., Tubillejas-Andres, B., & Samartin, K. (2023). Consumer value of virtual music festivals. *International Journal of Consumer Studies*, 47(5), 2012-2030. <https://doi.org/10.1111/ijcs.12978>
- Getz, D. (2008). Event tourism: Definition, evolution, and research. *Tourism Management*, 29(3), 403-428. <https://doi.org/10.1016/j.tourman.2007.07.017>
- Getz, D. (2010). The nature and scope of festival studies. *International Journal of Event Management Research*, 5(1), 1-47.
- Getz, D., & Andersson, T. D. (2009). Sustainable festivals: On becoming an institution. *Event Management*, 12(1), 1-17. <https://doi.org/10.3727/152599509787992625>
- Getz, D., & Page, S. J. (2014). Progress and prospects for event tourism research. *Tourism Management*, 52, 593-631. <https://doi.org/10.1016/j.tourman.2015.03.007>
- Getz, D., & Page, S. J. (2024). *Event Studies: Theory and Management for Planned Events* (5th Ed.). <https://doi.org/10.4324/9781003374251>
- Grant, C., & Osanloo, A. (2015). Understanding, selecting, and integrating a theoretical framework in dissertation research: Developing a "blueprint" for your house. *Administrative Issues Journal*, 4. <https://doi.org/10.5929/2014.4.2.9>
- Gretzel, U. (2011). Intelligent systems in tourism: A social science perspective. *Annals of Tourism Research*, 38(3), 757-779. <https://doi.org/10.1016/j.annals.2011.04.014>
- Gretzel, U., Sigala, M., Xiang, Z., & Koo, C. (2015). Smart tourism: Foundations and developments. *Electronic Markets*, 25(3), 179-188. <https://doi.org/10.1007/s12525-015-0196-8>
- Gretzel, U., Werthner, H., Koo, C., & Lamsfus, C. (2015). Conceptual foundations for understanding smart tourism ecosystems. *Computers in Human Behavior*, 50, 558-563. <https://doi.org/10.1016/j.chb.2015.03.043>
- Gursoy, I. T., Aktas, E., Tecim, V., & Kurgun, O. A. (2023). Beta tourist world: a conceptual framework for organizing an event in the metaverse. *Information Technology and Tourism*, 25(4), 529-548. <https://doi.org/10.1007/s40558-023-00266-9>
- Gursoy, D., & Kendall, K. W. (2006). Hosting mega events: Modeling locals' support. *Annals of Tourism Research*, 33(3), 603-623. <https://doi.org/10.1016/j.annals.2006.01.005>
- Gusakov (2020) (2020). Mechanisms to Support Open Innovation in Smart Tourism Destinations: Managerial Perspective and Implications. *Polish Journal of Management Studies*. <https://doi.org/10.17512/pjms.2020.21.2.11>
- Hlee, S., & Lee, H. (2023). Spatial agglomeration effects on eSports events: An intra- and inter-industry and regional analysis approach. *Information Processing and Management*. <https://doi.org/10.1016/j.ipm.2022.103246>
- Hsieh, H. P., Lee, T. C., Lai, S. Y., Tsai, P. C., & Hsieh, T. H. (2023). Enhancing urban crowd monitoring through predictive modelling system with diverse geospatial datasets. *ACIS 2023 Proceedings*, Article 30.
- Hur, D., Lee, S., & Kim, H. (2022). Are we ready for MICE 5.0? An investigation of technology use in the MICE industry using social media big data. *Tourism Management Perspectives*, 43, Article 100991. <https://doi.org/10.1016/j.tmp.2022.100991>
- Iványi, T. (2021). Analysis of sources for information gathering before visiting a festival in the case of generation Z. *Periodica Polytechnica Social and Management Sciences*. <https://doi.org/10.3311/PPSO.15947>
- Jiang, R., Cai, Z., Wang, Z., Yang, C., Fan, Z., Chen, Q., Song, X., & Shibasaki, R. (2022). Predicting Citywide Crowd Dynamics at Big Events: A Deep Learning System. *ACM Transactions on Intelligent Systems and Technology*. <https://doi.org/10.1145/3472300>
- Jovicic, D. Z. (2019). From the traditional understanding of tourism destination to the smart tourism destination. *Current Issues in Tourism*, 22(3), 276-282. <https://doi.org/10.1080/13683500.2017.1313203>
- Kang, H. C., & Jwa, J. W. (2018). Development of android based smart tourism application based on tourism bigdata analytics. *Journal of Engineering and Applied Sciences*, 13(5), 1164-1169. <https://doi.org/10.3923/jeasci.2018.1164.1169>
- Khan, M. S., Woo, M., Nam, K., & Chathoth, P. K. (2017). Smart city and smart tourism: A case of Dubai. *Sustainability*, 9(12). <https://doi.org/10.3390/su9122279>
- Kim, S. E. (2024). Virtual reality concerts: Determinants of success using the information system success model. *Journal of Convention & Event Tourism*. <https://doi.org/10.1080/15470148.2024.2401793>

- Kim, S. S., Choi, J. Y., & Koo, C. (2022). Effects of ICTs in mega events on national image formation: the case of Pyeong-Chang Winter Olympic Games in South Korea. *Journal of Hospitality and Tourism Technology*, 13(2), 217-239. <https://doi.org/10.1108/JHTT-09-2020-0212>
- Kim, S. E., & Jung, S. (2022). Exploring virtual race participants' perceptions of event mobile apps and behavioral intention: The stimulus-organism-response approach. *Journal of Convention and Event Tourism*. <https://doi.org/10.1080/15470148.2022.2102559>
- Koo, C., Shin, S., Gretzel, U., & Xiang, Z. (2025). AI-powered smart tourism 2.0: A 10-year retrospective and updated model. *Electronic Markets*, 35, Article 108. <https://doi.org/10.1007/s12525-025-00847-y>
- Kontogianni, A., & Alepis, E. (2022). AI, Blockchain & Cyber tourism joining the smart tourism realm. In *13th International Conference on Information, Intelligence, Systems and Applications (IISA 2022)*. Institute of Electrical and Electronics Engineers. <https://doi.org/10.1109/IISA56318.2022.9904393>
- Kontogianni, A., Kabassi, K., & Alepis, E. (2018). Designing a smart tourism mobile application: User modelling through social network user implicit data. In S. Staab, O. Koltsova, & D. Ignatov (Eds.), *Social Informatics (SOCINFO 2018)*, Part II, 148-158. https://doi.org/10.1007/978-3-030-01159-8_14
- Koukopoulos, Z., & Koukopoulos, D. (2017). Smart dissemination and exploitation mobile services for carnival events. *Procedia Computer Science*. <https://doi.org/10.1016/j.procs.2017.06.109>
- Koukopoulos, Z., Koukopoulos, D., & Jung, J. J. (2018). Real-time crowd management for cultural heritage events: A case study on carnival parades. *Journal of Ambient Intelligence and Smart Environments*. <https://doi.org/10.3233/AIS-180485>
- Kousiouris, G., Akbar, A., Sancho, J., Ta-shma, P., Psychas, A., Kyriazis, D., & Varvarigou, T. (2018). An integrated information lifecycle management framework for exploiting social network data to identify dynamic large crowd concentration events in smart cities applications. *Future Generation Computer Systems-The International Journal of Escience*, 78, 516-530. <https://doi.org/10.1016/j.future.2017.07.026>
- Kubler, S., Robert, J., Hefnawy, A., Framling, K., Cherifi, C., & Bouras, A. (2017). Open IoT Ecosystem for Sporting Event Management. *IEEE Access*, 5, 7064-7079. <https://doi.org/10.1109/ACCESS.2017.2692247>
- Lee, Y. J. (2023). Gamification and the festival experience: the case of Taiwan. *Current Issues in Tourism*, 26(8), 1311-1326. <https://doi.org/10.1080/13683500.2022.2053074>
- Lei, W. S., & Ngan, H. F. B. (2024). Antecedents and Consequences of Augmented Reality Experience in Mega-Sports. *Event Management*, 28(2), 197-213. <https://doi.org/10.3727/152599523X16907613842183>
- Liu, J., Hall, C. M., Zhu, C., & Cheng, V. T. P. (2024). Redefining the concept of smart tourism in tourism and hospitality. *Anatolia*, 35(3), 553-565. <https://doi.org/10.1080/13032917.2023.2282712>
- Liu, J., Shi, W., & Chen, P. (2020). Exploring Travel Patterns during the Holiday Season—A Case Study of Shenzhen Metro System During the Chinese Spring Festival. *Isprs International Journal of Geo-Information*, 9(11), Article 651. <https://doi.org/10.3390/ijgi9110651>
- Lu, Y., Liang, Y., & Wang, Y. C. (2024). AI dogs vs. real dogs and human-like robots: clarification, conceptualization, and applications in tourism and hospitality settings. *Journal of Hospitality and Tourism Technology*. <https://doi.org/10.1108/JHTT-12-2023-0416>
- Luo, L., & Zhou, J. (2021). BlockTour: A blockchain-based smart tourism platform. *Computer Communications*. <https://doi.org/10.1016/j.comcom.2021.05.011>
- Luxford, A., & Dickinson, J. (2015). The role of mobile applications in the consumer experience at music festivals. *Event Management*, 19. <https://doi.org/10.3727/152599515X14229071392909>
- M, H. S., & P, A. A. (2024). Smart tourism technology, a boon or a bane for event tourism? In the context of Kochi Muziris Biennale. *Journal of Convention and Event Tourism*, 25(3), 145-164. <https://doi.org/10.1080/15470148.2024.2306994>
- Margolies, D. S., & Strub, J. A. (2021). Music Community, Improvisation, and Social Technologies in COVID-Era Musica Huasteca. *Frontiers in Psychology*, 12, Article 648010. <https://doi.org/10.3389/fpsyg.2021.648010>
- Mu, C. (2022). Digitalization and information management mechanism of sports events based on cooperative sensing model of multisensor nodes. *Journal of Sensors*, Article 6467305. <https://doi.org/10.1155/2022/6467305>
- Nguyen, T., Lee, K., Chung, N., & Koo, C. (2020). The way generation Y enjoys a jazz festival: A case of the Korea (Jarasum) music festival. *Asia Pacific Journal of Tourism Research*, 25(1), 52-63. <https://doi.org/10.1080/10941665.2019.1580755>
- Norfolk, L., & O'Regan, M. (2020). Biometric technologies at music festivals: an extended technology acceptance model. *Journal of Convention and Event Tourism*. <https://doi.org/10.1080/15470148.2020.1811184>
- Numajiri, H., & Hayashi, T. (2024). Analysis on open data as a foundation for data-driven research. *Scientometrics*, 129(10), 6315-6332. <https://doi.org/10.1007/s11192-024-04956-x>
- Ozturk, A. B., Wei, W., Hua, N., & Qi, R. (2021). Factors affecting attendees continued use of mobile event applications. *Journal of Hospitality and Tourism Technology*, 12(2), 307-323. <https://doi.org/10.1108/JHTT-03-2020-0058>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, (n71). <https://doi.org/10.1136/bmj.n71>

- Pencarelli, T. (2020). The digital revolution in the travel and tourism industry. *Information Technology and Tourism*, 22(3), 455–476. <https://doi.org/10.1007/s40558-019-00160-3>
- Pereira, R. L., Sousa, P. C., Barata, R., Oliveira, A., & Monsieur, G. (2015). CitySDK Tourism API - building value around open data. *Journal of Internet Services and Applications*, 6, Article 24. <https://doi.org/10.1186/s13174-015-0039-z>
- Pranckutė, R. (2021). Web of Science (WoS) and Scopus: The titans of bibliographic information in today's academic world. *Publications*, 9(1). <https://doi.org/10.3390/publications9010012>
- Provenzano, D., & Baggio, R. (2019). Quantitative methods in tourism and hospitality: A perspective article. *Tourism Review*, 75(1), 24–28. <https://doi.org/10.1108/TR-07-2019-0281>
- Pujakusumah, R., Tonang, A. S. P. A., & Mutaqin, J. N. (2024). Smart tourism destinations of Sumedang Regency: Future trends and challenges. *ICISS 2024 Proceedings*. <https://doi.org/10.1109/ICISS62896.2024.10751014>
- Rajesh Kanna, B., Viswanathan, V., & George Ebbinason, A. J. (2017). Eventr - Design of an event management mobile application using ontology. *Asian Journal of Pharmaceutical and Clinical Research*, 10(13), 90–93. <https://doi.org/10.22159/ajpcr.2017.v10s1.19574>
- Ramos, C. M. Q., Henriques, C. H. N., & Lanquar, R. (2016). Augmented reality for smart tourism in religious heritage itineraries: Tourism experiences in the technological age. In *Handbook of Research on Human-Computer Interfaces, Developments, and Applications*. IGI Global. <https://doi.org/10.4018/978-1-5225-0435-1.ch010>
- Revilla, R. G., Moure, O. M., & Einsle, C. S. (2023). Advances in event management using new technologies and mobile applications. *International Journal of Event and Festival Management*, 14(1), 56–72. <https://doi.org/10.1108/ijefm-05-2022-0039>
- Roriz Junior, M., Olivieri, B., & Endler, M. (2019). DG2CEP: A near real-time on-line algorithm for detecting spatial clusters large data streams through complex event processing. *Journal of Internet Services and Applications*, 10, Article 8. <https://doi.org/10.1186/s13174-019-0107-x>
- Rotolo, D., Hicks, D., & Martin, B. R. (2015). What is an emerging technology?. *Research Policy*, 44(10), 1827–1843. <https://doi.org/10.1016/j.respol.2015.06.006>
- Ryan, G., Fenton, A., Ahmed, W., & Scarf, P. (2020). Recognizing Events 4.0: The digital maturity of events. *International Journal of Event and Festival Management*, 11(1), 47–68. <https://doi.org/10.1108/IJEFM-12-2019-0060>
- Sabbioni, A., Villano, T., & Corradi, A. (2022). An Architecture for Service Integration to Fully Support Novel Personalized Smart Tourism Offerings. *Sensors*. <https://doi.org/10.3390/s22041619>
- Silva-Pedroza, D., Marin-Calero, R., & Ramirez-Gonzalez, G. (2017). NFC Evaluation in the Development of Mobile Applications for MICE in Tourism. *Sustainability (Switzerland)*. <https://doi.org/10.3390/su9111937>
- Song, Y., Luo, R., Zhou, T., Zhou, C., & Su, R. (2024). Graph Attention Informer for Long-Term Traffic Flow Prediction under the Impact of Sports Events. *Sensors*, 24(15), Article 4796. <https://doi.org/10.3390/s24154796>
- Stroumpoulis, A., Kopanaki, E., & Varelakis, S. (2022). Role of artificial intelligence and big data analytics in smart tourism: A resource-based view approach. *WIT Transactions on Ecology and the Environment*, 256, 99–108. <https://doi.org/10.2495/ST220091>
- Suanpang, P., & Pothipassa, P. (2024). Integrating generative AI and IoT for sustainable smart tourism destinations. *Sustainability*, 16(17). <https://doi.org/10.3390/su16177435>
- Sufi, F. K. (2024). AI approach on identifying change in public sentiment for major events: Dubai Expo 2020. *Journal of Engineering Research*, 13(3), 2370–2380. <https://doi.org/10.1016/j.jer.2024.07.010>
- Tariq, Z. U. A., Baccour, E., Erbad, A., & Hamdi, M. (2024). Reinforcement Learning for Resilient Aerial-IRS Assisted Wireless Communications Networks in the Presence of Multiple Jammers. *IEEE Open Journal of the Communications Society*. <https://doi.org/10.1109/OJCOMS.2023.3334489>
- Trivedi, A., Pandey, M., Ramesh, G., & Chabra, R. (2024). An agent based modeling approach to evaluate crowd movement strategies and density at bathing areas during Kumbh Mela-2019. *Multimedia Tools and Applications*. <https://doi.org/10.1007/s11042-023-16267-z>
- Tsai, C. H., Su, C. H., Chan, H. K., & Liu, J. (2022). What Drives Event Discovery Apps User Behaviors Among Generation Z? Evidence from Macau. *Event Management*. <https://doi.org/10.3727/152599522X16419948391041>
- Ul Abideen Tariq, Z., Baccour, E., Erbad, A., & Hamdi, M. (2024). Reinforcement learning-based anti-jamming solution for aerial RIS-aided dense dynamic multi-user environments. *2024 International Wireless Communications and Mobile Computing Conference (IWCMC)*, 543–548. <https://doi.org/10.1109/IWCMC61514.2024.10592583>
- Um, T., & Chung, N. (2021). Does smart tourism technology matter? Lessons from three smart tourism cities in South Korea. *Asia Pacific Journal of Tourism Research*, 26(4), 396–414. <https://doi.org/10.1080/10941665.2019.1595691>
- Unson, S., Wang, W., & Harrison, K. (2023). Necessity is the mother of innovations: a qualitative study of event innovations during 'shock' events. *Journal of Convention and Event Tourism*, 24(5), 458–479. <https://doi.org/10.1080/15470148.2023.2228468>
- Urul, T., & Holmes, K. (2025). Enhancing the experience economy, marketing and sustainability in tourism event stages through smart technologies. *Journal of Hospitality and Tourism Technology*, 1–22. <https://doi.org/10.1108/jhtt-05-2025-0391>

- Wael, R., Talaat, H., & Soubra, H. (2023). Smart tourism in smart cities: Current trends and future challenges in sustainability and digitization. *Smart Cities 4.0. International Conference*, 95–98. <https://doi.org/10.1109/SmartCities4.056956.2023.10526099>
- Wan, B., Xu, C., Mahapatra, R. P., & Selvaraj, P. (2021). Understanding the Cyber-Physical System in International Stadiums for Security in the Network from Cyber-Attacks and Adversaries using AI. *Wireless Personal Communications*, 127(2), 1207–1224. <https://doi.org/10.1007/s11277-021-08573-2>
- Wang, S., & Binstin, M. (2021). A smart transmission optimization mechanism for sports events based on edge computing. *Internet Technology Letters*, 4(1), Article e174. <https://doi.org/10.1002/itl2.174>
- Wang, Y. C., & Uysal, M. (2024). Artificial intelligence-assisted mindfulness in tourism, hospitality, and events. *International Journal of Contemporary Hospitality Management*, 36(4), 1262–1278. <https://doi.org/10.1108/IJCHM-11-2022-1444>
- Wang, Y. C., Cai, R., Zhang, T., & Lu, Y. (2024). Event attendees' crafting behaviors for AI-powered autonomous driving at events: A monitor and acceptance theory perspective. *International Journal of Hospitality Management*, 122, Article 103855. <https://doi.org/10.1016/j.ijhm.2024.103855>
- Wreford, O., Williams, N. L., & Ferdinand, N. (2019). Together alone: an exploration of the virtual event experience. *Event Management*, 23(4–5), 721–732. <https://doi.org/10.3727/152599519X15506259855625>
- Xiao, Y., & Watson, M. (2019). Guidance on conducting a systematic literature review. *Journal of Planning Education and Research*, 39(1), 93–112. <https://doi.org/10.1177/0739456X17723971>
- Yamin, M. (2019). Managing crowds with technology: cases of Hajj and Kumbh Mela. *International Journal of Information Technology* (Singapore). <https://doi.org/10.1007/s41870-018-0266-1>
- Zhang, L., & Liu, Z. (2024). Designing an Event Management System for Campus Football Using 3D Images and Machine Vision. *Signal Image and Video Processing*, 18(3), 2965–2974. <https://doi.org/10.1007/s11760-023-02963-8>
- Zhang, Y. (2023). Artificial intelligence carbon neutrality strategy in sports event management based on STIRPAT-GRU and transfer learning. *Frontiers in Ecology and Evolution*, 11, Article 1275703. <https://doi.org/10.3389/fevo.2023.1275703>
- Zhang, Y., Zhao, X., Shen, J., Shi, K., & Yu, Y. (2021). Optimization of Sports Event Management System Based on Wireless Sensor Network. *Journal of Sensors*, Article 1174351. <https://doi.org/10.1155/2021/1174351>

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Digital Evolution in Tourism Sector: Transition to Industry 5.0 and Integration of Smart Applications to Hotels in Edremit Gulf

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ABSTRACT

Industrial revolutions have transformed economic structures and societal lifestyles significantly. Industry 4.0 has brought digitalization, artificial intelligence, the internet of things, and automation technologies to business processes. On the other hand, Industry 5.0 emphasizes a human-centric approach by integrating human intelligence with technological systems. This study examines the transition of 4- and 5-star hotels in the Edremit Gulf from Industry 4.0 to Industry 5.0 and evaluates the effects of smart applications on hotel operations. Semi-structured interviews have been conducted with hotel managers in the study. Data collected from hotel managers has been analyzed using content analysis technique. The findings show that smart applications enhance customer satisfaction and operational efficiency, while AI-supported customer analytics reduce complaints and increase re-stay intentions. Managers receiving in-house training adapt to digital transformation more effectively. Although digitalization improves service quality, reduced human interaction may weaken customer relationships. Overall, the study supports the human-centered transformation principles of Industry 5.0 and provides practical recommendations to help hotels achieve competitive advantage.

KEYWORDS

Industry 5.0, Hotel Businesses, Smart Hotel Applications, Edremit Gulf.

ARTICLE HISTORY

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1. Introduction

The relationship between humans and their environment should be viewed as that influences and shapes each other. Every action a person takes, whether small or large, can cause significant changes throughout the world. For example, discoveries such as fire, the wheel, and the telephone have changed human life and made it more comfortable from the moment they appeared. These inventions have formed important turning points in world history and have aimed to improve life (Ozden, 2022). Throughout different stages of human history, social structures have undergone major transformations. Each new phase has reshaped humanity's relationship with its environment and guided the development of society. Every invention developed by humans has the potential to influence not only its own era but all human history. Looking at the developmental timeline of human history, we see the emergence of the hunter-gatherer society (Society 1.0), the emergence of the agricultural society (Society 2.0), the industrial society following the industrial revolution (Society 3.0), the knowledge-based society (Society 4.0), and today's smart society or super-smart society (Society 5.0), which goes beyond the information society (Fukuyama, 2018). In other words, while mechanical production methods powered by steam and water were developed during the first industrial revolution, electricity came to the fore during the second industrial revolution, and mass production began on the production line. With the third industrial revolution, information technologies became an indispensable part of daily life. The Fourth Industrial Revolution has been shaped by advanced technologies such as the Internet of Things (IoT), big data, artificial intelligence (AI), and robotics (Dulgaroglu, 2021; Iyigunor, 2022). One of the main examples of these advanced technologies finding application in the tourism sector is automation systems. Automation systems are among the most prominent technological advances today. The acceleration of mechanization in the hotel sector and the continuous increase in innovations related to these systems have made the value of automation even more apparent. Observations show that many tasks in hotel management can be performed more efficiently and easily thanks to automation technologies. In particular, the secure digital recording of guest information and the execution of accommodation processes through these systems greatly facilitate management activities (Dulgaroglu, 2024a). Such digital solutions require not only businesses but also societies to integrate with technology. In this context, approaches that go beyond automation are becoming increasingly important. The Society 5.0 concept is a highly innovative concept for countries and communities striving to adapt in the era emerging after the fourth industrial revolution (Demirci Celep, 2020). These developments pave the way for accelerated digital transformation in the tourism sector, the automation of service processes, and the widespread adoption of data-driven management practices. Within the scope of the Society 5.0 vision, artificial intelligence, robotic systems, and big data technologies offer innovative solutions that both personalize the customer experience and increase business efficiency in tourism (Iyigunor, 2022; Dulgaroglu, 2024b). This situation contributes to tourism evolving beyond being merely an economic activity into a strategic sector integrated with smart society goals.

With the Industry 5.0 revolution and the increasing presence of smart applications in our lives, workers are expected to experience less fatigue. Smart systems are expected to be more deeply integrated into production and supply chains. This can lead to increased productivity and operational performance in production. In addition, smart solutions and environmentally friendly applications are expected to come to the fore, reducing workplace accidents and production times (Nahavandi, 2019). Industry 5.0 technologies can facilitate innovation and adaptation to environmental conditions for businesses in rapidly changing markets. In this context, artificial intelligence, the Internet of Things, and cyber-physical systems can increase business efficiency. This enables them to balance supply and demand more effectively. These technologies help companies optimize their operations more flexibly and quickly, enabling them to rapidly adapt to changes in the market (Kumar et al., 2023). Hotel managers, while technologies reduce time and labor costs in business processes (Buhalis & Law, 2008), also aims to improve service quality (Tuominen & Ascensão, 2016).

This study examines the transition process from Industry 4.0 to Industry 5.0 and the effects of smart technologies on 4- and 5-star hotels in the Edremit Gulf of Balıkesir Province, a region of significant tourism importance located in Türkiye's Western Marmara region. The region has distinct characteristics in terms of both natural resources and infrastructure capabilities and faces certain challenges in terms of

tourism management compared to other tourism regions in the Mediterranean. The study aims to analyze management experiences related to smart applications through interviews with hotel managers. This process highlights the importance of the human factor in implementing and developing technological evolution, creating impacts on employment and competency requirements in hotel businesses. The study identifies the effects of digitalization, which is intensifying across all sectors with Industry 5.0, on the performance of tourism businesses and develops recommendations for the evaluation of smart applications in the tourism sector.

2. Literature Review

2.1 Industry 4.0 and the Distinctive Features of Industry 4.0

Industry 4.0 is an innovation process that aims to create smart and autonomous production structures by bringing together companies' communication networks, digital technologies, and cyber-physical systems. This transformation enables companies to increase their technological capacity, respond more quickly to customer needs, and enhance their competitive strength (Yalçiner, 2020). New hardware aims to be low-cost, more efficient, smaller in size, and highly reliable, unlike traditional hardware. In addition, the operating systems and software that will run this hardware are also expected to be more efficient in terms of resources and memory. The Industry 4.0 process can take place in three stages. The first stage begins with the Internet of Things (IoT), where machines communicate wirelessly with each other. The second stage is based on the Internet of Services (IoS), which refers to new digitalized service areas. The third and final stage is cyber-physical systems; these are self-managing and self-operating systems that act as copies of virtual environments through sensors (Marangoz et al., 2022). Thanks to its broad scope, Industry 4.0 can eliminate deficiencies in industry by enabling the convergence of physical and digital systems. The transition to a technology-based production process and the promotion of more efficient use of resources are expected to increase the competitiveness of businesses. Therefore, Industry 4.0 is of critical importance for all countries and societies (Wang et al., 2016; Imamoglu et al., 2021).

The rapid spread and development of Industry 4.0 applications, the use of smart systems in manufacturing and industrial fields is expected to expand. Acatech's Industry 4.0 forum final report lists the significant innovations offered by this era as follows (Acatech, 2013):

- The global interaction of storage systems and machines,
- The development of smart products equipped with location information, the emergence of products that are each unique and can determine their own location,
- The establishment of smart factories that can adapt to product characteristics and enable more efficient use of resources,
- The emergence of new business models using Big Data, particularly the development of new services,
- A new social infrastructure in the workplace for employees and a work structure that takes individual differences into account,
- Better work-life balance,
- The ability to respond quickly to individual consumer demands,
- Increased capacity for engineering and instant problem solving through the development of smart software.
- These innovations demonstrate that the digital transformation brought about by Industry 4.0 will have a significant impact on the business world and social life.

2.2 Industry 5.0 and Enabling New Technologies

While Industry 4.0 was still gaining traction, Japanese Prime Minister Shinzo Abe introduced the concept of Society 5.0 at the CEBIT IT Fair held in Hannover, Germany, in 2017. Society 5.0 is also referred to as Industry 5.0. The fundamental philosophy behind this concept is based on the idea that technology should be accepted not as a threat to society, but rather as a supportive tool (Develi, 2017). The foundation of So-

ciety 5.0 is the collection of data from the real world, the processing of this data using computers, and the application of the results back into the real world (Alkaya, 2022). The main goal of Society 5.0 is to ensure that technological advances are integrated in a way that is compatible with society (Okan Gökten, 2018). The Industry 5.0 model aims to create a new industrial revolution that uses Industry 4.0 technologies to achieve social goals such as sustainability. This model is shaped not only by technological developments but also by a transformation that will provide social benefits (Sadic, 2021). European Commission (2020), has defined six enabling technologies for Industry 5.0. These are;

- Personalized human-machine interaction technologies that connect and combine the strengths of humans and machines,
- Smart materials and technologies supported by embedded sensors that enable materials inspired by biology and with recyclable properties to be equipped with advanced features,
- Technologies that enable holistic modeling of systems such as digital twins and simulations,
- Data transmission, storage, and analysis technologies that can manage data and system interoperability,
- Artificial intelligence technologies,
- Energy efficiency, renewable energy, and storage technologies.

Industry 5.0 aims to bring about a more sustainable, flexible, and human-centered transformation in production processes by combining these technologies. Advances in artificial intelligence technologies, one element of this transformation, are creating significant advantages in many areas, including the tourism sector (Xu et al., 2021). These innovative systems are among the technological tools increasingly adopted by the tourism industry. Artificial intelligence solutions play a critical role in solving problems encountered in service delivery and management processes. Thanks to these developing technologies, work processes for both managers and employees in tourism sub-sectors such as accommodation, transportation, aviation, and museums are becoming more efficient (Dulgaroglu, 2024b).

2.3 The Transformation of Hotel Operations with Smart Applications

Hotel businesses are economic entities that prepare, produce, and ultimately provide added value by offering tourist products and services based on economic principles to meet tourists' accommodation, food, and beverage needs, as well as certain levels of entertainment and other social requirements (Sener, 1997). These businesses organize their services to meet the needs of visitors and generate economic value (Oztekin & Ilhan, 1994). Hotel businesses, one of the types of businesses in the tourism sector, are also notable as a labor-intensive field. In this sector, the human-centered nature of the service highlights that the attitudes of employees are an important factor that directly affects the quality of the goods and services offered. Employee behavior plays a decisive role in the production and delivery of the service and is one of the factors that most influences the final quality (Kantarci, 1997).

Industry 5.0 technologies can facilitate innovation and rapid integration for businesses in rapidly changing markets. In this context, productive artificial intelligence, the Internet of Things, and cyber-physical systems aim to maximize production efficiency by increasing the balance between supply and demand for companies. These technologies improve overall output performance by providing businesses with greater flexibility and responsiveness (Kumar et al., 2023). The concept of a smart hotel can be defined as accommodation businesses where operational activities are carried out in harmony with technology through the integration of smart applications into hotel management processes (Ercan, 2019). Smart hotels provide competitive advantage by creating an innovative business model in the accommodation sector. These hotels automate their services using data-driven systems, advanced technologies, and solutions that require no human intervention (e.g., artificial intelligence (AI) and the Internet of Things (IoT)). This technological infrastructure is one of the fundamental characteristics of smart hotels and enables their differentiation within the sector (Kim et al., 2020).

2.4 Related Studies

Research conducted in the hospitality industry after 2011 has examined the impact of digital technologies on the sector in a multidimensional manner. Iranmanesh and colleagues (2022) reviewed 79 articles to assess the contributions of digital tools such as artificial intelligence, mobile applications, virtual reality (VR), and social media to hotel performance. The study noted that these technologies have positive effects, particularly on financial efficiency, service quality, and competitiveness, but that there are significant gaps in the literature regarding employee perspectives, innovation, and cybersecurity. Similarly, Dang and Nguyen (2023) analyzed value creation processes with customers in the digital age and revealed that artificial intelligence and Metaverse applications make the customer experience in tourism more interactive and personalized. These studies show that digitalization brings not only operational but also experiential transformation.

Post-COVID-19 studies have focused on the implementation processes of digital transformation. García-López, Galindo-Pérez-de-Azpíllaga and Foronda-Robles (2025) examined the levels of digitalization in hotels in the Andalusia region and identified economic constraints, integration problems, and lack of staff training as the main obstacles. Wynn and Lam (2023), based on interviews with information technology managers in the hospitality sector, emphasized that digitalization should be approached not only through technical infrastructure investments but also through factors such as strategic orientation, employee compliance, and system integration. Zeqiri (2024) also noted that digital platforms have transformed traditional hotel management practices in marketing and reservation processes, creating more flexible and technology-focused business models.

Recent studies have shown that digitalization has gained a human-centered dimension with the Industry 5.0 approach. Gangwar and Reddy (2023) emphasized that advanced technologies increase satisfaction by personalizing the guest experience, but that the human factor remains important. Ghazy and Fedorova (2022) examined hotel employees' attitudes toward collaboration with robots, noting that while employees view technology positively in terms of efficiency, they express concerns about job security and lack of interaction. Gajić and colleagues (2024) demonstrated that the integration of artificial intelligence and the Internet of Things (IoT) make significant contributions to operational efficiency and environmental sustainability. Finally, Colak (2024) emphasized that globally scaled unmanned smart hotels reduce costs through artificial intelligence and automation, but the lack of human contact remains a limiting factor in the user experience. These findings indicate that the hospitality industry's digital transformation process requires a balanced approach to technological innovation and the human element.

Previous studies have examined the impact of digital technologies on the hospitality industry, but they have mostly focused on general-level applications and performance outcomes, providing limited information on local-scale studies and human-centered assessments based on hotel managers' experiences (Iranmanesh et al., 2022; Dang & Nguyen, 2023; García-López et al., 2025). The significance of this study lies in filling this gap in the literature by directly revealing managers' experiences in the transition to Industry 5.0 and the managerial and operational impacts of smart applications through interviews conducted at 4- and 5-star hotels in the Edremit Gulf, thereby guiding the future.

3. Methodology

This study aims to examine the transition process from Industry 4.0 to Industry 5.0 in 4- and 5-star hotels in the Edremit Gulf and the effects of smart applications. The research was conducted using a qualitative research model. Qualitative research is an observation and commentary-focused approach that aims to develop an in-depth understanding of the subject matter. This method allows the researcher to examine and understand the problem in its natural environment under real conditions and is generally geared towards the detailed exploration of phenomena (Guba & Lincoln, 1994; Klenke, 2016). Data was collected using interview techniques. Semi-structured interview forms were used in interviews with hotel managers in the Edremit Gulf. Interviews with hotel managers were conducted using an interview form consisting of five research questions. The interview form was prepared using tourism literature related to smart applications. In addition, the opinions of twenty experts in the field of tourism were consulted.

Five are Associate Professor Doctors and five are Professor Doctors who teach in the field of tourism of the 20 individuals consulted for expert opinions. The other 10 individuals were selected to provide expert opinions and included three General Managers, three Front Office Department Managers, two Food & Beverage Department Managers, and two Executive Chefs who already use smart applications. Thus, both academic and tourism professionals' opinions were sought when formulating the research questions. The research questions prepared by drawing on the relevant literature and expert opinions are as follows (Karakus, 2020; Çolak & Karakan, 2021; Baykal & Yazıcı Ayyıldız, 2022; Durmaz, 2023):

- What are your hotel's initiatives regarding smart applications in the context of digital transformation?
- What advantages could your business gain from implementing smart applications?
- What are the disadvantages of smart applications for hotel managers?
- How do smart applications affect the competitive environment for hotel businesses?
- What are your suggestions for the widespread adoption and development of smart hotel applications in Türkiye?

The study was conducted using a case study design, and managers' experiences were examined in depth. Data collected through interview forms were analyzed and evaluated using content analysis techniques. Although content analysis is a technique that can be used in both qualitative and quantitative research, it is generally used to examine content in mass media (Sallan Gül & Kahya Nizam, 2021). This method aims to identify, classify, and interpret the fundamental elements of a text or discourse. Content analysis is conducted objectively by adopting a systematic and methodological approach (Robert & Bouilaget, 1997). The population of the study consists of individuals working in managerial positions at accommodation establishments in Türkiye, while the sample consists of hotel managers in the Edremit Gulf.

Purposive sampling was used to collect data in this study. Purposive sampling method has actually developed as part of the qualitative research process. This method allows for the examination of situations with in-depth knowledge on a specific topic, thereby offering the researcher the opportunity to obtain richer and more meaningful data (Yildirim & Simsek, 2000). Accordingly, the sample was determined from among 4- and 5-star hotel businesses affiliated with the Ministry of Culture and Tourism and located in the Edremit Gulf region, which use smart applications and have experienced the digital transformation process actively. It has been determined that only ten hotels use smart applications among the 4- and 5-star hotels in the region. Therefore, the purposive sampling method was employed in this study. Hotels that using smart applications of six are 5-star hotels and four are 4-star hotels, all of which are included in the scope of the study. Serving in managerial positions, being directly involved in the digitalization process at the decision-making and implementation levels and having at least three years of managerial experience were considered the main selection criteria for participants. These criteria aimed to reach participants with the knowledge and experience necessary to directly respond to the research questions. In addition, face-to-face interviews were conducted with the participants selected through purposive sampling between 20.05.2025 and 20.08.2025. The interview technique is referred to as an interview in some sources. According to this definition, an interview is a conversation between two or more people conducted for a specific purpose and within a specific framework (Coskun et al., 2017). Each interview lasted an average of 45 minutes, and all interviews were audio recorded to collect data. This method provides in-depth information on the impact of smart applications on hotel businesses.

Relevant literature and previous studies were utilized while preparing the interview form. The research questions were determined based on a literature review on digital transformation and smart hotel applications. The research questions were developed in line with the findings and recommendations of Karakus (2020), Çolak and Karakan (2021), Baykal and Yazıcı Ayyıldız (2022) and Durmaz (2023). The study includes the responses and evaluations provided by 20 participants consisting of four General Managers, four Front Office Managers, four Food & Beverage Managers, four Executive Chefs, two Assistant Front Office Managers and two Assistant Food & Beverage Managers working in hotel businesses to the research questions. As selection criteria, it was considered that participants were directly involved in the decision-making and implementation stages of their businesses' digitalization process and had at least three years of managerial experience. These criteria ensure that participants possess the knowledge and experience relevant to the research questions. The participants' identities were kept confidential and each

participant was assigned a code. A total of 20 participants were interviewed and each participant was numbered from P1 to P20 in a manner known only to the researcher.

4. Results

The findings section of the study presents data collected through interviews. This data was transferred to a digital format, resulting in 37 pages of raw data. The raw data collected was examined using content analysis and placed within a conceptual framework. Various codes have been developed in line with these concepts, and these codes have been classified according to their similarities and differences. The first research question is directed at participants' work on smart applications in their hotels in terms of digital transformation. The findings regarding the answers to the first research question asked to participants, "What are your hotel's efforts regarding smart applications in terms of digital transformation?", are presented in Table 1. The themes that emerged in the participants' views on what your hotel's smart application efforts are in terms of digital transformation, the categories of the emerging themes, and code examples are presented in Table 1. According to Table 1, the theme that stood out most in participants' views on what your hotel's smart applications are doing in terms of digital transformation was "Digital Infrastructure and Integration Systems" (N=84). The theme "Digital Infrastructure and Integration Systems" was most reflected in the categories "PMS (Property Management System)" and "Internet of Things" (f=20; f=20). The categories "Channel Manager," "CRM," and "Cloud Computing" followed the "PMS (Property Management System)" and "Internet of Things" categories in terms of value (f=16; f=9; f=19).

Table 1. Participants' opinions on the efforts in their hotels regarding smart applications within the scope of digital transformation

Themes	Categories	Code Examples	Frequency (f)	Frequency (N)
Smart Technologies and Automation	Artificial intelligence	In the digital transformation process, our hotel aims to increase operational efficiency with advanced technologies such as Artificial Intelligence and the Internet of Things (P1-P2-P3-P4-P5-P7-P8-P9-P10-P11-P12-P13-P14-P15-P17-P18-P19-P20).	18	
	Automation	Our hotel, which designs the guest experience according to the requirements of the age, features applications such as Automation systems (P3-P5-P10-P11-P12-P15-P17-P19).	8	36
	Personalized service	Personalized services are offered to guests (P8-P9-P13-P16).	4	
	Data analytics	Guest preferences are analyzed through data analytics and CRM applications to provide personalized services. (P1-P5-P15-P17-P19-P20).	6	
Digital Infrastructure and Integration Systems	PMS (Property Management System)	Thanks to software such as PMS, guest relations are managed more effectively (P1-P2-P3-P4-P5-P6-P7-P8-P9-P10-P11-P12-P13-P14-P15-P16-P17-P18-P19-P20).	20	
	Channel manager	Multichannel reservations are easily managed through systems such as channel managers (P1-P2-P3-P4-P6-P7-P8-P9-P10-P11-P12-P13-P14-P16-P18-P20).	16	
	CRM	An intelligent and integrated system has been established by using CRM solutions together (P1-P3-P5-P7-P14-P15-P16-P17-P19).	9	84
	Cloud computing	All these systems operate in the cloud environment and on a secure infrastructure (P1-P2-P3-P4-P5-P6-P7-P8-P9-P10-P11-P12-P13-P14-P15-P17-P18-P19).	19	
	Internet of Things	In our hotel, we implement digital transformation applications such as the Internet of Things (IoT) (P1-P2-P3-P4-P5-P6-P7-P8-P9-P10-P11-P12-P13-P14-P15-P16-P17-P18-P19-P20).	20	

Security and Reliability	Cybersecurity	Data is protected with cybersecurity measures (P2-P3-P4-P5-P6-P7-P8-P9-P10-P11-P12-P13-P14-P15-P16-P17-P18-P19).	18	23
	Cyber-physical systems	We secure this digital structure with cyber-physical security systems (P6-P20).	2	
	NFC	We provide fast and contactless guest check-in with NFC solutions (P3-P16-P20).	3	
Digitalization Processes	Digital check-in/check-out	Digital check-in/check-out and other technologies are increasing guest satisfaction (P1-P2-P4-P6-P7-P8-P9-P10-P11-P12-P13-P14-P16-P18-P20).	15	18
	Digital transformation	Our hotel utilizes applications such as Artificial Intelligence as part of its digital transformation (P2-P4-P18).	3	

Source: Our Elaboration

The theme that stood out most in participants' views on their work with smart applications in their hotels regarding digital transformation was "Digital Infrastructure and Integration Systems," followed by the theme "Smart Technologies and Automation" (N=36). This theme was most reflected in the "Artificial Intelligence" category (f=18). The "Artificial Intelligence" category was followed by the "Automation," "Personalized Service," and "Data Analytics" categories (f=8; f=4; f=6). The theme "Security and Reliability" followed the theme "Smart Technologies and Automation" (N=23). This theme is most reflected in the "Cybersecurity" category (f=18). The 'Cybersecurity' category is followed by the "Cyber-Physical Systems" and "NFC" categories (f=2; f=3). The theme "Security and Reliability" was followed by the theme "Digitalization Processes" (N=18). This theme is most reflected in the "Digital check-in/check-out" category (f=15). The "Digital transformation" categories followed the "Digital check-in/check-out" category in terms of value (f=3).

The findings in Table 1 indicate that hotel businesses focus on digital infrastructure and integration systems during the digital transformation process primarily. In particular, the use of systems such as PMS (Property Management System), the Internet of Things (IoT) and cloud computing has been observed to be prominent. Similarly, Anwar et al. (2024) found in their study that the integration of digital technologies and cloud-based PMS accelerates operational processes in hotels, enhances the quality of services provided to customers and provides a competitive advantage in the industry. Therefore, it can be said that the finding presented in Table 1 is also supported by the literature.

The second question of the research concerns the advantages that hotel managers can obtain through the implementation of smart applications in their businesses: "What advantages could you gain from implementing smart applications in your business?" The prominent themes in participants' opinions regarding the advantages of implementing smart applications in their businesses, along with the categories of emerging themes and sample codes, are presented in Table 2. According to Table 2, the theme that stood out the most in participants' opinions regarding the advantages of implementing smart applications in their businesses was "Efficiency and Business Processes" (N=23). The "Efficiency and Business Processes" theme was most strongly reflected in the "Efficiency" category (f=19). The "Efficiency" category was followed by the values of "Reduced Workload" and "Ease of Workload" categories (f=2; f=2).

Table 2. Participants' opinions on the advantages that can be gained from implementing smart applications in their businesses

Themes	Categories	Code Examples	Frequency (f)	Frequency (N)
Smart Applications and Digitalization	Smart Applications	Smart applications both accelerate and simplify tasks (P1-P2).	2	7
	Automation	Automation capabilities also enhance our performance (P2-P7).	2	
	Data Analysis	Data analysis capabilities also improve our performance (P2-P5).	2	
	Communication Alignment	Communication between departments is also more effective (P8).	1	
Speed and Time Management	Speed	Operations are becoming faster (P1-P2-P4-P14-P15).	5	18
	Time Savings and Gains	It saves time (P3-P6-P7-P8-P9-P10-P11-P12-P13-P16).	10	
	Organization	Work proceeds in a more organized manner (P2-P9-P10).	3	
Efficiency and Business Processes	Efficiency	Efficiency is increasing (P1-P2-P3-P4-P6-P7-P8-P9-P10-P11-P12-P13-P14-P15-P16-P17-P18-P19-P20).	19	23
	Reduced Workload	It reduces employees' workload and facilitates daily tasks (P5-P20).	2	
	Ease of Workload	The operational load is reduced, which also improves service quality and overall efficiency (P16-P20).	2	
Cost and Savings	Cost Reduction	It reduces costs (P1-P2-P3-P7-P8-P9-P11-P12-P14-P15-P16-P17-P20).	13	22
	Reduction in Personnel Costs	Costs are decreasing, and waste is being reduced (P7-P8-P9-P12-P13-P15-P18-P19).	8	
	Prevention of Waste	It reduces costs, prevents waste, and lowers the error rate (P20).	1	
Guest Satisfaction and Experience	Guest Satisfaction	It increases guest satisfaction (P1-P2-P3-P4-P7-P9-P10-P11-P13-P18).	10	14
	Ease of Guest Access	Services are delivered more quickly and accurately, which enhances quality (P5-P19).	2	
	Satisfaction and Loyalty	It increases both satisfaction and loyalty (P5).	1	
	Service Accessibility	Services are delivered more quickly and accurately, which improves quality (P19).	1	
Staff and Human Resources	Reduction in Required Staff	Reducing costs (P7-P8-P9-P12-P13-P15-P18-P19).	8	8
Service Quality and Competitiveness	Competitive Advantage	It allows us to respond more quickly to guests' expectations (P5-P14).	2	16
	Improvement in Service Quality	It directly reflects on both service quality and guest satisfaction (P1-P3-P4-P7-P8-P9-P10-P11-P12-P13-P14-P15-P16-P20).	14	

Source: Our Elaboration

In participants' opinions regarding the advantages that can be gained from implementing smart applications in their businesses, the most prominent theme, "Efficiency and Business Processes," was followed by the "Cost and Savings" theme (N=22). This theme was most strongly reflected in the "Cost Reduction" category (f=13). The "Cost Reduction" category was followed by the "Reduction in Personnel Costs" and "Prevention of Waste" categories (f=8; f=1). The "Cost and Savings" theme was followed by the "Speed and Time Management" theme (N=18), which was most strongly reflected in the "Time Savings and Gains" category (f=10). The "Time Savings and Gains" category was followed by the "Speed" and "Organization" categories (f=5; f=3). The "Speed and Time Management" theme was followed by the "Service Quality and Competitiveness" theme (N=16), which was most strongly reflected in the "Improvement in Service Quality" category (f=14). The "Improvement in Service Quality" category was followed by the "Competitive

Advantage" category (f=2). The "Service Quality and Competitiveness" theme was followed by the "Guest Satisfaction and Experience" theme (N=14), which was most strongly reflected in the "Guest Satisfaction" category (f=10). The "Guest Satisfaction" category was followed by the "Ease of Guest Access," "Satisfaction and Loyalty," and "Service Accessibility" categories (f=2; f=1; f=1). The "Guest Satisfaction and Experience" theme was followed by the "Staff and Human Resources" theme (N=8), which was most strongly reflected in the "Reduction in Required Staff" category (f=8). The "Staff and Human Resources" theme was followed by the "Smart Applications and Digitalization" theme (N=7), which was most strongly reflected in the "Smart Applications," "Automation," and "Data Analysis" categories (f=2; f=2; f=2). The "Smart Applications," "Automation," and "Data Analysis" categories were followed by the "Communication Alignment" category (f=1).

The findings in Table 2 show that smart applications are most commonly associated with the theme of "Efficiency and Business Processes" in businesses with advantages such as "Efficiency," "Reduced Workload" and "Ease of Workload" standing out. According to a study conducted by Zaharia (2025), the implementation of digital services and digital systems in hotels increases process automation, enhances operational efficiency and enables employees to perform their tasks more effectively. Therefore, it can be said that the finding presented in Table 2 is also supported by the literature.

The third research question of the study was designed to gather hotel managers' opinions on the disadvantages that may arise from smart applications: "What are the disadvantages of smart applications for hotel managers?" The prominent themes in participants' opinions regarding the disadvantages of smart applications for hotel managers, along with the categories of emerging themes and sample codes, are presented in Table 3. According to Table 3, the theme that stood out the most in participants' opinions regarding the disadvantages of smart applications for hotel managers was "Technological Problems and Systems" (N=28). The "Technological Problems and Systems" theme was most strongly reflected in the "Technical Issues" category (f=10). The "Technical Issues" category was followed by the "System Failure," "System Malfunctions," "Error Risk," "Risk of Incorrect Information," and "Integration Difficulty" categories (f=8; f=1; f=5; f=2; f=2).

Table 3. Participants' opinions on the disadvantages of smart applications for hotel managers

Themes	Categories	Code Examples	Frequency (f)	Frequency (N)
Performance and Operations	Departmental Differences	It has many disadvantages in departments other than the front office department (P1).	1	4
	Performance Pressure on Employees	It may create performance pressure (P1-P6).	2	
	Continuous Supervision	It may create constant oversight and performance pressure on managers (P6).	1	
Cost and Financial Challenges	High Cost	High initial costs may make it difficult to invest in smart technologies. Additionally, maintenance costs and technical issues of robotic systems and other automation tools can also pose an extra burden for businesses (P2-P3-P7-P9-P11-P12-P13-P14-P15-P18-P19-P20).	12	16
	Time and Financial Disadvantage	In the short term, it creates an additional burden in terms of both time and cost (P16-P19).	2	
	Personnel Employment Cost	Additional training is required for the staff; this also creates an extra burden in terms of both time and cost in the short term (P18).	1	
	Technical Maintenance Requirement	The necessity of employing personnel from different fields with technical knowledge for the regular maintenance and updates of smart systems also translates into a continuous cost element for the business (P18).	1	

Technological Problems and Systems	Technical Problems	Potential technical issues (P2-P3-P4-P10-P11-P15-P16-P17-P18-P20).	10	28
	System Failure	System malfunctions or security vulnerabilities can lead to both operational disruptions and breaches of data security (P3-P8-P10-P11-P15-P16-P17-P20).	8	
	System Malfunctions	Systemic disruptions can lead to both operational interruptions and data security breaches (P18).	1	
	Risk of Error	The inability to immediately correct errors that may occur in applications poses a significant problem (P2-P4-P7-P12-P13).	5	
	Risk of Incorrect Information Circulation	The risk of conveying incorrect information to guests can negatively affect customer satisfaction (P18-P20).	2	
	Integration Difficulty	Disruptions and issues that arise when smart applications are not properly integrated (P2-P16).	2	
Training and Human Factor	Need for Training	Providing training to employees is mandatory (P2-P3-P7-P9-P12-P13-P18-P19).	8	10
	Communication Problems	Communication and coordination between departments will not be effective (P9-P17).	2	
Security and Data Protection	Security Risk	Security risks pose challenges (P3-P7-P14-P15-P16-P17).	6	12
	Cybersecurity Risk	Cybersecurity vulnerability (P7-P14-P15).	3	
	Security Vulnerabilities and Weaknesses	System-related malfunctions or security vulnerabilities can lead to both operational disruptions and breaches of data security (P18-P20).	2	
	Data Privacy Concern	The visibility of big data in hotel reviews to everyone can be perceived as image damage for managers (P6).	1	
Customer Experience and Image	Guest Dissatisfaction	Guests' expectations regarding the hotel may not be met; this can lead to dissatisfaction (P8-P16-P18-P20).	4	7
	Lack of Emotional Contact	Environments lacking emotional contact (P8).	1	
	Cultural Incompatibility	Cultural mismatches and differences in expectations due to not targeting the right guest portfolio (P16).	1	
	Damage to Image	Issues and disruptions that arise when smart applications are not properly integrated (P16).	1	
Positive Opinions	No Disadvantages	Smart applications have no disadvantages for hotel managers (P5).	1	2
	Provides Benefits	Smart applications provide benefits for hotel managers (P5).	1	

Source: Our Elaboration

Among participants' opinions on the disadvantages of smart applications for hotel managers, the most prominent theme was "Technological Problems and Systems", followed by the "Cost and Financial Challenges" theme (N=16). This theme was most reflected in the "High Cost" category (f=12). The "High Cost" category was followed by "Time and Financial Disadvantages", "Personnel Employment Cost", and "Technical Maintenance Requirement" categories (f=2; f=1; f=1). The "Cost and Financial Challenges" theme was followed by the "Security and Data Protection" theme (N=12), which was most reflected in the "Security Risk" category (f=6). The "Security Risk" category was followed by "Cybersecurity Risk", "Security Vulnerabilities", and "Data Privacy Concerns" categories (f=3; f=2; f=1). The "Security and Data Protection" theme was followed by the "Training and Human Factor" theme (N=10), which was most reflected in the "Training Requirement" category (f=8). The "Training Requirement" category was followed by the "Communication Issues" category (f=2). The "Training and Human Factor" theme was followed by the "Customer Experience and Image" theme (N=7), which was most reflected in the "Guest Dissatisfaction" category (f=4). The

"Guest Dissatisfaction" category was followed by "Lack of Emotional Contact", "Cultural Mismatch", and "Image Damage" categories ($f=1$; $f=1$; $f=1$). The "Customer Experience and Image" theme was followed by the "Performance and Operation" theme ($N=4$), which was reflected in the "Departmental Differences", "Performance Pressure on Employees", and "Continuous Oversight" categories ($f=1$; $f=2$; $f=1$). Finally, the "Performance and Operation" theme was followed by the "Positive Opinions" theme ($N=2$), reflected in the "No Disadvantages" and "Provides Benefits" categories ($f=1$; $f=1$).

The findings in Table 3 indicate that, from the perspective of hotel managers, smart applications are most associated with the theme of "Technological Problems and Systems," with technical issues, system failures, malfunctions and integration difficulties being particularly prominent. This suggests that technological barriers are perceived as a significant disadvantage from a management perspective during the digital transformation process. Similarly, García López et al. (2025) found in their study that technical problems such as system integration, application compatibility and deficiencies in technological infrastructure affect the effectiveness of digital transformation in hotel businesses negatively. Therefore, it can be said that the finding presented in Table 3 is also supported by the literature.

The fourth question asked to hotel managers is a research question regarding the impact of smart applications on the current competitive environment: "What effects do smart applications have on the competitive environment for hotel businesses?" The prominent themes, categories, and code examples related to participants' opinions on the effects of smart applications on the competitive environment for hotel businesses are presented in Table 4. According to Table 4, the most prominent theme in participants' opinions on the effects of smart applications on the competitive environment for hotel businesses was "Competition and Market Position" ($N=34$). This theme was most reflected in the "Competitive Strength" category ($f=15$). The "Competitive Strength" category was followed by "Competitive Advantage", "Increase in Competition", "Dependence on Competitive Conditions", "No Contribution to Competition", "Market Position", and "Price Competition" categories ($f=3$; $f=1$; $f=1$; $f=1$; $f=12$; $f=1$).

Table 4. Participants' opinions on the effects of smart applications on the competitive environment for hotel businesses

Themes	Categories	Code Examples	Frequency (f)	Frequency (N)
Service Quality and Guest Experience	Service Quality	The improvement of service quality through applications directly increases the hotel's competitive strength (P1-P2-P3-P4-P5-P6-P7-P10-P11-P13-P14-P15-P16-P17-P18).	15	33
	Service Speed and Efficiency	Fast and efficient service is provided (P6-P17-P20).	3	
	Customer Loyalty	Through technologies, guests receive faster, more efficient, and personalized service, which increases customer loyalty. (P2-P5-P14).	3	
	Guest Satisfaction	Guests' greater utilization of services increases their satisfaction (P1- P2-P3-P5- P6-P10-P13-P14-P19).	9	
	Brand Value and Image	The brand image improves, reflecting positively on the brand value (P5-P6).	2	
	Digital Reputation	The hotel's digital reputation is also strengthened (P11).	1	
Competition and Market Position	Competitive Strength	Competitive strength increases (P1-P2- P3-P4-P5-P6- P7- P9-P10-P11-P12- P13- P14- P16- P18).	15	34
	Competitive Advantage	If different applications are used under different conditions, an advantage can be gained by staying ahead of competitors (P9- P19- P20).	3	
	Increase in Competition	It creates intense competition (P17).	1	
	Dependence on Competitive Conditions	If competing hotels use the same applications under the same conditions, equality is maintained (P8-P9).	2	
	Market Position	Its position in the market is strengthened (P1-P2-P7- P10-P12- P14- P15- P16-P17- P18- P19-P20).	12	
	Price Competition	It can create competition in pricing (P15).	1	

Technology and Digitalization	Technology Usage	Hotels that use technology effectively gain a more advantageous position compared to their competitors (P1-P2- P4- P5- P8- P14- P18- P19- P20).	9	
	Differentiation Through Technology	If different applications are used under different conditions, an advantage can be gained by staying ahead of competitors (P9).	1	
	Critical Perspective on Technology	Smart applications provide no benefits to hotel businesses in terms of the competitive environment (P8).	1	15
	Digital Marketing	Advertisements in the digital environment (P7).	1	
	Sales and Marketing	Positive results are also achieved in terms of sales and marketing activities (P20- P14- P5).	3	
Operational Efficiency and Cost	Operational Efficiency	Increase in the hotel's operational efficiency (P13).	1	
	Cost Reduction	By increasing the hotel's operational efficiency, it reduces costs (P13).	1	2
Overall Impact and Outcomes	Positive Impact	It has a positive impact (P2- P18).	2	2

Source: Our Elaboration

Among participants' opinions on the effects of smart applications on the competitive environment for hotel businesses, the most prominent theme was "Competition and Market Position", followed by the "Service Quality and Guest Experience" theme (N=33). This theme was most reflected in the "Service Quality" category (f=15). The "Service Quality" category was followed by "Service Speed and Efficiency", "Customer Loyalty", "Guest Satisfaction", "Brand Value and Image", and "Digital Reputation" categories (f=3; f=3; f=9; f=2; f=1). The "Service Quality and Guest Experience" theme was followed by the "Technology and Digitalization" theme (N=15), which was most reflected in the "Technology Usage" category (f=9). The "Technology Usage" category was followed by "Differentiation Through Technology", "Critical Perspective on Technology", "Digital Marketing", and "Sales and Marketing" categories (f=1; f=1; f=1; f=3). The "Technology and Digitalization" theme was followed by the "Operational Efficiency and Cost" and "Overall Impact and Outcomes" themes (N=2; N=2). These themes were reflected in the "Operational Efficiency", "Cost Reduction", and "Positive Impact" categories (f=1; f=1; f=2).

The findings in Table 4 indicate that smart applications have significant effects on the competitive environment for hotel businesses, particularly under the theme of "Competition and Market Position," with "Competitive Strength" standing out. This result aligns with previous academic studies showing that digital transformation strengthens competitive advantage and market position. For example, in their study, Demir & Şen Demir (2025) found that technology investments and innovative strategies significantly enhance competitive performance in hotel businesses and that the adoption of digital technologies supports competitive strength. Therefore, it can be said that the finding presented in Table 4 is also supported by the literature.

The final research question asked to hotel managers concerns recommendations for the dissemination and development of smart hotel applications in Türkiye: "What are your recommendations for the dissemination and development of smart hotel applications in Türkiye?" The prominent themes, categories, and code examples regarding participants' opinions on the dissemination and development of smart hotel applications in Türkiye are presented in Table 5. According to Table 5, the most prominent theme in participants' opinions on recommendations for the dissemination and development of smart hotel applications in Türkiye was "Digitalization and Technological Transformation in Hotels" (N=17). This theme was most reflected in the "Digital Infrastructure" category (f=7). The "Digital Infrastructure" category was followed by "Technology Dissemination", "Digital Investment", "Technology Adequacy", "Technological Equipment", "Digital Transformation", and "Digital Applications" categories (f=3; f=2; f=2; f=1; f=1; f=1).

Table 5. Participants' opinions on recommendations for the dissemination and development of smart hotel applications in Türkiye

Themes	Categories	Code Examples	Frequency (f)	Frequency (N)
Support and Collaboration	Government Support	Government incentives and support, tax incentives and R&D support, training programs supported by the government, government-backed digital investments, training-focused government assistance, and government support for infrastructure (P1-P5-P6-P7-P10-P11-P14-P16-P17).	9	15
	Public-Private Partnership	Public-private partnerships, training-focused public-private collaborations, training and employment cooperation, free and widespread training initiatives through collaboration, and pre-season training partnerships (P3-P12-P14-P18-P19).	5	
	University Collaboration	Collaboration with universities (P4).	1	
Training within the Scope of Smart Applications	Training	Staff training, government-supported training, high school and university education, training and human resources, government support, and joint government and private sector training (P1-P4-P6-P9-P10-P14-P15-P16-P18-P19-P20).	11	14
	Training Curriculum	A practical training curriculum and a tourism-focused education model can enhance skills and industry readiness (P2-P12).	2	
	Practical Training	Practical internship training (P2).	1	
Incentives, Taxes, and Regulations	Incentives	Government incentives, tax reduction incentives, and widespread incentive programs (P1-P2-P20).	3	9
	R&D Incentives	R&D incentives (P5).	1	
	Tax Reduction	Government tax reductions and tax relief regulations (P1-P8).	2	
	Tax Regulations	Tax regulations (P5).	1	
	Grant	Widespread grant programs (P20).	1	
	Regulatory Measures	Infrastructure regulations (P8).	1	
Seasonality in Hotels	Seasonal Staff	Seasonal employee balance (P3).	1	4
	Staff Integration	Staff integration (P3).	1	
	Staff Adaptation	Staff adaptation, staff digital adaptation (P6-P7).	2	
Digitalization and Technological Transformation in Hotels	Technology Dissemination	Technology dissemination, technology development, government-supported training (P4-P15-P18).	3	17
	Digital Investment	Digital investment training, the expansion of digital investment (P6-P7).	2	
	Technology Adequacy	Technology adequacy, technology training model (P9-P12).	2	
	Technological Equipment	Strong infrastructure equipment (P11).	1	
	Digital Transformation	Widespread digital transformation (P14).	1	
	Digital Applications	Digital applications (P16).	1	
	Digital Infrastructure	Incentives for digital infrastructure, infrastructure development, strong digital infrastructure, government-supported infrastructure, infrastructure and training support, infrastructure development and training (P5-P8-P11-P17-P18-P19-P20).	7	

Safety and Emergency Preparedness in Hotels	Security Systems	Digital security solutions (P1).	1	2
	Emergency Management	Security integration (P13).	1	
High Cost	High Cost	Chain hotel leadership (P15).	1	1

Source: Our Elaboration

The theme that stood out the most in participants' opinions regarding suggestions for the dissemination and development of smart hotel applications in Türkiye was "Digitalization and Technological Transformation in Hotels," followed by the "Support and Collaboration" theme (N=15). This theme was mostly reflected in the "Government Support" category (f=9). The "Government Support" category was followed by the "Public-Private Partnership" and "University Collaboration" categories (f=5; f=1). The "Support and Collaboration" theme was followed by the "Education" theme (N=14), which was mostly reflected in the "Education" category (f=11). This category was further divided into "Education Curriculum" and "Practical Training" categories (f=2; f=1). The "Education" theme was followed by the "Incentives, Taxes, and Regulations" theme (N=9), which was mostly reflected in the "Incentives" category (f=3). This category included "R&D Incentives," "Tax Reduction," "Tax Regulations," "Grants," and "Regulatory Measures" categories (f=1; f=2; f=1; f=1; f=1). The "Incentives, Taxes, and Regulations" theme was followed by the "Seasonal Staff in Hotels" theme (N=4), mostly reflected in the "Staff Adaptation" category (f=2). This category included "Seasonal Staff" and "Staff Integration" (f=1; f=1). The "Seasonal Staff in Hotels" theme was followed by the "Safety and Emergency Preparedness in Hotels" theme (N=2), reflected in the "Security Systems" and "Emergency Management" categories (f=1; f=1). Finally, the "Safety and Emergency Preparedness in Hotels" theme was followed by the "High Cost" theme (N=1), reflected in the "High Cost" category (f=1).

The findings in Table 5 show that, the theme of "Digitalization and Technological Transformation in Hotels" stands out with elements such as digital infrastructure, technology dissemination, digital investment, and technological equipment being highlighted among the participants' recommendations regarding the promotion and development of smart hotel applications in Türkiye. This result is consistent with previous academic studies emphasizing that investments in digital infrastructure hold strategic importance in the tourism and hospitality sector. For example, a study by Nikopoulou, Kourouthanassis, Chasapi, Pateli, & Mylonas (2023) found that, in the adoption of digital technologies by hospitality businesses, the adequacy of technological infrastructure, the availability of financial resources, and environmental regulations are significant determinants. This underscores the need for investments in digital infrastructure and technological transformation strategies. Therefore, it can be said that the findings in Table 5 are also supported by the literature.

Research shows that digital transformation in hotel operations increases operational efficiency, particularly through digital infrastructure and system integration. For example, technologies such as hotel management systems, the Internet of Things and artificial intelligence have the potential to improve service quality and process efficiency (Jabbar et al., 2024; Anwar et al., 2024). In addition, the contributions of smart applications to business processes show that digital transformation could play an important role in reducing the workload in hotels and improving service standards (Anwar et al., 2024). On the other hand, challenges such as system integration and employee training in the adoption of digital technologies are highlighted in the literature frequently (Anwar et al., 2024). Furthermore, the literature suggests that digital transformation applications have strategic value in terms of providing a competitive advantage, meeting customer expectations and improving hotel performance (Citak et al., 2025).

Hotel managers in the Edremit Gulf evaluated digitalization positively in terms of customer satisfaction, operational efficiency, and competitive advantage, supporting the findings of Iranmanesh et al. (2022), which indicate that digital technologies contribute to both the financial and service quality dimensions of hotel performance. Furthermore, views on the potential of smart applications to personalize services and transform guest experiences align with Dang and Nguyen (2023)'s emphasis on co-creating value with customers in the digital era. As noted by Wynn and Lam (2023), digitalization is not merely a technical process but also a management approach requiring a strong IT (information technology) strategy and employee alignment; this corresponds with the study's finding that managers emphasized differences in education

and adaptation. Similarly, Zeqiri (2024)'s observation that digital platforms transform business models aligns with the intensive use of online reservation systems and digital marketing channels by hotels in the region. Gangwar and Reddy (2023)'s emphasis on the human-centered technological transformation vision of Industry 5.0 is supported by this study, which shows managers' tendencies to integrate technology with the human factor. On the other hand, as seen in Ghazy and Fedorova (2022)'s findings on human-robot collaboration, employees approach digitalization with both opportunities and concerns, a pattern also observed in this research. Finally, the studies by Gajić et al. (2024) and Colak (2024) on sustainability and unmanned hotel applications support this research's combined focus on digitalization's contribution to operational efficiency and managerial sensitivity toward maintaining human interaction.

A review of the literature reveals that findings from the Edremit Gulf case study demonstrate that hotels' use of digital infrastructure and smart applications increases operational efficiency, improves business processes and provides a competitive advantage. These results, in line with general trends in the literature, show that digital transformation is not merely a technological innovation; it must also be approached as a human-centered, strategic and sustainable process in line with research objectives (Jabbar et al., 2024; Anwar et al., 2024; Citak et al., 2025).

5. Conclusion

Today, hotel businesses in the Edremit Gulf of Balıkesir Province are experiencing the digital evolution process at varying levels. While some hotels actively use mobile applications, digital room control systems, and online reservation infrastructures to enhance the guest experience, others continue to provide services through traditional methods. Especially in the post-pandemic period, rising digital expectations have guided hotel managers and directors toward technology investments. However, during the integration of digital applications, infrastructure deficiencies, staff adaptation issues, and cost concerns have emerged as the main challenges. This situation indicates that the digitalization process in the region is not progressing homogeneously. However, the positive effects of smart applications, particularly in improving customer experience, accelerating operational processes, and increasing brand visibility, encourage hotel managers and directors to take a more willing and supportive approach to this transformation. Hotel businesses in the Edremit Gulf show differences in the digitalization process when compared to other tourist regions in the Mediterranean. Lack of technical infrastructure in the region, employee integration issues, and cost concerns stand out as more significant challenges compared to hotels in other regions. However, positive outcomes such as increased customer satisfaction, improved operational efficiency and enhanced brand visibility demonstrate that hotels in the region have high potential for digital transformation. As a result, hotel businesses in the Edremit Gulf still demonstrate a structure open to development in the transition to digitalization and Industry 5.0, yet they hold the potential to contribute to the digital future of regional tourism with the right strategy and investments.

This study examines the impact of digital applications (mobile applications, digital room control systems, online reservation infrastructures, and smart hotel software), referred to as "smart applications" in the title, on management processes in hotel businesses operating in the Edremit Gulf. This study has been done through content analysis based on interviews with managers and directors of these businesses. The findings show that smart applications affect the decision-making, planning, implementation and performance evaluation stages of management processes. Digitalization processes accelerate, reduce operation errors and increase efficiency in terms of operational management. Online reservation systems and digital platforms strengthen brand awareness and provide a competitive advantage in terms of marketing and competition management. Smart technologies enhance customer experience and service quality within the scope of customer relationship management. It has been determined that hotel managers with high digital skills approached the process in a more planned and conscious manner, while employees with low digital skills struggled with the adaptation process in terms of human resources and strategic management. However, infrastructure deficiencies, cost factors and the digital skill level of employees are key factors determining the effectiveness of digital transformation in hotels. As a result, digital (smart) applications are emerging in hotel businesses not only as a technological innovation but also as a comprehensive management tool that transforms operational, strategic and human resources

processes. The success of digital transformation is not solely dependent on technological equipment, but is also directly related to employees' digital skills, adaptability and the training they receive. This situation further highlights the importance of human resources planning and employment strategies in hotel businesses. Particularly the need for digitally skilled personnel, the necessity of retraining existing employees and rising training costs are emerging as significant employment-related challenges for hotel businesses during the digital transformation process. The analysis of these data revealed that while participants exhibited varying levels of knowledge regarding digital transformation, they shared a common view that digitalization makes processes in hotel businesses more efficient and enhances customer satisfaction. In particular, managers and directors who received training on smart hotel software approached the process more consciously and willingly, whereas participants without any training experienced difficulties in adaptation. This finding indicates that digital evolution is not only a technological process but also a human resource-oriented one.

In their systematic review, Iranmanesh et al. (2022) emphasized the contribution of digital technologies to performance improvement in the hotel industry, particularly highlighting service quality, efficiency, and competitive advantage. Similarly, this study revealed a shared view that digitalization facilitates management processes and enhances customer satisfaction. Dang and Nguyen (2023) noted that innovative applications such as artificial intelligence and the metaverse transform value co-creation processes with customers; likewise, this research observed that smart applications make services more personalized. As in García-López et al. (2025), who drew attention to the challenges encountered in post-COVID-19 digital transformation, integration, cost, and staff training issues were frequently mentioned in this study. Wynn and Lam (2023) argued that digitalization is not merely a technical process but should be addressed alongside strategic orientation and employee alignment, a perspective supported by the findings of this research. Zeqiri (2024) highlighted the transformation of business models through digital platforms, and in this study, the effects of digitalization were observed in marketing, reservations, and customer relations. Consistent with Gangwar and Reddy (2023) regarding Industry 5.0, efforts to integrate technology with a human-centered approach were evident in hotels in the Edremit Gulf. Similarly, Ghazy and Fedorova's (2022) findings on human-robot collaboration reflect managers' approaches that carry both opportunities and concerns. Studies by Gajić et al. (2024) and Colak (2024) focus on sustainability and unmanned hotel models, while this research contributes locally to the literature by addressing both the contribution of digitalization to operational efficiency and expectations regarding human interaction.

Based on the findings, it is recommended that hotel businesses increase investments in robust digital infrastructure to promote digital transformation and the widespread adoption of smart applications. Additionally, enhancing employees' digital skills and implementing continuous training programs are crucial for human-robot collaboration and the integration of technology into operational processes. Assigning expert teams and optimizing system integration to minimize technological issues will support the effective use of smart applications. In this way, hotel businesses can strengthen their competitive advantage while increasing guest satisfaction and achieving sustainable growth.

The following recommendations can be proposed for the effective implementation of digital transformation processes in hotel businesses within the scope of Industry 5.0 and smart applications:

- Increase digital infrastructure investments: Ensure the up-to-date and efficient use of integration systems such as Property Management Systems (PMS), the Internet of Things (IoT), and cloud computing in hotels.
- Support human-robot collaboration: Strengthen employees' digital skills and provide training in robotics and AI to enhance the contribution of technology to operational efficiency and service quality.
- Prevent technical issues: Establish robust technical support and regular maintenance processes to address system failures, integration challenges, and error risks.
- Balance technology and human-centered personalization: Preserve the importance of human touch and creative tasks alongside technological solutions to enhance guest satisfaction.
- Promote sustainability and green energy usage: Encourage the adoption of renewable energy sources for energy efficiency and cost management.

- Develop strategies to increase competitive advantage: Leverage digitalization to achieve a competitive edge and implement innovative practices to strengthen market positioning.
- Collaborate with digital content creators and local stakeholders: Highlight cultural and environmental values through professional and original content in destination promotions.
- Expand smart applications that enhance guest experience: Support department-level digital solutions to accelerate business processes and improve service quality.
- Continuous development of employees' digital competencies: Regular training to update hotel staff's digital skills ensures effective and seamless use of technology, enhancing human-robot collaboration.
- Digitalization of guest feedback systems: Implement real-time guest feedback mechanisms integrated with smart applications to continuously monitor and improve service quality.
- Strengthening cybersecurity and data protection policies: As digitalization increases, safeguarding customer and business data becomes critical; hotels should develop comprehensive cybersecurity measures and data privacy policies.
- Establish multichannel communication and service models: Provide seamless, multichannel communication with guests via digital platforms, social media, and mobile apps to enhance satisfaction and loyalty.
- Deploy smart systems in energy and waste management: Use sensors and automation systems to optimize energy consumption and waste management in line with sustainability goals.

If these recommendations are implemented, the technological transformation process within the scope of smart applications in hotel businesses can result in sustainable success in terms of both efficiency and guest satisfaction.

REFERENCES

- Alkaya, A. (2022). Toplum 5.0 bağlamında dijital dönüşüm ve pazarlamadaki yansımaları. In *Endüstri 4.0'dan Toplum 5.0'a: Yeni üretim tarzının gelişimi ve yansımaları* (ss. 123–140). Gazi Kitabevi.
- Anwar, F. A., Deliana, D., & Suyamto. (2024). Digital transformation in the hospitality industry: improving efficiency and guest experience. *International Journal of Management Science and Information Technology*, 4(2), 428–437. <https://doi.org/10.35870/ijmsit.v4i2.3201>
- Baykal, M., & Yazıcı Ayyıldız, A. (2022). Otel yöneticileri ve misafirleri perspektifinden dijitalleşme. *GSI Journals Serie A: Advancements in Tourism, Recreation and Sports Sciences (ATRSS)*, 5(2), 307–324.
- Buhalis, D., & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the internet—The state of eTourism research. *Tourism Management*, 29(4), 609–623.
- Citak, M. E., Hatun, H. İ., Ecevit, A., & Körpe, B. (2025). Otel endüstrisinde dijital dönüşüm: Konuk deneyimini iyileştiren teknolojik çözümler. *Selçuk Turizm ve Bilişim Araştırmaları Dergisi*, 8, 26–33. <https://doi.org/10.71276/stbad.1772965>
- Coskun, R., Altunışık, R., & Yildirim, E. (2007). *Sosyal bilimlerde araştırma yöntemleri: SPSS uygulamalı*. Sakarya Yayıncılık.
- Colak, E. (2024). Unmanned smart hotel: Applications and examples. *Worldwide Hospitality and Tourism Themes*, 16(5), 611–626. <https://doi.org/10.1108/WHATT-06-2024-0137>
- Colak, O., & Karakan, H. İ. (2021). Akıllı otel uygulamaları ve bu uygulamalar hakkında yönetici görüşleri: Gaziantep ili örneği. *Pamukkale Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 42, 168–184. <https://doi.org/10.30794/pausbed.744680>
- Dang, T. D., & Nguyen, M. T. (2023). Systematic review and research agenda for the tourism and hospitality sector: Co-creation of customer value in the digital age. *Future Business Journal*, 9, Article 94. <https://doi.org/10.1186/s43093-023-00274-5>
- Demir, M., & Şen Demir, Ş. (2025). The relationship between technology investments, innovation strategies, and competitive performance in the hospitality industry: A mixed methods approach. *International Journal of Hospitality Management*, 128, Article 104151. <https://doi.org/10.1016/j.ijhm.2025.104151>
- Demirci Celep, N. (2020). *Toplum 5.0: İnsan merkezli toplum*. Türk Eğitim Derneği.
- Develi, H. (2017, Kasım 2). Endüstri 4.0'dan Toplum 5.0'a. *Dünya Gazetesi*. <https://www.dunya.com/kose-yazisi/endustri-40dan-toplum-50a/389146>
- Durmaz, M. Ş. (2023). *Yeşil anahtar ödüllü otellerde dijital dönüşüm uygulamaları: İzmir ve Ankara örnekleri* (Yüksek lisans tezi). Selçuk Üniversitesi, Sosyal Bilimler Enstitüsü, Konya.
- Dulgaroglu, O. (2021). Digitalization in tourism: Smart tourism applications, digital tourism and tourism 4.0. *Journal of Tourism and Management*, 2, 1–15.

- Dulgaroglu, O. (2024a). Otel işletmelerinde kullanılan ön büro otomasyon sistemlerine yönelik teknoloji temelli bir bakış. *Journal of Travel and Tourism Research*, 25(25), 94–111.
- Dulgaroglu, O. (2024b). Turizmde yapay zekâ teknolojileri ve robotlaşma. *Uluslararası Turizm, Ekonomi ve İşletme Bilimleri Dergisi*, 8(2), 82–95.
- Ercan, F. (2019). Smart tourism technologies: Applications in hotel business. In V. Krystev, R. Efe, & E. Atasoy (Eds.), *Theory and Practice in Social Sciences* (pp. 528–546). St. Kliment Ohridski University Press.
- European Commission. (2020). *Enabling technologies for Industry 5.0: Results of a workshop with Europe's technology leaders*. Directorate General for Research and Innovation.
- Fukuyama, M. (2018). *Society 5.0: Aiming for a new human-centered society*. https://www.jef.or.jp/journal/pdf/220th_Special_Article_02.pdf
- Gajić, T., Petrović, M. D., Milanović Pešić, A., Conić, M., & Gligorijević, N. (2024). Innovative approaches in hotel management: Integrating artificial intelligence (AI) and the internet of things (IoT) to enhance operational efficiency and sustainability. *Sustainability*, 16(17), Article 7279. <https://doi.org/10.3390/su16177279>
- Gangwar, V. P., & Reddy, D. (2023). Hospitality industry 5.0: Emerging trends in guest perception and experiences. In V. P. Gangwar (Ed.), *Opportunities and Challenges of Business 5.0 in Emerging Markets* (Chapter 10). IGI Global. <https://doi.org/10.4018/978-1-6684-6403-8.ch010>
- García-López, A. M., Galindo-Pérez-de-Azpillaga, L., & Foronda-Robles, C. (2025). The flow of digital transition: The challenges of technological solutions for hotels. *Social Indicators Research*. <https://doi.org/10.1007/s11205-024-03487-5>
- Ghazy, K., & Fedorova, A. E. (2022). Hotel employees' attitude and acceptance toward human-robot co-working based on the Industry 5.0 concept. *Changing Societies & Personalities*, 6(4), 906–926. <https://doi.org/10.15826/csp.2022.6.4.210>
- Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of Qualitative Research* (Vol. 2, pp. 163–194). Sage.
- Iranmanesh, M., Ghobakhloo, M., Nilashi, M., Tseng, M.-L., Yadegaridehkordi, E., & Leung, N. (2022, October). Applications of disruptive digital technologies in hotel industry: A systematic review. *Computers and Industrial Engineering*, 173, Article 108690. <https://doi.org/10.1016/j.cie.2022.108690>
- Imamoglu, S. Z., Erat, S., & Yörük, E. G. (2021). Endüstri 4.0 ve Toplum 5.0'a geçiş sürecinde sosyal inovasyonun rolü. In O. Yılmaz, H. Simsek, S. Sağtaş, & M. Aslan (Eds.), *Değişimden dönüşüme: Sosyal bilimlerde yeni normlar* (ss. 17–32). Gazi Kitabevi.
- Iyigunçor, T. (2022). Ekonomik ve toplumsal dijitalleşme: Endüstri 4.0'dan Toplum 5.0'a. *Uluslararası Sosyal Medya ve İletişim Araştırmaları Dergisi*, 4(1), 47–59.
- Jabbar, U. A., Prabowo, B. A., Hanafi, R. A., & Info, A. (2024). Digital transformation in hotel management: optimizing guest experience in the industry 4.0 Era. In *Proceeding of The International Global Tourism Science and Vocational Education*.
- Kantarıcı, K. (1997). *Otel işletmelerinde iş tatmininin ölçülmesi ve işgören performansına etkileri* (Yayımlanmamış doktora tezi). Dokuz Eylül Üniversitesi, Sosyal Bilimler Enstitüsü, İzmir.
- Karakus, F. (2020). *Endüstri 4.0 sürecinde lojistiğin yemek ve içecek endüstrisine etkisi* (Yüksek lisans tezi). Balıkesir Üniversitesi, Sosyal Bilimler Enstitüsü, Balıkesir.
- Kim, J. J., Lee, M. J., & Han, H. (2020). Smart hotels and sustainable consumer behavior: Testing the effect of perceived performance, attitude, and technology readiness on word-of-mouth. *International Journal of Environmental Research and Public Health*, 17(2), 1–19. <https://doi.org/10.3390/ijerph17020436>
- Klenke, K. (2016). *Qualitative research in the study of leadership* (2nd ed.). Emerald Group Publishing.
- Kumar, U., Kaswan, M. S., Kumar, R., Chaudhary, R., Garza-Reyes, J. A., Rath, R., & Joshi, R. (2023). A systematic review of Industry 5.0 from main aspects to the execution status. *The TQM Journal*. <https://doi.org/10.1108/TQM-06-2023-0183>
- Marangoz, M., Kara, E., Yılmaz, H., & Demirdağ, F. (2022). Sanayinin dönüşümü ve evreleri. In M. Marangoz & H. H. Özkoç (Eds.), *Endüstri 4.0 ve işletme yönetimi* (ss. 3–28). Beta Yayıncılık.
- Nahavandi, S. (2019). Industry 5.0—A human-centric solution. *Sustainability*, 11(16), Article 4371. <https://doi.org/10.3390/su11164371>
- Nikopoulou, M., Kourouthanassis, P., Chasapi, G., Pateli, A., & Mylonas, N. (2023). Determinants of digital transformation in the hospitality industry: technological, organizational, and environmental drivers. *Sustainability*, 15(3), Article 2736. <https://doi.org/10.3390/su15032736>
- Okan Gökten, P. (2018). Karanlıkta üretim: Yeni çağda maliyetin kapsamı. *Muhasebe Bilim Dünyası Dergisi*, 20(4), 880–897. <https://doi.org/10.31460/mbdd.460897>
- Ozden, A. T. (2022). 1.0'dan 5.0'a dünya: Web, pazarlama, endüstri ve toplum. *Journal of Business in the Digital Age*, 5(1), 29–44.
- Oztekin, H., & İlhan, İ. (1994). Konaklama endüstrisi ve konaklama işletmelerinin sınıflandırılması. *Anatolia: Turizm Araştırmaları Dergisi*, 5(2), 12–15.
- Robert, A. D., & Boullaguet, A. (1997). *Analyse de contenu*. Presses Universitaires de France (P.U.F.).

- Sadic, Ş. (2021). Endüstri 5.0 ve sürdürülebilirlik. In G. İ. Sönmeztürk Bolatan (Ed.), *Endüstri 5.0: Dijital toplum* (ss. 1–25). Ekin Yayınevi.
- Sallan Gül, S., & Kahya Nizam, Ö. (2021). Sosyal bilimlerde içerik ve söylem analizi. *Pamukkale Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 42(Özel sayı 1), Ö181–Ö198.
- Sener, B. (1997). *Modern otel işletmelerinde yönetim ve organizasyon* (2. Baskı). Gazi Kitabevi.
- Tuominen, P., & Ascenção, M. (2016). The hotel of tomorrow: A service design approach. *Journal of Vacation Marketing*, 22(3), 279–292. <https://doi.org/10.1177/1356766715608780>
- Yalçiner, A. Y., & Caylak, İ. (2020). Türkiye’de dijital dönüşüme başlangıç için AHP ve TOPSIS yöntemleri ile sektörel sıralama. *Afyon Kocatepe Üniversitesi Fen ve Mühendislik Bilimleri Dergisi (APJES)*, 8(2), 258–265. <https://doi.org/10.21541/apjes.526700>
- Yildirim, A., & Simsek, H. (2000). *Sosyal bilimlerde nitel araştırma yöntemleri* (2. baskı). Seçkin Yayıncılık.
- Zaharia, R.-M. (2025). The digital transformation of hotel services: employees’ perceptions on the reconfiguration of operational. In *Annals of Dunarea de Jos University of Galati. Economics and Applied Informatics*, 3, 179–184. <https://doi.org/10.35219/eai15840409563>
- Zeqiri, A. (2024). From traditional to digital: The evolution of business models in hospitality through platforms. *Platforms*, 2(4), 221–233. <https://doi.org/10.3390/platforms2040015>
- Wang, S., Wan, J., Li, D., & Zhang, C. (2016). Implementing smart factory of Industrie 4.0: An outlook. *International Journal of Distributed Sensor Networks*, 12(1), 1–10. <https://doi.org/10.1155/2016/3159805>
- Wynn, M. G., & Lam, C. (2023). Digitalisation and IT strategy in the hospitality industry. *Systems*, 11(10), Article 501. <https://doi.org/10.3390/systems11100501>

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Tracking Tourist Behaviour During Environmental Crises: Analysing Economic Indicators, Social Sentiment, and Tourist Mobility in the Mar Menor Lagoon

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ABSTRACT

The Mar Menor, one of Europe's largest coastal lagoons, has experienced severe ecological crises over the past decade due to ongoing environmental degradation. These events, characterized by algal blooms and mass mortality of marine life have sparked widespread public concern and threaten the region's vital tourism industry. This study quantifies the impact of these environmental catastrophes on tourism across three key dimensions: economic, social, and mobility. To achieve this, we employ a mixed-methods approach using three distinct data sources. First, we analyse official economic statistics to track fluctuations in traveller arrivals, overnight stays, and average stay durations between 2012 and 2022. Second, we utilize social sensing to Twitter data to evaluate public discourse and tourist sentiment regarding the crises. Finally, we analyse nationwide human mobility datasets to detect shifts and structural breaks in tourist flows. Our findings demonstrate a direct correlation between the ecological crises (specifically the 2016, 2019, and 2021 episodes) and significant declines in tourism. This research highlights how severe environmental degradation drastically alters tourist behaviour, emphasizing the need for sustainable coastal management to protect local economies.

KEYWORDS

Ecological Crisis, Tourism Impact, Social Sensing, Tourist Mobility, Economic Analysis.

ARTICLE HISTORY

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1. Introduction

Mar Menor is one of the largest coastal lagoons in Europe and the Mediterranean Sea with a surface area of 135.5 km² and a coastline of 74 km (Belando et al., 2021). The pleasant temperatures, lack of precipitation, and beach make Mar Menor a representative of Costa Cálida's main tourist attraction. However, for decades the Mar Menor has been suffering a progressive degradation from mining activity to the arrival of tourism in the 70s and uncontrolled urbanization (García-Ayllón, 2018). Marine pollution has been shown to generate negative economic impacts on coastal destinations, including a reduction in tourist arrivals, a decrease in housing prices, and an increased risk of business failure in affected area (Fernández Ferrero et al., 2022; Lamas Rodríguez et al., 2023; Aparicio et al., 2024).

These environmental disturbances often manifest as ecological crises that can attract media attention, particularly on social media platforms, where information spreads rapidly (Jurgens & Helsloot, 2017). User-generated content, including comments and opinions shared online, becomes a key factor in shaping the public perception of affected destinations (Correia-Loureiro et al., 2021), with direct implications for tourist demand and even destination image (Becken et al., 2017). In the case of Mar Menor, the widespread awareness of environmental issues changed the willingness of tourists to visit the coastal lagoon, leading many to choose alternative destinations (Fernandez Ferrero et al., 2022).

Given that these perception changes are primarily expressed through the news and user-generated textual content on social media, an analytical method capable of systematically evaluating opinions is required. In this context, sentiment analysis provides a useful methodological approach to assess public attitudes and emotional responses conveyed online. Sentiment analysis (SA) is the process of collecting and analysing people's opinions, ideas, and perceptions about different topics, products, subjects, and services, etc. It identifies and extracts subjective information from the text using natural language processing and text mining (Wankhade et al., 2022). SA provides a technological solution to sensing and understanding consumer experiences in all the areas, especially in tourism (Jain et al., 2021; Manosso & Domareski Ruiz, 2021).

The main objective of this study is to analyse the impact of the various ecological crises of Mar Menor on the three tourism dimensions: economic, social, and mobility. To do so, first, we relied on the publication of news and posts in social media about environmental problems that occurred in Mar Menor from 2014 to 2021 to distinguish the phases of the ecological crisis. For the economic part, we used statistical data from National Institute of Statistics (INE) (<https://ine.es>) that has been reprocessed with the collaboration of the Regional Statistics Centre of the Region of Murcia and the services of the Ministry of Industry, Tourism, Business and Innovation. This data includes the number of travellers and overnight stays in the Mar Menor area, and their average stays.

Moreover, we have used a social sensing tool developed as a part of the SMARTLAGOON project (Prandi et al., 2022) to study the sentiments and to measure the social impact on tourism of Mar Menor lagoon. Finally, we applied the analysis of tourist flows. By means of statistical data extracted from the INE mentioned previously, we could discover the number of travellers and overnight stays from 2012 to 2022 in the Mar Menor area to see the general tendency of arrivals. Next with the dataset of the Spanish Ministry of Transportation (SMT) we were able to evaluate the impact of the last crisis of the Mar Menor in 2021 in terms of tourist mobility.

This study was conducted to address the following research questions (RQs):

RQ1. Is there a relationship between ecological conditions in the Mar Menor lagoon and fluctuations in tourist arrivals over an eleven-year period based on statistical data?

RQ2. Do sentiment analysis patterns correspond with changes in economic indicators and ecological conditions on the Mar Menor lagoon?

RQ3. What patterns can be identified in tourist mobility in the region in relation to ecological changes in the Mar Menor lagoon?

This paper is structured as follows. Section 2 reviews the related literature, while section 3 highlights the background and problems related to the Mar Menor. Section 4 presents the research methodology

and the data used for the study. Section 5 presents the results. Discussion in section 6 debates the main results, while section 7 summarises the key findings and limitations along with future work lines.

2. Literature Review

2.1 Tourist Behaviour under Environmental Crises

Environmental crises pose a severe threat to destination sustainability and local economies. To understand how these crises affect tourism demands, there are some theoretical foundations in the literature that can be used to link environmental degradation with tourists' psychological and behavioral responses. Two main frameworks in this line are the Theory of Planned Behavior (TPB) (Ulker-Demirel & Ciftci, 2020) and Protection Motivation Theory (PMT) (Suess et al., 2024).

Under the TPB, behavioral intentions are shaped by attitudes, subjective norms, and perceived behavioral control. When an environmental crisis damages a destination's image, it acts as a significant "travel constraint," altering the tourist's positive attitude toward the location and reducing their willingness to recommend or revisit it (Awais-E-Yazdan et al., 2025). On the other hand, PMT explains how individuals evaluate risks and make protective travel decisions. PMT operates through a dual-appraisal system: threat appraisal (evaluating the severity and personal vulnerability associated with a crisis) and coping appraisal (assessing self-efficacy and response costs). When perceived ecological risk exceeds their coping capacity, tourists engage in protective behaviors, such as "spatial substitution" (choosing alternative, less contaminated destinations) or canceling planned trips (Smolčić Jurdana & Agbaba, 2025).

Consequently, modern crisis management in environmental tourism must move beyond physical ecosystem remediation; it must address how administrative and safety responses shape risk perceptions to prevent long-term socioeconomic decline.

2.2 Social Sensing and Sentiment Analysis during Environmental Disruptions

To evaluate public perception and the subsequent reputational damage caused by environmental crises, researchers have turned to social sensing (Wang et al., 2015). Social sensing leverages human-centric data streams to capture public opinions, feelings, and behavioral reactions in real time. Microblogging platforms, particularly Twitter (Now 'X', hereafter referred to consistently as Twitter to align with the historical nature of the 2010–2022 dataset and standard terms such as 'tweets'), serve as valuable public forums where tourists and residents openly express satisfaction or distress during ecological anomalies (Paolanti et al., 2021).

Current studies address this topic by utilizing advanced Natural Language Processing (NLP) pipelines. To map shifting public discourse during crises, topic modelling such as Latent Dirichlet Allocation (LDA) are used to automatically group millions of messages into thematic clusters (Correia-Loureiro et al., 2021). These topic modeling structures are combined with deep learning architectures like Bidirectional Encoder Representations from Transformers (BERT) to classify sentiment polarities as positive, neutral, or negative during disruptions like bushfires, earthquakes, and toxic spills (Yan et al., 2020; Willson et al., 2021; Viñán-Ludeña & de Campos, 2022).

These studies demonstrate that public online sentiment behaves as an early indicator of tourism demand. While online perception remains relatively stable during minor environmental events, acute crises (e.g., mass marine mortality) spark rapid, persistent increases in negative sentiment that correlate directly with declines in tourism destinations (Sánchez-Franco & Rey-Moreno, 2021; Wang et al., 2025). Social sensing thus acts as a virtual reflection of real tourism behavioral changes (Kurniawan et al., 2025).

2.3 Human Mobility Tracking

While social sensing captures cognitive perceptions, tracking technologies are required to map the physical spatiotemporal changes in tourist flows during crises. Literature in tourism geography identifies a methodological transition from active tracking to passive digital tracking (Schmücker & Reif, 2022).

Active methodologies, like travel diaries, often face limitations due to recall bias and low spatial resolution (Vu et al., 2020). In contrast, passive tracking utilizes network-level cellular data to capture macro-level human mobility (Möhring et al., 2021; Xu et al., 2021a). Passive mobile positioning data allow researchers to monitor tourist densities, calculate stay durations, and identify spatial clusters across extensive regions without active user intervention (Xu et al., 2021b). Recent studies highlight the value of combining passive mobile data with social media indicators to construct complete profiles of tourist behavior (Kovács et al., 2021).

During destination disruptions, human mobility analyses demonstrate that crises alter physical travel routes, generate structural breaks in traveler volume, and accelerate departure rates (Park et al., 2022). Applying structural break and change-point algorithms to high-frequency mobility datasets allows researchers to identify the exact moments tourist patterns deviate from baseline seasonality during health emergencies or environmental shocks (Czarnecki et al., 2023). However, mapping these physical flow anomalies to ecological changes is still an emerging domain, particularly within highly sensitive coastal ecosystems.

2.4 Identified Gaps

Existing literature has established that environmental degradation impairs destination attractiveness and tourist satisfaction, while social media sentiment tracking and human mobility analysis offer valid real-time tools to assess public perception and spatial behaviors during crises. However, what remains unknown is how these distinct dimensions interact and evolve together across the progressive phases of long-term environmental degradation. Previous research typically evaluates these factors in isolation, leaving a gap in understanding the temporal alignment between arrivals, subjective online discourse, and rapid destination departures. This study addresses this gap by presenting a multidimensional analysis that integrates economic statistics, online social sensing, and physical mobility analysis to provide a holistic assessment of tourist behavior during successive ecological crises in the unique Mar Menor environment.

3. Background

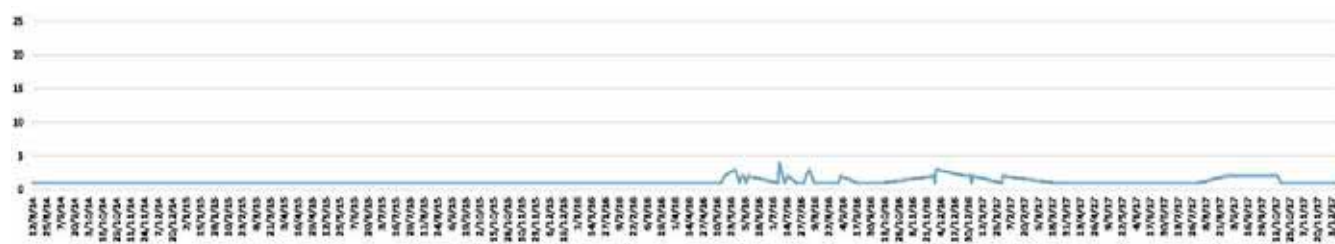
The Mar Menor is the largest hypersaline coastal lagoon of the Mediterranean basin with a surface area of 135.5 km², a coastline of 74 km (Belando et al., 2021). It is one of the ecosystems with higher ecological and socioeconomic importance of the region. It took part in several protected area networks established by regional, international, and European laws (Martínez Dalmau, 2023).

Figure 1 indicates the municipalities that surround Mar Menor: San Pedro del Pinatar (Lo Pagán and Los Cuarteros), San Javier (Santiago de la Ribera and a large part of La Manga), Los Alcázares and Cartagena (El Carmolí, Los Urrutias, Los Nietos, Islas Menores, Mar de Cristal, Playa Honda, Playa Paraíso and part of La Manga).

separately and then compared the observed effects. We relied on the publication of news about environmental problems occurred in Mar Menor since 2014 to 2021 in 3 regional newspapers (La Opinión de Murcia, La Verdad and Murciaplaza), 6 Spanish national newspapers (including the internationally prestigious “El País”) and 6 international newspapers and news agencies (Environmental Justice Atlas, Euro Weekly News, Express, BBC, The Guardian and National Geographic).

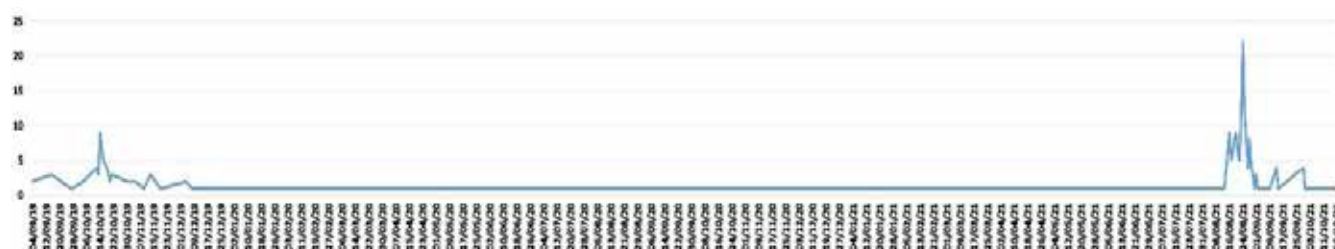
Figure 2 and 3 show the timeline of the total numbers of news found in these sources during those 7 years. As observed, it is possible to identify three intervals with different levels of impact and duration of news coverage related to ecological problems in the Mar Menor. The details of each interval are given next.

Figure 2. Number of News from August 2014 to December 2017



Source: Own Elaboration

Figure 3. Number of News from September 2018 to October 2021



Source: Own Elaboration

Phase 1 (May 2016-November 2017): This phase represents the first appearance of an ecological crisis on the media, although with a very low relevance according to the total number of news. It is observed a continuous series of publications, which involved several warnings about the degradation and extreme turbidity of the Mar Menor at that time. According to the news, it was observed that 85% of the initial extension of marine meadows had been lost. At the beginning of 2017, thousands of dead molluscs and sea cucumbers started to appear in the waters of Mar Menor and on its shores. Moreover, NASA images highlighted on the news a strong colour contrast between the Mar Menor lagoon and the Mediterranean Sea. Thus, this first crisis resulted in water in the Mar Menor turning green, a significant increase in turbidity levels and the death of some types of marine life.

Phase 2 (September 2019-December 2019): A second ecological crisis is detected at the end of 2019, with a moderate relevance on the media. In this crisis, the appearance of thousands of dead fish confirmed a new ecological catastrophe. The event was attributed to a large volume of fresh water, laden with sediments and organic matter, that was displaced by torrential rainfall. This event was commonly referred to as the cold drop of isolated high-level depression (DANA), which left marine life without oxygen. The media's focus on this crisis had a shorter duration than in the first occurrence.

Phase 3 (August 2021-October 2021): The third ecological crisis has showed the highest relevance in the media until now, again during a short period. It was covered not only in local/national newspapers, but also in international ones. In this crisis, hundreds of small fish appeared dead on the shores of the

beaches adjacent to the Mar Menor. The Regional Government of Murcia and researchers from the Polytechnic University of Cartagena initially rejected anoxia as the cause of aquatic fauna mortality, in contrast to the 2019 crisis, while environmental organisations attributed the event to aquifer over-exploitation and intensive agriculture.

Note that, between these intervals, there are silent periods in the news about any environment problems in the Mar Menor: August 2014–May 2016 (before the first crisis), December 2017–August 2019 (time lapse between the first and second crises) and January 2020–July 2021 (between the second and third crises). In this latter silent period, other news related to the Mar Menor highlighted the measures that the authorities and the people from Mar Menor were taking to improve the conditions of the lagoon, for example, achieving that the Mar Menor became a legal entity.

The following subsections delve into the impact of the identified crises in the Mar Menor from an economic, social, and tourist mobility perspective.

4.2 Economic Data

To assess the impact of the Mar Menor crises from an economic perspective, we analysed official statistical data on the number of travellers and overnight stays in the Mar Menor area. These statistical data was provided by the National Institute of Statistics (INE) by means of surveys on hotels' occupancy, in collaboration with the Regional Statistics Centre of the Murcia Region and the services of the Ministry of Tourism, Business and Innovation. The data is available on the Murcian Institute of Tourism's website (<https://www.itrem.es/itrem/estadistica>). According to the INE, the statistical data related to the tourism in the Mar Menor area involve the following towns: El Algar, Torre Pacheco, Los Urrutias, Los Alcázares, San Pedro del Pinatar, San Javier, Los Nietos, Los Belones and Cabo de Palos, which are in the proximate vicinity to the coastal lagoon.

Moreover, we modelled the monthly series of travellers (natural-log scale) within an interrupted time-series (ITS) (Box & Tiao, 1975; Bernal et al., 2017) to isolate the ecological degradation effect from the COVID-19:

$$\ln(Y_t) = \beta_0 + \beta_1 \cdot t + \beta_2 \cdot t^2 + \sum \gamma_m \cdot \text{Month}_m + \theta_1 \cdot \text{Lockdown}_t + \theta_2 \cdot \text{Restrictions}_t + \delta_1 \cdot \text{Phase1}_t + \delta_2 \cdot \text{Phase2}_t + \delta_3 \cdot \text{Phase3}_t + \varepsilon_t$$

where t is a linear trend; Month are eleven calendar-month indicators capturing seasonality; Lockdown and Restrictions capture the COVID-19 disruption (March–June 2020 and July 2020–December 2021); and Phase1–Phase3 are previously described intervals. Standard errors are heteroskedasticity- and autocorrelation-consistent (HAC) following Newey and West (1987), using 12 lags. The post-2021 ecological effect is identified from the post-pandemic period that started in 2022. We complemented this with a pre-pandemic subsample (2012m1–2020m2, $n = 98$) that isolates the 2016 and October-2019 events free of COVID-19; a seasonal ARIMA model with intervention regressors (SARIMAX(1,0,0)(0,1,1)₁₂); and a pre-pandemic counterfactual with a 95% prediction interval. Analyses were run in Stata 16 software.

4.3 Social Sensing Data

Beyond traditional tourism indicators, social sensing based on Twitter data was incorporated to analyse how environmental degradation of the lagoon is reflected in public discourse online.

As part of the SMARTLAGOON project mentioned in the introduction, a tool named SensingTools has been developed to measure the social impact of political, economic and/or environmental actions on the citizens living in the vicinity of the Mar Menor. SensingTools analyses the messages posted by users on Twitter since 2010 about the Mar Menor. These tweets have been collected through the Twitter Academic Research API.

We implemented a filtering procedure to identify tweets relevant to the Mar Menor ecological crisis. Tweets were classified according to three contextual groups based on the presence of specific location-related keywords. The first context (C_1) includes tweets explicitly mentioning “Mar Menor” or “#MarMenor”.

The second context (C_2) comprises tweets referring to lagoon-side towns within the Mar Menor basin that are closely associated with the environmental crisis. More specifically, the keywords added to C_2 are: “San Javier”, “Los Alcázares”, “La Manga”, “Lo Pagan”, “Los Narejos”, “Santiago de la Ribera”, “Los Cuarteros”, “Las Lomas del Rame”, “El Carmolí”, “Bahía Bella”, “Los Urrutias”, “Los Nietos”, “Islas Menores”, “Mar de Cristal” and “Playa de la Llana”. The third context (C_3) includes tweets mentioning the main nearby urban centres, Murcia and Cartagena. After applying these contextual filters, the proportion of false positives within each group was evaluated to estimate the number of relevant messages for each context.

The proportion of false positives was assessed through a manual labelling process carried out using the SensingTools application. A random sample of 500 tweets was extracted from each contextual group and manually reviewed by several experts and local citizens familiar with the Mar Menor area. Tweets were considered false positives when they did not express concern about the Mar Menor ecological crisis, did not refer to the environmental degradation of the lagoon, or were unlikely to affect other users’ perception of the crisis. This manual validation was necessary because the interpretation of local toponyms is highly context-dependent and may vary depending on the geographical and social knowledge of the annotators.

After selecting the most suitable context for the analysis, the tweet corpus was preprocessed to reduce noise. First, highly repetitive messages and near-duplicate tweets posted by the same users were removed using a text-similarity threshold of 0.8, corresponding to more than 80% similarity. Second, messages not written in Castilian Spanish were excluded because the topic modelling pipeline is sensitive to linguistic heterogeneity and the subsequent sentiment analysis was designed for Spanish-language content. Finally, tweets were normalised by converting text to lowercase and removing URLs, punctuation marks, emojis and digits.

Topic discovery was then performed on the preprocessed tweet corpus using BERTopic (Grootendorst, 2022), with the aim of identifying the main themes discussed in relation to the Mar Menor and, subsequently, isolating those topics related to tourism. BERTopic is a topic modelling framework that generates coherent topics from textual data through a multi-step pipeline. First, document embeddings are generated from the tweets using a pre-trained transformer-based model from the Sentence-BERT framework (Reimers & Gurevych, 2019). These embeddings represent tweets as dense vectors, allowing messages with similar semantic content to be located close to each other in the embedding space. The dimensionality of these embeddings is then reduced using UMAP (McInnes et al., 2018), which preserves relevant structures from the original high-dimensional representation. Next, HDBSCAN (Malzer & Baum, 2020) is applied to cluster semantically similar tweets and identify groups of messages corresponding to different topics, while also allowing outliers to be modelled. Finally, topic representations are generated using a class-based TF-IDF matrix (Sammur & Webb, 2010), which identifies the most representative terms for each topic. In this study, BERTopic was used exclusively for topic discovery and for identifying tourism-related tweets; sentiment polarity was assigned afterwards as a separate classification task.

Sentiment polarity was then used to characterise the tone of tourism-related messages. Polarity assignment was performed within the SensingTools pipeline using the multilingual Twitter-XLM-RoBERTa-base sentiment model developed by CardiffNLP (Barbieri et al., 2022), a transformer-based model adapted to social media text. According to the original model evaluation, this architecture achieves an F1-score of 68.5 when trained and evaluated on Spanish tweets. Each tourism-related tweet was classified into one of three categories: positive, neutral, or negative. Positive tweets were defined as those expressing favourable perceptions of the Mar Menor as a tourist destination, including enjoyment, satisfaction, recommendation, promotion of tourism activities, or positive references to local attractions. Negative tweets were defined as those expressing criticism, concern, dissatisfaction, or adverse perceptions associated with the ecological crisis, environmental degradation, water quality, loss of attractiveness, or the negative impact of the crisis on tourism. Neutral tweets corresponded to descriptive, informative, promotional, or ambiguous messages without a clearly identifiable positive or negative stance.

4.4 Mobility Data

Another important factor to measure the impact of crises in the Mar Menor is the analysis of its tourist mobility. Regarding the data related to this factor, the Spanish Ministry of Transportation (SMT) provides a

nation-wide human mobility dataset reporting displacements in Spain since February 2020 (<https://www.mitma.es/ministerio/covid-19/evolucion-movilidad-big-data/opendata-movilidad>). Given the time period covered by our study, this official dataset allows us to evaluate the impact of the Phase-3 crisis of the Mar Menor in terms of tourist mobility. Note that the SMT is the only public institution providing an open dataset on human mobility covering the Spanish territory. As it only covers the period from February 2020 onwards, it is not feasible to perform a similar study for the previous crisis in 2017 and 2019.

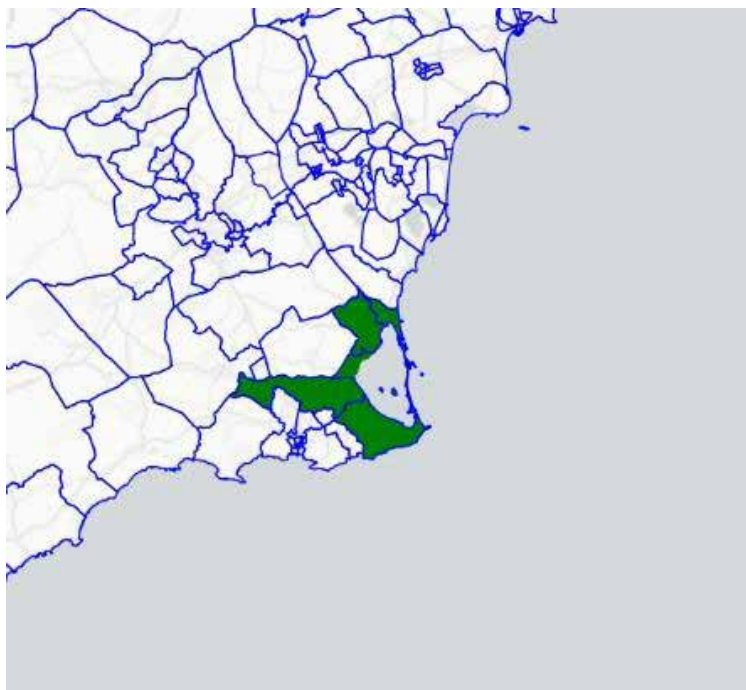
In terms of data format, the mobility dataset provides information on the number of trips among 3216 ad-hoc administrative areas (hereby Mobility Areas, MA) per hour in Spain, including both its peninsular and insular extension. A single trip represents the spatial displacement of an individual covering a distance greater than 500 meters. Consequently, this dataset could be regarded as a set of tuples, each following the format

$$\langle date, hour, m_{(origin)}, m_{(dest)}, a_{(origin)}, a_{(dest)}, n_{(trp)}, dist \rangle$$

reporting that there were $n_{(trp)}$ human trips from the MA $m_{(origin)}$ with $a_{(origin)}$ as primary activity to the MA $m_{(dest)}$ with $a_{(dest)}$ as primary activity and whose distance were $dist$ km during the indicated date and hour. Regarding the primary activities, the study only indicates home, work and other as possible values. As a result, the study distinguishes flows related to frequent movements (e.g. home-to-work trips) or infrequent ones (e.g. work-to-other trips).

In this work, we focus our analysis on the 5 MAs that are next to the Mar Menor sea. Figure 4 shows these MAs in green along with the spatial boundaries of their surrounding MAs as blue lines.

Figure 4. Map Showing the Target MAs of the Mobility Study in Green. The Boundaries of the Surrounding MAs are Shown as Blue Lines



Source: Own Elaboration

The following section presents the main results of the analyses described above, which contribute to addressing the research questions of this study.

5. Findings

5.1 Economic Outcomes

This section presents the results of the tourism data analysis, highlighting the evolution of travellers and overnight stays in the Mar Menor area over the eleven-year period, with the aim of addressing Research Question 1.

Figure 5 and Figure 6 show the timeseries with the number of travellers and overnight stays from 2012 to 2022 in the Mar Menor area, grouped by their country of residence. As defined by the INE, travellers refer to “individuals who have made one or more consecutive overnight stays in the same accommodation”, while overnight stays are each night that a traveller stays at the establishment. Seasonality strongly shapes tourist arrivals, with peak flows in August for Spanish residents, while foreign visitors peak mainly in September–October, with some other relevant peaks in June 2016 and June 2019.

Figure 5. Timeseries with the Number of Travellers in the Area of Mar Menor



Source: Own Elaboration

Regarding the periods of crises in the Mar Menor, a first significant decline occurred in August 2016, where both the total number of travellers and Spanish residents experienced a 13% decrease (from 26,614 total travellers in 2015 to 23,284 in 2016). According to Figure 2, the highest concentration of news related to the onset of the first crisis took place in July and August 2016.

The next decrease of 6% was observed in September 2019, which continued in the following month, with a 14.5% decrease in the total number of tourists and with a decline of 8.6% in overnight stays compared to October 2018. Those negative trends coincided with the Phase-2 crisis of the Mar Menor, when the marine life of the coastal lagoon was left with no oxygen and started to die out (Figure 3).

Figure 6. Timeseries with the Number of Overnight Stays in the Mar Menor Area



Source: Own Elaboration

In 2020, a significant decrease in the number of travellers occurred due to the impact of the Covid-19 pandemic. Therefore, it is more appropriate to compare the data from 2021 with that of 2019. In August 2021, there was a noticeable increase in the number of travellers. However, in October of the same year, there was a decline of 7.7% in the total number of tourists and a decrease of 37.7% in overnight stays in the Mar Menor area. The reduction in the number of travellers could have been impacted by the Phase-3 crisis, which consequences were discussed until the end of October in both national and international news (Figure 3). In August 2022, both the total number of tourists, the number of Spanish residents and total number of overnight stays experienced a decline of 18%, 24.5% and 13%, respectively, when compared to August 2021.

Finally, Figure 7 shows the duration of the average stay in the hotels of Mar Menor. It is calculated as the ratio of overnight stays to the number of travellers. From 2012 to 2015, the average stay rates ranged from 4 to 4.2 days. However, in the summer of 2016, there was a noticeable increase, with Figures rising by 15% compared to the previous years. Nevertheless, from 2017 to 2019, the average stay number declined and fell below 4 days. Lastly, compared to August 2019, summer indicators in 2021 and 2022 remained lower, with average stays decreasing by 19% and 14.5%, respectively.

Figure 7. Timeseries with the Number of Average Stay of Travellers in the Mar Menor Area



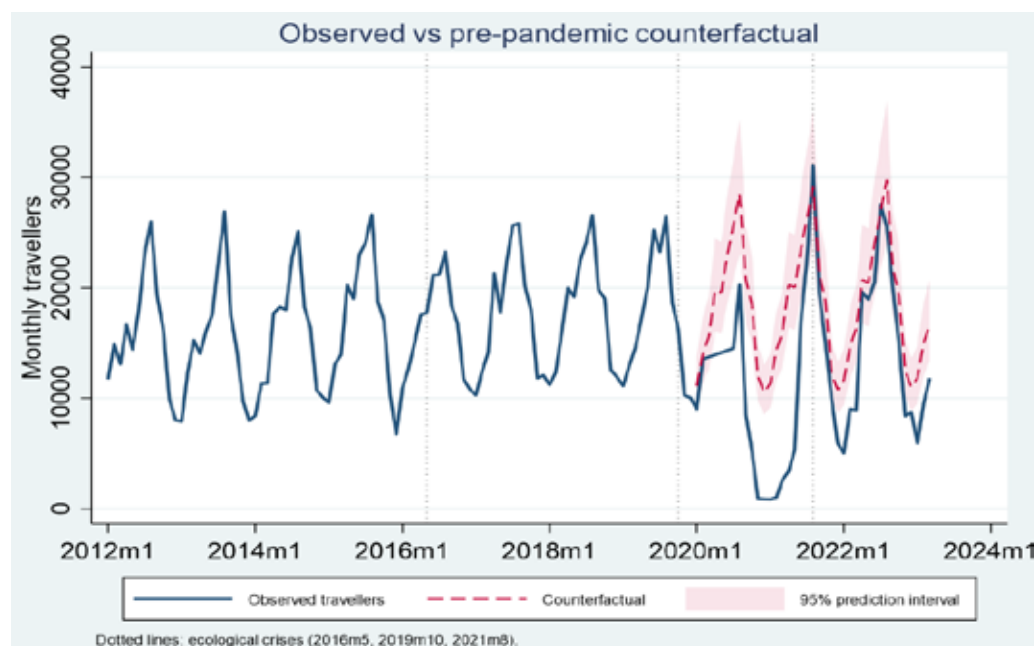
Source: Own Elaboration

After visual timeline comparison, to better quantify the relationship between ecological crises and declines in tourism indicators we applied time series techniques, which estimated effects are summarised in Table 1. Phase 1 showed no significant effect on travellers (+2.4%, $p = 0.57$). Nevertheless, October 2019 (Phase 2) is associated with a significant reduction of 12% (−12.4%, $p < 0.001$), estimated on pre-pandemic interval. The August 2021 event (Phase 3) could not be separated from the pandemic: its coefficient is non-significant once COVID-19 controls are included ($p > 0.10$). The pre-pandemic counterfactual (Figure 8) observed travellers 40% below trend in 2021 and 18% below in 2022, so the 2021–2022 decline cannot be attributed specifically to the ecological crisis with single-destination data.

Table 1. Estimated Effects on Monthly Travellers

Event / shock	Window	Model	Effect	<i>p</i> -value
Phase 1 — 2016 eutrophication	Pre-COVID	ITS (quadratic trend)	+2.4%	0.57 (n.s.)
Phase 2 — Oct 2019 mortality	Pre-COVID	ITS (quadratic trend)	−12.4%	< 0.001
Phase 3 — Aug 2021 mortality	Full sample	ARIMA intervention	+33.0%	0.60 (n.s.)
COVID-19 restrictions	Full sample	ARIMA intervention	−34.6%	0.011
2021 vs counterfactual	2021	Pre-pandemic projection	−40.1%	outside 95% PI
2022 vs counterfactual	2022	Pre-pandemic projection	−18.4%	within 95% PI

Source: Own Elaboration. n.s. = not significant; PI = prediction interval. Effects are multiplicative (percentage) changes derived from log-linear coefficients

Figure 8. Monthly Travellers Versus the Pre-Pandemic Counterfactual

Source: Own Elaboration. 95% prediction interval. Vertical dotted lines mark the three ecological crises; the model controls for COVID-19

Moreover, we applied the same models to the other two indicators – overnight stays and average stay (Table 2). In the pre-pandemic interval, the October 2019 event significantly reduced both travellers (–12.4%) and overnight stays (–7.8%, $p = 0.02$), while average stay was not affected. Phase 1 again showed no adverse effect, and the COVID-19 period depressed all three indicators (overnight stays –55%, $p = 0.006$; average stay –15%, $p = 0.04$).

Table 2. Ecological-crisis Effects Across the Three Outcomes (Clean Pre-Covid Estimates)

Outcome	Phase 1 — 2016	Phase 2 — Oct 2019
Travellers	+2.4% (n.s.)	–12.4% ($p < 0.001$)
Overnight stays	+8.9% ($p = 0.001$)	–7.8% ($p = 0.02$)
Average stay	+6.4% (n.s.)	+5.2% (n.s.)

Source: Own Elaboration

5.2 Social Sensing Outcomes

With the three contexts defined, the number of tweets retrieved for each context was compiled together with the corresponding percentage of false positives. Table 3 shows that the percentage of false positives increased as the context expanded, indicating that broader geographical filters retrieved a higher proportion of messages unrelated to the Mar Menor ecological crisis. The baseline context, C_1 , which only considered tweets explicitly mentioning “Mar Menor” or “#MarMenor”, retrieved 30,235 tweets and showed a false-positive rate of 32.2%. Context C_2 , which also included lagoon-side towns, retrieved 65,999 tweets and showed a false-positive rate of 43.0%. Finally, context C_3 , which additionally included Murcia and Cartagena, retrieved 835,614 tweets but reached a substantially higher false-positive rate of 82.6%.

It is also important to note that the number of retrieved tweets increased substantially as more location-related terms were included. Context C_2 more than doubled the number of tweets retrieved by C_1 , while C_3 retrieved more than 27 times the number of tweets obtained with C_1 . However, this increase in volume came at the cost of a much higher proportion of false positives. Based on these results, C_2 was selected as the final context for the analysis. This context increased the number of potentially relevant tweets compared with C_1 while maintaining a considerably lower level of noise than C_3 . Moreover, C_2 in-

cludes the neighbouring towns most directly affected by the ecological crisis, particularly in relation to its potential effects on tourism activities. In contrast, C_3 introduced substantial noise because many tweets mentioning Murcia or Cartagena were unrelated to the lagoon or to the environmental crisis.

Table 3. Ecological Evaluation Results for the Different Contexts Analysed

Context	Total messages	% False positives
C_1	30,235	32.2
C_2	65,999	43.0
C_3	835,614	82.6

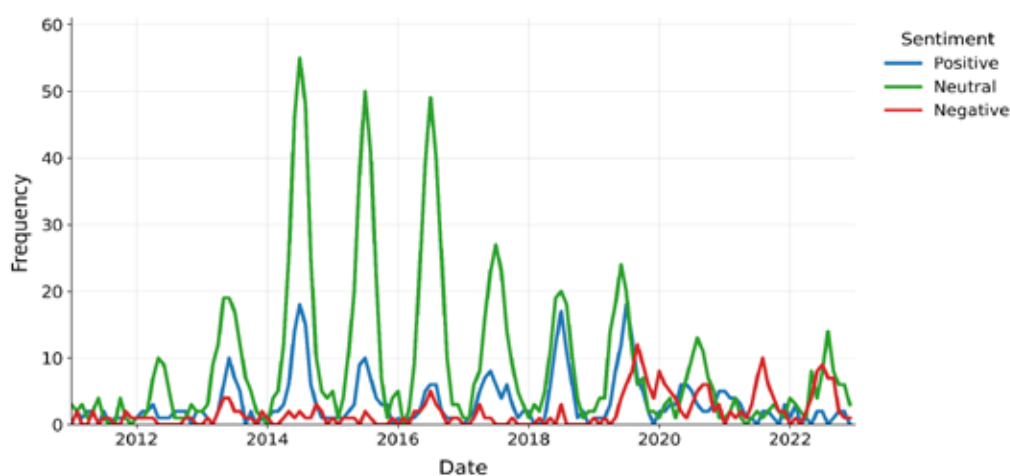
Source: Own Elaboration

After selecting C_2 , the corpus was preprocessed following the procedure described in Section 4.3. Highly repetitive messages and near-duplicate tweets from the same users were removed, resulting in the exclusion of 9.3% of the original tweets. In addition, more than 8,000 messages not written in Castilian Spanish were excluded to ensure linguistic consistency in the topic modelling and sentiment analysis pipeline. After all preprocessing steps, the final corpus contained 51,622 tweets.

BERTopic was then applied to the preprocessed C_2 corpus to identify the main topics discussed in relation to the Mar Menor. The model initially returned more than 500 topics, although only a limited number of them were directly related to tourism. Overall, 2,096 messages out of 51,622, corresponding to 4.1% of the final corpus, were assigned to tourism-related topics. These topics included terms associated with tourism activities and accommodation, such as “hotel”, “camping”, “resort”, and related expressions.

After identifying the tourism-related topics, sentiment polarity was assigned within the SensingTools pipeline following the criteria described in Section 4.3. Figure 9 shows the temporal distribution of tourism-related tweets according to their polarity classification. Since 2014, tourism-related tweet activity showed a seasonal pattern, with higher activity during the summer months and lower activity during the winter. A decrease in tourism-related tweets was observed in 2017 and again in 2021. Regarding sentiment polarity, most summer peaks between 2014 and 2017 were dominated by neutral tweets. However, from late 2019 onwards, negative mentions related to tourism in the Mar Menor became more visible, coinciding with the second major ecological crisis affecting the lagoon.

Figure 9. Sentiment Analysis of Tourism-Related Tweets



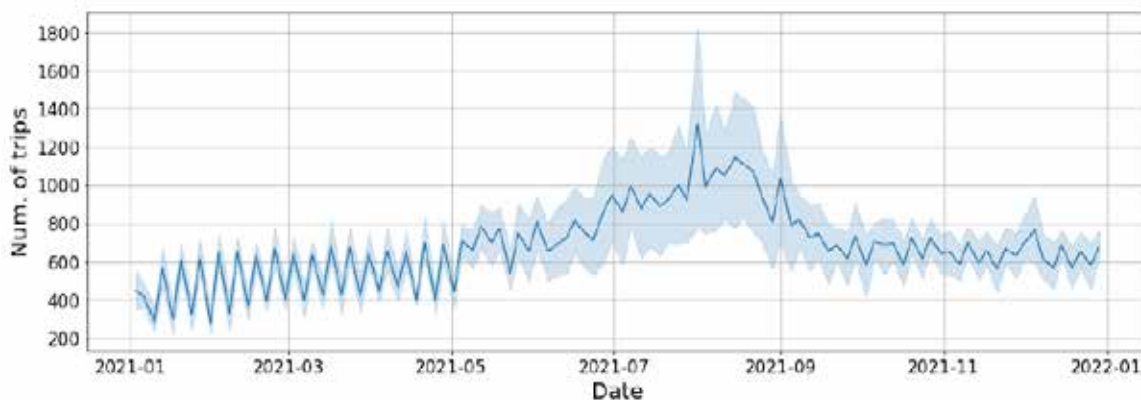
Source: Own Elaboration

5.3 Mobility Outcomes

To answer RQ3 and to measure the impact of crises in Mar Menor, we performed the analysis of tourist mobility, using a nation-wide human mobility dataset provided by the Spanish Ministry of Transportation (SMT).

The first step in the analysis was to extract the flows that corresponded to tourist trips (mobility movements exceeding 100 km in which the destination is neither the user's home nor workplace) towards such MAs from the dataset. To do so, we retained the mobility records that met the following two conditions: (1) $a_{dest} = \text{other}$ and (2) $\text{dist} \geq 100$. Thus, we only considered long displacements (distance higher than 100 km) whose destination was not a frequent spot for the travellers (destination activity neither home nor work). This filter removed 94.2% of the original mobility records in the dataset. As a result, Figure 10 shows the timeseries with the total number of daily incoming trips to each of the 5 MAs in the Mar Menor region. Let us call this timeseries dataset T_{2021} . Observe that the largest number of trips occurred during July and August. This is consistent with the tourist seasonality of the 5 target cities (Arroyo-Mompeán & Vegas-Juez, 2019).

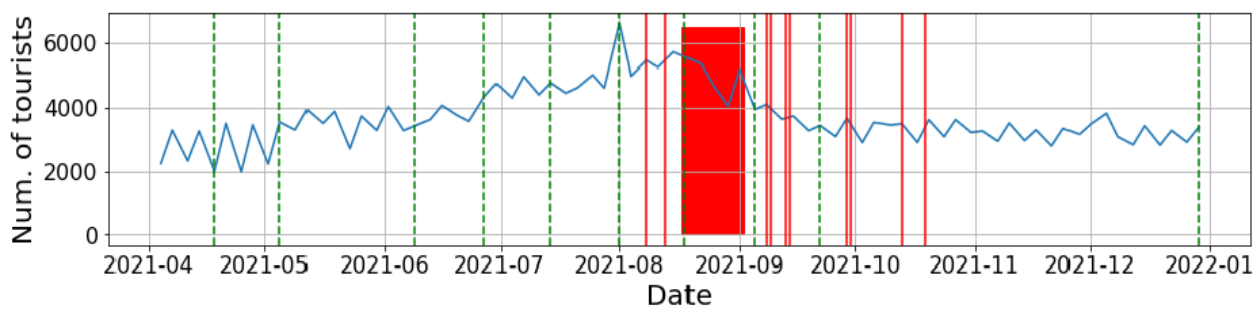
Figure 10. Timeseries with the Total Number of Incoming Trips to the Mar Menor Municipalities



Source: Own Elaboration. The dark blue line indicates the average value of all the MA whereas the bluish area around the line indicates the 95% confidence interval

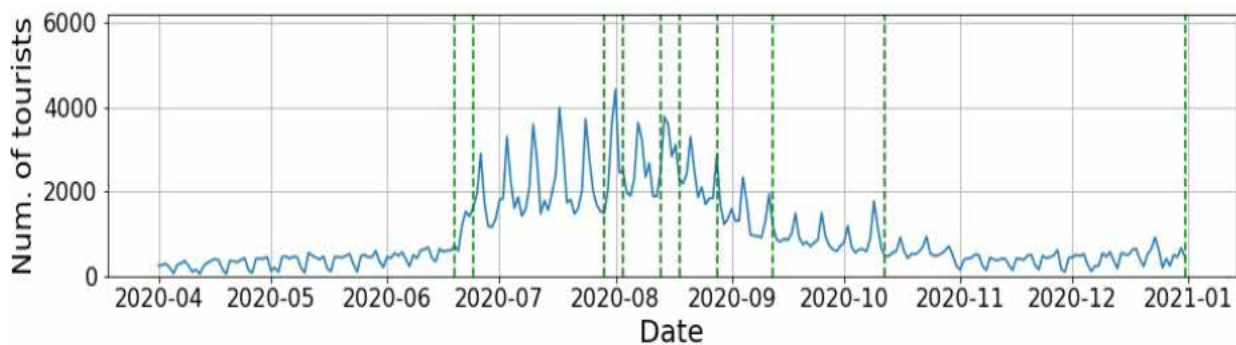
Next, we computed the change points of T_{2021} , i.e., the points where the timeseries meaningfully changed. These points were calculated following a bottom-up strategy (Fryzlewicz, 2007). More in detail, this algorithm starts with a maximum number of change points and gradually deletes the less significant ones. In this manner, the timeseries is divided into many sub-signals along a regular grid. Subsequently, contiguous segments are merged one by one, considering a measure of their similarity. By means of these breakpoints, we were able to detect the moments throughout the year where the arrival of tourists experienced a meaningful change.

Figure 11(a) shows the break points detected in T_{2021} as dashed green lines. The vertical red lines in 11(a) indicate the dates when a piece of news about the Mar Menor was published. The vertical dashed green lines indicate the breakpoints of each timeseries. Bearing in mind the crisis in Phase 3 (August 2021-October 2021), the algorithm detected 3 different points on 2021-08-18, 2021-09-05 and 2021-09-22. This reveals that during the second half of August and September, the arrival of tourist to the Mar Menor region had some relevant shifts.

Figure 11(a). Tourist Mobility in the Mar Menor in 2021

Source: Own Elaboration

Furthermore, we compared these breakpoints with those related to the tourist flow in 2020, T_{2020} (see Figure 11(b)). This timeseries was extracted from the human mobility dataset released by the Spanish Institute of Statistics (INE), which covered the year 2020. The dataset utilized the same Mobility Areas (MA) tessellation as defined in the SMT (https://www.ine.es/experimental/movilidad/experimental_em4.htm). Since the INE dataset did not include the origin and destination activities of the trips, we applied the same 100-km filtering criteria than for T_{2021} to compose the final timeseries. We obtained some interesting findings from this comparison. First, the number of breakpoints in August and September of 2020 was slightly higher than in 2021: there were 5 breakpoints (2020-08-03, 2020-08-13, 2020-08-18, 2020-08-28, 2020-09-12, 2020-10-12). This reflects a different pattern in the arrival of tourists during these months, particularly in the latter half of August. Indeed, T_{2021} only involved 1 breakpoint (2021-08-18), whereas there were 3 in T_{2020} (2020-08-13, 2020-08-18, 2020-08-28).

Figure 11(b). Tourist Mobility in the Mar Menor in 2020

Source: Own Elaboration

To delve deeper into this finding, Table 4 shows the slope of T_{2021} between consecutive breakpoints. For example, the slope of the linear curve fitting the slice of T_{2021} between 2021-08-18 and 2021-09-05 was -0.111. This table provides valuable insights into the rate of increase or decrease in tourist arrivals during specific time intervals. Additionally, we have included the corresponding slopes of T_{2020} for comparison. It is important to note that the slopes in the table have been calculated based on the normalized version of the timeseries. Thus, the negative values of all the slopes presented in Table 4 are consistent with the visual pattern depicted in Figure 10(a) and 10(b), indicating a steady decline in tourist arrivals from August 18th to October 19th in both years.

Table 4. Slopes of the Tourists' Timeseries for the Time Periods between Break Points

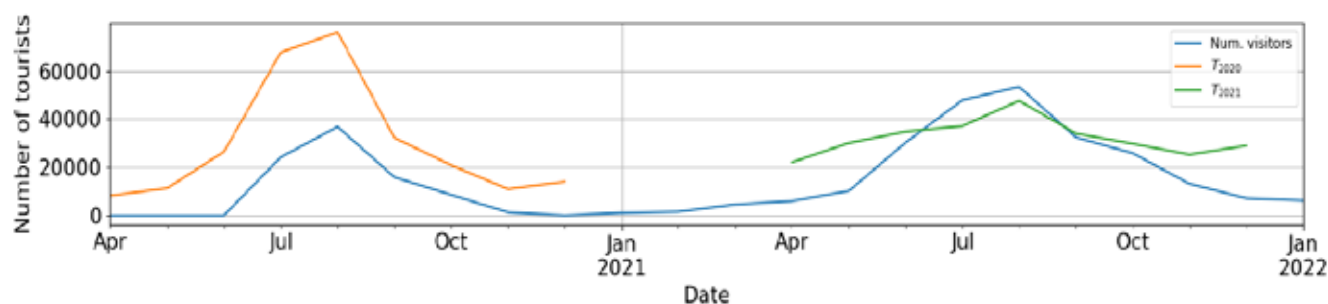
Period (month-day)	T ₂₀₂₁ slope	T ₂₀₂₀ slope
08-18→09-05	-0.111	-0.099
09-05→09-22	-0.135	-0.080
09-22→10-19	-0.022	-0.033
08-08→10-19	-0.041	-0.038

Source: Own Elaboration

As shown in Table 4, the slopes in the first two slides (08-18→09-05 and 09-05→09-22) were more negative in 2021 than in 2020. This indicates that tourists left the Mar Menor region in 2021 at a faster pace during the last two weeks of August and the first of September than in the previous year. It is worth mentioning that these 3 weeks coincided with the central period of the Phase 3 crisis of the Mar Menor, during which a significant number of articles were published in the media. Finally, the last row of Table 4 shows the slope of both timeseries covering the whole time period of the Phase 3 crisis. In this case, the slope of T₂₀₂₁ (-0.041) was slightly more negative than the one in the same period of 2020 (-0.038). This confirms that, in global terms, the decrement of tourist arrivals during the Phase-3 crisis was slightly faster than in the previous year.

Finally, to validate the reliability of the human mobility flows used in this study, they were compared with the official number of visitors to the municipalities of the Mar Menor reported by the Tourism Office of the Region of Murcia (https://www.turismoregiondemurcia.es/es/estadisticas_de_turismo?pagina=viajeros-y-pernoctaciones-segun-destinos). In this regard, Figure 12 shows this visitor flow alongside the mobility flows previously analysed. The Pearson correlation between this visitor flow and the human mobility series T2020 and T2021 was 0.949 and 0.900, respectively. This indicates that both mobility flows reliably capture touristic-related movement within the target geographical area.

It is important to note that the aforementioned official tourist flow presents significant limitations that prevent its use as the primary data source for this study. First, it has a monthly granularity, which precludes a weekly analysis such as that conducted using the mobility flows. Second, the dataset does not include data from March to June 2020, a period that is particularly relevant for the intended analysis.

Figure 12. Tourist Mobility in the Mar Menor in 2020 and 2021 along with the Official Number of Visitors

Source: Own Elaboration

6. Discussion

In this section we are going to answer the established Research Questions (RQs) and relate the results obtained with those of studies related to use of social media for measuring the effect of certain events and actions on the population and surroundings.

6.1 RQ.1: Is there a relationship between ecological conditions in the Mar Menor lagoon and fluctuations in tourist arrivals over an eleven-year period based on statistical data?

The analysis confirms a relationship between the ecological condition of the Mar Menor and tourism performance, measured through travellers, overnight stays, and average stay. Periods without major environmental disturbances show relatively stable tourism indicators, whereas ecological crisis phases coincide with declines across variables, in line with recent evidence linking eco-degradation to changes in tourist behaviour in the Mar Menor (Sarabia-Sánchez et al., 2025).

From 2016 onward, the number of travellers and overnight stays declined steadily after peaking in 2015, with the largest reductions among Spanish residents in 2017, corresponding to Phase 1 of the ecological crisis. However, when time-series models were applied, the observed variation in 2016 was not statistically significant. A further downturn was observed in late 2019, particularly in October, aligning with the Phase 2 environmental degradation of the coastal lagoon, when the number of travellers (-12,4%) and overnight stays (-7,8%) declined significantly, while the average stay remained stable. These patterns are consistent with previous findings showing that marine pollution in the Mar Menor reduces accommodation attractiveness and tourism intensity (Fernandez Ferrero et al., 2022).

After excluding 2020 due to the Covid-19 pandemic, tourism indicators did not recover to pre-crisis levels. Despite an increase in August 2021, which could not be separated from Covid-19 pandemic shock, subsequent months and the year 2022 exhibited renewed declines in travellers and overnight stays, particularly following the Phase 3 crisis. The persistence of these effects supports evidence that once environmental degradation becomes widely perceived, its economic consequences are long-lasting (Lamas Rodríguez et al., 2023).

6.2 RQ.2: Do sentiment analysis patterns correspond with changes in economic indicators and ecological conditions on the Mar Menor lagoon?

It is common among researchers to use social media data to study the sentiments and spatiotemporal behaviour of individuals. Twitter can be used to measure the impact of tweets on tourism (Ramanathan & Meyyappan, 2019; Paolanti et al., 2021; Ramya et al., 2021). Moreover, it allows researchers to trace visitors' satisfaction in natural areas (Becken et al., 2017; Hale, 2018), and shows the correlation between tourism and environment. It even helps to see the sentiments of people during critical events (Ruz et al., 2020). In our study we analysed the messages posted by users on Twitter since 2010 about the Mar Menor.

Since 2014, tweet activity related to the Mar Menor has followed a stable and clearly seasonal pattern, with higher volumes during the summer months and lower activity in winter. This behaviour reflects the strong seasonality of tourism demand in the area and suggests that social media discourse evolves in parallel with tourism dynamics. Notably, a reduction in tourism-related tweets was observed in 2017 and later in 2021, which corresponds with the declines identified in economic tourism indicators, including the number of travellers, overnight stays, and average length of stay during the same periods.

As we mentioned before, social media platforms such as Twitter have been widely recognised as valuable sources for capturing tourists' expressed sentiments, satisfaction levels, and overall perceptions of destinations through user-generated content (Paolanti et al., 2021; Kurniawan, et al., 2025).

In this regard, messages posted during the summer peaks between 2014 and 2017 were predominantly neutral, indicating a relatively stable perception of the destination despite the onset of environmental degradation. However, from late 2019 onwards, a gradual increase in negative tourism-related mentions was detected.

This shift coincides with the second ecological crisis and aligns with the deterioration observed in tourism demand indicators, reinforcing previous evidence that changes in online sentiment reflect broader perception shifts and behavioural responses in coastal tourism contexts (Wang et al., 2025).

Nevertheless, some methodological limitations of the social sensing analysis should be acknowledged. First, messages not written in Castilian Spanish were excluded to ensure linguistic consistency in the topic modelling and sentiment analysis pipeline. Although this decision improves the comparability of the analysed tweets, it may underrepresent the perceptions of international tourists, foreign residents, or users who discussed the Mar Menor in other languages. Therefore, the results should be interpreted

primarily as reflecting Spanish-language public discourse. Second, although the XLM-RoBERTa-based sentiment model used in the SensingTools pipeline reports an F1-score of 68.5 when trained and evaluated on Spanish tweets, no additional supervised training or corpus-specific validation was developed in this study. Creating such a benchmark would require the manual annotation of a sufficiently large sample of tweets, which is a subjective and non-trivial task due to the short length of tweets, the presence of irony or ambiguity, and the need for local knowledge to correctly interpret references to the Mar Menor ecological crisis. Consequently, polarity labels should be interpreted as indicators of the dominant tone of tourism-related discourse rather than as definitive individual-level sentiment annotations.

6.3 RQ.3: What patterns can be identified in tourist mobility in the region in relation to ecological changes in the Mar Menor lagoon?

To answer RQ3 and identify the mobility patterns in Mar Menor area, we performed the analysis of tourist mobility. While some researchers obtained GPS-based location data from mobile apps (Möhring et al., 2021) or car navigation systems, or data from cell phone towers (Schmücker & Reif, 2022), we used a nation-wide human mobility dataset provided by the Spanish Ministry of Transportation (SMT) since February 2020.

Moreover, tourism mobility analysis has contributed to tracking of the behaviour of tourists and its changes before, during and after crisis and disaster events, whether it's a health or economic crisis or an environmental issue. Park et al. (2022) and Czarnecki et al. (2023) ascertained behavioural changes in travel mobility of tourists in periods before and during such a massive issue as the COVID-19 pandemic. Our study aimed to see the relation between the Mar Menor crisis, and the movements of tourist flows in the area – tourists' altered behaviour. According to our findings travellers left the Mar Menor region in 2021 faster than in the previous year. The time of their leaving coincided with the central time period of the Phase 3 crisis of the Mar Menor. Our results also confirmed that, during the third phase of the crisis, the decline in visitor arrivals was quicker than it was the year before, which shows a clear mobility pattern related to the ecological changes of Mar Menor.

7. Conclusion

This study successfully demonstrates how tourism declines resulting from environmental degradation can be systematically measured and tracked across economic, social, and mobility dimensions. Focused on the Mar Menor crisis, our proposal shows that the ecological crisis phases of 2016, 2019, and 2021 coincided with declines in traveler arrivals and overnight stays. Social sensing demonstrated a sharp drop in tourism-related discourse and a rise in negative sentiment during these events. Finally, the mobility analysis corroborated these findings, indicating that the departure of tourists from the region was significantly accelerated during the 2021 crisis compared to the baseline trends of the previous year.

7.1 Theoretical and Practical Implications

The theoretical implications of this study lie in extending behavioral decision-making models to environmental crises by showing how risk assessments and threat evaluations translate into both cognitive online sentiment and physical mobility changes. Methodologically, this study demonstrates the value of integrating economic, mobility and social sensing data, offering a more complete framework than studies relying on single data sources. Practically, our framework provides the basis for an actionable tool for different actors to manage environmental crises. Thus, for stakeholders, the integration of public data streams serves as a proactive decision-making system to monitor tourism health alongside environmental indicators. Destination management organizations can utilize the social sensing and mobility-tracking dimensions of our proposal to monitor shifts in reputation and tourist flows in real time. Finally, the framework can be adapted to provide tourists with access to transparent information dashboards, empowering travelers to make well-informed destination choices.

7.2 Limitations

Several limitations must be acknowledged in this work. First, the human mobility dataset from the Spanish Ministry of Transportation was only available from February 2020 onward, preventing a comparative long-term mobility analysis for the earlier 2016 and 2019 crisis phases. Second, the social sensing analysis was restricted to Twitter, which might reflect a demographic bias and does not capture the opinions of travelers who do not use microblogging platforms or who utilize specialized travel review sites. Third, while the official economic statistics provide a reliable baseline of traveler behavior, they primarily represent formal hotel and registered apartment accommodation, potentially omitting informal stays or secondary residences. Lastly, the August 2021 event coincides with pandemic restrictions and an uneven recovery, and with single-destination data the two events cannot be fully separated.

7.3 Future Line of Research

Some lines of future work can follow this work. First, the mobility analysis could be expanded by integrating alternative historical datasets—such as localized mobile network data or app-based GPS traces—to evaluate tourist movement patterns during the earlier 2016 and 2019 crises. Second, the social sensing methodology could be broadened to include specialized tourism and hospitality platforms, such as TripAdvisor or Booking.com, to directly correlate environmental sentiment with verified accommodation reviews and local business performance. Finally, future studies should aim to develop predictive machine learning models that integrate real-time water quality indicators with social and mobility data, providing local authorities with proactive early-warning systems to forecast and mitigate the socio-economic impacts of future ecological anomalies.

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REFERENCES

- Aparicio, G., Camacho, M., & Maté-Sánchez-Val, M. (2024). Quantifying the impact: Are coastal areas impoverished by marine pollution? *Ecological Economics*, 221, Article 108213. <https://doi.org/10.1016/j.ecolecon.2024.108213>
- Arroyo-Mompeán, P., & Vegas-Juez, A. (2019). Turismo en la Región de Murcia 2019 (Technical report). Instituto de Turismo de la Región de Murcia. <https://www.carm.es/web/pagina?IDCONTENIDO=20657&IDTIPO=246>
- Awais-E-Yazdan, M., Popescu, V., Birau, R., & Bărbăcioru, I. C. (2025). Enhancing tourist's perceived safety and their behavioral intention in Thailand: A pathway to sustainable tourism and sustainable economic growth. *Sustainability*, 17(10), 4297. <https://doi.org/10.3390/su17104297>
- Barbieri, F., Espinosa Anke, L., & Camacho-Collados, J. (2022). XLM-T: Multilingual Language Models in Twitter for Sentiment Analysis and Beyond. In *Proceedings of the Thirteenth International Conference on Language Resources and Evaluation (LREC 2022)* (pp. 258–266). European Language Resources Association (ELRA). <https://doi.org/10.63317/4fhqtpvii3vg>
- Becken, S., Stantic, B., Chen, J., Alaei, A. R., & Connolly, R. M. (2017). Monitoring the environment and human sentiment on the Great Barrier Reef: Assessing the potential of collective sensing. *Journal of Environmental Management*, 203, 87–97. <https://doi.org/10.1016/j.jenvman.2017.07.007>
- Belando, M. D., Bernardeau-Esteller, J., Paradinas, I., Ramos-Segura, A., García-Muñoz, R., García-Moreno, P., Marín-Guirao, L., & Ruiz, J. M. (2021). Long-term coexistence between the macroalga *Caulerpa prolifera* and the seagrass *Cymodocea nodosa* in a Mediterranean lagoon. *Aquatic Botany*, 173, Article 103415. <https://doi.org/10.1016/j.aquabot.2021.103415>
- Bernal, J. L., Cummins, S., & Gasparrini, A. (2017). Interrupted time series regression for the evaluation of public health interventions. *International Journal of Epidemiology*, 46(1), 348–355. <https://doi.org/10.1093/ije/dyw098>
- Box, G. E. P., & Tiao, G. C. (1975). Intervention analysis with applications to economic and environmental problems. *JASA*, 70(349), 70–79. <https://doi.org/10.2307/2285379>
- Correia-Loureiro, S. M., Guerreiro, J., & Han, H. (2021). Past, present, and future of pro-environmental behavior in tourism and hospitality: A text-mining approach. *Journal of Sustainable Tourism*, 258–278. <https://doi.org/10.1080/09669582.2021.1875477>

- Czarnecki, A., Dacko, A., & Dacko, M. (2023). Changes in mobility patterns and the switching roles of second homes as a result of the first wave of COVID-19. *Journal of Sustainable Tourism*, 30(1), 149–167. <https://doi.org/10.1080/09669582.2021.2006201>
- Fernández Ferrero, M., Teruel Gutiérrez, R., & Sánchez-Val, M. (2022). The environmental degradation impact in Mar Menor on Airbnb prices. *Revista de Métodos Cuantitativos para la Economía y la Empresa*, 34, 446–465. <https://doi.org/10.46661/revmetodoscuanteconempresa.6202>
- Fryzlewicz, P. (2007). Unbalanced Haar technique for nonparametric function estimation. *Journal of the American Statistical Association*, 102(480), 1318–1327. <https://doi.org/10.1198/016214507000000860>
- García-Ayllón, S. (2018). Retro-diagnosis methodology for land consumption analysis towards sustainable future scenarios: Application to a Mediterranean coastal area. *Journal of Cleaner Production*, 195, 1408–1421. <https://doi.org/10.1016/j.jclepro.2018.02.160>
- Grootendorst, M. (2022). BERTopic: *Neural Topic Modeling with a Class-based TF-IDF Procedure*. arXiv. <https://arxiv.org/abs/2203.05794>
- Hale, B. W. (2018). Mapping potential environmental impacts from tourists using data from social media: A case study in the Westfjords of Iceland. *Environmental Management*, 62, 446–457. <https://doi.org/10.1007/s00267-018-1056-z>
- Jain, P. K., Pamula, R., & Srivastava, G. (2021). A systematic literature review on machine learning applications for consumer sentiment analysis using online reviews. *Computer Science Review*, 41, Article 100413. <https://doi.org/10.1016/j.cosrev.2021.100413>
- Jurgens, M., & Helsloot, I. (2018). The effect of social media on the dynamics of (self) resilience during disasters: A literature review. *Journal of Contingencies and Crisis Management*, 26(1), 79–88. <https://doi.org/10.1111/1468-5973.12212>
- Kovács, Z., Vida, G., Elekes, A., & Kovalcsik, T. (2021). Combining social media and mobile positioning data in the analysis of tourist flows: A case study from Szeged, Hungary. *Sustainability*, 13, Article 2926. <https://doi.org/10.3390/su13052926>
- Kurniawan, S., Pramayoga, A. S., & Ashari, Y. F. (2025). Sentiment analysis in coastal tourism: A systematic literature review. *Engineering, Technology & Applied Science Research*, 15(6), 30226–30233. <https://doi.org/10.48084/etasr.14644>
- Lamas Rodríguez, M., García Lorenzo, M. L., Medina Magro, M., & Pérez Quirós, G. (2023). Impact of climate risk materialization and ecological deterioration on house prices in Mar Menor, Spain. *Scientific Reports*, 13, Article 11772. <https://doi.org/10.1038/s41598-023-39022-8>
- Malzer, C., & Baum, M. (2020). A hybrid approach to hierarchical density-based cluster selection. In *2020 IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems (MFI)*. IEEE. <https://doi.org/10.1109/MFI49285.2020.9235263>
- Manosso, F. C., & Domareski Ruiz, T. C. (2021). Using sentiment analysis in tourism research: A systematic, bibliometric, and integrative review. *Journal of Tourism, Heritage & Services Marketing*, 7(2), 16–27. <https://doi.org/10.5281/zenodo.5548426>
- Martínez Dalmau, R. (2023). Una laguna con derecho a existir: La naturaleza como sujeto de derechos y el reconocimiento de la personalidad jurídica del Mar Menor. *Teoría y Realidad Constitucional*, 52, 357–375. <https://doi.org/10.5944/trc.52.2023.39021>
- McInnes, L., Healy, J., & Melville, J. (2018). UMAP: *Uniform Manifold Approximation and Projection for Dimension Reduction*. arXiv. <https://doi.org/10.48550/arXiv.1802.03426>
- Möhring, M., Keller, B., Schmidt, R., & Dacko, S. (2021). Google Popular Times: Towards a better understanding of tourist customer patronage behavior. *Tourism Review*, 76(3), 533–569. <https://doi.org/10.1108/TR-10-2018-0152>
- Newey, W. K., & West, K. D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica*, 55(3), 703–708. <https://doi.org/10.2307/1913610>
- Paolanti, M., Mancini, A., Frontoni, E., Felicetti, A., Marinelli, L., Ernesto, M., & Pierdicca, R. (2021). Tourism destination management using sentiment analysis and geo-location information: A deep learning approach. *Information Technology & Tourism*, 23, 241–264. <https://doi.org/10.1007/s40558-021-00196-4>
- Park, S., Kim, Y. R., & Ho, C. S. T. (2022). Analysis of travel mobility under COVID-19: Application of network science. *Journal of Travel & Tourism Marketing*, 39(3), 335–352. <https://doi.org/10.1080/10548408.2022.2089954>
- Pérez-Martín, M. Á. (2023). Understanding nutrient loads from catchment and eutrophication in a salt lagoon: The Mar Menor case. *Water*, 15(20), Article 3569. <https://doi.org/10.3390/w15203569>
- Prandi, C., Cecilia, J. M., Manzoni, P., Peña-Haro, S., Pierson, D., Colom, W., Blanco, P., Amurrio García, C., Jiménez Navarro, I., & Senent, J. (2022). On integrating intelligent infrastructure and participatory monitoring for environmental modelling: The SMARTLAGOON approach. In *Proceedings of the 2022 ACM Conference on Information Technology for Social Good* (pp. 236–243). Association for Computing Machinery. <https://doi.org/10.1145/3524458.3547228>
- Ramanathan, V., & Meyyappan, T. (2019). Twitter text mining for sentiment analysis on people's feedback about Oman tourism. In *2019 4th MEC International Conference on Big Data and Smart City (ICBDSC)* (pp. 1–5). <https://doi.org/10.1109/ICBDSC.2019.8645596>

- Ramya, V., Sheema, S., Lavanya, V., Heena, S., & Seshiah, T. (2021). Geolocation data and sentiment analysis combined with deep learning for tourism destination management. *Mathematical Statistician and Engineering Applications*, 70(2), 585–602. <https://doi.org/10.17762/msea.v70i2.1834>
- Región de Murcia Digital Integra (n.d.). Naturaleza, Mar Menor. Mar Menor- Turismo - Región de Murcia Digital (regmurcia.com)
- Reimers, N., & Gurevych, I. (2019). Sentence-BERT: Sentence embeddings using Siamese BERT-networks. In *Proceedings of the 2019 Conference on Empirical Methods in Natural Language Processing* (pp. 3982–3992). Association for Computational Linguistics. <https://doi.org/10.18653/v1/D19-1410>
- RTVE. (2021). Cientos de peces muertos vuelven a cubrir el Mar Menor. RTVE Noticias. <https://www.rtve.es/noticias/20210816/cientos-peces-muertos-banan-mar-menor/2159500.shtml>
- Ruz, G. A., Henríquez, P. A., & Mascareño, A. (2020). Sentiment analysis of Twitter data during critical events through Bayesian networks classifiers. *Future Generation Computer Systems*, 106, 92–104. <https://doi.org/10.1016/j.future.2020.01.005>
- Sammut, C., & Webb, G. I. (Eds.). (2010). TF-IDF. In *Encyclopedia of Machine Learning* (pp. 986–987). Springer. https://doi.org/10.1007/978-0-387-30164-8_832
- Sánchez-Franco, M. J., & Rey-Moreno, M. (2022). Do travelers' reviews depend on the destination? An analysis in coastal and urban peer-to-peer lodgings. *Psychology & Marketing*, 39, 441–459. <https://doi.org/10.1002/mar.21608>
- Sarabia-Sánchez, F. J., Bruno, J. M., Sarabia-Andreu, F., & Moreno-Micol, M. A. (2025). The impact of eco-degradation on residential tourism: The case of the Mar Menor, Spain. *Tourism and Hospitality*, 6(1), Article 19. <https://doi.org/10.3390/tourhosp6010019>
- Schmücker, D., & Reif, J. (2022). Measuring tourism with big data? Empirical insights from comparing passive GPS data and passive mobile data. *Annals of Tourism Research Empirical Insights*, 3, Article 100061. <https://doi.org/10.1016/j.annale.2022.100061>
- Smolčić Jurdana, D., & Agbaba, R. (2025). Management of crisis situations towards tourism destination sustainability: Key factors and measures. *Sustainability*, 17(23), Article 10871. <https://doi.org/10.3390/su172310871>
- Suess, C., Maddock, J. E., Palma, M., Youssef, O., & Kyle, G. (2024). An application of protection motivation theory to understand the influence of fear-appeal media on stated donations for coral reef restoration. *Tourism Management*, 100, Article 104797. <https://doi.org/10.1016/j.tourman.2023.104797>
- Ulker-Demirel, E., & Ciftci, G. (2020). A systematic literature review of the theory of planned behavior in tourism, leisure and hospitality management research. *Journal of Hospitality and Tourism Management*, 43, 209–219. <https://doi.org/10.1016/j.jhtm.2020.04.003>
- Viñán-Ludeña, M. S., & de Campos, L. M. (2022). Discovering a tourism destination with social media data: BERT-based sentiment analysis. *Journal of Hospitality and Tourism Technology*, 13(5), 907–921. <https://doi.org/10.1108/JHTT-09-2021-0259>
- Vu, H. Q., Li, G., & Law, R. (2020). Discovering highly profitable travel patterns by high-utility pattern mining. *Tourism Management*, 77, Article 104008. <https://doi.org/10.1016/j.tourman.2019.104008>
- Wang, D., Abdelzaher, T., & Kaplan, L. (2015). *A New Information Age. Social Sensing: Building Reliable Systems on Unreliable Data* (pp. 1–8). Elsevier. <https://doi.org/10.1016/C2013-0-18808-3>
- Wang, Y., Zhang, Z., & Zhang, Z. (2025). Exploring coastal tourism experience through social media text mining: Sentiment and thematic patterns. *Applied Sciences*, 15(21), Article 11721. <https://doi.org/10.3390/app152111721>
- Wankhade, M., Rao, A. C. S., & Kulkarni, C. (2022). A survey on sentiment analysis methods, applications, and challenges. *Artificial Intelligence Review*, 55, 5731–5780. <https://doi.org/10.1007/s10462-022-10144-1>
- Willson, G., Wilk, V., Sibson, R., & Morgan, A. (2021). Twitter content analysis of the Australian bushfires disaster 2019–2020: Futures implications. *Journal of Tourism Futures*, 7, 350–355. <https://doi.org/10.1108/JTF-10-2020-0183>
- Xu, Y., Li, J., Belyi, A., & Park, S. (2021a). Characterizing destination networks through mobility traces of international tourists: A case study using a nationwide mobile positioning dataset. *Tourism Management*, 82, Article 104195. <https://doi.org/10.1016/j.tourman.2020.104195>
- Xu, Y., Xue, J., Park, S., & Yue, Y. (2021b). Towards a multidimensional view of tourist mobility patterns in cities: A mobile phone data perspective. *Computers, Environment and Urban Systems*, 86, Article 101593. <https://doi.org/10.1016/j.compenvurbsys.2020.101593>
- Yan, Y., Chen, J., & Wang, Z. (2020). Mining public sentiments and perspectives from geotagged social media data for appraising the post-earthquake recovery of tourism destinations. *Applied Geography*, 123, Article 102306. <https://doi.org/10.1016/j.apgeog.2020.102306>

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Local Communities Don't Walk the Greens: The Case of Portugal and Spain (Andaluzia)

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ABSTRACT

This research aims to understand why non-golfers in Portugal and Spain do not take advantage of golf, despite their popularity as golf tourist destinations. Given golf's association with mental and physical health, the question arises: why aren't residents playing more? The study is based on the three-dimensional leisure construct model - intrapersonal, interpersonal, and structural, comprises six in-depth interviews (with golf professionals and amateurs) and a questionnaire survey. The survey received 306 valid responses from non-golfers in Portugal and Spain, representing a diverse range of professions. The data was processed using thematic analysis for the interviews and descriptive statistics for the questionnaires. The results show that golf is perceived as elitist, expensive, and challenging, but as a good way to meet friends, beneficial for mental and physical health, and a means to enhance social status. Findings also reveal a lack of knowledge and participation among residents, as well as mostly self-perceived interpersonal and intrapersonal constraints. This suggests that public stakeholders should take action to change perceptions and motivate local residents to play regularly, thereby promoting social interaction and sustainability. Examining individuals' perceptions of the game and identifying the relevant factors could inform guidelines to assist local governance and development.

KEYWORDS

Golf, Resident Communities, Facilitators, Constraints, Portugal, Spain.

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1. Introduction

In May 2025, a news article in the British newspaper *The Guardian* announced that Holland had started a national “Welcome to the Club” campaign to encourage more women and younger golfers aged 25–50. The article noted that many people thought golf was a sport for old men and that it was extremely expensive. Moreover, to keep the sport young, more young people and talent were needed on golf courses. It further indicated that this “also makes commercial sense” (Boztas, 26 May 2025). Some argue golf is in decline due to its long track record of exclusivity and that golf advocates should be “anxious” about the game’s future (Couture et al., 2023).

This current research, conducted in Portugal and Andalusia (Spain), examines the motivations and reasons why local (and young) people are uninterested in playing golf despite the geographical and contextual conditions that seem to offer an ideal setting for practising the sport. Additionally, promoting amateur golf within local communities could contribute significantly to both economic and environmental sustainability. Economically, amateur golf could strengthen local resilience by circulating revenue within the community and reducing reliance on international visitors. Supporting local clubs could potentially create year-round employment, stabilize seasonal economies. These initiatives can also generate green jobs related to course maintenance, water management, and ecological monitoring, while offering affordable recreation that fosters community cohesion.

From an environmental perspective, encouraging local participation helps maintain existing golf courses without expanding into new, ecologically sensitive areas (Casals-Miralles, 2023). Community involvement also fosters environmental awareness. Moreover, emphasising local play reduces long-distance travel and associated carbon emissions, transforming golf courses into hubs for environmental education and stewardship as well as tourism sites.

Suitable climate conditions for practising this sport throughout the year, combined with the availability of facilities, have converted Southern European countries into destinations for this type of tourism (Madrigal & Lara, 2019). Golf tourism destinations, such as Andalusia/Costa del Sol in Spain or the Algarve in Portugal, are considered among the top destinations to play golf during the winter season, when central and northern countries experience rain and snow. For these two regions, this is highly beneficial, as the golf season aligns with their primary sun and sea tourism product (Mendes et al., 2011).

As a result of the golf activity and the increment of its derived products (accommodation, hospitality, catering, rental cars, etc.), these areas in Southern Europe have long developed conditions to attract and receive high-quality golf tourism. The supply of golf facilities has grown in line with the influx of tourism. The number and design of golf courses respond to the tourism these destinations receive (Oliveira et al., 2013). However, considering the existing golf courses and facilities in these areas, both regions show a very low number of local players. Thus, for them to be sustainable, both economically and environmentally, the involvement of the resident population is crucial.

In fact, although golf is a highly attractive sport for tourists in Portugal and Spain, residents and the younger population often regard it as an elite sport for seniors, showing little interest in participating (Portugal et al., 2020). Arguably, for the country to maintain its privileged position, golf must be regarded as a leisure activity for the Portuguese (Completo & Gustavo, 2014), and, therefore, it is crucial to change the negative perception that the younger local population has of golf, both as a sport and an activity (Portugal et al., 2020). Bearing in mind that non-golfers, young populations, and local residents should gain new perceptions of golf, and in order to attract their engagement, this study focuses on identifying the affordances, i.e. the interaction between the individual’s capabilities and their circumstances (Buckley & Akhoundoglu, 2020), that provide the facilitators and constraints to participation in golf by local non-golfer residents in the golf tourism destinations of Andalusia/Costa de Sol (Spain) and Algarve (Portugal).

In this paper we focus on the possible emergent affordances that golf courses provide to local residents, operationalizing affordances as the “functional and relational aspects which frame, while not determining, the possibilities for agentic action in relation to an object” (Hutchby, 2001, p. 444); “in the case of humans, they offer a range of potential practices that are conditional on dispositions, abilities and intentions” (Kaaristo et al., 2025), which can also be framed as facilitators or enablers and constraints. As such, our focus on affordances attends to how golf is (not) practiced, perceived, and represented in relation to its material and environmental qualities (Ingold, 2000).

To identify these facilitators and constraints, we employ a mixed-methods approach based on a variety of primary data, following an exploratory sequential design. Considering this, this study takes a pragmatic approach to epistemology, acknowledging both the objective patterns evident in the data and the subjective meanings constructed by the participants in the interviews. First, in-depth interviews were conducted with six golfers to gain an understanding of the narratives and discursive constructions of both professional and amateur individuals regarding golf. This was examined within the framework of the three-dimensional paradigm, which comprises intrapersonal, interpersonal, and structural factors (Crawford et al., 1991; Godbey et al., 2010). These factors are perceived as either facilitators (Raymore, 2002) or constraints to participation in leisure activities (Jackson, 2005). The categories obtained through thematic analysis served as the basis for developing a questionnaire survey administered to non-golfers from Portugal and Spain, yielding a total of 306 valid responses.

As the interviews proved to be immensely rich and informative, this paper focuses primarily on their content. The questionnaire data will be utilized as supplementary material to corroborate and contextualize the central findings derived from the semi-structured interviews. While the interviews serve as the primary source for rich, in-depth qualitative data and emergent themes, the questionnaire, which gathers quantitative and descriptive metrics, will be referenced only where its results directly support, quantify, or provide a broader expressive context for the qualitative themes and outcomes identified. This approach ensures that the analysis maintains a qualitative focus, with the questionnaire providing another layer of validity and generalizability rather than forming an independent data set for major claims.

This study makes several contributions to the literature. First, from an empirical perspective, it illustrates the low level of golf participation among residents in two of Europe's leading golf tourism destinations. Secondly, it identifies the factors that have supported and continue to support this status quo. Thirdly, it focuses on the interaction between individuals and their context, as well as the facilitators and constraints of participation theory. The ultimate goal is to contribute to the body of knowledge about more sustainable practices for local communities.

After the introduction, section two of this paper provides a contextual overview of the current situation in the Algarve and Andalusia. Sections three and four present the theoretical framework and the theories that underpin this research. Section five presents the findings, followed by a discussion of the conclusions and limitations.

2. Portugal and Spain as Golf Destinations

The growth in golf tourism has led to an increase in infrastructure in host destinations, allowing them to diversify their tourist offerings and break the seasonality characteristic of the tourism sector (Garau-Vadell & Borja-Solé, 2008; Completo & Gustavo, 2014). The overall revenue from golf tourism is not limited to the income received by facilities dedicated to this sport; value is also added to the entire tourist offer necessary for golf, including accommodation, catering services, transportation, and income from complementary activities in the destination. Golf tourists spend more on average at the destination than conventional tourists (Madrigal & Lara, 2019), which is crucial for Spain and Portugal, leaders in golf tourism in Southern Europe (López-Bonilla et al., 2020).

Portugal is making continuous efforts to brand golf tourism as a fundamental and strategic axis within its economic policy (Madrigal & Lara, 2019). Golf tourism has been established in the Algarve, located in the southernmost region of the country, and has been recognized for its significant economic impact for a long time (Correia et al., 2006; Portugal et al., 2020). As a golf destination, the Algarve stands out for the high quality of its facilities and has been recognized by the International Association of Golf Operators (IAGTO) and by specialized golf magazines as one of the best destinations in the world (Portugal et al., 2020). In 2025, its offer comprises over 40 golf courses.

The primary destination for golf tourism in Spain is Andalusia, situated in the south of the country, which boasts 105 golf courses. In 2017, it was recognized as the Best European Destination for promoting the golf segment by IAGTO, due to the quality of its facilities and services (Official Tourism Website of Andalusia, 2019). Within this region lies the Costa del Sol, a well-established golfing destination in Europe also known as the Costa del Golf. It currently holds 78 golf courses (Ministerio de Industria y Turismo,

n.d.). It is home to some of Europe's most renowned courses, such as Valderrama (Ministry of Industry, Commerce and Tourism, 2023). The region also offers a variety of golf courses categorised by level. Most golf courses offer green fee packages that are more affordable for locals (Royal Andalusian Golf Federation, 2023). In contrast to the Algarve, which has no public facilities, apart from Academies or Cliniques provided by the private golf courses, Andalusia also has three public golf courses (two 9-hole courses operated by the Andalusian government and one 18-hole municipal course) and two public schools (Royal Spanish Golf Federation, 2023).

Within Andalusia, the Costa del Sol is the destination that most closely resembles the Algarve in terms of its offer and price structure. It is noteworthy that the supply of golf facilities in both countries has grown in response to the growing demand for this niche tourism and the increasing number of players coming from Central and Northern Europe. By contrast, there are very few golf players from Portugal and Spain. Of the 4.7 million registered golfers in Europe, 85% are concentrated in the top ten markets, most of which are located in Western Europe (R&A, 2025). Participation in the sport can be measured by the ratio of players to population in each country. The percentage of golfers in relation to the population in the countries that comprise the main European golfing market. Spain (0.63%) and Portugal (0.17%) have the lowest number of golfers per capita compared to other European countries, such as Sweden (5.33%) or Scotland (3.83%), indicating the relatively low popularity of the sport in these countries (see The Royal & Ancient Golf Club of St. Andrews, Report June 2025).

Consequently, exploring individuals' own narratives about their relationship with and trajectory in golf, and highlighting the factors that contribute to a lack of interest from residents in both regions, is a first step towards possibly bringing residents closer to the greens.

3. Perceptions of Golf

The view that golf courses and clubhouses have long served as spaces where men of similar social standing gather in a homosocial setting - maintained through exclusive costs and membership policies (Vamplew, 2010) - has endured over the centuries. The news article cited in the introduction to this paper echoes this perspective. Among research carried out, it is possible to highlight studies focusing on the low participation in golf among women (McGinnis & Gentry, 2006; Reis & Correia, 2016), and, more recently, among young generations (Portugal et al., 2020) as well as the sport's current image as a health sport from (non-) golfers' perspectives (Huth & Breitbarth, 2020). Portugal, Carmo and Correia (2020) describe the Portuguese Golf Federation's endeavor to promote activities among schoolchildren, which, of course, impacts their interest and motivation to practice this sport. Other studies have also focused on millennials, as well as the overall decline in participation, highlighting the amount of time needed to play and the resulting lack of leisure time, in both genders (McGinnis et al., 2021). However, McGinnis et al.'s (2021) research was conducted in the United States, where traditional male participation has been declining over the past decade. The differing perceptions of golf between golfers and non-golfers may be another reason for the low participation in this sport (Neo, 2010; Huth & Breitbarth, 2020). Considering a longer life expectancy, a greater desire for open-air activities, such as long walks, and a better connection with nature, new approaches could be presented to communities, as golf offers all these benefits. Thus, Huth and Breitbarth (2020), focusing on the German context, follow the recent trend to position golf as a health-promoting sport. However, their study did not reach a positive conclusion, especially among non-golfers, who do not perceive golf as a sport for health.

4. Affordance Theory

Affordance theory focuses on the relationship between individuals and their environments, examining how the physical environment enables specific activities. Drawing on Gibson's (1979) environmental psychology, the theory is applied across various disciplines (Buckley, 2019). Affordances are shaped by both the environment's physical traits and the inhabitants' perceptions (Gibson, 1979), enabling people to interact with the world through their activities and skills (Ingold, 2018).

Therefore, this study assumes that the activity of playing golf involves potential actions within a spatial, material, and social-cultural context that either constrain or enable behaviours, within which individuals encounter and interact with their own capabilities and intentions (Kaaristo et al., 2025).

In this context, affordances are relational and context-dependent. They are neither specific attributes of the environment nor of the perceiving human. Accordingly, integral to affordance theory is an understanding of the role of perception, behaviour, and cognition in how organisms relate to environments (Kaaristo et al., 2025). Affordance theory focuses on how encounters with things, places, and landscapes can generate a range of affective and imaginative experiences and inspire practices that develop over time or are enacted in situ and in the moment (Kaaristo et al., 2025). Affordances are interconnected with shared, socio-culturally regulated practices, habits, and beliefs (Kiverstein, 2015). As the affordances framework integrates theoretical analyses of freedoms and constraints (Buckley, 2020), the next section details these concepts.

5. Facilitators and Constraints

5.1 The three-dimensional factors

Several studies on leisure have increasingly relied on affordance theory to report on perceived facilitators and constraints (Buckly & Akhoundogli, 2020). Expanding upon this framework, it is essential to consider that decision-making is often influenced by socio-cultural or life contexts (Portugal et al., 2020), particularly when decisions involve tourism or leisure (Woodside et al., 2005). Building on this, the present study adopts the three-dimensional framework comprising intrapersonal (individual), interpersonal (social), and structural dimensions (environmental) (Crawford et al., 1991; Godbey et al., 2010).

The intrapersonal, interpersonal and structural dimensions perform as facilitators (Raymore, 2002) or constraints (Jackson, 2005), being facilitators the ones that encourage participation in an activity, whereas constraints inhibit it, since these are factors perceived or experienced by individuals as limiting a preference for an activity or inhibiting participation (Jackson et al., 1993). The authors argue that the theory has evolved to the extent that constraints are not merely barriers to participation; rather, they are interrelated with other variables and lead to lower participation in an activity. The relationship between constraints and the behavioural aspects of participation – such as frequency of participation, preferences for specific activities, and loyalty and specialisation in recreational activities - has been widely studied by authors such as McGinnis et al. (2021), Portugal et al. (2020), and others.

The intrapersonal (I love/hate sports), interpersonal (I play golf because my friends and family also play), and structural (I play because there is a golf course near my home) are categorised within the three-dimensional theory. The intrapersonal category stems from an individual's beliefs, past experiences, and personal history, which shape their motivations and personality. Intrapersonal limitations are perceived internally and directly related to an individual's psychological factors (Funk & Brunn, 2007; Alexandris et al., 2002). It has been proposed and empirically verified that intrapersonal limitations are the most important factor in deciding whether to participate in leisure activities (Alexandris et al., 2011; Portugal et al., 2020).

Interpersonal factors encompass an individual's relationships with their family, friends, colleagues, peer group, reference groups, strangers, and opinion leaders/market mavens (Raymore, 2002; Reis & Correia, 2013), reflecting their social background. Very often, interpersonal limitations result from social interaction and the individual's inability to find partners to participate in activities.

The structural are external and contextual factors that relate to socioeconomic status, geographical and political conditions, institutions, infrastructures, time, money, gender, and race (Raymore, 2002), availability and resources that enable the individuals' willingness to engage in certain events or not (Crawford et al., 1991; Funk & Brunn, 2007; Godbey et al., 2010; Reis & Correia, 2014; Portugal et al., 2020).

This framework has been widely used in tourism research (Carroll & Alexandris, 1997; Palen et al., 2010; Reis & Correia, 2014; Crossman et al., 2024) as it helps to identify the reasons for low participation (McGinnis et al., 2021), enabling the adoption of strategies to address this issue (McGinnis & Gentry, 2006;

Reis et al., 2016). Reis and Correia (2013) created a comprehensive map of the factors highlighted in the literature, which serves as a reference for the present study, details of which are provided below.

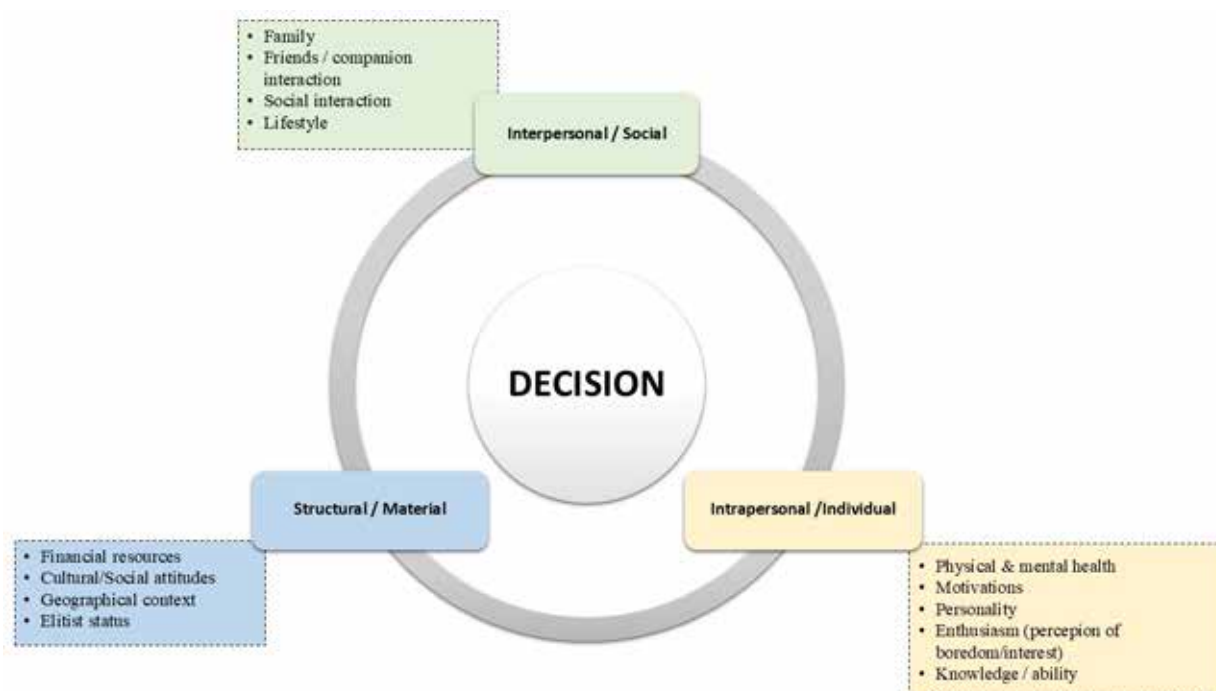
5.2 Facilitators and Constraints

The three dimensions of factors are not static, meaning that the same factor can incorporate more than one dimension (Godbey et al., 2010), and can either encourage or hinder participation. For instance, the factor ‘friends’ (interpersonal) can facilitate participation in golf, but becomes a constraint if golf is not played. Indeed, Raymore (2002) argues that ‘constraints and facilitators are not always polar opposites [...] suggesting that the absence of constraints does not necessarily facilitate participation’ (Raymore, 2002, p. 40).

This study adopts the facilitators/constraints framework to propose a comprehensive model that synthesises the key perspectives identified in the literature (Figure 1). The model aims to capture the individual, social, and material factors that shape how individuals perceive and respond to the opportunities - or affordances - associated with golf participation. This approach is essential for understanding the behaviours of both participants (interviewees) and non-participants (questionnaire respondents) within the golfing contexts of Andalusia/Costa del Sol in Spain and Portugal.

Figure 1 illustrates the various factors identified for each dimension. Intrapersonal factors to consider include personality, childhood, past experiences, particular life experiences, ability, knowledge, personal fears, motivation, preference for another sport, personal skills, lack of ability and a sense of failure (Reis & Correia, 2013), among others. The following are listed under interpersonal factors: family incentives; interaction with friends and companions; societal expectations and images; lifestyle factors; professional contexts; difficulties in finding a partner to participate with; and negative cultural and social attitudes and images, among others (Reis & Correia, 2013). Finally, structural factors include financial resources, economic conditions, time pressure, geographic location, socio-demographics, course policies, infrastructure, and a lack of facilities (Reis & Correia, 2013).

Figure 1. Facilitators and Constraints for the Decision Process



Source: Adapted from Reis and Correia (2013).

6. Research Design

The data presented in this study are based on a set of six in-depth, semi-structured interviews with golf players and a questionnaire developed from the interview outputs applied to non-players.

The aim of this study is twofold: first, to determine the facilitators and constraints that influence professional and amateur golf players; and, consequently, to use the interview data to design a questionnaire. Second, to determine in light of affordance theory the facilitators and constraints that influence non-golf players.

This is primarily a qualitative descriptive study. This method enables the identification of the most significant conditions or processes within our three-dimensional theoretical model. Additionally, this method allows for a flexible approach. One of the key advantages of conducting interviews is the depth and richness of the data they generate in a given area of research. They are designed to produce narratives that focus on fairly specific research objectives (Crabtree & Miller, 1999). Within the three-dimensional framework, the present study aimed to understand the freedoms and constraints imposed on the interviewees' golf practice by their individual, social, and material circumstances. This included analysing how the participants identify with the sport and how they perceive others' identification with it. Additionally, the interview data provided sufficient textual information to be codified within the theoretical frameworks of the three-dimensional model and affordance theory, forming the basis for the design of the questionnaire.

To guarantee the trustworthiness of the qualitative data derived from the interviews, the criteria of credibility, confirmability, and transferability were systematically considered. Credibility was established through careful transcription (and subsequent translation of the illustrative excerpts presented below), several readings, coding of the same data passage by at least three researchers, and the use of verbatim quotations to precisely represent the participants' perspectives. The researchers kept a record of analytical decisions to minimise researcher bias and to ensure the confirmability of the findings. By describing the research context, participants, and procedures (see section 6.1), readers can assess the applicability of the findings to other contexts. Together, these strategies enhanced the study's overall trustworthiness and rigour.

Nevertheless, the interviews present disadvantages, as they adopt a subjective epistemological approach, and their critics raise questions about the "reliability and validity" of the material (Jennings, 2010, p. 175). Therefore, to validate the interpretation of the interviews, and to test if the interpretations of the authors are exactly what the interviewees state in the interviews, plus deriving from the theories that frame this study, and the statements of the six semi-structured interviews, a questionnaire was built comprising the dimensions and constraints and facilitators highlighted in the literature and validated by the interviewees.

If the initial six interviews identified key themes from the literature that constrain or facilitate the practice of the sport, the questionnaire survey was crucial to confirm why, in fact, the "local communities don't walk the greens", by collecting data directly from the population who could practice the sport and does not do so. The careful coding of the interview data by three researchers, according to the three-dimensional model and the subsequent design of the questionnaire based on those codes, ensured that the study would capture the actual facilitators and constraints within the material and social-cultural aspects, i.e., affordances under study, aligning the research design and tools with the research aims. The questionnaire was based on the key themes identified in Reis and Correia's (2013) map of factors derived from the literature and interview data. The questionnaire consisted of three sections: the first with 22 questions related to the factors that may act as facilitators or constraints, with a concordance scale of five points (ranging from 'strongly disagree' (=1) to 'strongly agree' (=4) and 5 = 'don't know / no answer'). The second part comprised a set of six questions to build a socio-demographic profile of the participants (age, gender, place of residence, profession, golf practice), and one last open-ended question for participants to define golf in their own words. The questionnaire, made available in Portuguese and Spanish, was applied via a snowball sampling technique using LimeSurvey software (between February and March 23) and was codified with Excel and SPSS. The questionnaire was approved by the University [of researchers] data protection officer, and it included a section on the privacy policy of this institution and authorization for the

collection and analysis of data for the purpose of the study. Its objective was to understand individuals' self-reported perceptions of the game and what would motivate them to engage in playing golf, categorized by the dimensions or factors described above. A pilot test involving ten participants was conducted, revealing the need for minor adjustments to the scale items.

6.1 Interview Participants

Participants were chosen by purposeful sampling. The interviewees, comprising five men and one woman, provided extensive information about their life trajectory as golf players: one golf professional (António, hc1.2), one municipal golf course manager (Filipe, hc 6), two regular players (Dolores and Eduardo, hc 7.9 and 17.8) and two amateur players (Bernardo and Carlos, hc 36). Since there are no municipal golf courses in the Algarve, it was essential to solicit the manager's opinion to assess the course's performance. The golf professional works for a company that owns five of the best golf courses in the Algarve, and he manages one of them. The two golfers play regularly every week/weekend, and the two amateurs also play on a consistent basis, but not so often. Table 1 details the interviewees' profiles.

Table 1. Profile of Interview Participants

Participant (aliases used)	Age	Gender	Country	Handicap (hc)	Occupation	Initial Experience/Learning
António	45	Male	Portugal	1.2	Golf Manager in the Algarve	Golf Clinique near his house
Bernardo	18	Male	Portugal	36	Student	Grand Father
Carlos	47	Male	Portugal	36	Teacher	Golf Clinique in Algarve; Uncle in Lisbon; now plays with 2 sons (8 and 12)
Dolores	51	Female	Spain	7.9	An architect in Granada, but plays in Almeria	Family, since 12 years old; Group of 8/10 friends
Eduardo	55	Male	Spain	17.8	Family business	Brother and cousins
Filipe	52	Male	Spain	6	Managing director of Municipal Course	A friend who worked at a golf course

Source: Survey's Data

The interviews were conducted in colloquial Portuguese or Spanish and subsequently translated into English. The interview guideline was composed of questions concerning demographics and background, participation and habits such as frequency, engagement, and practical aspects of the interviewee's golf activity, social influences and preferences, such as role of the interviewee's social network - family, friends, and acquaintances - in their participation, as well as their preferred playing company, and finally, perception and accessibility, e.g., views on the social and economic nature of golf, its accessibility, and the barriers to participation.

The interviews took place at the clubhouse or at a location of their choice; two were conducted via Zoom. The interviews lasted between 30 minutes and three hours. All interviews were recorded, and the verbatim transcripts were translated into English, becoming the object of interpretative and comparative analyses. Participants received information about the purpose and procedure of data collection when they were asked to participate. Informed consent was obtained in oral form at the beginning of the conversation. The right to refuse answers to inconvenient questions and the anonymity of data were assured.

6.2 Questionnaire Respondents

6.2.1 Brief profile of the questionnaire participants

The majority of respondents were Portuguese, comprising 63.1% of the sample, while Spanish respondents constituted 36.9%. This distribution ensures a fairly balanced representation of both nationalities,

allowing for a comparative analysis of cultural influences on perceptions towards golf participation. The gender distribution among the respondents reflects a nearly equal split, with 44.8% identifying as male and 55.2% identifying as female (Table 2).

Table 2. Profile of Respondents (N = 306)

Variable	Profile	
Nationality	Portuguese	63,1%
	Spanish	36,9%
Gender	Male	44,8%
	Female	55,2%
Age	Mean	21,3
	Median	36
	Mode	18
	Minimum	14
	Maximum	99
Practice of golf	Never tried	59,2%
	Tried once or twice	29%
	Practice once in a while	7,9%
	Other & no answer	4%

Source: Survey's Data

The age distribution within the sample (Tables 2 and 3) is characterized by a mean age of 21.3 years. The median age stands at 36, indicating a potential presence of outliers that skew the distribution. The mode, representing the most frequently occurring age, is 18. The age range spans from a minimum of 18 years to a maximum of 89 years, providing a broad spectrum for assessing attitudes towards golf across different life stages. The age distribution reveals a diverse representation, with a substantial portion of respondents falling within the 18-29 age group, making up the largest segment at 43%. This reveals a significant presence of younger individuals in the sample, offering potential insights into the attitudes and preferences of the younger demographic regarding golf participation. The 30-49 age group, comprising 27% of the sample, reflects a substantial but comparatively smaller segment. This group's perspectives bridge the gap between the younger and older cohorts, providing insights into a transitional phase of life. The ≥ 50 age group, accounting for 20% of the sample, indicates a notable presence of older individuals. Their perspectives display long-term trends, potential barriers, and facilitators to golf participation among the more mature demographic. Table 3 illustrates the age distribution.

Table 3. Age of Respondents

Age	Frequency	Percentage
18-29	133	43
30-49	82	27
≥ 50	91	20
Total	306	100

Source: Survey's Data

6.2.2 *The practice of golf*

Exploring the respondents' engagement with golf, the data reveal that a substantial portion of the sample, 59.2%, has never tried golf; those who have tried once or twice account for 29%, while 7.9% practice golf once in a while, whereas 4% either provided other responses or did not answer, as Table 2 summarizes.

7. Findings

The following section focuses primarily on the interview results. The data is organised according to the three dimensions. This is followed by the e analysis of the questionnaire results, which support and validate the qualitative findings.

7.1 Interviews

The data were analysed using the constant comparative method outlined by Creswell and Poth (2017), by which the researcher simultaneously codes and analyses data in order to develop concepts, and then "refines the concepts, identifies their properties, explores their relationships to one another, and integrates them into a coherent explanatory model." (Creswell & Poth, 2017, p. 126).

The data analysis followed a five-step process adapted from McCracken (1988), which included: (a) preparing the interview transcripts; (b) reading each transcript in-depth; (c) generating general themes supported by direct quotes; (d) comparing themes across transcripts to extract salient excerpts and define sub-themes; and (e) interpreting the general and sub-themes. To ensure rigor, three researchers independently reviewed each transcript. Any minor discrepancies identified were resolved through discussion to achieve full consensus.

The researchers independently coded the interview responses using the three-dimensional analytical framework (see Figure 1) and engaged in an iterative process of homogenization to ensure consistency and reliability in the coding scheme. For instance, a statement such as "At the beginning, when you take lessons and you need a membership club and you need a lot of money, golf is a little expensive" was classified under the structural or material dimension, within the financial resources factor. The extracts were translated while remaining as close as possible to the original wording, which sometimes results in an odd reading in English.

7.1.1 *Intrapersonal factors*

Golf as a source of mental and emotional well-being

A primary theme that emerges from the interviews is the significant role golf plays in promoting mental and emotional well-being. Participants explicitly describe the activity's setting as conducive to mental peace and introspection. The environment is "very quiet, very peaceful, then your problems are forgotten, it's just you or you with your mates playing, you are there, listening to the birds, the wind, the crickets, all that is very attractive to me, you forget everything" (Bernardo).

The benefits are holistic, as it is considered "very good for your heart and your mind [...] in a beautiful scenery" (Carlos). This introspective quality is further emphasized by the sport's nature as being "not as intensive as other sports, you can be more thoughtful, calmer, more introspective, in a state of mind, you talk to yourself or with others" (Bernardo). As respondent Dolores clearly states: "I relax playing golf, I go quietly enjoying the company, the course, and you escape from everyday life. [...] you get physically fit and there are also older people who find it helps them to be active, to be with their friends, to stop thinking about things."

Yet another participant highlights a different benefit: "and one thing that seems tremendous to me is the longevity with which this sport can be practiced. I am over 50 years old, what sport do you think I can practice? Some people say that they go out cycling, but I ask them, how long will you be able to go cycling, play soccer, and tennis?" (Filipe)

Intrinsic motivation and early life influence

The initial attraction to the sport is often tied to an appreciation for the natural setting, which provides a deep, intrinsic reward: "I really like to look at the golf course, there used to be rabbits, birds, fish, and a lot of things that give me a lot of pleasure" (Bernardo). This is combined with the specific, simple pleasures of participation: "I like to walk in the golf course, the beautiful environment and hitting the ball" (Carlos). The ease of access and enjoyment also contribute to this motivation, as "the course is easy to enjoy" (António). "It adapts to any age, you can play very young, very old. When I started there was a deaf man who went every afternoon to play, it doesn't matter how busy your life is, how old you are or how bad you are, you can always go and enjoy the course, go for a walk, watch the birds" (Dolores).

The introduction to the sport during childhood is cited as a key enabler. Both Filipe and António recall a defining moment of early access: "One summer, when I was 11 years old, there was a golf Clinique in Vilamoura, a bus picked us up. I tried it and I met other friends who played, so I talked to my family, and I started that summer, it was a practically free school with the support of the golf courses" (António). "We were practicing, and I fell in love with golf, and we asked him [course manager] what we had to do to start playing golf. [...] That same summer I did my golf course and in September I got my license. From that moment I was hooked on golf" (Filipe). This highlights how accessible early exposure can cement long-term engagement.

The barrier of skill and the role of frustration

The most significant intrapersonal barrier identified is the challenge of the learning curve, which directly impacts an individual's sense of competence and risk of drop-out: "I think the level of emotional satisfaction is very important. At the beginning, when you start playing, it's difficult, but suddenly contact comes and the ball starts to roll, and that gives you a lot of satisfaction" (Eduardo).

Participants acknowledge that the activity requires some degree of initial success to prevent discouragement. For Bernardo, ability is a prerequisite for continued interest: "If I was really bad, I wouldn't want to play. I wouldn't. You need a bit of skill. If you swing and you don't hit the ball, it makes you a bit bored."

Golf is recognized as having a "high learning curve" (Bernardo), where the initial difficulty (doing "the swing in the air") can lead to significant frustration. The data strongly suggest that overcoming this barrier depends on external support and patience. Bernardo reflected on how critical familial support was in his early days: "If my grandfather hadn't been there...Yes, I would have been frustrated, why am I going to do this if I can do something else that I can enjoy more...". The presence of a supportive figure mitigated the internal sense of failure. However, another view suggests that persistence outweighs innate talent: "You need a lot of practice and a lot of patience, you don't need any skills" (Carlos). Filipe, who manages a golf course, tries to overcome this obstacle: "We provide [beginners] with the equipment, we leave the clubs with them throughout the beginners' course, and they can come and practice whenever they want at no cost to them. We try to make it easy for them".

7.1.2 Social or interpersonal factors

The gateway role of family and socialisation

The most powerful initial factor identified is the influence of family and/or friends' incentive, suggesting that the activity is largely introduced through close relatives. For many participants, the activity is not something they have discovered spontaneously, but rather a legacy or pre-existing fixture in their family network.

Family members serve as the primary initiators and companions. Participants were introduced to the sport by their grandfather, uncle, or because of pre-existing family engagement. António noted "My family plays golf and my house was 5 km from golf courses", highlighting both social and physical proximity (structural) as factors. The grandfather-grandchild relationship is particularly prominent, where the activity was a vehicle for connection: "I used to play with my grandfather, who is the one who introduced me to golf [...] I liked it and we played and had fun together, to play golf was a pretext to be with each other"

(Bernardo). Another interviewee has good reasons to play: "My mother, my father, my three brothers, one of my sisters-in-law, and my 6 nephews and nieces. Two aunts, two uncles, and two cousins play. We are about 20 people playing in the family, sometimes we do family tournaments" (Dolores).

Companion interaction and the social function of golf

Once initiated, the activity is overwhelmingly valued for the opportunities it provides for social interaction and companionship, suggesting a strong social function beyond the mere physical pursuit. Participants frequently describe the activity as "a very social sport". The nature of the game - with its inherent "pause time" - facilitates conversation: "You hit the ball and you walk to the ball and talk to your family or your friends" (Bernardo). For many, the main purpose is social enjoyment: "The player who just pushes the ball, to be with friends and have a good time" (António) or "the vast majority have started through a friend, have tried it and have seen how much fun it is. I think there is a lack of information about what golf is, how it works, its health benefits, and above all, how much fun it is" (Filipe). This social need is so strong that the inability to find a partner factor is identified as a barrier, as one participant stated, "it was difficult for me to play alone" (Bernardo).

One of the respondents brought up a gendered point of view: "Women take golf as a time with girlfriends...They go out to spend time with friends; they don't care about the handicap, as it is more like a social event for them [...] Men, even if they don't play a tournament, go out to play and compete with friends, even if it's just for a beer. However, women don't care, they play golf to be together, their main objective is not to compete as in the case of most men" (Filipe).

However, there is one contrasting view, showing that while preference is social, playing alone is possible: "I don't mind, I usually play alone" (Carlos); "I play with a group of 8,10 friends, half of them I knew before and others I made in golf. Having a group to play with encouraged me to continue playing, although I also like to play alone" (Eduardo). "I usually play with my nephews and nieces but I don't mind playing alone, I have been playing alone for many years" (Dolores).

Eduardo highlighted a new factor: "I made good professional relationships with some friends I met at golf, helpful for work. At the end of the day, you make friends from different professions, and if you need something...".

Lifestyle and socio-cultural barriers

While golf is a source of connection, participation is often constrained by lifestyle factors and domestic situations, and it is also challenged by external cultural and social attitudes.

Lifestyle constraints related to work and family schedules present a major practical barrier. Golf often requires playing "very early, at 8 o'clock in the morning" (Bernardo), which conflicts with work or class schedules, leading to temporary cessation: "if I have classes or I have to work, I can't play" (Bernardo). Similarly, a spouse's commitment to work and weekend sleep patterns can prevent joint participation, as one participant noted: "My wife doesn't play because she has a lot of work, and I usually go to play early in the weekends, while she is sleeping" (Carlos).

Cultural and social attitudes also act as constraints, particularly among younger cohorts. The sport suffers from a negative image or lack of popularity among peers, leading to disbelief and judgment: "I spoke to some friends and asked them what they thought of golf, and they were astonished, they looked at me with a face... who at our age plays golf? That's it, disbelief" (Bernardo). Eduardo states: "Some people think it's not a sport, associated with people who are a bit special. Non-players are skeptical, and this has been influenced by the image of overweight players, smokers. ... From the outside, it's not seen as a sport".

It is perceived as a niche activity: "I started when I was 12, and when I played golf, we looked like Martians, and on top of that, I was a girl. I have classmates who, when they went to university, didn't even say they played golf because they were looked at strangely" (Dolores).

Maturation as a temporary interruption

For adolescents, maturation and the associated life changes act as a strong, but often temporary, constraint on participation. The data suggest a common pattern of abandonment of the sport around the age of maturity, with participants often stopping, as "when they turn 18, they stop playing golf for many

reasons" (António). Crucially, the data suggests this interruption is not permanent, as individuals "tend to return to the sport as time goes by and they have a stable life" (António). Filipe, the other course manager being interviewed, confirms: "University age is bad...many go out to study and stop playing because they don't have a golf course to go to, they don't have their clubs, or they simply want to do another activity and then, when they enter the labour market, many come back". This highlights golf's endurance and enduring value despite life-stage interruptions.

7.1.3 Structural or material factors

Economic barriers: The cost of entry and participation

The most immediate and universally cited obstacle to engagement is financial constraints and economic factors, which severely limit accessibility for the general population, particularly youth.

Participants repeatedly emphasize the prohibitive cost, noting that the sport is "for young people, it is completely prohibitive" (Bernardo). This issue is intensified in specific regions, such as the Algarve, where courses are perceived as better but "more expensive than the rest of the country" (Bernardo). The barrier is multi-faceted, encompassing initial expenses: "At the beginning, when you take lessons and you need a membership club and you need a lot of money, golf is a little expensive. When you start out, it's a sport that you need a lot of money for equipment and for learning" (Carlos).

Yet, other opinions emerge: "In the past, it was understood as an elitist sport, associated with economic level or social class. Today, you can play for a reasonable price. You can also play with a lot of money or with less money, as there is a significant second-hand market and a range of public and private courses with affordable prices (Eduardo). Dolores speaks about the "myth" of being too costly, as "everyone is willing to pay between €60 and €100 a month for a gym they don't go to. It's not for posh people, it's not for older people, and it's not expensive. There are people who cycle and spend more on their bikes than on playing golf. And cycling is not considered a posh sport, nor is it an expensive one. At the Federation level, a lot more could be done to promote it" (Dolores).

This high cost reinforces a widespread negative cultural and social attitude that "golf is only for the rich" and "a sport of the rich, very elitist" (António). Although some participants mention more accessible courses and argue against the elitist tag, the prevailing public mentality that the sport is solely for the wealthy remains a significant non-monetary barrier. Filipe states peremptorily: "It's for rich people and it's for old people. You need to eliminate those two aspects that were true years ago but are no longer true today. For example, thanks to facilities like the one I manage, which is a public course, we offer popular prices. When people come here, they realize that they spend the same on golf as they do on any other sport".

Time commitment: A double-edged constraint

Time emerges as a dual-natured factor: a necessary barrier to entry but also the ultimate reward for established players. "On holidays, I play almost every day. However, working every day makes it difficult to play golf; some golf courses have a practice area with floodlights for nighttime play [...] but I don't have any nearby, there are none in Granada and none in Almeria either. This would make it easier for many people who work during the week" (Dolores).

The activity demands a significant time-pressure commitment to achieve competence. Participants note that to start playing on a course, it "takes a long time... It is necessary to dedicate at least six months to start playing" (António). This substantial requirement leads to attrition, as people "know you need a long time to learn, and normally they leave" (Carlos). Furthermore, the actual time required to play a full round (18 holes) is considerable: "If it were the 18 holes, it would be 4 to 5 hours; it is a game that takes a long time" (Bernardo). But solutions are being met: "Alternatives are already being sought, for example, in the USA, there are proposals to make the game in blocks of 6 holes and tournaments, for example, of 12 holes" (Filipe).

Paradoxically, this time commitment is highly valued by regular players. The lengthy period spent on the course is celebrated as the "best" aspect: "The time spent disconnected from the world, 4 or 5 hours without a phone and in connection with nature... Time is the disadvantage, but it is also what the player values most" (António). Strategies to mitigate the time barrier include playing shorter rounds, such as "9

holes" (Bernardo) or using smaller "city" courses where one can play in "one hour" (Carlos). As Filipe says: "It's funny because I think it's an advantage. If there is something I enjoy doing in my free time that brings me great satisfaction, and if it's 5 hours instead of 2, I think that's great".

Socio-geographic and infrastructural context

The geographical location, existing course policies, and conduciveness also dictate accessibility and participation, particularly in Portugal. A significant cultural and social attitude barrier is the perception that the activity is not Portuguese but a foreign import, historically "brought by the English" and associated with "Nordic countries" (Bernardo). This is exacerbated by the perception that the activity in Portugal is primarily "focused on tourism" with most courses being "for English or Irish tourists". This foreign association contributes to a "barrier" and the feeling that "it is not for us" (Bernardo).

The proximity of facilities is a pragmatic concern. Good access to a course that is "easy to get to" (Carlos) is important, especially for those playing less frequently. For those without a car, challenges like "carrying my clubs" to a course accessible by bus remain a hurdle (Bernardo). Carlos highlights the importance of proximity: "It is important to have a golf course nearby. I play once a week; it is important to have good access to the golf course, which is easy to get to. In the city, there is one that you can reach in 10 minutes by car, although it is small, it is comfortable to go to and play".

In terms of infrastructure and policies, there is a notable lack of facilities in schools: "In my schools, none of them had golf" (Bernardo). However, there are initiatives to offset the economic barrier, such as programs that visit schools to offer introductory sessions, and courses that provide equipment and supplies for children until they are twenty (António).

7.2 Questionnaire Analysis

The data were analysed using descriptive statistics. Table 4 presents the frequencies and descriptive measures for the 20 items, organised by facilitators and constraints within the three dimensions of intrapersonal, interpersonal, and structural factors that influence non-players' engagement in golf. Item 15 ('I play golf because members of my family also play') and item 21 ('I play golf because I like nature') were discarded because our final sample of respondents did not play golf. The instrument's validity was supported by the KMO (0.67) and a statistically significant Bartlett's test of sphericity ($p < 0.001$). After removing five items with communalities below 0.50, an exploratory factor analysis using principal component analysis as the extraction method with Varimax rotation yielded five factors, each with an eigenvalue greater than 1, accounting for 62% of the total variance. Factor reliability was indicated by Cronbach's alpha values ranging from 0.44 to 0.69, consistent with values reported in similar studies (e.g., alpha = 0.42–0.55 in Hubbard & Mannell, 2001). Although the instrument was theoretically structured into three dimensions, the analysis revealed a slightly different factor structure, which will be explored in detail in a subsequent study.

An overall analysis of the results suggests that the greatest constraints on playing golf are not structural in nature, but rather individual or social. On an intrapersonal level, the main constraint identified is the preference for other sports. This perception is particularly relevant given that the respondents are young (average age 21), tending to prefer more dynamic activities and to associate golf with a physically unstimulating practice. However, the majority of respondents recognise the positive impacts of golf on mental health (63%) and physical health (68%), indicating awareness of its benefits as a wellness practice.

Regarding the interpersonal dimension, the main constraint is that golf is not practised among the respondents' circle of friends, a situation reported by 33% of the sample. This aspect is particularly relevant among younger age groups, where leisure choices tend to be greatly influenced by peer groups. Nevertheless, 63% of respondents recognise that golf facilitates meeting new people, which suggests the sport's potential as a space for socialisation among younger age groups.

As for structural constraints, although less significant than the others, the idea that golf is a sport for wealthy people stands out (64%). However, only 64% of respondents consider golf to be a very expensive sport, which, combined with 59% who believe some people play only for status, suggests that the con-

straint is more associated with an elitist perception of the sport than with the actual costs of playing it. Overall, these results suggest there is potential to attract this age group through communication strategies that clarify costs and dispel the sport's elitist image.

Table 4. Frequencies for the 20 items organised by the three dimensions and facilitators, and constraints, and percentage of responses for totally agree/partially agree

		Aver.	Median	Mode	Std. Dev.	Totally agree / Partially agree %
INTRAPERSONAL						
Constraints	Q3. You need to be skilled to play golf	3,05	3	4	1,35	47%
	Q8. I think golf is a very boring activity	2,60	2	2	1,36	30%
	Q10. I prefer to play other sports	4,08	4	5	1,10	75%
Facilitators	Q6. I would like to try to play golf	3,25	4	4	1,45	57%
	Q16. Golf has a positive impact on our mental health	3,76	4	4	1,10	63%
	Q22. Golf has a positive impact on our physical health	3,79	4	4	1,17	68%
INTERPERSONAL						
Constraints	Q1. It is very difficult to find people to play with	3,10	3	3	1,11	34%
	Q20. I don't play golf because none of my friends do	2,61	2	1	1,48	33%
Facilitators	Q7. I would like to play golf if I had company to play with	2,87	3	4	1,45	44%
	Q18. Playing golf helps us meet other people	3,61	4	4	1,12	63%
STRUCTURAL						
Constraints	Q2. Golf is for rich people	3,55	4	4	1,29	64%
	Q4. A round of golf takes a long time to play	3,64	4	4	1,16	59%
	Q14. Golf is a very expensive activity	3,78	4	4	1,07	64%
Facilitators	Q5. A round of golf takes less time than a game of tennis	2,80	3	3	1,14	26%
	Q13. I would play golf if there was a course close to home	2,47	2	1	1,34	29%
	Q17. Golf is not as expensive as riding (horses) or hunting	3,36	3	3	1,02	42%
Not constraints nor facilitators	Q9. Some people only play because of status	3,55	4	4	1,29	59%
	Q11. Golf is for older people	2,31	2	1	1,32	25%
	Q12. Golf has a positive image amongst young people	2,59	2	2	1,18	27%
	Q19. The majority of golf players are British (English and Scottish)	3,15	3	3	1,24	41%

Source: Survey's Data

Independent-samples t-tests were conducted to examine differences in golf engagement between Portuguese and Spanish non-players. Table 5 only presents the variables that showed statistically significant differences at a 5% significance level.

Table 5. Significant t-test differences in golf engagement between Portuguese and Spanish non-players

Items	Independent t test					
	Portuguese		Spanish		t	p
	Mean	SD	Mean	SD		
Q3. You need to be skilled to play golf	3,27	1,3	2,67	1,35	3,87	<0,001
Q6. I would like to try to play golf	3,46	1,4	2,9	1,49	3,26	0,001
Q12. Golf has a positive image amongst young people	2,73	1,15	2,36	1,2	2,69	0,007
Q13. I would play golf if there was a course close to home	2,59	1,34	2,26	1,32	2,1	0,036
Q16. Golf has a positive impact on our mental health	3,63	1,08	3,99	1,11	-2,82	0,005
Q17. Golf is not as expensive as riding (horses) or hunting	3,23	0,27	3,57	1,07	-2,88	0,004
Q19. The majority of golf players are British (English and Scottish)	3,38	1,13	2,77	1,32	4,12	<0,001

Source: Survey's Data

In terms of interpersonal aspects, the observed differences indicate that Spaniards are less willing to try playing golf than the Portuguese, probably because they place greater value on the required skill. Spaniards also believe more strongly in golf's positive impact on mental health.

As for structural issues, Spaniards seem more inclined to play when a course is nearby. Finally, regarding items that are neither constraints nor facilitators, Portuguese respondents have slightly more faith in golf's positive image among young people. Similarly, given that the Algarve is a popular destination for British tourists, it is not surprising that the Portuguese mainly associate golf with this nationality.

Deconstructing the image: lay definitions of the game

The results for the open-ended question, in which participants were asked to define golf in their own words (3 or 4 words), were categorised into 12 topics and organised according to relevant factors and dimensions (Table 5). Since some participants chose to write more extensive statements or more than 3 or 4 words, focusing on more than one aspect of golf, their occurrence was counted under each factor/question touched upon. Null answers such as "a ball, a club, and a hole" were excluded. A total of 387 occurrences were categorised. The intrapersonal /constraint dimension has the highest number of occurrences, followed by intrapersonal facilitators and structural facilitators. Interestingly, structural constraints such as the perception of golf as an expensive, elitist, and high-status sport did not seem particularly salient in this open-ended question.

Table 6. Describe the sport of golf in your own words (3 to 4 words)

Dimension	Factor	Sample extracts	Nr. occurrences
Interpersonal	facilitator	helps to socialize	6
	constraint	skills; difficult technique; testing your patience; concentration and focus boring; uninteresting; not challenging; non-attractive	65 53
Intrapersonal	facilitator	mental and physical health; nature; beautiful scenery; open air walking	51
		calming; relaxing; quiet	41
	constraint	I don't know the game; can't say; if I could, I'd play; I'd like to try	25
		spending many valuable resources; not sustainable	4
Structural	constraint	it's a luxury; expensive	37
		takes too much time	19
		good image; positive perception; elegant; passionate; interesting;	51
	facilitator	enjoyable; challenging; success; fantastic; classic; for everyone	
	neutral	to make contacts	3
Total nr. of occurrences			387

Source: Survey's Data

Aligning these results with the findings from the interviews can lead to a plethora of valuable guidelines for the golf managers and marketers to adopt strategies to attract new players to the game.

8. Discussion

The current study aimed to provide a holistic understanding of the facilitators and constraints influencing golf participation by integrating the lived experiences of current players (qualitative data) with the perceptions of non-players (quantitative data). The synthesis of these findings reveals both alignment and contrast across the intrapersonal, interpersonal, and structural dimensions, offering crucial insights for the future development and marketing of the sport.

Intrapersonal factors: value recognition versus skill barrier

The intrapersonal dimension highlights a duality: while current players report golf as a significant source of mental and emotional well-being, this inherent value is largely recognised by non-players, with 63% acknowledging its positive impact on mental health, somewhat contradicting Huth & Breitbarth (2020) findings. This suggests that the core benefit of golf is broadly accepted across the population. However, despite this recognition and a substantial 57% willingness to try the sport, non-players face major intrapersonal constraints rooted in perceived competency. The most significant barriers identified were a preference for other sports (75%) and the perception of the required ability to play (47%). This aligns directly with the interview data from players, who noted that the barrier of skill and the role of frustration are significant early hurdles. This suggests that while non-players value the outcome (mental well-being), the perceived effort, difficulty, and fear of initial frustration are the primary psychological deterrents preventing them from trying. Addressing the skill barrier through accessible, low-pressure introductory formats is therefore crucial for converting latent interest (57% willing to try) into actual participation.

Interpersonal and social dynamics: the need for guided entry

Both data sets affirm that golf is fundamentally a social activity, but the mechanisms of entry differ. Players emphasised the gateway role of family and socialisation, as well as the importance of companion interaction for the game's social function. Non-players overwhelmingly echoed this need, with 44% expressing a desire to play if they had company, and almost two-thirds agreeing that golf helps to meet other people.

Despite this strong social facilitator, non-players cited the challenge of finding playing partners (34%) and the absence of friends in the golfing community (33%) as constraints, as already noted by Portugal et al. (2020). This creates a participation paradox: people want to play for the social element, but the lack of existing social ties prevents them from starting. The data strongly support the conclusion that the industry must clearly communicate the structured social opportunities available at golf clubs. By highlighting that the group of players is organised at the golf club—thereby eliminating the requirement to have a partner before arrival—golf clubs can effectively mitigate this crucial social entry barrier.

Structural factors: cost, time, and accessibility

The structural constraints, less prominent than the former two, represent the most aligned findings across both groups of participants – interviewees and questionnaire respondents. Players cited explicit economic barriers and the inherent time commitment as key constraints. This supports McGinnis et al.'s (2021) findings regarding the increasing lack of leisure time. Non-players mirrored these concerns, viewing golf as an exclusive sport for the wealthy (64%) and citing the perceived expense (64%) and time-consuming nature of rounds (59%) as major deterrents; see Portugal et al.'s (2020) similar findings.

While non-players show some resilience to the cost perception (e.g., 42% concede it is less expensive than horse riding), the overwhelming perception of exclusivity must be addressed. Additionally, the structural context of where to play is a relevant facilitator, as 29% of respondents expressed a willingness to play if a course were close to home. This, combined with the players' observation that maturation often acts as a temporary interruption due to life and career demands, underscores the necessity of proximity and the ability to play short, time-flexible rounds to overcome the established time constraint.

9. Conclusion

This study explored the affordances that golf practice could provide to residents, perceived by both golf players and non-players. It relied on a well-known and well-tested research design (Alexandris et al., 2002) for leisure and sports practice. However, it also introduced the less-explored feature of providing a detailed analysis of the qualitative data, highlighting the positive emotional attachment that the six interviewees have to the sport's practice, and comparing and contrasting the interviewees' perceptions and narratives with those of the questionnaire respondents. Additionally, it surveyed the less-explored population of non-golfers from two distinct counties.

The limitations of this study stem from the fact that the sample comprises only two regions, in Portugal and Spain, thereby limiting the scope of the context. However, this is one of the study's key strengths, as it provides a framework for understanding golf participation among the resident populations of these two major golf tourism destinations in southern Europe. As mentioned earlier, the main focus was on analysing qualitative interview data; therefore, a detailed discussion of comparisons between cohorts is not provided. Having said that, after applying the Mann-Whitney test to compare means for gender and nationality, no gender differences were found. However, as Table 5 illustrates, a few cross-cultural differences were observed between Portuguese and Spanish non-players. Due to space constraints, these findings, which are beyond the scope of this paper, will be presented in detail elsewhere.

As mentioned earlier, both Spain and Portugal offer excellent economic and environmental conditions for residents to play golf (Correia et al., 2006; Madrigal & Lara, 2019; Portugal et al., 2020). This study confirms what other studies have argued: first, there is a negative relationship between perception of constraints and sport participation (Carrol & Alexandris, 1997), and second, that the future appeal of golf hinges on mitigating the perceived barriers of skill, cost, and time (Completo & Gustavo, 2014; Portugal et al., 2020) while strategically capitalizing on the already acknowledged mental and health well-being benefits (Huth & Breitbarth, 2020) and the strong latent desire for social connection and trial. Based on Crawford et al. (1991) explicit propositions that individuals encounter and negotiate through intrapersonal, interpersonal, and structural constraints in a sequential manner, we find that even for non-players, this is true: the greatest constraints on playing golf are not structural in nature, but rather intra- or interpersonal.

While certain perceptions, such as golf being a status symbol (59%) or primarily for older individuals (25%), appear to be relatively neutral, the high barrier to entry based on skill and expense remains the primary focus area for industry strategy. The most effective interventions must simplify the entry process, clearly communicate available social structures, and provide accessible, time-efficient playing opportunities to capitalise on the 57% of non-players who are willing to try, viewing golf as a means to promote health and well-being.

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REFERENCES

- Alexandris, K., Funk, D. C., & Pritchard, M. (2011). The impact of constraints on motivation, activity attachment, and skier intentions to continue. *Journal of Leisure Research*, 43(1), 56–79. <https://doi.org/10.1080/00222216.2011.11950226>
- Alexandris, K., Tsorbatzoudis, C., & Grouios, G. (2002). Perceived constraints on recreational sport participation: Investigating their relationship with intrinsic motivation, extrinsic motivation and amotivation. *Journal of Leisure Research*, 34(3), 233–252. <https://doi.org/10.1080/00222216.2002.11949970>
- Algarve Promotion Bureau (2020). Algarve – the best golfing destination. www.visitportugal.com
- Boztas, S. (26 May 2025). 'I thought it was a yuppie sport': Holland's new wave of golf clubs. *The Guardian*. https://www.theguardian.com/sport/2025/may/26/holland-the-netherlands-new-wave-of-golf-clubs?CMP=Share_iOSApp_Other
- Buckley, R., & Akhoundoglu, M. (2020). Tourism affordances as a research lens. *Journal of Travel Research*, 59(7), 1331–1334. DOI: 10.1177/0047287519877241

- Carroll, B., & Alexandris, K. (1997). Perception of constraints and strength of motivation: Their relationship to recreational sport participation in Greece. *Journal of Leisure Research*, 29, 279-299. <https://doi.org/10.1080/00222216.1997.11949797>
- Casals-Miralles, C., Barioni, D., Mancini, M. S., Colon-Jorda, J., Roura, M., Salas, S. P., Argelaguet, L. L., Galli, A. (2023). The Footprint of tourism: a review of Water, Carbon, and Ecological Footprint applications to the tourism sector. *Journal of Cleaner Production*, 422, Article 138568. <https://doi.org/10.1016/j.jclepro.2023.138568>
- Completo, F., & Gustavo, N. (2014). Golf Tourism Destination Management: Looking for a Sustainable Demand: The Case of Portugal. *Journal of Management and Sustainability*, 4(1), 142-153. DOI:10.5539/jms.v4n1p142
- Correia, A., Videira, N., Alves, I., Ramires, C., Subtil, R., & Martins, M. V. (2006). Tourism golf scenarios: The Algarve case. *Tourism and Hospitality Research*, 6(3), 179-196. <https://doi.org/10.1057/palgrave.thr.6050015>
- Couture, J., Millington, B., Wilson, B. (2023). Who is the city for? Sports facilities and the case of Vancouver's public golf courses. *International Journal of Sport Policy and Politics*, 15(1), 45-62. <https://doi.org/10.1080/19406940.2022.2161601>
- Creswell, J., & Poth, C. (2017). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). SAGE Publications.
- Crabtree, B., & Miller, W. (1999). *Designing Qualitative Research*. Sage.
- Crawford, D., Jackson, E., & Godbey, G. (1991). A hierarchical model of leisure constraints. *Leisure Sciences*, 13(4), 309-320. <https://doi.org/10.1080/01490409109513147>
- Crossman, S., Drummond, M., Elliott, S., Kay, J., Montero, A., & Petersen, J. M. (2024). Facilitators and constraints to adult sports participation: A systematic review. *Psychology of Sport and Exercise*, 72, Article 102609. <https://doi.org/10.1016/j.psychsport.2024.102609>
- Funk, D., & Brunn, T. (2007). The role of socio-psychological and culture-education motives in marketing international sport tourism: A cross-cultural perspective. *Tourism Management*, 28(3), 806-819. <https://doi.org/10.1016/j.tourman.2006.05.011>
- Garau-Vadell, J., & de Borja-Solé, L. (2008). Golf in mass tourism destinations facing seasonality: A longitudinal study. *Tourism Review*, 63(2), 16-24. <https://doi.org/10.1108/16605370810883914>
- Gibson, J. J. (1979). *The Ecological Approach to Perception*. Houghton Mifflin.
- Godbey, G., Crawford, D., & Shen, X. (2010). Assessing hierarchical leisure constraints theory after two decades. *Journal of Leisure Research*, 42(1), 111-134. <https://doi.org/10.1080/00222216.2010.11950197>
- Hubbard, J., & Mannell, R. C. (2001) Testing Competing Models of the Leisure Constraint Negotiation Process in a Corporate Employee Recreation Setting. *Leisure Sciences*, 23, 145-163. <http://dx.doi.org/10.1080/014904001316896846>
- Hutchby, I. (2001). Technologies, texts and affordances. *Sociology*, 35(2), 441-456. <https://doi.org/10.1177/S0038038501000219>
- Huth, C., & Breitbarth, T. (2020). Golf's current image and its future role as a health sport from (non-)golfers' perspectives. *German Journal of Exercise and Sport Research*, 50(3), 377-384. <https://doi.org/10.1007/s12662-020-00653-y>
- Ingold, T. (2000). *The perception of the Environment: Essays on livelihood, dwelling and skill*. Routledge.
- Ingold, T. (2018). Back to the future with the theory of affordances. *HAU: Journal of Ethnographic Theory*, 8(1-2), 39-44. <https://doi.org/10.1086/698358>
- Instituto de Estadística y Cartografía de Andalucía (2022). *Encuesta de Coyuntura Turística de Andalucía*. <https://www.junta-deandalucia.es/institutodeestadisticaycartografia/dega/encuesta-de-coyuntura-turistica-de-andalucia-ecta>
- Jackson, E. L. (2005). *Constraints to Leisure*. Venture Publishing.
- Jackson, E. L., Crawford, D., & Godbey, G. (1993). Negotiation of leisure constraints. *Leisure Sciences*, 15(1), 1-12. <https://doi.org/10.1080/01490409309513182>
- Jennings, G. (2010). *Tourism Research* (2nd ed.). John Wiley & Sons Australia, Ltd.
- Kaaristo, M., Edensor, T., & Warnaby, G. (2025). Creative responses to an informal space: the affordances of Pomona Island. *Urban Geography*, 46(7), 1564-1584. DOI: 10.1080/02723638.2025.2480932
- Kiverstein, J. (2015). Empathy and the responsiveness to social affordances. *Consciousness and Cognition*, 36, 532-542. <https://doi.org/10.1016/j.concog.2015.05.002>
- López-Bonilla, L. M., Reyes-Rodríguez, M. C., & López-Bonilla, J. M. (2020). Golf tourism and sustainability: Content analysis and directions for future research. *Sustainability*, 12(9), Article 3616. <https://doi.org/10.3390/su12093616>
- Madrigal, M. A., & Lara, J. A. (2019). Golf tourism in southern Europe: A potential market. *Studies of Applied Economics*, 37(1), 64-79. <https://doi.org/10.25115/eea.v37i1.2573>
- McCracken, G. D. (1988). *The Long Interview* (vol. 13). Sage.
- McGinnis, L. P., & Gentry, J. W. (2006). Getting past the red tees: Constraints women face in golf and strategies to help them stay. *Journal of Sport Management*, 20(2), 218-247. <https://doi.org/10.1123/jsm.20.2.218>
- McGinnis, L. P., Gentry, J. W. & Haltom, T. M. (2021). Gender, millennials, and leisure constraints: Exploring golf's participation decline. *Journal of Policy Research in Tourism, Leisure and Events*, 13(1), 59-76. <https://doi.org/10.1080/19407963.2019.1662427>

- Mendes, J., Do Valle, P. O., & Guerreiro, M. (2011). Destination image and events: A structural model for the Algarve case. *Journal of Hospitality Marketing & Management*, 20(3-4), 366–384. <https://doi.org/10.1080/19368623.2011.562424>
- Ministry of Industry, Commerce and Tourism (2023). *Why choose Spain to play golf?* <https://www.spain.info/en/top/golfing-spain/>
- Neo, H. (2010). Unpacking the postpolitics of golf course provision in Singapore. *Journal of Sport & Social Issues*, 34(3), 272–287. <https://doi.org/10.1177/0193723510377313>
- Official Tourism Website of Andalusia (2019). <https://www.andalucia.org/es/golf>
- Oliveira, R., Pedro M. I., & Marques, R. C. (2013). Efficiency and its determinants in Portuguese hotels in the Algarve. *Tourism Management*, 36, 641–649. <https://doi.org/10.1016/j.tourman.2012.06.009>
- Palen, L. A., Patrick, M. E., Gleeson, S. L., Caldwell, L. L., Smith, E. A., Wegner, L., & Flisher, A. J. (2010). Leisure constraints for adolescents in Cape Town, South Africa: A qualitative study. *Leisure Sciences*, 32(5), 434–452. <https://doi.org/10.1080/01490400.2010.510975>
- Portugal, M. N., Do Carmo, M., & Correia, A. (2020). Why do the young generations not play golf? *Tourism Analysis*, 25(2-3), 309–318. <https://doi.org/10.3727/108354220X15758301241819>
- Raymore, L. A. (2002). Facilitators to leisure. *Journal of Leisure Research*, 34(1), 37–51. <https://doi.org/10.1080/00222216.2002.11949959>
- Reis, H., & Correia, A. (2013). Gender asymmetries in golf participation. *Journal of Hospitality Marketing & Management*, 22(1), 67–91. <https://doi.org/10.1080/19368623.2012.686149>
- Reis, H., & Correia, A. (2014). Facilitators and constraints in the participation of women in golf. *Tourists' Perceptions and Assessments* (Advances in Culture, Tourism and Hospitality Research, vol. 8). Emerald Group Publishing Limited, 137–146. <https://doi.org/10.1108/S1871-317320140000008008>
- Reis, H., Correia, A., & McGinnis, L. P. (2016). Women's strategies in golf: Portuguese golf professionals. In M. Kozak and N. Kozak (Eds). *Tourist Behaviour: An International Perspective* (pp.37–45). Cabi. <https://doi.org/10.1079/9781780648125.0037>
- Royal Andalusian Golf Federation (2023). *Andalucía GolfHub*. <https://hub.golfandalucia.com/es/>
- Royal Spanish Golf Federation (2023). *Guía Oficial de Campos de Golf RFEG 2023*. <https://hub.golfandalucia.com/es/>
- Silva, O., & Correia, A. (2008). Facilitators and constraints in leisure participation: The case of the southeast of Portugal. *International Journal of Culture, Tourism and Hospitality Research*, 2(1), 25–43. <https://doi.org/10.1108/17506180810856121>
- The Royal & Ancient Golf Club de St. Andrews (R&A) (2025). *European Golf Participation Report June 2025*. <https://www.randa.org/downloads-and-publications>.
- Ministerio de Industria y Turismo (n.d). TurEspaña, accessed 30oct2025, <https://www.tourspain.es/en/>
- Vamplew, W. (2010). Sharing space: Inclusion, exclusion, and accommodation at the British Golf Club before 1914. *Journal of Sport and Social Issues*, 34(3), 359–375. <https://doi.org/10.1177/0193723510377327>
- Woodside, A., MacDonald, R., & Burford, M. (2005). Holistic case-based modelling of customer's thinking-doing destination choice. In R. March, & A. Woodside (Eds.), *Tourism Behavior: Travellers' Decisions and Actions* (73–111). CABI.

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