REVIEW

Enhancing sustainable development through tourism digitalisation: a systematic literature review

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Abstract

The world's economic structure is increasingly moving towards a digital framework, boosted by the fourth industrial revolution. As a versatile sector, tourism is also embedded within this digital transformation process, albeit at a slower pace due to the uncountable challenges and uncertainties surrounding it. Nevertheless, the most recent implications of the pandemic crisis warned both managers and politicians of the urgent need for new development paths aligned with sustainability, particularly with the United Nations' sustainable development goals. Furthermore, direct issues related to tourism activity, such as overtourism, pollution, and economic dependency, call for alternative and balanced approaches. Smart and digital solutions might play a key role in this process, but little is known concerning their potential. Aiming to extend knowledge concerning these potentials, a systematic literature review was conducted to examine the state-of-the-art about the implications of digital transformation in tourism as a catalyst for sustainable development, identifying gaps and providing directions for future research. From the analysis of 38 manuscripts, visitor experience, destination management, business solutions, and smart sustainable destinations emerged as the most common topics. However, inconsistencies were identified concerning the management narratives and the actual implementation of smart approaches. Additionally, the novelty of the concepts gravitating around smart tourism promotes some theoretical inconsistencies, which also need to be remedied.

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1 Introduction

Technology has accompanied tourism since its early stages, and new challenges are arising. The sector's digital transformation is now an ongoing process, enhanced by a set of disruptive innovations that changed the industrial panorama and are starting to be transferred into the tourism sector. This trend was triggered by the emergence of Industry 4.0 (I4.0), where operations occur in a 'phygital' world, meaning that both digital and physical spheres converge into a unique system (Posada et al. 2015), enabling smartness to embrace the production process (Xu et al. 2018). The effectiveness of this process is guaranteed by the interconnectivity of a set of advanced information and communication technologies (ICTs) (e.g. artificial intelligence (AI), the internet of things (IoT), blockchain, cloud computing, big data), creating an intelligent value chain where data is constantly processed and exchanged through autonomous and independent methods (Posada et al. 2015; Xu et al. 2018).

This 'revolutionary' trend was rapidly adopted by the tourism sector, creating space for the emergence of a new concept that some hastily called *tourism 4.0* (T4.0). T4.0 can be simply understood as an extension of I4.0 principles, meaning that technologies, such as blockchain, IoT, AI, augmented reality (AR), virtual reality (VR) and others, are key elements in the operationalisation of tourism activity (e.g., Buhalis et al. 2019; Jeong and Shin 2020; Stankov and Gretzel 2020). Even so, very few studies attempted to conceptualise T4.0 (e.g., Pencarelli 2020; Stankov and Gretzel 2020), which promoted a growing, but decontextualised, use of the concept by governments and academics, making it difficult to clarify its true meaning. Alternatively, development processes that are driven by ICTs are commonly described as *smart* (Gajdosik and Orelová 2020; Gretzel et al. 2015a). For instance, ICTs represent a vital element of the smart tourism concept, aiming to create innovative processes by maximising and optimising the contribution of all the stakeholders (Buhalis 2020). However, the emphasis is on the technological potentialities and not on the technologies as a tangible dimension (Li et al. 2017). Within a smart context, the aim is also to improve sustainability through the efficient use of technologies and existing resources, which consequently enhance competitiveness or, in the words of Crouch and Ritchie (1999), "sustainable competitiveness". Therefore, smart tourism involves innovative forms of collaboration and value creation based on the treatment of data from all the actors involved, facilitated by the implementation of new technologies. It aims to create value propositions based on efficiency and sustainability (Gretzel et al. 2015b), suggesting a clear alignment between technological solutions and the United Nations' sustainable development goals (SDGs) (Sachs et al. 2019). Thus, the question that should be addressed within tourism management and planning fora is whether it is possible to maintain profitable tourism growth without disregarding the sustainable paradigm. Or, from a more ambitious perspective, how can the tourism industry be restructured to guarantee appropriate sustainability levels by adopting technologies and smart-oriented strategies?

Due to their disruptive characteristics, tourism managers are increasingly aware of the benefits and added value of T4.0 and smart technologies (Buhalis

et al. 2019). Technologies in services (and tourism inherently) are highly linked to the interactions between the service provider and customers and can be helpful in the co-creation of value (Buhalis et al. 2019; Pencarelli 2020). ICTs have also been supporting the tourism industry in developing effective marketing strategies to attract visitors and provide unique experiences at the destination (Buhalis et al. 2019; Jeong and Shin 2020). However, some of these solutions were primarily aimed at tourism companies and were not adapted for visitors, resulting in negative experiences (Stankov and Gretzel 2020). At the same time, smart technologies might arouse visitors' behavioural intentions (Koo et al. 2016), influencing their motivations, recommendation intentions, and interest in a specific attraction or destination (Koo et al. 2016). Thus, it seems mandatory to thoroughly understand the extent to which visitors are willing to deal with new ICTs in a tourism context. At the same time, it is also relevant to evaluate tourism companies' ability to effectively implement these ICTs in their favour and add value to the customer.

Within a context where more and more voices emerge calling for a rearrangement of tourism development models, the role of ICTs and new emerging concepts, such as T4.0, needs to be questioned. An opportunity seems to exist for genuine sustainable tourism development, guiding the sector toward a more ecological path centred on the well-being of local communities (Niewiadomski 2020). The latest developments and proliferation of technologies are viewed as an opportunity to manage sustainability challenges within a tourism destination (Choudhary et al. 2020; Romão and Neuts 2017). For instance, the impacts caused by the latest pandemic crisis call for innovative ways of providing services and recovery strategies (Fennell 2021). This might be achieved through innovation processes and the gradual implementation of new technologies (Gössling 2020). In this sense, some discourses are already advocating disruptive approaches towards a sustainable reboot and rethink of tourism structure anchored on technological innovations (Mohanty et al. 2020), designing the path towards a new era of economic growth. Sustainable development implies that the exploitation of resources, allocation of investments, technological development, and institutional change are aligned and in harmony with the needs of the present and future generations (Brundtland 1987; Rogers et al. 2012). Thus, it must be adapted to the current panorama to guarantee that all the actors involved will be consistent and act in line with sustainability (Brundtland 1987; Rogers et al. 2012). However, an incorrect interpretation of the concepts, in both theoretical and managerial fields, might lead to a decontextualised integration in the perspective of strategic planning (Williams et al. 2020), distorting the discourses of policymakers and 'emptying' the concepts of their true content and meaning.

Today's society is driven by a digital setting in constant transformation. This scenario creates daily challenges for the sustainable development of both individuals and territories, making it vital to understand the influence of technologies (Popkova et al. 2022). In line with this, two main pillars sustain the rationale of the present study. First, despite it being argued that smart tourism is sustainability-oriented and that the implementation of technologies will enhance smart sustainable models, there is insufficient evidence supporting this (Gomis-López and González-Reverté 2020; González-Reverté 2019). Secondly, the relevance of new ICT solutions is increasing amongst tourism destinations due to the emergence of digital visitors and the

need to promote fully sustainable strategical approaches (Gomez-Oliva et al. 2019). Thus, the following research question is addressed in this paper: *To what extent can smart and technological approaches foster sustainable tourism development strategies?* Therefore, based on a systematic literature review, this study aims to identify, summarise, and critically review what has been published concerning T4.0, smart tourism, and sustainable development. It should be added that, to date, to the best of our knowledge, no works have adopted a similar methodological approach, except for a systematic review related to the development of a model for sustainable smart tourism destinations (e.g., Shafiee et al. 2019). This literature review is expected to expand the discussion and understanding concerning the transition towards digital tourism and how the process relates to sustainable development. Additionally, this study aims to identify the main gaps in the literature and contribute to the emergence of new research concerning this theme.

The paper is structured in five sections. The following section outlines the methods used to select and analyse the retrieved papers. Section 3 addresses the quantitative findings, particularly by describing and examining the number of studies published within a period range, main sources, academic fields, number of citations, keywords network analysis, and the geographical basis. In the fourth section, first the main research methodologies are identified, which is then followed by a content analysis organised by categories highlighting and discussing the key findings and topics. The paper closes with a summary of the main conclusions, underlining the implications of technology towards a more sustainable path within the tourism industry, beyond reporting the most prominent research gaps and suggestions for future research paths.

2 Methodology

2.1 Records selection

A literature review is a versatile procedure aiming to indicate innovative directions to investigate a specific field (Davis et al. 2014; Snyder 2019). Different approaches can be implemented to conduct an effective literature review, namely systematic, semi-systematic, and integrative literature reviews (Pickering and Byrne 2013; Snyder 2019). This work draws on a systematic literature review to investigate the relationship between smart tourism and sustainable development, aiming to identify the methodologies applied, research subjects, and the main research gaps within the topic that might contribute to future research. By doing so, this method portrays emergent research themes and the fields demanding further theoretical support (Tölkes 2018). To accomplish this aim, the present study followed the PRISMA protocol encompassing four different stages adapted from Liberati et al. (2009). This protocol was chosen due to its reliability and use in various fields of study and its potential to improve consistency across reviews (Liberati et al. 2009). The research protocol was previously defined to select the most appropriate documents, identifying the excluding criteria. The procedure used to decide on the works to be analysed is detailed in Fig. 1.
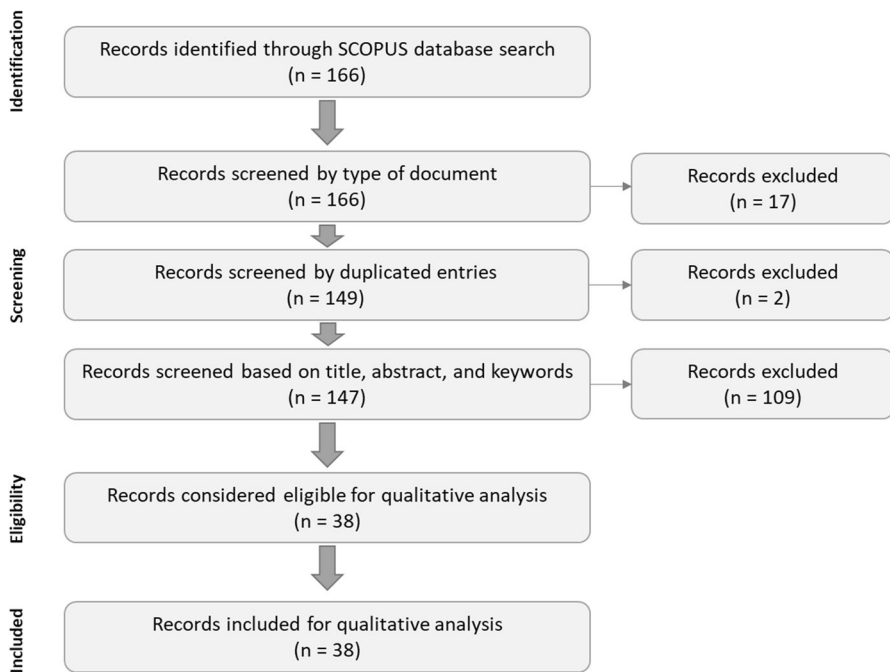
Fig. 1 Systematic review process based on the PRISMA diagram

The Scopus database was used to identify the studies within the field in analysis. Scopus was chosen because it is the most comprehensive database covering scientific data and literature subject to peer review, and due to the availability of metrics and analytical tools supporting the analysis process (Elsevier 2021). To define the most appropriate search terms, the first step was the analysis of the existing and relevant literature on the topics, as suggested by Hausberg et al. (2019) and Siddaway et al. (2019). Thus, the analysis of seminal literature (e.g., Boes et al. 2016; Gretzel et al. 2015a,b; Pencarelli 2020; Rogers et al. 2012) and the review article by Shafiee et al. (2019) supported the design of the theoretical background, enabling the identification of several buzzwords (Hausberg et al. 2019). After a brainstorming and discussion process, different combinations of search terms were tested (Hausberg et al. 2019; Mehraliyev et al. 2019; Siddaway et al. 2019), allowing the researchers to determine the final search string: "tourism 4.0" or "smart tourism" or "digital tourism" AND "sustainable development goals" or "sustainab*" or "sustainable development". As the purpose was to be as holistic as possible concerning the sustainability side, it was decided not to focus on specific dimensions, e.g., environmental, social, or economic. Moreover, the asterisk wildcard character (*) was employed to search for term variations.

The identification phase was accomplished in January 2022, according to the following search string filtered by title, abstract and keywords: "tourism 4.0" or "smart tourism" or "digital tourism" AND "sustainable development goals" or "sustainab*" or "sustainable development". A total of 166 records were obtained. Then, the

screening phase covered three stages. The records were firstly filtered by document type, excluding conference reviews, editorials, erratum, and reviews. Due to the novelty of the topics in discussion, this first screening opted to include both conference papers and book chapters to enlarge the sample and the probability of finding relevant insights that go along with the purpose of the present work. Thus, the number of documents was reduced to 149 records. Secondly, duplicated records were excluded. This second step excluded two publications. The third step encompassed an individual analysis (by title, abstract, and keywords) of each article to ensure their reliability for the study. If this process was inconclusive, the article was thoroughly analysed. Both theoretical and empirical studies were considered valid for the analysis if focusing on issues addressing the role of T4.0 and/or smart approaches towards sustainable tourism. Conversely, papers disregarding one of these dimensions or approaching the topic in a meaningless way, thus providing limited insights, were excluded from the literature review process. Concluded this screening phase, a total of 38 records was considered eligible and included for analysis.

2.2 Records analysis

This review was divided into two main categories of analysis: bibliometric and content analysis. Bibliometric analysis of the reviewed records was carried out through the review of (i) year-wise distribution of studies, (ii) journals by disciplinary field and the number of citations, and (iii) keyword co-occurrence. This last step was accomplished using the VOSviewer software to generate a keyword co-occurrence network. Secondly, the content analysis was mainly focused on the identification of the (i) research methods, and (ii) thematic fields (e.g. demand, supply, public policies) and discussion of the results concerning the implications of smart tourism and sustainability in each of the fields identified.

3 Bibliometric analysis

3.1 Year-wise distribution of studies

A total of 38 records were retrieved for analysis. The number of studies analysing sustainability and smart tourism has been increasing since the first publication in 2014. The first article was published by Graziano (2014) and addressed the potential of smart tourism in Italian smart cities. The author performed a SWOT analysis examining the level of smartness and the future challenges, further proposing a territorial planning instrument looking towards both social and economic sustainable development. The author concluded that smart tourism would only be plausible if the decision-makers perceive the territorial context and dynamics, particularly to guarantee the sustainability of development strategies and plans.

Most publications were registered between 2019 and 2021, which makes up 76.3% of the total, meaning that these subjects are relevant and gaining increasing prominence in the tourism field. The peak registered between 2019 and 2020 might

be due to the increasing use of technologies in the tourism industry and the emergence of pro-sustainability segments within tourism demand. Moreover, particularly in 2020, the number of publications might be justified by the pandemic crisis that boosted the digitalisation process within the tourism sector, along with the need to design more sustainable development models (Fig. 2). As mentioned earlier in the introduction, the proliferation of smart and I4.0 technologies within the tourism sector is expected to generate greater awareness towards the necessity of investigating its implications. Moreover, several questions related to tourist behaviour towards smartness and companies' adaptation to technological progress remain to be solved (Buhalis et al. 2019). Additionally, the potential of technologies in the sustainability field is still on a theoretical basis (Gössling 2020), and thus an increase in publication numbers is expected in upcoming years.

3.2 Journals, disciplinary field, and citations

Among the 38 publications under analysis, 94.7% were found to be articles, while only two were conference papers. These studies were published in 19 distinct journals or proceedings, representing a wide diversity of disciplinary fields (Table 1). In particular, the journal *Sustainability* is the most prolific, with 19 publications, while the remainder registered only one record. There were also two papers published in the *e-Review of Tourism Research*. Ten disciplinary fields were identified. The wide range of disciplinary backgrounds demonstrates the multi-disciplinarity of the research subjects. It should be mentioned that this diversity might also be justified by the fact that journals are associated with more than one field of study, as demonstrated in Table 1. There is a considerable prevalence of studies published in "geography, planning, and development" (63.2%), due to the high number of publications in the journal *Sustainability*. There is also a significant contribution of publications in the field of "tourism, leisure, and hospitality management" (18.4%), followed by the areas of "computer science" (13.2%), and "business, management and
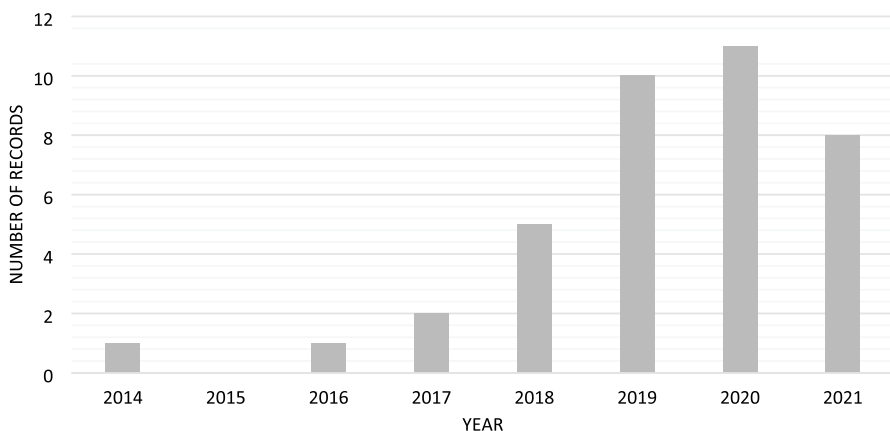
Fig. 2 Number of records published by year

Table 1 Journals by disciplinary field

Journal or proceeding	Nr. of publications	Tourism, leisure, and hospitality management	Computer science	Information systems	Sociology and political science	Social sciences	Business, management and accouting	Geography, planning and development	Development	Urban studies	Ecology
Austrian Journal of South-East Asian Studies	1					x					
Companion Proceedings of the 2019 World Wide Web Conference	1		x								
e-Review of Tourism Research	2	x						x			
EuroMed Journal of Business	1						x				
European Journal of Geography	1							x			
European Journal of Tourism Research	1	x						x			

Table 1 (continued)

Journal or proceeding	Nr. of publications	Tourism, leisure, and hospitality management	Computer science	Information systems	Sociology and political science	Social sciences	Business, management and accouting	Geography, planning and development	Development	Urban studies	Ecology
GeoJournal of Tourism and Geosites	1							x			
IEEE Access	1		x								
Information Technology and Tourism	1	x	x	x							
International Journal of Recent Technology and Engineering	1						x				
International Journal of Information Management	1		x	x		x	x				
Journal of Destination Marketing and Management	1	x					x				

Table 1 (continued)

| Journal or proceeding	Nr. of publications	Tourism, leisure, and hospitality management	Computer science	Information systems	Sociology and political science	Social sciences	Business, management and accouting	Geography, planning and development	Development	Urban studies	Ecology
Journal of Regional Research	1				x				x	x	
Journal of Urban Technology	1									x	
Land	1										x
Sustainability	19							x			
Proceedings of the Ninth International Symposium on Information and Communication Technology	1		x								
Tourism Management Perspectives	1	x									

Table 1 (continued)

Journal or proceeding	Nr. of publications	Tourism, leisure, and hospitality management	Computer science	Information systems	Sociology and political science	Social sciences	Business, management and accounting	Geography, planning and development	Development	Urban studies	Ecology
Tourism Review International	1	x									
Total number of papers per disciplinary field		7 (18.4%)	5 (13.2%)	2 (5.3%)	1 (2.6%)	2 (5.3%)	4 (10.5%)	24 (63.2%)	1 (2.6%)	2 (5.3%)	1 (2.6%)

accounting" (10.5%). Perhaps one major gap is the fact that tourism and hospitality journals have no more than one or two publications. These results suggest that the aggregation of smart and digital tourism with sustainability topics is not embraced exclusively by tourism and hospitality journals. Instead, they are spread through distinct areas, despite the prevalence of managerial, planning, and development disciplinary fields.

A citation analysis was also employed based on Scopus metrics. Analysing the most cited articles might be useful for researchers to identify seminal literature, which is argued to support the development of an effective theoretical framework (Cavalcante et al. 2021). According to this rationale, the study by Sun et al. (2016) appears as the most influential, with a total of 584 citations, followed by Shafiee et al. (2019) and Pencarelli (2020), both with 80 citations. Only one article was found to have no citations (Liu et al. 2019), and 44% have less than ten citations. One possible reason justifying the low number of citations might be attributed to the fact that most of the publications were published predominantly since 2020. A second reason might be associated with the topic under analysis by the authors, e.g. circular economy, accessible tourism, and participatory planning, which might still be poorly related to the smart and/or sustainability subjects. The citation analysis network, indicating the number of times each author cites another, is presented in Fig. 3. The network shows a minimum number of one document and one citation per author. Limited results were generated. This is justified by the fact that the most prominent links are formed only by two clusters composed of 26 authors citing each other, from a total of 118. This suggests that these nodes have similar theoretical approaches to the topic (Hausberg et al. 2019). Among these, the studies by Pasquale Del Vecchio and Antonio J. Jara appear as the most mentioned within this network.

3.3 Keyword analysis

An analysis of the keywords network by co-occurrence was carried out (Fig. 4). The VOSviewer software was used to create the network map. The node size represents the keywords' weight, measured by the number of occurrences, while the lines indicate the link between the terms. From the 38 documents, a total of 131 keywords were identified. From these, 106 appeared only once, equivalent to 81% prevalence, while only 25 had two or more co-occurrences. For that reason, and for a more accurate visualisation of the network, all the keywords with a minimum number of one occurrence were included. This lower prevalence of keywords with two or more co-occurrences might be partially explained by the limited number of documents in analysis, but mainly by the fact that some terms (e.g., "smart") are used in bulk and applied to a wide range of constructs, supporting the observation of Gretzel et al. (2015a), who criticise the arbitrary implementation of this concept. In this case, the term smart is presented in 16 keywords (e.g., smart communities, smart governance, smart frameworks, smart tools, smart tourism city, smart tourists), showing the lack of conceptual background around the topic. "Smart tourism" has the majority of occurrences and the highest link strength, along with "sustainability", with
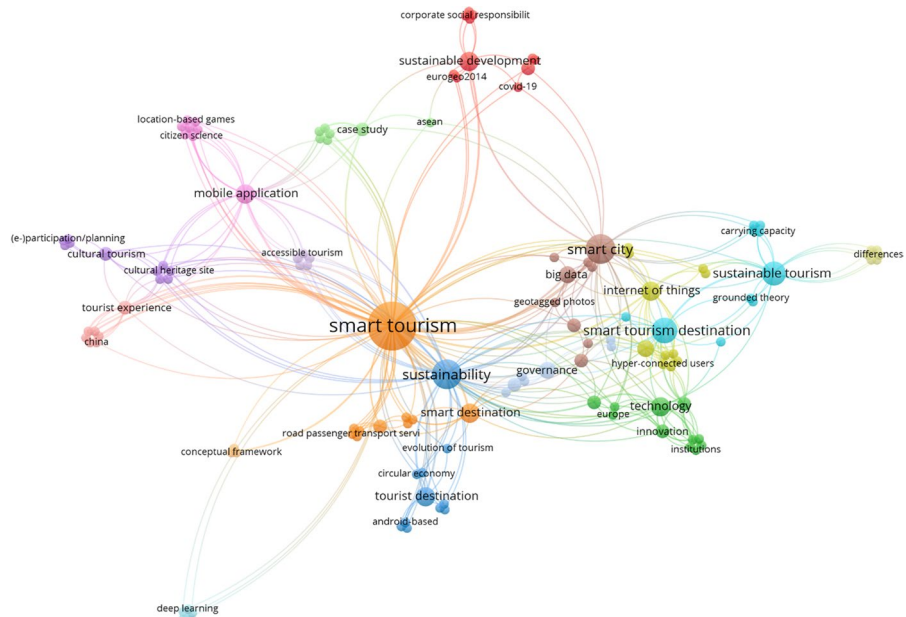
Fig. 3 Keywords network by co-occurrence

Fig. 4 Citation network analysis

nine occurrences and a total link strength of 53, and "smart city", appearing in nine articles and with a link strength of 42. This was somewhat of an expected outcome as the first two keywords composed the search code. Then, some other keywords are worth mentioning, specifically "smart tourism destination" and "sustainable tourism", composing the remaining top five positions.

From this analysis, 16 clusters were identified in total. The first cluster combines studies around the topic of sustainable development. The second cluster is more focused on technology, involving issues such as innovation, value co-creation, and smart tourism plans. A third cluster is formed around sustainability, involving studies focused on tourist destinations' solutions, such as circular economy practices or open innovation issues. The fourth cluster relates to studies mainly centred on the IoT and connecting terms such as information and communication technologies, near-field communication, or tourist attractions. The central topic in the fifth cluster is cultural tourism, related to heritage sites, world heritage, senior tourists, or Web 2.0. Cluster 6 groups words around the smart tourism destination topic, emphasising

sustainable tourism. The seventh cluster is formed around the word smart tourism, including, among others, major terms such as tourism innovation and smart destination. Cluster 8 has the smart city topic as central, gathering other issues such as big data and social networks. Mobile application is the central topic compounding cluster 9. Following this, clusters 10, 11, and 12 evolve around themes such as tourist experience, case study, and governance, respectively. Finally, clusters 13 to 16 are based only on one article, each analysing a wide range of topics such as smart destination governance, neural networks, accessible tourism, and smart tools. One interesting fact is the modest relevance of the term "technology", despite being a key element within both smart and digital paradigms. Nevertheless, and as in Schimperna et al. (2021), this is not representative of the slight importance of technological tools in the studies, even because several technologies are visible in the network, e.g., the IoT, mobile applications, big data, information and communication technologies, blockchain. On the other hand, this might indicate future research paths, perhaps highlighting the role of specific technologies or establishing a stronger link between the concepts.

Finally, the relevant data retrieved from this network analysis, in addition highlighting the key research constructs and streams, supported the identification and structuring of the content analysis section (Niñerola et al. 2019; Schimperna et al. 2021). These results highlight the potential role of the smart paradigm within cities and tourism destinations, also addressing other key subjects, such as sustainable development and technologies, particularly in tourist-oriented and tourism destination management studies.

3.4 Geographical context

Contrary to other systematic literature review studies (e.g., Schimperna et al. 2021), the present geographical context analysis was based on the territorial area where the study took place. This enables a more profound understanding of the territorial basis where the case studies are being implemented. In this case, it gains additional relevance as it might allow differences to be identified between developed and developing countries. Among the studies under analysis, Europe is the predominant geographical focus (42.1%), followed by Asia (21.1%), and the Americas (5.3%) (Fig. 5). Within the European setting, almost all studies were conducted in the South, mostly in Spain (50%) and Italy (25%). This suggests that southern countries might be a step ahead concerning the implementation of technological solutions towards sustainability, probably aware of the short- and long-run impacts resulting from climate change (Hein et al. 2009; Pintassilgo et al. 2016), to which they are most exposed, and the urgent need to employ alternative development models. In the Asian context, China and South Korea stand out, both with two studies, followed by Hong Kong, Indonesia, Japan, and Vietnam. Although not significant in terms of prevalence, it is worth mentioning the studies conducted in Indonesia and Vietnam, two developing countries, where solutions such as IoT and a smart service centre are implemented to manage visitors. It is particularly interesting to understand that these countries are also aware and able to design technological facilities, despite

Fig. 5 Distribution of studies by geographical context

the disparities with developed countries. Three studies used a multiple-country setting, particularly centred in European and Asian countries, while one used a global approach. Nine studies were not based on a geographical background, consisting primarily of theoretical discussions.

4 Content analysis

Content analysis of the articles encompassed the assessment of the research methods and the research context of the studies. Concerning the latter, the goal was to identify the main fields in which the topics of smart tourism and sustainability were embraced. In this case, only the papers adopting an empirical research method were included in the analysis.

4.1 Research methods

Table 2 synthesises the methodologies used in the studies considered in this analysis. The majority are empirical studies (65.4%), while the remaining represent theoretical ones. Concerning the empirical studies, ten adopted a quantitative methodology, eight applied qualitative methods, six implemented mixed methods, and only one followed a systematic review approach. Furthermore, within each research approach, distinct data collection methods were employed. This might be justified by the novelty of the topics that call for the need to implement exploratory research, usually associated with qualitative research methods. Moreover, since the digital transformation and the transference of technologies to the tourism context is still in an early stage, there are only shreds of evidence about its implications for sustainable tourism.

Questionnaires and secondary data sources (e.g., business analytics) were prevalent in the quantitative studies. These methods were particularly applied to research

on spatial distribution and visitor flow monitoring (e.g., Encalada et al. 2017; Kim et al. 2019; Zubiaga et al. 2019), eco-technologies (e.g., Chung et al. 2019), smart tourism tools (e.g., Vizuete et al. 2021), smart tourism destinations (e.g. Ivars-Baidal et al. 2021; Ortega and Malcom 2020; Saltos et al. 2021), and smart tourists and sustainable behaviours (e.g., Shen et al. 2020). In turn, qualitative approaches used the Delphi method, focus groups, ethnography, interviews, and secondary sources (e.g., strategic plans, institutional reports) to retrieve data. These studies were more dispersed regarding their focus of analysis. Specifically, topics were found related to gamification and accessible tourism (e.g., Huang and Lau 2020), smart and sustainable tourism systems (e.g., Lim et al. 2017; Moustaka et al. 2019), value co-creation and smart service ecosystem (e.g., Polese et al. 2018), promotional strategies (e.g., Idris et al. 2021), and smart tourism sustainability (e.g., Gomis-López and González-Reverté 2020; González-Reverté 2019; Križaj et al. 2021; Zeng et al. 2020). Questionnaires and interviews (e.g., Gomez-Oliva et al. 2019; Liu et al. 2019), interviews and secondary data provided by business analytics (e.g., Del Vecchio et al. 2018; Del Vecchio et al. 2022), or questionnaires and focus groups (e.g., Ramos-Soler et al. 2019) were the most observed methods among mixed methods approaches. Mixed- methods were particularly adopted by studies analysing topics concerning big data (e.g., Del Vecchio et al. 2018; Del Vecchio et al. 2022), cultural heritage and visitors' experience (e.g., Gomez-Oliva et al. 2019; Ramos-Soler et al. 2019; Slavec et al. 2021), and smart tourism destinations (e.g., Gomez-Oliva et al. 2019; Liu et al. 2019). Finally, the paper by Shafiee et al. (2019) is the only one implementing a systematic review. However, it diverges from the aims of the present paper, since its main purpose was to present a model for smart tourism destinations, positioning sustainability as a central issue, and identifying the main elements supporting the model. Specifically, the review article by Shafiee et al. (2019) looks forward to the clarification of both smart tourism and smart tourism destination concepts, addressing that the digital transformation efforts patronised by governmental authorities are mostly technology-based, a path that the authors argue as insufficient for an effective smart transformation. Aiming to contribute to theory development through the design of a sustainable smart tourism destination model, the literature review process was based on the grounded theory method. Using the smart tourism destination as the main research field, the authors added smart city and smart tourism due to their complementarity. Additionally, and since sustainability is a main pillar within the smart ecosystem (Gretzel et al. 2015b), the authors add the concepts of 'smart sustainable city' and 'sustainable cities' to their search string. Although recognising some similarities, the present study is not established under the smart tourism destination concept. The novelty of this study relies on the identification and discussion of smart approaches within distinct tourism areas, particularly by addressing their potential contribution to enhance sustainable development and sustainability in its fullness.

Table 2 Research methods

Research design	Methods	Authors
Theoretical	n.a.	Errichiello and Micera (2021), Graziano (2014), Gretzel and Scarpino-Johns (2018), Lee et al. (2020), Panagiotopoulou et al. (2020), Pencarelli (2020), Perles-Ribes and Baidal (2018), Perles-Ribes and Ramón-Rodríguez (2019), Tyan et al. (2020), Stephenson and Dobson (2020), Sun et al. (2016) and Vu et al. (2018)
Quantitative	Questionnaires	Chung et al. (2019), Ivars-Baidal et al. (2021), Shen et al. (2020) and Vizuete et al. (2021)
	Secondary data analysis (e.g., Business analytics of Big Data)	Encalada et al. (2017), Kim et al. (2019), Moustaka et al. (2019), Saltos et al. (2021) and Zubiaga et al. (2019)
	Prediction method	Crivellari and Beinat (2020)
Qualitative	Delphi	Gomis-López and González-Reverté (2020) and Ortega and Malcolm (2020)
	Ethnography	Huang and Lau (2020), Idris et al. (2021) and Lim et al. (2017)
	Focus group	Idris et al. (2021)
	Interviews	Huang and Lau (2020), Idris et al. (2021), Lim et al. (2017), Polese et al. (2018) and Zeng et al. (2020)
	Secondary data analysis (e.g., institutional documents)	Gomis-López and González-Reverté (2020), González-Reverté (2019) and Križaj et al. (2021)
Mixed		Del Vecchio et al. (2018), Del Vecchio et al. (2021), Gomez-Oliva et al. (2019), Liu et al. (2019), Ramos-Soler et al. (2019) and Slavec et al. (2021)
Review	n.a.	Shafiee et al. (2019)

4.2 Research topics

After a methodical full-text analysis of each paper, four main topics emerged (Table 3): visitor experience, destination management, business solutions, and smart sustainable destinations. Visitor experience concerns the analysis of how smart solutions influence or impact visitors' on-site experience and, consequently, the implications for a destination's sustainability. In its turn, destination management encompasses studies examining the contribution of smartness toward effective planning and management of a tourism destination. The topic of business solutions focuses on studies analysing the implementation of smart technologies to improve a business's operationalisation, while smart sustainable destinations emerge from research centred on the ability of tourism destinations to foster sustainability through the adoption of smart approaches.

4.2.1 Visitor experience

Visitors already use smart technologies at tourism destinations, on their own or encouraged by the destination environment, contributing to memorable travel experiences (Jeong and Shin 2020). The rise of smart technologies promotes great changes in traditional tourists, shaping their consumption and behavioural patterns (Sigala 2018). This necessarily entails several implications regarding sustainability issues. Different perspectives have been addressed to analyse the interaction between visitors and technology and how it influences sustainability practices or contributes to the sustainable development of tourism destinations. The studies analysed in this section (Chung, Tyan and Lee 2019; Gomez-Oliva et al. 2019; Huang and Lau 2020; Ramos-Soler et al. 2019; Shen, Sotiriadis and Zhou 2020) do not follow the same rationale, as different technologies have been analysed (e.g., near-field communication, beacons, mobile applications, social networks, IoT) in distinct contexts (e.g., museums, accessible tourism, responsible behaviour, cultural heritage). Moreover, some studies follow a win-win approach, showing how interaction with technology can contribute to visitors' experience while guaranteeing the destination's sustainability (e.g., Gomez-Oliva et al. 2019; Ramos-Soler et al. 2019; Shen et al. 2020).

Table 3 Research topics (empirical papers only)

Research topic	Authors
Visitor experience	Chung et al. (2019), Gomez-Oliva et al. (2019), Huang and Lau (2020), Ramos-Soler et al. (2019) and Shen et al. (2020)
Destination management	Crivellari and Beinat (2020), Del Vecchio et al. (2018), Encalada et al. (2017), Idris et al. (2021), Kim et al. (2019), Saltos et al. (2021), Slavec et al. (2021), Vizuete et al. (2021) and Zubiaga et al. (2019)
Business solutions	Del Vecchio et al. (2021), Lim et al. (2017), Moustaka et al. (2019) and Polese et al. (2018)
Smart sustainable destinations	Gomis-López and González-Reverté (2020), González-Reverté (2019), Ivars-Baidal et al. (2021), Križaj et al. (2021), Liu et al. (2019), Ortega and Malcolm (2020) and Zeng et al. (2020)

In their turn, other studies investigate how adopting and disseminating eco-friendly technological tools by supply stakeholders impacts visitors' perceptions (Chung et al.. 2019). There are also authors more focused on the capacity of technologies to promote inclusiveness within marginalised segments (Huang and Lau 2020).

The role of ICTs in improving cultural tourism experiences was addressed by Ramos-Soler et al. (2019). Accordingly, ICTs (e.g., mobile apps) positively contribute to the overall experience among senior citizens, particularly during the pre-travel and on-site stages. However, when analysing the impact of specific tourist apps, the authors found that visitors did not use them, mainly due to a lack of knowledge about their existence. Still, it is recognised that embracing the senior market with tourist apps would improve the sustainability of world heritage sites, due to their propensity to use online review platforms and the associated potential of ICTs to promote cultural heritage. In turn, the study of Shen, Sotiriadis and Zhou (2020) analysed the influence of social networks on improving visitors' sustainable behaviours during the overall experience. Accordingly, smart technologies can promote and drive visitors' pro-sustainability behaviours in all three stages of a tourism trip, particularly during the pre-trip and on-site moments, also contributing to the sustainable management of tourism resources by the destination's managers.

Chung, Tyan and Lee's (2019) research shows that the adoption of green technologies (e.g., near field communication, beacons) in museums positively influences visitors' perceptions concerning corporate social responsibility practices, particularly environmental, social and economic ones, which, in turn, influence the way visitors perceive and evaluate the quality of tourism attractions. Thus, this will enhance sustainable practices by both supply and demand sides, once both parties' interests are reinforced in the process. Supporting the implementation of technological tools to ensure a positive experience for the visitor, Gomez-Oliva et al.'s (2019) experiment demonstrated that the dissemination of technological solutions (e.g., IoT devices) through specific points of a tourism destination would enable autonomous sharing of tourists' content, co-created by residents (e.g., storytelling), based on a web-app that contributes to economic, environmental and socio-cultural sustainability of tourism destinations. This contribution is materialised through attracting digital tourists, collecting data regarding the environmental impact of tourist activities, and promoting local communities' participation in the tourism development process. More precisely, the creation of smart areas within the destination, resulting in an alternative communication channel, allows the dissemination of cultural offers to both visitors and residents, revitalising the destination's heritage and promoting the digitalisation transformation process.

In their turn, Huang and Lau (2020) propose a gamification approach, namely an app to enhance the tourism experience of people with visual impairments. In addition to establishing an emotional bond with the destination, through a gamified approach that also enables visitors to increase their knowledge about it, this study contributes to the social inclusion of people with visual disabilities in the tourism context, providing the opportunity for tourism managers to develop more accurate and accessible travel apps, according to the needs expressed by these travel segments. The study strengthens the observation of Buhalis et al. (2019) regarding the added value of technologies for the inclusiveness of visitors with disabilities.

Furthermore, the results demonstrate that these technological solutions enrich visitors' experience and personal quality of life, mainly due to the sense of enjoyment and autonomy provided to citizens with visual constraints.

Despite the different approaches, digitalisation seems to enable tourism attractions and destinations to enrich their bond with and knowledge about target markets, improving visitors' experience and supporting sustainability.

4.2.2 Destination management

Smartness can have a great impact on tourism destination management (Boes et al. 2016; Gretzel et al. 2015a). Taking advantage of smart technological tools, destination managers are able to collect, analyse, and share a vast amount of data concerning the destination ecosystem (Sun et al. 2016). For instance, smart technologies can be implemented to track visitors' movements and consumption patterns (Gretzel et al. 2015a), analyse online user-generated content (Encalada et al. 2017; Schimperna et al. 2021), or connect and interact with visitors (Mirzaalian and Halpenny 2019; Neuhofer et al. 2015). These potentialities offer new management model opportunities (Ivars-Baidal et al. 2019; Zubiaga et al. 2019), where technology and data are central actors (Ivars-Baidal et al. 2019). The main applications of smart technology in this field concern spatial distribution and monitoring visitors' flows (Crivellari and Beinat 2020; Del Vecchio et al. 2018; Encalada et al. 2017; Kim et al. 2019; Zubiaga et al. 2019), sustainable tourism (Saltos et al. 2021; Vizuete et al. 2021), tourism promotion (Idris et al. 2021), and heritage preservation (Slavec et al. 2021).

The phenomenon of overtourism can be a real issue for a tourism destination if managed improperly. The mass of visitors at specific attractions/areas might harm the destination's overall environment (e.g., businesses' life-cycle, local communities' well-being, ecological equilibrium) and jeopardise the visitor experience as well (Zubiaga et al. 2019). In that way, effective management approaches are mandatory to guarantee the functionality of tourism destinations. Within it, big data analytics arise as a smart tool with considerable usefulness in tourism management, particularly to ensure truly sustainable development. For instance, in Encalada et al.'s (2017) study, the spatial distribution of visitors in Lisbon is analysed through geotagged photos published on social networks (Panoramio). By doing so, the authors identified the main tourism hotspots of Lisbon. More than that, they also found marginalised sites that were disregarded by tourism managers but valued by visitors, showing great potential for tourism purposes. These insights prove that by using technological tools, such as big and open data, tourism managers can adequately cope with sites that are under pressure, particularly by reallocating visitors to alternative points of interest. This will revitalise specific areas, create new business opportunities, and optimise the visitor experience, thus contributing to the sustainable development of the destination. Similarly, Del Vecchio et al. (2018) claim that through this type of analysis, managers can identify specific patterns regarding the destination (e.g., critical points, areas needing intervention, opportunities for development) and the demand (e.g., satisfaction, expectations, needs). Accordingly, there is great potential associated with the analysis of visitor-generated content on social media, particularly the creation of knowledge, allowing the destination to improve

its performance on critical issues (e.g., accessibility, price, waste management) and to identify market segments (assessing visitors' personal information). Moreover, social networks are also an important marketing channel. Through big data analytics, tourism managers can directly involve visitors in this process, contributing to a more personalised offer and guaranteeing a constant interaction between the provider and the demand, thus supporting the premiss of value co-creation (Buhalis et al. 2019; Pencarelli 2020). By doing so, tourism managers are a step ahead of sustainable tourism, as the results support the fact that big data analytics enable new opportunities for destinations based on non-conventional natural and cultural settings, which, in turn, have considerable positive implications for economic, environmental, and societal development. Implementing a network of IoT-related technologies in tourism sites enables tourism planners to efficiently manage visitor flows (Gretzel et al. 2015a). In this field, Zubiaga et al.'s (2019) study demonstrates how integrating IoT and Geographic Information Systems (GIS) within a management model can contribute to monitoring visitor flows and, consequently, improve destination management towards sustainability. To do so, the authors designed a monitoring system to collect and share data about visitors' mobility patterns (e.g., occupation level, most-visited sites) within the historic centre of Ávila. The results demonstrate that the system supports decision-makers in developing strategies to avoid overcrowding situations and lighten the pressure on specific attractions/sites. Despite this primary outcome, it also provides the opportunity to design new attractions, improve less-visited places, and define new visitor routes, particularly in the surrounding areas of the destination. The added value of this solution is in the alarm method that notifies managers in overcrowded situations, allowing them to put into practice measures to control visitor flows (e.g., activating barriers) and to notify visitors through a mobile app, suggesting alternative activities or attractions to visit. Supporting the potential efficiency of IoT technologies within these contexts, a pilot project aiming to develop a visitor counting system using ultrasonic sensors and Bluetooth modules was implemented on Jeju Island (Indonesia) to deal with the gradual increase of visitors and the consequent environmental impacts on the destination (Kim et al. 2019). This solution allows authorities to properly design strategies toward limiting the number of visitors, thus preventing environmental constraints and associated costs. Moreover, the device also measures and provides environmental data (e.g., air pollution, wind speed, humidity, temperature) to visitors. Therefore, the system helps to support control and restrictive policies and, simultaneously, provides environmental information to visitors, allowing them to manage their experience effectively. The study by Crivellari and Beinat (2020) proposes a model that captures visitors' mobility patterns to identify and predict future behaviour during visitation. Individual spatial choices are determined and predicted based on a long short-term memory neural network. In other words, the model is expected to define visitors' movements within a destination. Accordingly, this solution might be helpful in developing location-based services, crowd control, and, in a broader context, destination management and planning. The model also paves the way to optimise the visitor experience, particularly by offering the possibility of informing visitors about crowded areas, providing personalised information and recommendations, or highlighting specific attractions, in line with the predicted trajectory. Through

this prediction method, tourism planners might be able to properly comprehend the future spatial distribution of visitors, allowing them to reallocate facilities and services along with the trajectory, and predict crowded areas, thus contributing to more informed and balanced decisions.

A distinct approach was chosen by Vizuete et al. (2021) and Saltos et al. (2021), although looking toward improving destination management conditions. By measuring the importance of 38 smart tourism tools based on visitors' opinions, the study by Vizuete et al. (2021) concluded that visitors tend to value technologies related to safety, mobile payment, and e-tools (e.g., websites and blogs, recommendation systems, mobile technologies), meaning that the authorities should concentrate on implementing these technological facilities within the territory. As "data is the new oil", the proliferation of technologies will enable both tourism suppliers and managers to understand and manage the needs of the demand side, customising services and adapting the territory. Consequently, new businesses will emerge, as well as direct investments, thus contributing to economic and social development. Moreover, by stimulating the stakeholders' direct participation in selecting the most appropriate technologies, the path towards sustainable development is created, as the needs and worries of distinct actors that actively contribute to the destination's growth can thus be collected together. In turn, based on the premise that social networks are valuable assets in a destination management context, Saltos et al. (2021) examined how Spanish destinations were using it to improve their management capacity. Despite finding that almost 90% of the analysed destinations were present on three or more social networks, no consistency was shown concerning their dynamism (e.g., daily publications), proactivity (e.g., engagement with visitors), or interaction (e.g., collaboration with websites from public administration, companies). This means that destination managers still use social networks for their traditional purpose, mainly promotion or to obtain information about visitors, disregarding active communication with visitors and other stakeholders. Moreover, the authors found no differences between smart and non-smart destinations, suggesting that the former were not benefiting from their technological advancements. Although focusing exclusively on the role of social networks, these findings seem to create a certain doubt concerning the added value of the smart destination paradigm, while demonstrating that there might be a lack of technological capabilities among tourism managers due to their apathy in engaging with the remaining stakeholders.

Identifying major issues in the promotional information strategy of Madura Island, Idris et al. (2021) designed an android-based tourism information system using VR. The application was elaborated in an integrative way, by listening to a wide range of stakeholders, encompassing tourism companies, tourism managers, tourists, and local communities. Although recognising the added value of involving both managerial and societal sides in the design process, concerning the technological side, it seems that VR was poorly implemented, as the application only provided 360º panoramic images of each available feature (e.g., attractions, accommodation, amenities). Nonetheless, the application proved to be an effective solution for sharing tourism information about Madura Island and became a promotional tool contributing to the development of the tourism sector.

Finally, Slavec et al. (2021) aimed to comprehend the extent to which it was feasible to involve visitors in the monitorisation of cultural heritage using technologies, such as smartphone cameras, visitors apps, and location-based games, for instance, by reporting damage to local authorities. Based on a focus group approach, the study suggests that preservation of cultural heritage might be improved through smartphone travel apps and location-based games, ensuring a greater interaction between visitors and cultural attractions. This solution might contribute to enhancing the destination's sustainability, firstly by involving visitors in the preservation process as main actors, increasing their motivation towards sustainability issues, and, secondly, by ensuring that the authorities are aware of the heritage that needs urgent intervention.

Smart technologies arise as valuable resources to collect, share, and analyse the massive amount of data resulting from the 'interaction' between visitors and destinations. Furthermore, their effective implementation is required for balanced and profitable management strategies to enhance destinations' competitiveness.

4.2.3 Business solutions

Smart technologies play a critical role in the competitiveness of tourism businesses (Neuhofer et al. 2015). Specifically, these tools arise as strategic resources for the success or revitalisation of a tourism company. For instance, the COVID-19 pandemic seriously affected the global economic structure with tremendous negative impacts on the tourism industry, particularly the shutdown of several businesses. Tourism players must rethink their business models to prevent similar consequences in the future and guarantee their sustainability. With the economic ecosystem nowadays being ruled by disruptive businesses where sharing and circular models are emerging approaches, reconfiguration and flexibilisation are necessary to remain competitive (Buhalis et al. 2019). With this in mind, the study by Del Vecchio et al. (2022) regarding the development of an eco-friendly accommodation network is discussed. Further, Polese et al. (2018) propose an integrative smart service ecosystem based on value co-creation and innovation, in line with the observation of Buhalis et al. (2019) about the impacts of technologies and the smart paradigm on service management. The literature reviewed highlights some experiments used to illustrate how businesses could be improved through the implementation of digital solutions without compromising sustainable development. In particular, the study by Lim, Mostafa and Park (2017) designs a mobile application based on the preservation of cultural heritage to improve business operations and, consequently, visitors' experience. The optimisation of transportation services through smart technologies is then discussed by Moustaka et al. (2019).

Aiming to enhance Japanese cultural traditions (*Omotenashi* culture) and narrow the existing gap between service providers and foreign visitors due to language and communication barriers, the study conducted by Lim, Mostafa and Park (2017) proposes the design and implementation of a technological-based service-assisting system – *Eatjoy* – supporting this dysfunctional communication process. According to the results, the system enhanced visitors' sustainable values and shone a light on cultural elements of Japanese history, positioning smart approaches as key factors

towards tourism performance and competitiveness. The study demonstrates how technology can improve tourism services to support business growth without disregarding important assets of nations' cultural traditions, which, in this case, constitute the basis of high-quality services in the tourism sector. Centred on an environmental perspective, the study of Del Vecchio et al. (2022) analyses the case of a network-based booking company promoting eco-friendly accommodation through a circular economy business model – '*Ecobnb*'. The results demonstrate that as well as promoting responsible travel behaviour among potential guests, the company offers the possibility for new or already existing accommodation establishments, to engage in a more ecological path.Support is provided towards the transition to a sustainable business model, which is the requirement to become part of the online network. Moreover, through big data analysis, the company can sustain and optimise its offer according to the expectation and needs of the target segments, by obtaining insights that improve decision-making and allowing companies involved in the network to design competitive strategies concerning ecological sustainability. Although focused on different dimensions of sustainability, both studies demonstrate how digitalisation supports the growth of tourism companies through an integrative process that is genuinely balanced and not exclusively driven by motivations of profit. By preserving elementary cultural aspects, such as *Eatjoy*, or operating in an ecological-oriented niche market, such as *Ecobnb*, these solutions prove that tourism businesses have the margin to develop more responsible growth models supported by ICTs solutions.

The study by Moustaka et al. (2019) proposes a framework – *TOMI* – based on data analytics to improve the service of road passenger transport operators in Thessaloniki, Greece. Several technologies support the development of this framework, particularly big data analysis (e.g., bookings, routes, itineraries), IoT devices to monitor each vehicle's data (e.g., engine status, fuel consumption, failures), and social network analysis to manage user-generated content. The aggregation of this data in one database allows different stakeholders (e.g., tour operators, travellers, local authorities) to benefit, first by optimising the service operation of tour companies (e.g., reducing costs, adopting fare strategies); secondly, by enabling the development of customised and economical services for travellers; and thirdly, through improving a destination's competitiveness, by attracting new businesses, revitalising attractions, supporting decision-making, and diminishing environmental pollution resulting from tour operations.

In turn, Polese et al.'s (2018) study discusses the perspective of Italian bed and breakfast businesses by analysing how smart service ecosystems contribute to value co-creation and innovation. Four components of the ecosystem were identified, particularly the stakeholders, the resources, the type of technologies, and the communication strategies. Through interviews with bed and breakfast owners, the authors understood that technologies operate as management tools, increasing the links between all the stakeholders within the ecosystem and, consequently, exchanging considerable amounts of data that can be used to improve business models. Particular attention was given to the relationship with guests. The process of continuous information exchange and data analysis (provided by guests' opinions or recommendations through online platforms) ensures that businesses can detect areas that need improvement to increase guests' satisfaction. Therefore, technologies ensure that all the stakeholders within the

ecosystem interact and contribute to value co-creation, increasing the amount of data exchanged among them (Buhalis et al. 2019). Consequently, economic, societal, and environmental benefits are spread to all the actors and the territory, thus granting companies innovation in services, strengthening relationships among stakeholders, and establishing networks that contribute to territorial development.

4.2.4 Smart sustainable destinations

Tourism sustainability implies an effective balance between social, economic, and environmental pillars. However, the traditional development models, seem to emphasise the economic side, perhaps because most stakeholders consider that the benefits for the society stem from the economic dynamic of the tourism destination (Serra et al. 2017). On the other side, the environmental dimension, despite being referred to as a key feature in most strategic plans, is hardly operationalised (Križaj et al. 2021). As emphasised earlier, different visions lead to misinterpretations of both sustainable and sustainability constructs (Williams et al. 2020). The solution for effective sustainable tourism strategies might be through innovation dynamics where smartness and new technologies have a central role (Choudhary et al. 2020; Gössling 2020; Romão and Neuts 2017). However, there is no space for the 'one-size-fits-all' logic in smart and sustainable strategies. To argue about these assumptions, several studies discussing how both sustainability and smart issues complement each other within development policies in different geographical contexts and levels are presented.

To investigate cities' capacity to foster sustainability through smart approaches, González-Reverté (2019) conducted a content analysis of strategic documents related to urban sustainability in Spain. The results reveal the absence of action plans centred on implementing technological solutions as a catalyst for urban sustainability. The author identified a lack of coherence and coordination within those combining both dimensions, particularly concerning a shared sustainable vision. This promotes a disconnected, diversified, and rhetorical approach to urban sustainability in smart destinations' plans, meaning that these strategies may not represent an efficient policy tool to achieve sustainable patterns within tourism growth. Gomis-López and González-Reverté (2020) examined how mature beach destinations incorporate smart and sustainable measures to prevent decline and improve competitiveness. The results of this study are in line with the conclusions of González-Reverté (2019). For instance, smart tourism plans aiming to improve sustainability were underrepresented, with technological solutions (e.g., apps, Wi-Fi, presence of digital platforms) being adopted on a very small scale and with very limited implications for sustainability. This limited technological scope, along with the restricted relevance of technological solutions towards urban sustainability, led the authors to suggest that smart strategies are understood as plans to revitalise the competitiveness of declining destinations, almost disregarding sustainability, which might constitute an issue in the mid or long term. In turn, Križaj et al. (2021) evaluated the smartness level of European smart tourism projects by analysing the adoption and implementation of technological solutions, as well as their sustainability orientation. Of the eligible projects (352), only 10% were truly smart, proving the commercialisation of

the smartness paradigm (Gretzel et al. 2015a) and emptying the concept of its real meaning. Among the smart projects, emphasis was given to technologies such as big data, sensors, mobile apps, and IoT, particularly in the fields of transportation, air pollution, and social innovation. Concerning the sustainability orientation, most of the projects were focused on the sustainable dimension, while few highlighted the social or environmental dimensions. However, little information was provided about the meaning of the sustainable dimension and it was inferred that it might be related to all the dimensions of sustainability (e.g., economic, environmental, social). Through this approach, Križaj et al. (2021) propose a model that is expected to contribute to an effective classification of emerging 'smart' projects.

Despite these findings, the study by Liu et al. (2019), based on an evaluation matrix for the construction of a smart tourism city, addresses sustainable development (e.g., mobility, accessibility, renewable energy, biodiversity) as a key feature. Nevertheless, based on the insights of the previous studies (e.g., Gomis-López and González-Reverté 2020; González-Reverté 2019), this indicates the existence of a gap between stakeholders' narratives and actions in practice, compromising the real meaning and purpose of smart approaches. The truth is that it is not feasible to separate sustainability from smartness and vice-versa. As Ortega and Malcolm (2020) reported, based on the perceptions of tourism stakeholders about smart tourism destinations in Mexico, sustainability is the nuclear and strategic factor inthe effective implementation of a smart tourism destination. However, the concept of a smart destination still lacks a conceptual definition, which might lead to incoherent and uncoordinated development of smart approaches, as reported by the previous studies in this analysis. Nevertheless, smart tourism is also perceived as a strategy for promoting equity among tourists and locals, enhancing the development of new business models and enriching the overall tourism experience.

Ivars-Baidal et al.'s (2021) study examined how tourism destinations evaluate the smart paradigm by analysing a system encompassing specific indicators, such as sustainability. The results demonstrate that sustainability was centred on the environmental field. Within it, it was concluded that governments showed a certain commitment to sustainability goals. Nonetheless, environmental certificates and indicators to measure environmental performance were scarce among companies, as were actions to raise awareness and plans to prevent climate change. Thus, despite integrating an indicator evaluating the sustainable performance of smart destinations, the focus is on the environmental component, disregarding the social and economic dimensions. This might misstate the real meaning and purpose of the smart tourism concept, calling once more for clarification of the concept, as suggested by Ortega and Malcolm (2020).

Zeng et al. (2020) investigated the role of big data analytics as a trigger for the transformation of Qinhuangdao, China, into a smart tourism destination. Supported by qualitative interviews and under the affordance theory, a three-stage model was developed, identifying how big data analytics technologies (e.g., stream analytics, predictive analytics, visualisation applications) were used in different stages of the process. Great potential was associated with the implementation of this technological solution, particularly an informed transformation according to the main requirements and opportunities identified, the development of customised tourism services

in line with visitors' needs (e.g., personalised recommendations), and the creation of sustainable ecosystem involving different stakeholders in coordinated efforts towards effective development strategies.

5 Conclusion

This study conducted a literature review aiming to thoroughly investigate how sustainable development is being addressed in the literature along with the emerging concepts of smart and digital tourism. The rationale behind this study relied on the increasing need to adopt alternative strategies concerning tourism development models toward sustainability. Specifically, the transition to a digital economy, where new information and communication technologies associated with the 4.0 paradigm are central players, seems to arise as a feasible path. Thus, the content of 25 publications was analysed to identify the methods, successful approaches, and best practices in distinct contexts.

Valuable insights for academics and managers result from this study. From the theoretical side, this is the first attempt to explore the combination of these topics, apart from the review study of Shafiee et al. (2019), detailed earlier. This study contributes to the smart and sustainable tourism literature by listing several topics in the context of smart technology use towards sustainability. Particularly, four main research themes - visitor experience, destination management, business solutions, and smart sustainable destinations - seem to be of significant relevance in the documents examined. Particular attention has been paid to the potential role of technologies in improving visitors' overall tourism experience and how this interaction could also benefit the sustainability of a tourism destination. The influence of smart tourism on the inclusiveness of specific market segments (e.g., seniors, disabled) was also discussed, contributing to the dissemination of tourism experiences for all, under the sustainable development goals principles. Smart approaches were also associated with destination management. Particularly, the added value regarding the control of visitors' flows was highlighted, providing the opportunity for the identification and promotion of new and alternative tourism products, reducing the pressure on the main hotspots and ensuring the well-being of visitors and local communities, as well as the preservation of tourism attractions/sites. Digital transformation of businesses was also emphasised as a factor contributing to the resolution of business constraints or as a key factor to the development of new models based on the co-creation of value where economic, societal, and environmental aspects are embraced. However, further studies are needed on implementing smart technologies in tourism firms and how those innovation strategies contribute to internal and external sustainability practices. This can be done through research on smart tourism, sharing economy and circular economy (Del Vecchio et al. 2022) and the adoption of case studies. Finally, the results showed the proliferation of smart and sustainable strategies in tourism destinations, although some dissimilarities were revealed. On one side, there is a gap between policy strategies' narratives and the implementation of those policies in practice. On the other, sustainability is advocated as a key feature of the success of smart tourism destinations. This calls for a more accurate and holistic

approach to smart and sustainable tourism strategies, namely, to support a concept that still lacks conceptual and empirical clarification. Throughout the discussion, the main technologies were also   pinpointed. In this case, there is a clear concentration on social network sites and mobile applications, which opens space for future studies to explore the implications of other smart tourism technologies, using reference studies (e.g., Buhalis et al. 2019; Gretzel et al. 2015b; Jeong and Shin 2020) as background for the identification of the most prominent ones. This study also demonstrates the existence of several world regions with scarce or non-existent publications in this field. This is particularly true for North America, Central Europe, and Africa. Although recognising disparities between developed and developing countries concerning the adoption of the smart paradigm, its great potential has been addressed throughout this study and should be acknowledged with further research in distinct geographical contexts.

From the managerial standpoint, this study has shown practical examples of how businesses and tourism destinations use smartness in their favour to support sustainability practices or to attain sustainable development. Greater interactive practices between stakeholders and effective data collection and analysis methods might assist playmakers in improving their business models and/or managing their destinations effectively. The study also shows that smartness contributes to value co-creation, enabling visitors and local communities to be part of the tourism experience and the managerial process. However, the extent to which companies and institutional organisations are prepared to deal with the ongoing digital transformation and yet be sustainable or contribute to the ecosystem's sustainability should be thoroughly explored. Moreover, some existing smart tourism strategies seem to use both smart and sustainability concepts in a marginal ,propagandist way, more similar to a marketing point of view. This might be due to theoretical inconsistencies, which need to be addressed in future studies, defining a reliable basis for fully understanding the smart approach in tourism.

Since the pandemic crisis has boosted the digitalisation transformation, it is expected that the number of publications encompassing these topics will grow in the short term. Thus, one recommendation for further research, in the systematic review field, concerns the analysis of the role of technologies within this panorama. In that way, researchers would be able to divide their findings by type of technology and, consequently, understand those with major relevance in the tourism context, since 4.0 technologies cannot be simply transferred to the tourism context, particularly because they were primarily designed as industrial solutions, while tourism is mainly characterised by services. Future studies should also concentrate on the comparison of digital dynamics before and after the COVID-19 pandemic as an increase in technology use is expected during and after the pandemic crisis. Another recommendation for future studies concerns the investigation of the role of smart approaches in crisis management. It is relevant to understand whether technological approaches arise as real solutions to prevent the total shutdown of the tourism industry in crisis scenarios (e.g., economic collapse, pandemics), saving millions of jobs and businesses, and providing alternative development models that might constitute the future for a more sustainable sector. Despite some studies focused on the impact of smart tourism on the visitor experience and its influence on sustainability, further evidence is needed to comprehend the implications of smartness and technologies

on visitors. More precisely, more evidence should be provided concerning the extent to which visitors accept the increasing digitalisation of the sector, their digital literacy levels, and their contribution to a sustainable path.

Despite the relevant contributions of this study, some limitations can be presented. As it was a preliminary approach to a systematic literature review, only articles and conference papers were analysed in the present work. The continuation of this work aims to integrate different document types, namely book chapters and additional 'grey literature' that might be relevant to extend the literature review around the topic in discussion. Furthermore, it is also intended to analyse the references of each document encompassed in this process to enlarge the sample and provide additional insights. A second limitation concerns the exclusive use of the Scopus database as the main source to access documents. Despite being one of the most extensive databases, cross-analysis with other databases, such as ISI Web of Science and the Directory of Open Access Journals (DOAJ), which also integrate peer-reviewed publications, would be a complementary way to broaden the sample. Additionally, the search query could be expanded to include keywords such as "smart technology", "information and communication technology", and "technology". This would allow for an in-depth understanding of the phenomenon in analysis, particularly by identifying the leading technologies being implemented within this context.

Even though sustainability has received the attention of several studies in the past, it is also true that the tourism industry still fails in the integration of the overall dimensions of the concept. Moreover, despite being argued that technologies might play a valuable role as management tools by bridging gaps and bringing people and places together, even if in a virtual framework, their incorporation in tourism destinations and businesses is still in a preliminary stage. This is particularly the case because tourism is mainly composed by micro, small and medium enterprises, with several constraints regarding human, financial, and investment resources that make it difficult to engage in the digital transformation process. In a certain way, this might also justify the slight empirical evidence regarding the relationship between these topics. Nonetheless, this study provided a thorough understanding of the relationship between smart and digital tourism and sustainability, as well as the basis for future research.

Data availability No datasets were analysed or generated during the development of the current study.

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

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