

Outcomes of Smart Tourism Applications On-site for a Sustainable Tourism: Evidence from Empirical Studies



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Abstract In this study, we explore the outcomes of Smart Tourism on-site applications for Sustainable Tourism. Smart Tourism describes a plethora of advanced information and communication technologies applied in the tourism industry. Although various applications of Smart Tourism are described in the literature, the outcomes of ST for a Sustainable Tourism is still under research. To address this gap, we conduct a literature review over Scopus by seeking empirical Smart Tourism applications on-site. We assess the sustainability outcomes by using the framework of the three pillars of sustainability, composed of the economic, environmental and socio-economic pillars. The results show that Smart Tourism applications on-site support the three pillars of sustainability, but not simultaneously. The study has certain implications for practitioners and researchers.

Keywords Smart tourism · Sustainability framework · ICT in tourism development

1 Introduction

Tourism is defined by [1] as a socio-cultural and economic phenomenon entailing movement of people to a destination for personal or business purposes. Tourism is one of the world's largest economic industries contributing to 10.3% of the global GDP [2]. As one of the main sources of economic development, tourism has been widely recognized [3–11]. According to UNWTO [12] by 2030, 1.8 billion people will engage in the tourism industry.

The current tourism development strategies are unsustainable for destinations because they are resource-demanding in terms of capital, social value and natural resources [13]. Tourism mobility represents an issue for its negative environmental

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impact related to the increase of CO₂ emissions pollution [14]. Furthermore, the phenomenon of Overtourism is the negative impact of tourism on the quality of life of residents. It negatively impacts the quality of the visitors' experience and destination resources [15]. According to WTTC and OECD [2, 4], the industry is forecasted to continue growing steadily after the pandemic, meaning that the physical, ecological, social, economic, psychological and/or political capacity of a destination are and will be exceeded [7, 16, 17].

A way to enhance the sustainability of the tourism industry, and reach sustainable tourism, is the adoption of information and communication technologies (ICTs). They have proliferated recently [18] and is used extensively from operational and business perspectives [19–21] as well as in other settings representing key actions for sustainability [22–24]. Moreover, the constant progress in the development of ICTs has also induced significant transformations in tourist behaviour, leading to tourists to an easy acceptance of them. Using ICTs, the tourists are informed, empowered and wishes to obtain more personalized and better-designed experiences leading the industry to adapt tourism products and experiences [25–27].

Smart tourism (hereinafter ST) is the sum of all integrated efforts at a destination that takes advantage of smart technology to achieve environmental, social, economic sustainability, innovation and competitiveness [20]. ST considers the technologies which are used in the pre and post-travel experience and on-site travel experience. The most significant technologies of ST are cloud services, Internet of Things (IoT), end-user internet service system, social media platforms, user modelling, big data, open data and ubiquitous connectiveness [28, 29].

Although various ST applications are described in the literature, the sustainability outcomes of ST for sustainable tourism are in an early stage of research [20].

With this study, we address this gap investigating the sustainability outcomes of ST applications used on-site for sustainable tourism. To this end, we conduct a literature review over Scopus by seeking for empirical applications of ST. To assess the sustainability of these ST applications, we employ the framework of the three pillars of sustainability, that includes the economic, environmental and socio-cultural pillars [30]. It extends the previous sustainability perspective in tourism. That encourages only tourism strategy to safeguard the environment by adding tourism practices to increase the socio-economic conditions of people within a destination. Our study mainly answer the following research question: “*What are the outcomes of Smart Tourism applications on-site for a Sustainable Tourism?*”.

Therefore, we contribute to the literature by illustrating the sustainability outcomes of ST applications on-site for sustainable tourism under the framework of the three pillars of sustainability.

2 Theoretical Background

Our study is framed in two different literature streams: smart tourism and the concept of sustainability in tourism. These literature streams are illustrated in this section.

2.1 *The Smart Tourism Paradigm*

Generally, the term “smart” has become a popular term to describe technological, economic and social developments fueled by smart technologies that rely on sensors, open data, big data, open API, new ways of connectivity between humans and machines and multi-device, networked exchange of information [20].

The term “smart” applied to the tourism industry brought the concept of ST which refers to the use of technologies (e.g. internet, mobile communication and augmented reality) to collect enormous amounts of data to provide real-time support to all stakeholders in the destination and context-aware as well as personalized experiences to tourists [20, 31, 32].

Gretzel et al. [20] explain the origins of ST as derived from traditional tourism and more recently e-tourism. E-tourism differs from ST in the travel sphere considered, the core technology used, the travel phase included. In essence, although in both concepts there is a predominant presence of ICT technologies to enhance the tourist experience, e-tourism merely handles the digital part of the experience during the pre and post-travel phases of a trip and websites are the core technology. Instead, ST aims at being a bridge between the digital and physical spheres of the travel experience and also includes the on-site phase of a trip with Big Data as the core technology.

To build successful strategies based on the ST concept, Gretzel et al. [20] describe ST as comprising five layers: (1) a physical layer (transportation, resources, and service infrastructures); (2) a smart technology layer (business solutions and consumer applications); (3) a data layer (data storage, open data and data-mining applications); (4) a business layer (innovation based on the available technologies and data sources); and (5) an experience layer (technology and data-enhanced experiences’ consumption). The technical infrastructure integrated into the physical layer of a destination forms the basis of all other layers as ST most innovative feature entails the connection between the physical and digital world. The physical layer enables the technology layer to develop the data layer with a useful and varied kind of data. ST, through the data layer, combines different kinds of data to boost innovation and allow the creation of a business layer. Services and applications created by the business layer using ST data enable the development of improved touristic experiences and sustainability goals in a destination. Consequently, the experience layer considers tourists but also residents and hosts of a destination.

Smart technologies form the foundation of ST [21]. These technologies are described by [33] as those that sense (bringing awareness to everyday things), learn (using experience to improve performance), adapt (modifying behaviour to fit the environment), infer (drawing conclusions from rules and observations), predict (thinking and reasoning about next steps) and self-organize (self-generating and self-sustaining at technology level).

According to Zhang Ling-Yung et al. [29], the most significant technologies of ST are cloud services, Internet of Things (IoT), and end-user internet service system. However, it is worth also mentioning Social Media platforms, User modelling, Big Data, Open Data and ubiquitous connectiveness [28].

Cloud services enable the creation of multiple tourism applications and share information by providing scalable access [34].

IoT helps with information analysis, data collection, and system automation with the introduction of a host of sensors, chips, and actuators integrated extensively in the physical infrastructure of a destination. Finally, the end-user internet service system supports cloud services and IoT through applications and devices. The three ST technologies have a high value in the interaction at all levels of stakeholders in the tourism context. Indeed, these technologies can boost the achievement of relationships among various tourism and non-tourism stakeholders [18, 20, 35, 36]. These technologies can be adopted on existing infrastructure to increase the sustainability value of IT [37, 38].

Examples of ST technologies are SHCity, a mobile application that integrates real-time data and routing algorithms to enrich the tourism experience. SNBSOFT, a tourism business that uses open geospatial data to provide a mobile application with multilingual maps of the city for visitors [21].

Special mention needs to be made for Open Data and ubiquitous connectedness in a destination. These two elements are important in the development of an ST destination. Ubiquitous connectiveness under the form of Wi-Fi networks allows smart technologies to communicate with each other and facilitates interactions with ST end-users, who are the ones more in need of access points for ST content [21]. Making a Smart tourist rely on limited connection due to restrictive data plans or high roaming rates can damage the quality of the experience and harm destination competitiveness.

A good example is Seoul (South Korea) which was awarded as the world's most wired city offering also the fastest Internet speeds [39, 40]. Another example is El Hierro (Spain), the first island in the world to have Wi-Fi networks and WiMAX that covers the entire territory with 26 free points of access among touristic attractions and open public spaces so that benefits both residents and visitors. Plus, solar panels have been installed that provide power to the connection points to reduce the impact on the environment [41].

Open data, which is also seen as an essential feature for smart development [42], is defined as data freely accessed, used, modified and shared by anyone for any purpose [...] [43]. Indeed, an ST destination differs from a traditional one because it is a knowledge-based destination in which information is available to all stakeholders in a systematic and efficient way [44]. The city of Marbella (Spain) with the project "Open Data Marbella" offers an example of this concept with open data service open to all citizens [41]. Seoul (South Korea) is once again an example of good practice having national, metropolitan and tourism-specific open data that stimulates the development of tourism apps and consequently tourism businesses in the destination [21].

The ST scope is three-fold: on the one hand, the data transformed by advanced technology helps to create on-site personalized smart experiences for the tourist. On the other hand, it helps create smart business value-propositions with a clear focus on efficiency, sustainability and experience. Finally, ST helps develop tourist destination management strategies that guarantee the sustainable development of tourist areas, accessible to everyone that increases the quality of the experience at the destination

as well as residents' quality of life [20, 41]. According to Rocha [65], computing and ICT coupled with big data and IoT enable governments and businesses to improve products and service delivery to citizens and tourists by analyzing the general and most common preferences, as well as being able to offer personalized services to each individual.

Therefore, several researchers acknowledge the potential of ST to enhance the experience of the tourist, the livelihood of residents and the efficient use of resources in a destination [20, 45].

ST allows the development of smart destinations capable of creating smart business ecosystems that ultimately develop smart experiences for tourists enhancing the competitiveness of a destination while making sustainable use of resources and enhancing the quality of life for residents.

2.2 Sustainability Framework for Smart Tourism Development

Historically, sustainability in Tourism is often focused on tourism actions or strategies directed towards the safeguard of the environment [17, 46, 47]. However, UNWTO [30] recommends extending this perspective by using the three pillars of sustainability to assess sustainable tourism. The three pillars of sustainability are the environmental, economic and socio-cultural aspects of tourism development.

The environmental pillar refers to the optimal use of environmental by tourism stakeholders that constitute a key element in tourism development, maintaining essential ecological processes and helping to conserve natural heritage and biodiversity.

The socio-cultural pillar refers to the consideration and respect of the socio-cultural authenticity of host communities, conservation of their cultural heritage and traditional values as well as contribution to intercultural understanding and tolerance.

Finally, the economic pillar refers to the ability of tourism businesses to ensure viable, long-term economic growth by providing socio-economic benefits distributed among all stakeholders fairly. This includes secure employment, income-earning opportunities, as well as a contribution to poverty alleviation. Besides, it refers to the ability to maintain a high level of tourist satisfaction by ensuring a meaningful experience to the tourist [30].

Although sustainability lies at the root of the smart concept [17], and some literature has addressed the relevance of sustainability in ST [46, 48, 49] there is a lack of studies that address all three pillars of sustainability simultaneously. Studies addressing social sustainability (poverty reduction and social inclusion) are still underrepresented. Both industry and research are more focused on technology implementation, showing little interest or concern for the environmental or social implications that technologies have in a destination [17, 45].

3 Methodology

We conducted a literature review over Scopus with the following keyword search: “Smart Tourism” OR “Smart Destination” AND “Sustainability” OR “Sustainable” [50]. We add in the keyword search Smart Destination because it is a component of the ST concept. We refined the research selecting only papers in English. We conducted the review in December 2020. The keyword research revealed 89 results. We read all the title and abstract of the papers, and we chose the more appropriate for our research [51]. We aimed at exploring empirical applications of Smart Tourism and the consequent sustainability outcomes. After reviewing the reference from the chosen papers, we reached a database composed of 3 studies illustrating 9 ST applications on-site, which we used for the literature review. To analyze the papers, we followed a qualitative coding technique [52].

We considered three criteria when choosing destinations: I) we considered those destinations that are considered “smart tourism destinations”; II) we then considered those smart tourism destinations that supported their strategies at least one pillar of sustainability. III) We checked that the sustainable strategies were the result of ST applications on site. Consequently, we excluded from our analysis of those destinations that have great sustainable based strategies but not based on smart tourism technologies.

4 Findings

Table 1 summarizes the outcomes of St applications on-site for a Sustainable Tourism. Several studies explore ST’s impact on destination competitiveness [41, 53, 54].

Table 1 Outcomes of Smart Tourism Applications on the three pillars of sustainability (✓ represents the pillar supported by Smart Tourism application)

Smart Tourism Applications on-site	Sustainability pillar		
	Economic	Environmental	Socio-cultural
Aix-en-Provence (France)	✓	✓	
Copenhagen (Denmark)		✓	✓
Helsingborg (Sweden)		✓	
Helsinki (Finland)		✓	
Las Palmas (Spain)	✓		
Madrid (Spain)	✓		
San Sebastian (Spain)		✓	✓
Venice (Italy)		✓	✓
Zagreb (Croatia)		✓	

Through big data, AI, IoT and other state-of-the-art technologies, tourism destinations and businesses offer more personalized and varied experiences to tourists. They support the economic development and competitiveness of destinations [6, 55–58]. In the case of the city of Madrid, the destination is seeking to redirect the flow of tourists in the city with “Madrid 21 Destinos”. This project makes use of smart technologies such as sensors and beacons for the monitoring of tourists throughout the city to promote different less visited areas of Madrid with the intent of redirecting the flow of tourists and enhancing destination competitiveness [54].

In Las Palmas (Spain), IoT sensors such as beacon trackers were located in big open shopping areas to stimulate the shopping tourism segment. That is a form of tourism carried out by individuals for whom the acquisition of goods (outside their place of residence) is a determining factor in their decision to travel [1]. This initiative wants to enhance the competitiveness of the destination. It helps local businesses to reach tourists through their mobile phones while visiting the city [41].

Zagreb (Croatia) instead represents an example of ST supporting the environmental pillar: Freewa Project has the goal of preserving drinking water sources. The project runs through a web platform (Freewa) that has a mobile app for finding free drinking water locations and reusable water bottles across the city. Zagreb has good water quality, and through this mobile application, not only tourists but also locals can enjoy it while contributing to the preservation of drinking water sources in the city [53, 59].

Another example of environmental sustainability is Aix-en-Provence with The project ‘Aix Living Places’. The plan is to install hundreds of sensors in the streets of Aix-en-Provence. These sensors will collect data that will be analyzed by local startups to develop solutions that improve the city center for tourists and locals. Among these solutions, tracking pedestrians to ease the flow of people walking through the city, and the measurement of air quality [53, 60].

The city of Helsingborg is an example of environmental sustainability. Through the city’s interactive online map, visitors can access a highly developed cycling infrastructure stimulating green tourism mobility across the city [61].

The ‘Miljokajakken’ initiative (The Green Kayak) in Copenhagen represents an example of environmental and social sustainability. Through this initiative, visitors can rent a kayak for free if they share on social media all good actions they made while visiting the city of Copenhagen and commit to collect rubbish while kayaking. Through social media, they can increase the visibility of the attraction but also of the good practices showing tourist responsible behaviour [53, 62].

Helsinki represents an example of environmental sustainability having the ambitious target of becoming a carbon-neutral city by 2030. For this goal, several hotels are offering to tourists digital carbon footprint calculators so that visitors are aware of their impact on the destination [63].

Concerning social sustainability, Venice (Italy) launched a campaign “#EnjoyRespectVenezia to convince visitors to behave responsibly in the city and to respect the environment, landscapes, art and Venice’s locals. The campaign wants to raise awareness about tourism’s impact firmly believing in responsible tourist behaviour as a key element for sustainable tourism development. Sensors are present

all over the city to monitor the number of tourists. And through a website visitors have day-to-day forecasts of the number of expected visitors to the town and choose in which day to visit the destination. The website also offers tips on less visited areas of Venice worth seeing with the intent of redirecting the flow of tourists in the destination [53, 64].

Finally, San Sebastian (Spain) with the ‘Live San Sebastian, Love Donostia’ campaign aims to involve visitors in the city’s sustainability. The destination created a list of good practices available for visitors in several languages and through various online devices. In this list, visitors are encouraged to public places clean, respect the resident’s need for quiet at night, use public transport and to support local businesses. San Sebastian represents a good example of social sustainability by giving visitors the tools to visit the city with sustainable behaviour. The purpose is to allow tourists to enjoy the city while still respecting the area and those who live in it [63].

5 Discussion

According to the literature, ST applications on-site are mainly used to boost tourist experience and destination competitiveness, that is, economic sustainability. And to sustain and safeguard the environment. Our study adds a “sustainable piece” in the tourism literature, illustrating applications that support the socio-economic pillars. Based on our results, the socio-cultural pillar is supported when ST applications on-site support: the outcome of ST initiatives support on the socio-cultural pillar is a responsible behaviour of tourist during their stay at a destination in terms of their impact on attractions and residents (e.g., San Sebastian, Venice).

The support to the economic pillar includes initiatives promoting local businesses and destination competitiveness (e.g., Las Palmas, Madrid). Also, the environmental pillar is supported by limiting the use of resources by tourists for example by promoting the use of tap water (e.g., Zagreb) and promoting the use of green tourism mobility (e.g., Helsingborg).

Also, we found a lack of studies of ST applications on-site that supports the three pillars. This is a prominent research area because whether ST applications support the three pillars simultaneously boosts a Sustainable Tourism. Further studies are needed to explore the ST applications and how the three pillars are supported simultaneously.

Moreover, our results show a large variety of technologies used in the ST paradigm, which confirmed the literature in defining ST strategies. Indeed, many strategies considered ST-based are instead smart city strategies (e.g. Eolic plants whose purpose is to enhance the quality of life of the city yet the direct link with tourism is missing). Therefore, it may seem like part of a destination marketing strategy to promote these actions as smart tourism initiative which contributes to the terminology confusion that orbits around the ST concept. We looked at those destinations that employed smart tourism technologies to enhance the impact of tourism destinations. By doing so, we excluded those destinations which technologies were not smart tourism-related or those which did not employ smart tourism technologies in their sustainability

strategies. The main point of this paper is to study how to reduce the impact of tourism in terms of economic, social and environmental sustainability in destinations. Therefore, with this paper, we go as far as to tell that aside for awards for being smart tourism capitals, there should be less confusion between a smart destination and a sustainable destination. Although a destination can be sustainable and smart, it is clear that there is still some confusion about what is sustainable and what is smart. Smart tourism is a tool to boost sustainability, yet it is not the only tool. Indeed, several sustainable strategies are not based on smart tourism. A destination can be sustainable without being smart. The fact that some initiatives are considered as smart tourism can be related to the confusion around the concept of smart tourism (which this paper tries to clarify) and the desire of increasing the visibility of the destination by promoting it differently.

5.1 Implications for Practitioners and Researchers

Through the combination of theory and examples showed, this paper has certain implications for academics and practitioners. The development of ST based experiences will alter the tourism industry in terms of destination development, businesses and experiences. It will offer a better future for tourism-based economies and sustainable tourism. Destination management organizations can use this study as a guideline of ST application in order to achieve sustainability.

This study has implication for researchers because it wants to make some clarity about the origin and definition of ST believing that a better understanding of the ST concept will lead to clearer ST strategies in destinations and businesses. In addition, by explaining the impact of technologies and potential benefits for all tourism stakeholders, this review pinpoints the positive relationship between ST and sustainable development. Still, by acknowledging the lack of research on sustainability and ST, this paper wants to encourage future studies on this still underexplored field to advance knowledge and possible solutions. We also invite scholars to study outcomes of ST applications, both on-site and in the pre and post-travel stages to explore the entire spectrum of ST technologies.

The study also has a limitation because we used Scopus database. Thus, a prominent research avenue is to extend our investigation employing further search databases, such as Web of Science and Google Scholar.

6 Conclusion

The study is motivated by a lack of studies which explore the out-comes of ST application for a Sustainable Tourism. To address this gap, we conduct a literature review over Scopus by seeking for empirical applications of ST and their sustainability outcomes We assess the sustainability we employ the framework of the three pillars

of sustainability, that includes the economic, environmental and socio-cultural pillars, which is barely used in the tourism research. The results show that the outcomes ST applications are on the three pillars. Some studies support the economic pillar by promoting local businesses and enhancing destination competitiveness, some others the social pillar by enhancing the responsible tourist behaviour and finally the environmental pillar by limiting the use of resources from tourists in the destination. Moreover, we found the risk of the ST concept to become a tool for destination marketing to promote the destination is far from being eradicated due to a lack of clarity on the scope of ST.

The outcomes of ST applications on-site on the environmental pillars are limited use of natural resources as well as the reduction of pollution of tourism activities.

Moreover, the outcomes of ST applications on-site on the socio-economic pillars are initiatives that are increasing the responsible behaviour of the tourist at a destination. These initiatives also raise awareness of the negative impact of tourism activities. This pillar is barely investigated in the tourism literature and requires further studies. Lastly, to study ST strategies that reach sustainable tourism development, further research should explore those ST initiatives that support all three pillars at the same time.

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