IMPACT OF THE PERCEIVED VALUE ATTRIBUTES OF SMART TOURISM TECHNOLOGIES (STTs) IN PROMOTING SUSTAINABLE TOURISM ON TRAVEL EXPERIENCE

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Abstract

The article explores the central role of Smart Tourism Technologies (STTs) in promoting and facilitating the transition toward sustainable tourism. Five key attributes of STTs were identified—information, accessibility, interactivity, personalization, and security—as essential elements for maximizing the perceived value of these technologies, which in turn influences the overall sustainable travel experience. These attributes were drawn from various studies in the literature. Our research involved an online survey conducted with a sample of 147 tourists who used STTs during a sustainable trip. A linear regression analysis confirmed significant relationships between all STT attributes and the perceived value of STTs, particularly highlighting the importance of interactivity and personalization. The findings also revealed that the perceived value of STTs is strongly linked to the evaluation of the travel experience. By facilitating access to relevant information and personalizing offerings, STTs empower travelers to make informed decisions, thereby reducing their environmental impact while enhancing their overall experience. Moreover, they encourage eco-friendly practices, strengthen connections with local communities, and promote less-visited destinations.

Keywords: Smart Tourism Technologies (STTs) ; sustainable tourism ; perceived value ; travel experience.

1. INTRODUCTION

Smart Tourism Technologies (STTs) have become indispensable tools in facilitating the transition towards sustainable tourism. These technologies enable real-time dissemination of information on environmental best practices, optimize the management of tourist flows, and promote sustainable alternatives. According to Huang et al. (2017), STTs encompass all forms of online tourism applications and information sources, such as online travel agencies, personal blogs, public websites, corporate websites, social media platforms, and smartphone applications. These technologies hold particular importance in advancing sustainable tourism. Saura et al. (2018) emphasize that new technologies help raise consumer awareness of environmental issues and influence their choices. However, as highlighted by a study conducted

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by Buhalis et al. (2015), the effectiveness of these technologies depends on the perceived value of the information's efficiency and credibility. Similarly, studies by Moro et al. (2018) and Del Chiappa and Baggio (2015) underscore that the perceived value of technologies—including aspects such as utility, innovation, and interactivity—plays a critical role in the adoption of responsible tourism practices. These technologies also transform travelers' experiences by offering increasingly personalized and interactive services.

In this article, we will adopt the perceived value attributes of STTs identified by several authors, including No and Kim (2015), Buhalis and Amaranggana (2015), Huang et al. (2017), and Jeong and Shin (2020). These authors argue that the most significant attributes of STTs are information, accessibility, interactivity, personalization, and security. We focus specifically on the role of these five attributes in shaping the overall perceived value of Smart Tourism Technologies (STTs) and their impact on travel experiences within the specific context of sustainable tourism. The adoption of these technologies is crucial, particularly for tourists seeking an authentic experience while minimizing the impact of their stay on local communities, which are increasingly resistant to traditional forms of tourism. Many tourism stakeholders are becoming aware of the limitations of the traditional tourism model and are striving to offer alternative forms of tourism that are better suited to the well-being of all parties involved, particularly local communities. These alternatives prioritize the preservation of nature, energy resources, and the quality of life. These concerns have grown increasingly urgent. During the 2017 World Tourism Organization (UNWTO) summit and the World Travel Market (WTM), alarm was raised about the excessive levels of tourism in certain destinations. The UNWTO Secretary-General stated that "the enemy is not growth or affluence. What matters is managing this growth in a sustainable, responsible, and intelligent way." He also emphasized the need to "diversify the activities offered to visitors, reduce seasonality, and better promote less-frequented destinations" (UNWTO, 2017). This article seeks to explore how the perceived value attributes of STTs can influence travelers' experiences by encouraging them to adopt more responsible and sustainable practices. By analyzing the impact of information, accessibility, interactivity, personalization, and security, this study aims to highlight the key drivers for promoting a more sustainable tourism model.

2. LITERATURE REVIEW: PERCEIVED VALUE

Perceived value is a multidimensional concept, dynamically influenced by both benefits and risks (Snoj et al., 2004). It is defined as "the consumer's overall assessment of the utility of a product (or service) based on their perception of what is received relative to what is given" (Zeithaml, 1988). Perceived value is considered a superior indicator of behavioral intentions and satisfaction (Sánchez-Fernández, 2007). In this research, we focus specifically on the perceived value of Smart Tourism Technologies (STTs) used to promote and market eco-friendly tours and destinations. STTs play a critical role in how travelers perceive and adopt sustainable travel behaviors. These technologies offer significant perceived value by providing environmentally conscious travel options, such as eco-friendly accommodations, low-carbon transportation modes, and sustainable local activities. By centralizing tourism offerings aligned with sustainability principles, STTs empower travelers to make informed decisions while minimizing the environmental impact of their trips (Budeanu, 2007). Huang et al. (2017) further argue that by providing accessible interfaces and clear information, STTs enhance users' trust in eco-friendly practices, encouraging them to opt for more sustainable alternatives. Research indicates that the visibility of these eco-friendly options directly influences travelers' choices,

as they increasingly prioritize environmental considerations in their decision-making processes (Han et al., 2011). For instance, the mission of the GreenGo platform is to offer eco-friendly destinations with unique experiences. The site allows users to filter accommodations based on strict sustainability criteria, thereby fostering a positive perception of environmentally responsible lodging and increasing travelers' intention to choose such options (Cohen et al., 2014). Similarly, platforms like HOURRAIL, which promote train and ferry travel over car or air travel, raise awareness about the importance of reducing carbon footprints, thereby enhancing the value placed on greener transportation choices. Smart Tourism Technologies (STTs) are often considered the primary starting point for initiating information searches, as their content remains a critical element in travelers' decision-making processes (Kaplanidou and Vogt, 2006). According to these authors, tourism-related information is provided in various forms, including public websites, corporate websites, and personal platforms like travel blogs. Buhalis et al. (2015) identified four attributes that determine the perceived quality of STTs: information, accessibility, interactivity, and personalization. No and Kim (2015) later added a fifth attribute, security. Numerous studies have examined these factors to assess the perceived value of tourism-related platforms (Buhalis et al., 2015; No and Kim, 2015; Zhang et al., 2022). In this study, we aim to explore these five factors to evaluate STTs that encourage responsible behavior among travelers.

3. PERCEIVED VALUE ATTRIBUTES OF SMART TOURISM TECHNOLOGIES (STTs)

3.1 Information

Tourism is inherently an information-based phenomenon. Unlike physical goods or products, tourism services cannot be directly seen, felt, or experienced in advance (Ye et al., 2014). The internet serves as a well-established medium for acquiring a wide range of information, enabling customers to communicate directly with online tourism information sources to inquire about destinations, accommodations, attractions, restaurants, shops, and more (Gursoy et al., 2014).Information sources are predominantly generated by tourists themselves or by tourism service providers (Zhang et al., 2022). Kim and Hiemstra (2004) affirm that information sources play a pivotal role in destination and attraction selection during a trip. For tourists, gathering information about tourism services and destinations has become a critical step in the decision-making process. Kim and Hiemstra (2004) affirm that information sources play a critical role in destination and attraction selection during a trip. Gathering information about tourism sites or services has become a pivotal step in the decision-making process for choosing a destination or provider.Thanks to advancements in Smart Tourism Technologies (STTs), tourists can now access a wealth of information through various channels, such as social media, online review platforms (e.g., TripAdvisor), and travel blogs (Xiang et al., 2015). These user-generated sources provide detailed feedback, recommendations, and firsthand experiences that significantly influence destination perception (Filieri and McLeay, 2014). However, when tourists are seeking sustainable destinations, the information search process can become more challenging and complex due to factors related to the quality and credibility of the available data. Indeed, sustainable tourism relies on multidimensional criteria, including environmental, social, and economic aspects, which are not always clearly defined or standardized in the information available online (Hindley and Font, 2017). Unlike conventional tourism products, assessing the sustainability and eco-responsible impact of an offering is more challenging as it

involves subjective and intangible aspects, such as respect for local communities or ethical management of natural resources (Delmas and Burbano, 2011).

3.2 Accessibility

Accessibility refers to the degree of ease with which tourists can access and utilize tourism-related information provided by service providers via various STTs (No and Kim, 2015). High accessibility indicates the simplicity with which tourists can use digital technologies to obtain information about destinations, services, and tourist attractions (Gretzel et al., 2015). This includes platforms such as mobile applications, optimized websites, geolocation systems, and real-time personalized services. When easily accessible, these technologies empower tourists to plan their trips, adjust itineraries according to current conditions, and obtain practical information when needed (Wang et al., 2013). Enhanced accessibility not only reduces effort but also improves the overall travel experience, fostering greater satisfaction and trust in the technology. Accessibility to Smart Tourism Technologies (STTs) is particularly significant for sustainable tourism, as it enables travelers to adopt more eco-responsible practices while facilitating the sustainable management of destinations. Through STTs, tourists can easily access information about low-impact transportation options, eco-friendly accommodations, and local activities that adhere to sustainability standards.This accessibility plays a crucial role in empowering travelers to make environmentally responsible choices that reduce their carbon footprint and support local communities (Gretzel et al., 2015). Enhanced accessibility to STTs reduces travelers' uncertainty and increases trust in these technological tools. This results in a better perception of the ease of use of such technologies, which is a key determinant of their adoption (Davis, 1989). For instance, when a tourist can effortlessly access reviews of restaurants, book accommodations, or find information about transport routes via STTs, it enriches their overall experience and enhances satisfaction levels (Moro et al., 2019). Moreover, improved accessibility of these technologies contributes to making the tourism experience more seamless and efficient at every stage of the journey, from planning to post-trip activities. Intuitive and user-friendly technologies allow tourists to access up-to-date and relevant information, whether they are in the preparation phase or already at the destination (Neuhofer et al., 2012). Consequently, the accessibility of STTs is directly tied to the quality of the tourism experience, enabling travelers to exercise greater autonomy and optimize their choices in real-time according to their preferences and needs (Huang et al., 2017). Furthermore, the accessibility of STTs can impact digital inclusion by enabling a broader range of tourists, including those less familiar with technology, to access services and information that were previously difficult to obtain (Gretzel et al., 2015). By making digital tools more accessible, tourist destinations can attract and satisfy a more diverse audience.

3.3 Interactivity

The interactivity of Smart Tourism Technologies (STTs) refers to the ability of interested or involved stakeholders to actively engage with one another. It enables fast and dynamic two-way communication between stakeholders, whether they are tourists, destination managers, or service providers (Jeong & Shin, 2020). This attribute of interactivity significantly simplifies information search by allowing users to ask questions, receive immediate responses, and access information in a more engaging way. High-level interactivity also encourages tourists to actively use STTs, participate in online discussions, and provide reviews and feedback (Lee et al., 2018). This leads to a significant improvement in the quality of the tourist experience, as

users can adjust their plans and receive personalized information in real-time, thereby enhancing satisfaction and trust in the technologies used (Kim, 2017). This interactivity is particularly essential for tourists seeking sustainable destinations or activities. Interactive platforms enable destinations to better educate tourists on sustainability issues by disseminating information about natural resource management, ecosystem preservation, and the environmental impact of travel choices. For instance, mobile applications and location-based systems can guide tourists toward more environmentally friendly practices, such as using public transportation or participating in local conservation activities (Li et al., 2017).

3.4 Personalization

User-generated content has significantly contributed to the increase in information available on the internet. The advent of artificial intelligence has further facilitated the identification of alternatives best suited to individual tourists' preferences (Bulchand-Gidumal, 2020). AI has enabled all tourism stakeholders to better tailor their offerings through the use of recommendation systems (RS). Gavalas et al. (2014) and Ricci et al. (2015) assert that recommendation systems in tourism have become essential tools for managing information overload. These systems analyze user profiles and community behavior to compare available information with reference characteristics, thereby providing relevant and customized recommendations. According to these authors, recommendation systems function as information filtering tools designed to predict the "rating" a user would assign to a specific piece of information. By recommending items predicted to best match user preferences, these systems reduce cognitive and informational overload (Ricci, 2002). For instance, platforms like *Tripadvisor* recommend trips, destinations, and activities tailored to individual user profiles while incorporating a social component. This social aspect allows other users to review, comment on, and rate various elements, thereby aiding the complex decision-making process.

Personalization techniques signal a shift from mass marketing to individualized marketing. This customization is particularly vital in the context of sustainable tourism, as its requirements and expectations are more nuanced and demanding. Recommendation systems can guide travelers toward less crowded destinations, eco-friendly accommodations, or low-impact activities, thus supporting responsible travel practices (Gretzel, 2011). Park and Gretzel (2007) note that the personalization of online services, based on behavioral data analysis, reduces the cost of information search and facilitates the discovery of more sustainable options. By offering tailored itineraries or environmentally friendly travel packages, tourism businesses can not only meet travelers' expectations but also promote more eco-conscious practices (Ricci et al., 2015). This approach supports the transition to more sustainable tourism, where travelers' choices are influenced by sustainability criteria while respecting their individual preferences. For example, platforms like *Glob-Trotting* and *Evaneos* offer unique eco-responsible travel experiences based on ethical considerations and users' specific needs.

3.5 Security

Security refers to the degree of confidentiality of private information during various transactions. In tourism destinations, the extent to which Smart Tourism Technologies (STTs) are utilized depends on tourists' perceptions of privacy protection and the handling of shared personal information (Lee et al., 2018). Users' trust in how their personal information is managed and safeguarded directly impacts their engagement with a site or platform. Inadequate security management can not only discourage users from making bookings or purchasing

services online but also negatively affect the image of the destination or the tourism service provider (Jeong & Shin, 2020). Kolsaker et al. (2004) emphasize that privacy concerns play a significant role in inhibiting online purchases of travel-related products. To enhance perceived value, platforms must ensure secure transactions and demonstrate transparency regarding the use of users' personal data. Companies that invest in robust data protection systems not only bolster their credibility but also foster customer loyalty. Tourists are more likely to use online services when they feel secure, which not only improves their experience but also increases the perceived value of online tourism platforms (Cui et al., 2015).

The first hypothesis will examine the impact of these five attributes on the perceived value of STTs:

- **H1a**: Information provided by Smart Tourism Technologies (STTs) has a significant relationship with the perceived value of their effectiveness.
- **H1b**: The accessibility of STTs has a significant relationship with the perceived value of their effectiveness.
- **H1c**: The interactivity offered by STTs has a significant relationship with the perceived value of their effectiveness.
- **H1d**: The personalization of offerings through STTs has a significant relationship with the perceived value of their effectiveness.
- **H1e**: The security and confidentiality of private data have a significant relationship with the perceived value of their effectiveness.

4. THE IMPACT OF PERCEIVED VALUE OF SMART TOURISM TECHNOLOGIES (STTs) ON SUSTAINABLE TRAVEL EXPERIENCES

By integrating smart technologies, sustainable tourism has reimagined the traveler experience by offering differentiated services and opportunities. Shen (2020) highlighted that smart tourism technology (STT) does not merely represent the advancement of a single technology but is the result of the interconnection and simultaneous development of multiple advanced technologies, such as the Internet of Things, artificial intelligence, mobile devices and applications, and intelligent conversational robots. These technologies work collaboratively to provide a smoother and more optimized tourism experience. Alletto et al. (2015) argued that STTs can be leveraged to rekindle travelers' interest in cultural heritage by ensuring an interactive cultural experience. A study by Chianese et al. (2013) explored a location-based cultural heritage management application called *Smartweed*. The project aimed to integrate various geolocation services and technologies to create an intelligent multimedia guide capable of detecting the nearest artworks. It enabled users to interact during their visits and automatically narrated the story of the artworks through multimedia installations. These technologies are essential for fostering the adoption of more sustainable tourism practices, emphasizing unique locations and activities that deviate from mass tourism pathways. Buhalis and Amaranggana (2015) confirmed that STTs facilitate interaction between tourists and local stakeholders, thereby enhancing the perception of an authentic and tailored experience. This personalization strengthens the emotional connection with the destination and positively shapes the travel experience. Femenia-Serra and Gretzel (2020) added that STTs improve the transparency and traceability of tourism offerings by providing travelers with verifiable information about environmental certifications. This transparency builds trust in eco-friendly services and encourages the adoption of sustainable tourism practices. Furthermore, Neuhofer

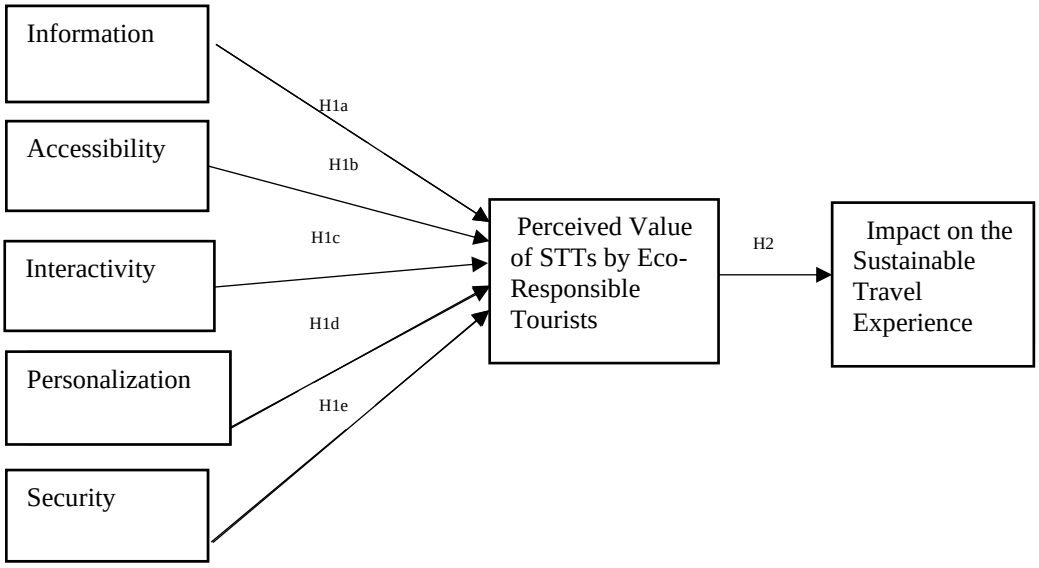
et al. (2015) demonstrated that STTs' ability to deliver personalized services, optimize travel itineraries, and minimize travelers' cognitive and logistical efforts plays a critical role in creating memorable and satisfying travel experiences. The adoption of these technologies thus enhances not only immediate satisfaction but also travelers' intentions to revisit and recommend destinations. This leads to the formulation of our second hypothesis:

- **H2**: The perceived value of STTs has a significant relationship with the overall experience of sustainable travel.

5. CONCEPTUAL MODEL

This model aims to explore the relationship between each attribute of perceived value and the overall perceived value of Smart Tourism Technologies (STTs) from the perspective of tourists. The overall perceived value is hypothesized to impact the travel experience, particularly in the context of sustainable travel.

Figure 1. Conceptual model of research



Source: Author

6. RESEARCH METHODOLOGY

6.1 Research Objective

The objective of this research is to examine the impact of the attributes of Sustainable Travel Technologies (STTs)—namely information, accessibility, interactivity, personalization, and security—on the perceived value of their effectiveness, as well as their contribution to enhancing the overall experience of sustainable travel.

6.2 Measurement Scales

Table 1 provides a summary of the measurement scales used. All variables were assessed using a 7-point Likert scale, ranging from strongly disagree to strongly agree.

Table 1. Measurement scale

Variables	Measurement scale	Authors
Information	The information provided about my eco-friendly trip via smart tourism technologies is useful. Smart sustainable tourism technologies allow me to supplement my trips with reliable and detailed information. Smart sustainable tourism technologies help to minimize my concerns related to travel.	No et Kim. (2015) Lee et al. (2018) Yoo al. (2017)
Accessibility	I can use smart sustainable tourism technologies anywhere and anytime during my trips. Smart sustainable tourism technologies are easily accessible during my trips. Smart sustainable tourism technologies are easy to find without complicated processes when I travel	No et Kim. (2015) Lee et al. (2018)
Interaction	Smart sustainable tourism technologies are interactive during my trips. Smart sustainable tourism technologies are highly responsive during my trips. It is easy to share information and content via sustainable tourism technologies during my trips.	No et Kim. (2015) Lee et al. (2018) Yoo al. (2017)
Personalization	I have received personalized information through smart sustainable tourism technologies when traveling. Smart sustainable tourism technologies provide me with easy-to-follow links and advice during my trips. I can obtain personalized information through interactions with smart sustainable tourism technologies when traveling.	No et Kim. (2015) Lee et al. (2018)
Security	Smart sustainable tourism technologies protect my personal and sensitive information. Smart sustainable tourism technologies respect my privacy and the security of my transactions. Smart sustainable tourism technologies are reliable and trustworthy.	Huang et al. (2017) No et Kim. (2015) Zeithaml et al. (1996)
Percieved Value of STTs	Considering the price I paid, it is worth using smart sustainable tourism technologies. Considering the time and effort involved, it is worth using smart sustainable tourism technologies. The overall value of using smart sustainable tourism technologies is high; the value for money is excellent. I have a very positive feeling about my experiences with smart sustainable tourism technologies.	Lee et al. (2018) Sweeney et GN. (2001) Petrick J F. (2002)
Evaluation of the overall sustainable travel experience	The use of smart sustainable tourism technologies contributed to enhancing my overall satisfaction during the trip. I am satisfied with the eco-friendly services and recommendations provided by smart sustainable tourism technologies. Smart sustainable tourism technologies allowed me to have a smoother and more enjoyable travel experience.	Olivier (1980)

6.3 Sample

Data collection was conducted over a period of four months, from June to September 2024, targeting tourists who had previously used smart tourism technologies (STTs) during the planning of their trips and/or while traveling. These technologies include sustainable websites (e.g., Evaneos, Globe Trotting), augmented reality, virtual reality, online guides, geolocation applications, chatbots, smart transportation apps (such as bike-sharing, carpooling), the Internet of Things, and eco-friendly mobile applications like GreenGo, among others. A convenience sampling method was employed for data collection. The data were collected exclusively online, with the questionnaire, created on Google Forms, distributed across various forums and websites dedicated to eco-friendly travel. The survey was posted in both French and English on forums dedicated to sharing experiences and opinions related to sustainable travel. A total of 147 questionnaires were retained. Of the respondents, 86 were female, and 61 were male. Questionnaires completed by individuals who had never used STTs for sustainable travel were excluded. To ensure the relevance of the sample, a screening question was included at the start of the questionnaire to select only those who had previously engaged with these technologies.

6.4 Factor Analysis of the Measurement Scales

Data analysis was performed using SPSS version 29.0. A factor analysis was conducted on the seven scales to verify the validity and reliability of the measurement scales. Table 2 presents the results from SPSS regarding the reliability and validity of the measurement scales:

Table 2. Results of the Factor Analysis for the Constructs of the Study

Variables	Items	loadings	α de Cronbach
Information	Info1	0,772	0,870
Total variance explained :73,556	Info2	0,843	
KMO=0,725	Info3	0,776	
Accessibility	Acc1	0,622	0,849
Total variance explained :77,664	Acc2	0,842	
KMO=0,684	Acc3	0,866	
Interactivity	Int1	0,689	0,868
Total variance explained: 78,143	Int2	0,854	
KMO=0,692	Int3	0,802	
Personalization	Pers1	0,722	0,863
Total variance explained: 77,873	Pers2	0,799	
KMO=0,721	Pers3	0,815	
Security	Sec1	0,654	
Total variance explained: 79,091	Sec2	0,805	
KMO=0,608	Sec3	0,913	
Perceived value of the experience with STTs	Val1	0,652	0889
	Val2	0,846	
Total variance explained :73,556	Val3	0,808	
KMO=0,809	Val4	0,724	
Sustainable travel experience	Exp1	0,799	0,877
Total variance explained: 80,286	Exp2	0,876	
KMO=0,694	Exp3	0,733	

7. RESULTS AND DISCUSSION

To test the hypotheses, we used simple linear regression with SPSS 29.0. Montgomery et al. (2012) state that the goal of simple linear regression is to model the relationship between an independent (or explanatory) variable and a dependent (or response) variable by fitting a straight line to the data. This model allows for predicting the value of the dependent variable based on the independent variable. Table 3 summarizes the results of the linear regression and the validation of the research hypotheses.

Table 3. Results of the Regression and Hypothesis Validation

Hypothesis	**F**	**R**	**R²**	**Bêta**	**t**	**p**	**Results**
H1a- Information→ Perceived value of the experience with STTs	11,96	0,269	0,072	0,269	3,34	0,001	Confirmed
H1b- Accessibility→ Perceived value of the experience with STTs	16,658	0,322	0,097	0,322	4,081	0,001	Confirmed
H1c-Interactivity→ Perceived value of the experience with STTs	103,072	0,646	0,417	0,646	10,152	0,001	Confirmed
H1d- personalization→ Perceived value of the experience with STTs	102,415	0,645	0,412	0,645	10,120	0,001	Confirmed
H1e-Securitu→ Perceived value of the experience with STTs	49,744	0,507	0,257	0,507	7,053	0,001	Confirmed
H2- Perceived value of the experience with STTs → Impact on the Sustainable Travel Experience	111,744	0,661	0,433	0,661	10,571	0,001	Confirmed

For the first hypothesis, the results indicate that all five sub-hypotheses were validated. However, we observed, according to our respondents, that the variables with the greatest influence on the perceived value of Smart Tourism Technologies (STTs) are interaction and personalization. For information and accessibility, although the relationships are significant, the R^2 coefficients are relatively low: 0.097 for accessibility and 0.072 for information. This can be explained by the specific context of sustainable tourism. Indeed, only a few STTs are solely dedicated to promoting this type of tourism. While sustainable tourism is on the rise, STTs that promote it (such as Evaneos, a website specialized in promoting sustainable tourism and combating overtourism, which focuses on promoting lesser-known and more unusual destinations, real-time eco-friendly route mapping, or transport options with the lowest carbon impact available nearby, as well as certified eco-friendly hotels) are still in the minority compared to those promoting mass tourism. Nevertheless, information remains a crucial step

during trip planning. Buhalis and Law (2008) confirm that information is a key component in the purchasing process, and that STTs not only reduce uncertainty and perceived risks, but also enhance the quality of the trip. Regarding accessibility, the results show a significant link with the perceived value of STTs, with an R^2 of 0.092. As previously noted, accessibility refers to the level of difficulty a tourist may encounter when using STTs. The relatively low coefficient may be due to the fact that accessibility to these technologies is directly linked to the technological development of the destination in question. Gretzel et al. (2015) assert that technological infrastructure, including access to high-speed internet, mobile networks, and digital platform access, is crucial for the integration of smart technologies in a tourist destination. Well-equipped destinations in terms of digital infrastructure facilitate access to technology-based services, such as tourist guide applications, intelligent booking systems, and visitor experience management solutions. For interaction, which refers to exchanges between tourists and tourism stakeholders via STTs, the results showed that this variable plays a decisive role in the overall perceived value of STTs. Indeed, the R^2 coefficient of 0.417 indicates that a large part of the variance in perceived value is explained by interaction. STTs facilitate real-time communication between tourists and local businesses. Gretzel et *al*. (2015) suggest that tourists can receive updated information about local conditions, events, or recommended itineraries through mobile apps and digital platforms, while tourism stakeholders can adapt their offerings based on the immediate needs of visitors. Additionally, by providing instant feedback via reviews or social networks, tourists contribute to the continuous improvement of services, creating a virtuous cycle of interaction between tourism demand and supply. In the context of sustainable tourism, this continuous, bidirectional interaction is essential to balance the economic needs of destinations with the protection of the environment and the well-being of local communities (Boes et al., 2016). Personalization also showed a strong R^2 coefficient of 0.412. This result is expected, as the personalization of tourism products and services has become a key success factor in any marketing strategy, particularly in sustainable tourism, where the very foundation of the strategy is based on allowing travelers to plan their trips in ways that align with their preferences, convictions, and desires, ensuring their journeys are as sustainable as possible. Buhalis and Amaranggana (2015) argue that the greatest advantage of personalization, as experienced by travelers, is an increased level of comfort, both emotionally and physically, such as receiving things exactly as they want and feeling well taken care of. STTs are designed to satisfy this need for escape to hidden places, to learn about local customs, live with the community, participate in local events, and contribute to preserving the ecological and social environment of host countries. Gretzel et al. (2020) emphasize that the use of STTs can encourage sustainable practices, such as reducing carbon footprints or supporting the local economy, by facilitating access to specific and relevant information. Finally, for security, the results showed that this attribute significantly contributes to explaining the perceived value of STTs, with an R^2 coefficient of 0.257. These findings are supported by studies from No and Kim (2015), Jeong and Shin (2020), and Zhang et al. (2022), who found that security is a strong indicator of the perceived value of STTs. They add that tourists require a technological environment with a high level of security and confidentiality. According to Tussyadiah and Miller (2019), tourists are becoming increasingly aware of the risks associated with using their personal data, which directly influences their trust in STTs and their adoption of these technologies. Inadequate data management can lead to breaches of privacy, cyberattacks, or leaks of sensitive information, thus compromising the reputation of tourism platforms and the security of users.

Hypothesis H2, which posits that the perceived value of STTs is significantly related to the overall experience of sustainable travel, was validated. Indeed, the results show that 43.3% of the variance in the overall experience is explained by the perceived value of STTs. This result confirms the growing importance of tourism technologies in shaping the appreciation of the trip. These findings have been supported by several studies. Zhang et al. (2022) found that STTs contribute 30.7% to tourist satisfaction, while Huang et al. (2017) found a similar result of 35.7% regarding the impact of STTs on the satisfaction of the travel experience. Jeong and Shin (2020) found that the memorable travel experience is strongly linked to the attributes of information, interactivity, and personalization. According to Wang and Fesenmaier (2013), these attributes enable travelers to experience smoother, more immersive, and relevant experiences, thus contributing to greater satisfaction and increased engagement with the destinations.

7. CONCLUSION

Several studies have explored the impact of the attributes of Smart Tourism Technologies (STTs) on the travel experience (Park & Gretzel, 2007; No & Kim, 2015; Buhalis & Amaranggana, 2015; Huang et al., 2017; Jeong & Shin, 2020; Zhang et al., 2022). All of these studies have confirmed that utilizing STTs enables travelers to access reliable information and contributes to the enhancement of service quality, thereby improving the overall travel experience. The results of this study, particularly focusing on sustainable travel, highlight the significant importance that tourists place on all attributes of STTs in the overall evaluation of their travel experience, especially for the attributes of interactivity and personalization. Indeed, for this type of travel, tourists tend to rely heavily on STTs as their choices require more specific information, flexibility, and customization to align with their environmental and social values. By providing precise and real-time information, STTs allow tourists to make more responsible choices, such as opting for eco-friendly transportation modes or selecting certified sustainable accommodations (Gretzel et al., 2015). This helps raise awareness among travelers about environmentally friendly practices and encourages more sustainable behaviors. The accessibility provided by STTs, via mobile apps and online platforms, facilitates access to sustainable options, such as low-carbon itineraries, even in remote areas, thus reducing barriers to adopting responsible practices (Wang et al., 2016). Additionally, the interactivity of STTs enables travelers to actively participate in sustainable initiatives, such as recycling programs or local volunteer activities, thus strengthening their commitment to sustainability. The personalization offered by these technologies allows for the recommendation of experiences specifically tailored to tourists' sustainability preferences, such as participation in eco-responsible tours or visits to local communities, fostering a more positive impact on the environment and local communities (Lamsfus et al., 2015). Finally, the security and confidentiality of personal information are crucial for maintaining trust and continuity in relationships with all stakeholders in tourism. By combining these attributes, STTs offer solutions that cater to travelers concerned about their impact, while also contributing to the broader adoption of sustainable practices within the tourism industry.

The rapid growth of sustainable tourism and the increased demand for this type of travel present a challenge for all tourism stakeholders to align with the evolving expectations of tourists in this domain. The development of advanced technological platforms represents a considerable competitive advantage. For instance, the platform Evaneos, which specializes in promoting sustainable travel, offers a website based on co-creating the trip with the traveler.

This platform provides an easily accessible interface rich in information about sustainable tours across all continents, available sustainable transportation modes, customized hikes with professional guides, and a space for interaction with local agencies all committed to promoting responsible tourism. Tourism stakeholders should also consider implementing reward systems for tourists who opt for sustainable choices. Zhang et al. (2022) suggest that tourism actors should enhance interaction with tourists and encourage them to create content and leave positive reviews on tourist sites and social media by offering small incentives. The New York-based company Loyyal has developed "Dubai Points" using blockchain and smart contracts. The idea is to encourage tourists to visit historical and cultural sites that are less frequently mentioned in guides but may align with tourists' preferences. Points will be earned and redeemed at participating locations based on the tourist's lifestyle, with blockchain ensuring user identity authentication and automating transactions. Another recommendation for tourism stakeholders concerns the mastery of various STTs by workers in the tourism sector in order to provide accurate and real-time information to travelers. Additionally, proper training enhances their ability to respond quickly and relevantly to tourists' needs, relying on updated information, which is essential in a sector where immediacy and accessibility are key factors in customer satisfaction (Buhalis & Sinarta, 2019). Tourism stakeholders can also educate tourists through STTs on sustainable practices that may not be very visible or important to them, such as paying more for a trip to ensure proper compensation for employees or improving life for local communities, by implementing a compensation system for each trip. These practices will directly impact the quality of the stay and the traveler's experience. Finally, the development of critical reviews generated by tourists can guide travelers toward sustainable choices, such as the Green Leader certification on Tripadvisor or the Smart Score on Direct Flights, which provide information on sustainable practices (Aydin & Alvarez, 2020).

These research findings indicate that STTs are an essential growth lever for the development of tourism, particularly sustainable tourism, which is not only necessary to preserve ecological and social balance but also constitutes a crucial determinant of competitiveness.

8. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The first limitation lies in the convenience sampling method, which restricts the generalization of the results. Additionally, the survey was conducted entirely online, preventing us from verifying the accuracy of respondents' claims regarding whether they actually undertook a sustainable trip. Finally, we focused solely on five attributes of STTs, which does not exclude the existence of other relevant attributes that should be considered.

Future research could examine the impact of STTs usage on feedback generated by tourists (ewom) on social media or travel platforms like TripAdvisor. A study of the sociocultural characteristics of travelers would also be interesting to verify the impact of these variables on the importance given to STTs in evaluating the overall travel experience. Smart Tourism Technologies (STTs) can be employed to manage tourist flows more effectively, reduce overcrowding in certain areas, and contribute to more balanced and sustainable tourism while also enhancing the tourist experience. Further research on how STTs can be utilized to better regulate site visitation in real-time would be highly relevant.

REFERENCES

Alletto, S., Cucchiara, R., Del Fiore, G., Mainetti, L., Mighali, V., Patrono, L., & Serra, G. (2015). An indoor location-aware system for an IoT-based smart museum. *IEEE Internet of Things Journal*, 3(2), 244-253. 10.1109/JIOT.2015.2506258

Aydın, B., & Alvarez, M. D. (2020). Understanding the tourists' perspective of sustainability in cultural tourist destinations. *Sustainability*, 12(21), 8846. http://dx.doi.org/10.3390/su12218846

Budeanu, A. (2007). Sustainable tourist behaviour–a discussion of opportunities for change. *International Journal of Consumer Studies*, 31(5), 499-508. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.

Buhalis, D., & Law, R. (2008). Progress in information technology and tourism management: 20 years on and 10 years after the Internet—The state of eTourism research. *Tourism management*, *29*(4), 609-623. https://doi.org/10.1016/j.tourman.2008.01.005

Buhalis, D., & Foerste, M. (2015). SoCoMo marketing for travel and tourism: Empowering co-creation of value. *Journal of destination marketing & management*, 4(3), 151-161. https://doi.org/10.1016/j.jdmm.2015.04.001

Buhalis, D., & Amaranggana, A. (2015). Smart tourism destinations enhancing tourism experience through personalisation of services. *The International Conference in Lugano, Switzerland, February* 3-6, 2015. Springer International Publishing, pp. 377-389. https://doi.org/10.1007/978-3-319-14343-9_28

Buhalis, D., & Sinarta, Y. (2019). Real-time co-creation and nowness service: lessons from tourism and hospitality. *Journal of Travel & Tourism Marketing*, 36(5), 563-582. https://doi.org/10.1080/10548408.2019.1592059

Bulchand-Gidumal, J. (2020). Using smart tourism destinations to manage post COVID-19 travel & tourism. In Rebuilding Tourism and Hospitality Sectors. COVID 19 Crisis, Policy Solutions and the Way Forward. Bharti Publications, New Delhi, India, pp. 1-10. https://www.worldcat.org/isbn/9789389657661

Boes, K., Buhalis, D., & Inversini, A. (2016). Smart tourism destinations: Ecosystems for tourism destination competitiveness. *International Journal of Tourism Cities*, 2(2), 108-124. http://dx.doi.org/10.1108/IJTC-12-2015-0032

Capital. https://www.capital.fr/entreprises-marches/greengo-reference-2-400-sites-de-tourisme-ecoresponsables (accessed on 30 May 2024)

Chianese, A., Marulli, F., Moscato, V., & Piccialli, F. (2013). SmARTweet: A location-based smart application for exhibits and museums. *International Conference on Signal-Image Technology & Internet-Based Systems*, Kyoto, Japan, 2–5 December 2013, pp.408–415. 10.1109/SITIS.2013.73

Cui, F., Lin, D., & Huang, Y. (2015). The impact of perceived security on consumer e-loyalty: A study of online tourism purchasing. *IEEE First International Conference on Big Data Computing Service and Applications*, Redwood City, CA, USA, pp.314-322. 10.1109/BigDataService.2015.41

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340. https://doi.org/10.2307/249008

Del Chiappa, G., & Baggio, R. (2015). Knowledge transfer in smart tourism destinations: Analyzing the effects of a network structure. *Journal of Destination Marketing & Management*, *4*(3), 145-150. https://doi:10.1016/j.jdmm.2015.02.001

Delmas, M. A., & Burbano, V. C. (2011). The drivers of greenwashing. *California management review*, *54*(1), 64-87. . https://doi.org/10.1525/cmr.2011.54.1.64

Evanos. https://www.evaneos.fr/presse/actualites/index-surtourisme/ (accessed on 22 June 2024).

Femenia-Serra, F., & Gretzel, U. (2020). The impact of Smart Tourism on the sustainability of tourist destinations. *Journal of Tourism and Sustainability*, 12(2), 45-58. https://doi.org/10.1007/978-3-030-36737-4_6

Filieri, R., & McLeay, F. (2014). E-WOM and accommodation: An analysis of the factors that influence travelers' adoption of information from online reviews. *Journal of Travel Research*, 53(1), 44-57. https://doi.org/10.1177/0047287513481274

Gavalas, D., Konstantopoulos, C., Mastakas, K., & Pantziou, G. (2014). Mobile recommender systems in tourism. *Journal of network and computer applications*, 39, 319-333. https://doi.org/10.1016/j.jnca.2013.04.006

Globe-Trotting. https://www.globe-trotting.com/ (accessed on 03 October 2024)

Gretzel, U., Sigala, M., Xiang, Z., & Koo, C. (2015). Smart tourism: Foundations and developments. *Electronic Markets*, 25(3), 179-188. https://doi.org/10.1007/s12525-015-0196-

Gretzel, U., Ham, J., & Koo, C. (2020). Creating the city destination of the future: The case of Smart Seoul. *Tourism Management*, 74, 314-324. https://doi.org/10.1007/978-981-10-

Gursoy, D., Milito, M. C., & Nunkoo, R. (2017). Residents' support for a mega-event: The case of the 2014 FIFA World Cup, Natal, Brazil. *Journal of Destination Marketing & Management*, *6*(4), 344-352. https://doi.org/10.1016/j.jdmm.2017.09.003

Han, H., Hsu, L.T., Lee, J.-S., & Sheu, C. (2011). Are lodging customers ready to go green? An examination of attitudes, demographics, and eco-friendly intentions. *International Journal of Hospitality Management*, 30(2), 345-355. https://doi.org/10.1016/j.ijhm.2010.07.008

Hindley, A., & Font, X. (2017). Ethics and influences in tourist perceptions of climate change. *Current Issues in Tourism*, 20(16), 1684-1700. https://doi.org/10.1080/13683500.2014.946477

Hourrail. https://www.hourrail.voyage/fr (accessed on 29 September 2024)

Huang, C. D., Goo, J., Nam, K., & Yoo, C. W. (2017). Smart tourism technologies in travel planning: The role of exploration and exploitation. *Information & Management*, 54(6), 757-770. https://doi.org/10.1016/j.im.2016.11.010

Jeong, M., & Shin, H. H. (2020). Tourists' experiences with smart tourism technology at smart destinations and their behavior intentions. *Journal of Travel Research*, 59(8), 1464-1477. https://doi.org/10.1177/0047287519883034

Kaplanidou, K ., & Vogt, C. (2006). A Structural Analysis of Destination Travel Intentions as a Function of Web Site Features. *Journal of Travel Research* 45(2), 204-216. https://doi.org/10.1177/0047287506291

Kim, W.G., Lee, C., & Hiemstra, S.J. (2004). Effects of an online virtual community on customer loyalty and travel product purchases. *Tourism Management*, 25, 343–355. https://doi.org/10.1016/S0261-5177(03)00142-0

Kim, J. H. (2017). The Impact of Memorable Tourism Experiences on Loyalty Behaviors: The Mediating Effects of Destination Image and Satisfaction. *Journal of Travel Research*, 57, 856–870. https://doi.org/10.1177/0047287517721369

Kolsaker, A., Lee-Kelley, L., & Choy, P. C. (2004). The reluctant Hong Kong consumer: purchasing travel online. *International Journal of Consumer Studies*, 28(3), 295-304.

https://doi.org/10.1111/j.1470-6431.2004.00373.

Lamsfus, C., Wang, D., Alzua-Sorzabal, A., & Xiang, Z. (2015). Going mobile: Defining context for on-the-go travelers. *Journal of Travel Research*, 54(6), 691-701.

https://doi.org/10.1177/0047287514538839

Lee, H., Lee, J., Chung, N., & Koo, C. (2018). Tourists' happiness: Are there smart tourism technology effects? *Asia Pacific Journal of Tourism Research*, 23, 486–501. https://doi.org/10.1080/10941665.2018.1468344

Li, Y., Hu, C., Huang, C., & Duan, L. (2017). The concept of smart tourism in the context of tourism information services. *Tourism Management*, 58, 293-300. https://doi.org/10.1016/j.tourman.2016.03.014

Montgomery, D.C., Peck, E.A., & Vining, G.G. (2012). Introduction to Linear Regression Analysis, 4th ed. WILEY. http://sutlib2.sut.ac.th/sut_contents/H133678.pdf

Neuhofer, B., Buhalis, D., & Ladkin, A. (2012). Conceptualising technology enhanced destination experiences. *Journal of Destination Marketing & Management*, 1(1-2), 36-46. https://doi.org/10.1016/j.jdmm.2012.08.001

Neuhofer, B., Buhalis, D., & Ladkin, A. (2015). Smart technologies for personalized experiences: a case study in the hospitality domain. *Electronic Markets*, 25, 243-254.

https://doi.org/10.1007/s12525-015-0182-1

No, E., & Kim, J. K. (2015). Comparing the attributes of online tourism information sources. *Computers in human behavior*, 50, 564-575. https://doi.org/10.1016/j.chb.2015.02.063

Park, Y. A., & Gretzel, U. (2007). Success factors for destination marketing web sites: A qualitative meta-analysis. *Journal of Travel Research*, 46(1), 46-63. https://doi.org/10.1177/0047287507302381

Petrick, J. F. (2002). Development of a multi-dimensional scale for measuring the perceived value of a service. *Journal of Leisure Research*, 34(2), 119-134.

https://doi.org/10.1080/00222216.2002.11949965

Ricci, F. (2002). Travel recommender systems. *IEEE Intelligent Systems*, 17(6), 55-57. https://d1wqtxts1xzle7.cloudfront.net/

Ricci, F., Rokach, L ., & Shapira B. (2015). Recommender Systems: Techniques, Applications, and Challenges. In: Ricci, F., Rokach, L., Shapira, B. (eds) Recommender Systems Handbook. Springer, New York, NY. https://doi.org/10.1007/978-1-0716-2197-4_1

Sánchez-Fernández, R., & Iniesta-Bonillo, M. Á. (2007). The concept of perceived value: a systematic review of the research. *Marketing Theory*, 7(4), 427-451. https://doi.org/10.1177/1470593107083165

Saura, J. R., Palos-Sanchez, P. R., & Martin, M. Á. (2018). Attitudes Expressed in Online Comments about Environmental Factors in the Tourism Sector: An Exploratory Study. *International Journal of Environmental Research and Public Health* (IJERPH), 15(3), 1-20. https://doi.org/10.3390/ijerph15030553

Shen, S., Sotiriadis, M., & Zhang, Y. (2020). The Influence of Smart Technologies on Customer Journey in Tourist Attractions within the Smart Tourism Management Framework. *Sustainability*,12, 4157. https://doi.org/10.3390/su12104157

Snoj, B., Korda, A. P., & Mumel, D. (2004). The relationships among perceived quality, perceived risk and perceived product value. *Journal of product & brand management*, 13(3), 156-167. https://doi.org/10.1108/10610420410538050

Sweeney, J. C., & Soutar, G. N. (2001). Consumer perceived value: The development of a multiple item scale. *Journal of Retailing*, 77(2), 203-220. https://doi.org/10.1016/S0022-4359(01)00041-0

Tussyadiah, I., Li, S., & Miller, G. (2019). Privacy protection in tourism: Where we are and where we should be heading for. In Information and Communication Technologies in Tourism, Proceedings of the International Conference in Nicosia, Cyprus, January 30–February 1, 2019, Springer International Publishing, pp. 278-290: https://doi.org/10.1007/978-3-030-05940-8_22

UNWTO & WTM Ministers' Summit 2017. https://www.unwto.org/archive/europe/unwto-wtm-ministers-summit-2017 (accessed on 12 May 2024)

Wang, D., Li, X. R., & Li, Y. (2013). China's "smart tourism destination" initiative: A taste of the service-dominant logic. *Journal of Destination Marketing & Management*,2(2), 59-61.https://doi.org/10.1016/j.jdmm.2013.05.004

Wang, D., & Fesenmaier, D. R. (2013). Transforming the travel experience: The use of smartphones for travel. In Information and Communication Technologies in Tourism: Proceedings of the International Conference in Innsbruck, Austria, January 22-25, 2013, Springer Berlin Heidelberg, pp. 58-69. https://doi.org/10.1007/978-3-642-36309-2_

Wang, X., Li, X. R., Zhen, F., & Zhang, J. (2016). How smart is your tourist attraction?: Measuring tourist preferences of smart tourism attractions via a FCEM-AHP and IPA approach. *Tourism management*, 54, 309-320. https://doi.org/10.1016/j.tourman.2015.12.003

Xiang, Z., Magnini, V. P., & Fesenmaier, D. R. (2015). Information technology and consumer behavior in travel and tourism: Insights from travel planning using the internet. *Journal of Retailing and Consumer Services*, 22, 244-249. https://doi.org/10.1016/j.jretconser.2014.08.005

Ye, Q., Li, H., Wang, Z., & Law, R. (2014). The influence of hotel price on perceived service quality and value in e-tourism: An empirical investigation based on online traveler reviews. *Journal of Hospitality & Tourism Research*, 38(1), 23-39. https://doi.org/10.1177/1096348012442540

Yoo, C., Kwon, S., Na, H., & Chang, B. (2017). Factors affecting the adoption of gamified smart tourism applications: An integrative approach. *Sustainability*, 9(12), 2162. https://doi.org/10.3390/su9122162

Zeithaml, V. A. (1988). Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. *Journal of marketing*, 52(3), 2-22. https://doi.org/10.1177/002224298805200302

Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The behavioral consequences of service quality. *Journal of marketing*, 60(2), 31-46. https://doi.org/10.1177/00222429960600

Zhang, Y., Sotiriadis, M., & Shen, S. (2022). Investigating the impact of smart tourism technologies on tourists' experiences. *Sustainability*, 14(5), 3048. https://doi.org/10.3390/su14053048