

EXPLORING THE DETERMINANTS OF ADVENTURE TOURISM DEMAND IN SMART TOURISM DESTINATIONS: A FACTOR ANALYSIS APPROACH

EXPLORANDO OS DETERMINANTES DA DEMANDA POR TURISMO DE AVENTURA EM DESTINOS TURÍSTICOS INTELIGENTES: UMA ABORDAGEM DE ANÁLISE FATORIAL

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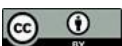
Abstract

This research evaluates adventure tourism demand determinants in smart tourism destinations relating to smart technology use, perceived safety, cultural engagement, and innovativeness of destinations. Structural equation modeling on data from 300 adventure tourists indicates that Perceived Safety Via Smart Technologies, the Attractiveness and Innovativeness of the Destination, Engagement of Local Culture and Nature, and Digital Cultural Interpretation greatly enhance tourists' beliefs of Smart Tourism Service Integration, which in turn very strongly predicts Adventure Tourism Demand. Tourist Experience Satisfaction and Perceived Value for Money were not significant predictors of their beliefs of smart service. The findings underscore the importance of functional assurances, cultural immersion, and impactful technological innovative solutions over traditional tourist perceptions of satisfaction and value, on tourist behaviour in smart tourism contexts. Overall, the study plays an essential role in advancing smart tourism theory, while also providing useful recommendations for destination managers and marketers looking to use technology-based solutions to engage in adventure tourism.

Keywords: Smart Tourism. Adventure Tourism. SEM. Smart Service Integration. Perceived Safety. Digital Cultural Interpretation. Destination Innovativeness. Tourist Behavior.

Resumo

Esta pesquisa avalia os determinantes da demanda por turismo de aventura em destinos turísticos inteligentes relacionados ao uso de tecnologia inteligente, segurança percebida, envolvimento cultural e inovação dos destinos. A modelagem de equações estruturais em dados de 300 turistas de aventura indica que a segurança percebida por meio de tecnologias inteligentes, a atratividade e a inovação do destino, o envolvimento com a cultura e a natureza locais e a interpretação cultural digital aumentam significativamente a crença dos turistas na integração dos serviços de turismo inteligente, o que, por sua vez, é um forte indicador da demanda por turismo de aventura. A satisfação com a experiência turística e a percepção de custo-benefício não foram preditores significativos de suas crenças em serviços inteligentes. Os resultados ressaltam a importância das garantias funcionais, da imersão cultural e das soluções tecnológicas inovadoras e impactantes sobre as percepções tradicionais de satisfação e valor dos turistas, no comportamento turístico em contextos de turismo inteligente. No geral, o estudo desempenha um papel essencial no avanço da teoria do turismo inteligente, ao mesmo tempo em que fornece recomendações úteis para gestores de destinos e profissionais de marketing que buscam usar soluções baseadas em tecnologia para se envolver no turismo de aventura.



Palavras-chave: *Turismo inteligente. Turismo de aventura. SEM. Integração de serviços inteligentes. Segurança percebida. Interpretação cultural digital. Inovação do destino. Comportamento do turista.*

1 INTRODUCTION

The fast digital transformation of the global tourism industry has redefined how destinations are experienced, marketed, and managed. In particular, the advent of smart tourism destinations—where mobile technologies, Internet of Things (IoT) devices, big data analytics, and real-time service systems converge—has brought about a paradigm change in destination competitiveness and tourist behavior (Gretzel *et al.*, 2015; Buhalis & Amaranggana, 2014). Smart tourism enhances both efficiency and personalization in service delivery, and it creates new forms of experiential value, trust, and convenience across tourism contexts.

In this rapidly changing space, adventure tourism has gained traction, with the potential for physical activity, environmental exploration, and the factors of unpredictability and risk (UNWTO, 2014; Buckley, 2012). Increasingly adventurous travelers are seeking experiences that have accompanying thrills and meaningful moments, but also involve safety and seamless facilitation. Indeed, as destinations are integrating smart tourism technologies to deliver on this type of experience, there is a need to understand how the adoption of smart tourism technologies impacts tourists' behavioural intention towards engaging with adventure activities. The research is still nascent at the intersection of adventure tourism and smart technology adoption, especially across emerging destinations where digital infrastructures continue to evolve alongside adventure tourism offerings.

While previous studies have investigated the performance drivers of tourism demand, such as satisfaction, destination image, and perceived value, much less is known about how these drivers relate in digitally mediated adventure contexts (Prayag & Ryan, 2012; Wu & Ma, 2022). Factors such as smart service integration, safety by digital means, engagement with culture and nature, and perceptions of technological innovativeness are becoming increasingly relevant to tourists' decision-making process. However, the area

of adventure tourism demand in smart environments and the consequential interplay between factors is largely unexplored.

This study aims to fill that gap by determining and examining the determinants of adventure tourism demand in smart tourism destinations using an exploratory factor analysis (EFA) approach. By drawing on theoretical insights from the disciplines of smart tourism, experience design, and adventure consumer behavior, this study has provided a more nuanced perspective on demand formation in technology-embedded tourism contexts. The findings are intended to benefit scholarship and practice through practitioner and scholarly implications, resulting in implications for destination planners and marketers, along with technology providers planning to meet adventure travelers' expectations via a digital transformation strategy.

2 LITERATURE REVIEW

2.1 Adventure tourism demand

Adventure tourism is one of the most active and rapidly growing sectors of tourism on a global scale, with a focus on physical activity, nature, and risk (UNWTO, 2014; Sung, 2004). Its rise dovetails nicely with a fundamental attitude shift towards experiential consumption in tourism, where visitors care less about accumulating material items. Instead, they prioritize novelty, challenge, and authenticity (Pine & Gilmore, 1999; Gilmore & Pine, 2007). Motivations to participate in adventure activities centre on thrill-seeking, sensation seeking, and self-actualization in combination with attraction attributes such as service quality and environmental qualities (Buckley, 2012; Pomfret, 2006).

Demand for adventure tourism is likely to be significantly moderated by perceived risk and safety. Although controlled risk can enhance desirability, too many perceptions of danger can discourage involvement, especially with novice travelers (Cater, 2006, Bentley *et al.*, 2001). More specific influences on risk perception and behavioral intentions include destination attractiveness, guide professionalism, and demographic variables (Pomfret, 2011; Williams & Soutar, 2009; Ewert & Hollenhorst, 1989).

The advent of smart tourism technologies has transformed adventure tourism through greater accessibility, safety, and personalization. Mobile applications, real-time alerts, and augmented reality devices provide transparency to information and situational

support, lowering perceived risks and enhancing experiences (Wang *et al.*, 2020; Gretzel *et al.*, 2015; Neuhofer *et al.*, 2015). Wearable devices provide additional reassurance and allow for greater participation and engagement (Dickinson *et al.*, 2014; Tussyadiah, 2020; Sigala, 2018). As a result, future research should adopt a smart tourism perspective to recognize the influence of digital mediation on adventure travel behavior.

2.2 Smart tourism service integration

Smart tourism has altered destination management and tourist experience design by providing advanced digital technologies, including mobile applications, IoT infrastructures, big data, AI, and cloud computing (Gretzel *et al.*, 2015; Xiang & Fesenmaier, 2017). These technologies provide immediate information delivery, predictive services, and personalized content, helping organizations to achieve better functional efficiency and enhancing satisfaction (Buhalis & Sinarta, 2019).

In adventure tourism, the uncertainties associated with environmental challenges are inherent, and the advent of smart services enables a level of safety, access, and engagement previously unavailable. Whether through the provision of real-time updates, geolocation tracking, environmental monitoring systems, or others, smart service-oriented business models allow tourists to navigate distant terrains with increased levels of confidence (Buhalis & Amaranggana, 2015; Sigala, 2018). Even more, the skills/resources we develop, such as personalized recommendations and adaptive service models supported by wearables, the Internet of Things, and others, enable us to respond to conditions and needs as they change (Li *et al.*, 2017; Tussyadiah, 2020).

The convergence of smart technologies and adventure tourism technologies has broadened the landscape of experience optimization to include emotional, cognitive, and educational experiences. Digital storytelling, immersive virtual previews, and live interaction platforms are increasingly common in adventure tourism, contributing richness to the experience and adding to the sense of destination authenticity (Huang *et al.*, 2016; Gretzel *et al.*, 2015). As adventure tourists continuously seek more seamless experiences in regards to technology and experiences, it is important to expand to the strategic role of smart tourism service integration in consideration of innovation in terms of sustainability, personalization, and experiential value (Buhalis & Leung, 2018; Wang *et al.*, 2020).

2.3 Perceived safety through smart technologies

Perceived safety is an important component when tourists evaluate their behavior, particularly in risky contexts construed as adventure tourism, where travelers struggle to balance their risk along with the concern of being safe (Reisinger & Mavondo, 2005; Kozak *et al.*, 2007). Ultimately, tourists tend to emphasize subjective risk evaluations more than objective risk indicators, suggesting that for destinations, establishing a solid safety system not only requires reasonable precautions but also emotional reassurance and feelings of trust (Lepp & Gibson, 2003; Floyd & Pennington-Gray, 2004).

Intelligent technologies are changing conceptions of safety and how support can be provided via real-time assistance, real-time location alerts, wearable health devices, and information around environmental risks (Dickinson *et al.*, 2014; Kim, 2008). They can enhance the tourist sense of control and autonomy, which strengthens trust in the destination's safety infrastructure and can reduce perceived risk (Tussyadiah, 2020; Fuchs & Reichel, 2011). Predictive analytics and smart surveillance can also supplement proactive risk management and bolster actual and perceived safety (Bélanger & Carter, 2008).

Technological advancements that improve safety perceptions have been shown to positively impact tourists' engagement, satisfaction, and loyalty. Destinations can entice a wider market and facilitate deeper engagement in adventure activities in terms of the term "safe uncertainty" (George, 2010; Chew & Jahari, 2014). As safety concerns continue to grow in the global marketplace, there will be a greater importance to successfully incorporate new smart technologies into the risk management approaches that will allow destinations to gain a competitive advantage and encourage sustainable trust from tourists (Karl *et al.*, 2020).

2.4 Tourist experience satisfaction

Tourist experience satisfaction is the leading influence on behavioral outcomes such as loyalty, word-of-mouth, and intention to revisit (Pine & Gilmore, 2013; Oliver, 2014). Satisfaction is defined to occur when pre-travel expectations have been confirmed, and involves cognitive evaluations and effective responses across multiple realms, such as service quality, authenticity, and value-for-money (Yoon & Uysal, 2005). In addition

to these evaluations, satisfaction in adventure tourism is influenced by the authenticity, spontaneity, and intensity of the experience (Swarbrooke *et al.*, 2003).

Smart tourism technologies enhance satisfaction by enabling seamless, efficient, and personalized experiences. Real-time updates, location-based services, mobile payments, and augmented reality reduce friction points and personalize experiences, leading to higher perceived service quality and service-related feelings of engagement (Neuhofer *et al.*, 2015; Gretzel *et al.*, 2015; Buhalis & Sinarta, 2019). Experiences enabled by big data and artificial intelligence through context-aware services can further dynamically adapt experiences to changing conditions, thus reshaping satisfaction as a dynamic co-creating process (Li *et al.*, 2017).

Adventure tourism especially capitalizes on smart technologies that expand situational awareness, rapid communication, and adaptive assistance (Kim & Fesenmaier, 2017). Wearables capturing environmental or biometrics provide greater safety or excitement, while social media increases emotional engagement (Tussyadiah, 2020). Understanding how smart systems mediate the emotional, cognitive, and behavioral facets of satisfaction can shape high-value adventure experiences in a digital age (Buckley, 2012; Pomfret, 2006).

2.5 Destination attractiveness and innovativeness

Destination attractiveness is an important influence on travelers' behavior, including factors relating to natural beauty, culture, quality of service, and travel safety (Formica & Uysal, 2006; Crouch, 2011). In the case of adventure tourism, where travelers are looking for excitement and security, destination attractiveness is defined relative to the destination's ability to balance authentic experiences, accessibility, and the quality of service (Klenosky, 2002; Prayag & Ryan, 2012).

In the emerging smart tourism context, the attractiveness is seen not only as an objective reality but also subjectively as perceived technology sophistication. Spatially and temporally integrated real-time information sharing within destinations in conjunction with IoT services and digital storytelling is perceived to be more reliable and more convenient, along with being more than ready for the future (Ahn & Seo, 2018; Sigala, 2018). Smart technologies do not simply provide the means for operational efficiency; they are also a source of experiential values via personalization, co-creation,

and engagement (Buhalis & Amaranggana, 2015; Gretzel *et al.*, 2015), thereby engendering and evolving greater trust and loyalty among digitally literate tourists (Neuhofer *et al.*, 2015).

For adventure travelers, indicators of innovativeness represent safety, professionalism, and dynamism (Wang *et al.*, 2020; Pomfret, 2006). Destinations that embrace technology demonstrate superior risk management, reliability, and adaptive responses, which in turn facilitate participation in high-risk activities, and hopes of encouraging intentions to revisit (Wu & Ma, 2022). Wildly innovative digital recreational activities, such as augmented reality (AR) tours and gamified interpretations, provide the benefit of emotional state enhancement while promoting destination loyalty (Han *et al.*, 2023).

2.6 Engagement with local culture and nature

Engagement with local culture and nature is at the core of contemporary adventure tourism, as it represents a movement toward immersive, responsible, and transformative travel experiences (Richards, 2011; Scott & Campos, 2024). Adventure tourists are looking for authentic interactions and cultural exchange, as well as ecological awareness, and emphasise more active participation than passive consumption (Kolar & Zabkar, 2010; Weaver, 2001). Cultural and ecological immersion promotes learning about others' cultures, sense of personal development, and sustainable travel behaviour that positively influence the attractiveness of a destination and traveller satisfaction (Moscardo, 2008).

Technological enhancements offered more ways to engage. Mobile apps, geolocation technologies, and augmented reality platforms present rich, contextual stories that deepen tourists' understanding of local heritage and environmental relevance (Tussyadiah, 2020; Han *et al.*, 2023). Interactive applications and virtual experiences marked a shift from passive to active cultural and ecological discovery, offering personalized, participatory learning opportunities, and extending the definition of what sightseeing can be (Neuhofer *et al.*, 2015; Wang *et al.*, 2013).

Using technology to facilitate cultural and ecological engagement creates more responsible tourism practices, and in the process aids community development (Pomering, 2017; Lee, 2011). When tourists engage meaningfully, there is greater tourist satisfaction and greater socio-economic benefits, including but not limited to cultural

pride and heritage preservation (Chhabra, 2010). For example, when adventure tourism has digital cultural interpretation within experience design, this becomes a mechanism for sustainability, critical to aligning tourism and values around environmental sustainability and culture (Beaumont, 2011).

2.7 Digital cultural interpretation

Digital cultural interpretation enhances tourism experiences through cultural learning via augmented reality (AR) and mobile storytelling, virtual tours, and through narrative based on geolocation (Tussyadiah *et al.*, 2018; Jung *et al.*, 2018). Digital interpretation offers content that is dynamic, adapting according to the depth of engagement, and should also provide personalized context, which facilitates cognitive engagement and affective attachment to the destination beyond what is possible with traditional signage (Yovcheva *et al.*, 2012).

In adventure tourism, digital interpretation connects the enjoyment of exploration and the learning process. This is done by activating travelers' connections to the historical, ecological, and sociocultural stories (Benckendorff *et al.*, 2014; Han *et al.*, 2019). Augmented reality overlays, 3D reconstructions, and stories that are activated by location provide a deeper learning process, encourage environmental behaviour, and reduce the impacts of physical infrastructure on outdoor environments, which supports notions of sustainable tourism (Jung *et al.*, 2017).

Digital interpretation is a strategic ally in the development of tourist knowledge retention, visitor emotional connection, and visitor satisfaction (Tussyadiah, 2020; Huang *et al.*, 2016). It can lead to equity of access to cultural stories and allow wider access for visitors beyond the traditional guided experience. With the advent of smart tourism, digital cultural interpretation forms essential elements in developing adventure destinations' ability to differentiate their offerings, develop responsible behaviors, and increase visitor loyalty (Buhalis & Sinarta, 2019; Fuchs *et al.*, 2021).

2.8 Perceived value for money

Perceived value, an important concept in consumer behavior literature, illustrates the balance between the benefits a customer receives, like quality of service, emotional

rewards, and richness of experience, and the costs incurred (Zeithaml, 1988; Sánchez *et al.*, 2006; Petrick, 2002). It has been established in tourism that perceived value for money is closely related to satisfaction, willingness to repurchase, willingness to recommend or endorse, and willingness to pay a price premium (Chen & Tsai, 2007; Gallarza & Saura, 2006).

In smart tourism contexts, perceived value increasingly depends on technology convenience, novelty, and personalization (Huang *et al.*, 2022; Neuhofer *et al.*, 2015). Determining the value of smart services involves technology features such as real-time updates and technology such as mobile apps and IoT technology, which adds to navigation, safety, and tourists' engagement, positively influencing tourists' perceived value (Tussyadiah, 2020; Gretzel *et al.*, 2015). Poorly designed and poorly executed technology detracts from value by adding friction or detracting from authenticity (Buhalis & Sinarta, 2019).

Adventure travelers' value is based on the differential cost of perceived risk against emotional experience and technology support (Buckley, 2012; Williams & Soutar, 2009). Technological solutions such as risk notifications, interactive advisors, and experiential storytelling provide additional adventure experience at no additional cost (Han *et al.*, 2019). Technology that promotes autonomy, personalization, and cultural connection also promotes tourists' perceptions of value, satisfaction, loyalty, and advocacy behaviours (Wu & Ma, 2022; Huang *et al.*, 2017).

2.8.1 Based on literature reviews, the following hypotheses are proposed

Hypothesis 1 (H1): Perceived Safety through Smart Technologies has a positive and significant impact on Smart Tourism Service Integration.

Hypothesis 2 (H2): Tourist Experience Satisfaction has a positive and significant impact on Smart Tourism Service Integration.

Hypothesis 3 (H3): Destination Attractiveness and Innovativeness have a positive and significant impact on Smart Tourism Service Integration.

Hypothesis 4 (H4): Engagement with Local Culture and Nature positive and significant impact on Smart Tourism Service Integration.

Hypothesis 5 (H5): Digital Cultural Interpretation has a positive and significant impact on Smart Tourism Service Integration.

Hypothesis 6 (H6): Perceived Value for Money has a positive and significant impact on Smart Tourism Service Integration.

Hypothesis 7 (H7): Smart Tourism Service Integration has a positive and significant impact on Adventure Tourism Demand.

2.9 Research methods

2.9.1 Questionnaire design and measurement constructs

In order to examine the underlying motivators of adventure tourism demand within smart tourism destinations, we developed a structured questionnaire with dependent and independent constructs shaped by state-of-the-art theoretical underpinnings. Each construct was operationalized using multi-item measures, many of which were adapted from previously validated scales in tourism and consumer behaviour.

The survey instrument included eight latent constructs; one dependent variable and seven independent variables, to assess tourists' perceptions and behavioral intentions about smart-enabled adventure experiences. All items utilized a 5-point Likert scale from 1 = Strongly Disagree to 5 = Strongly Agree; a scale found to be appropriate in assessing attitudinal and perceptual responses in behavioral research (Hair *et al.*, 2019). The constructs were selected as having the same functional and experiential characteristics for smart tourism, including technology integration, perceived safety, cultural engagement, perceived value, and satisfaction.

In order to maintain content and face validity, the questionnaire was evaluated by tourism academics and industry leaders. The final measurement framework is summarized in Table 1, which identifies the variable types, definitions of the variables as they are used in the study, the way the variables were measured, and key references supporting the measurement approaches.

Table 1*Dependent and Independent Variables*

Type	Variable Name	Definition	Measurement Approach	Key References
Dependent Variable	Adventure Tourism Demand (AT_Demand)	The behavioral and attitudinal intention of tourists to engage in adventure tourism in smart tourism destinations	4–5 items on 5-point Likert scale	Buckley (2012); UNWTO (2014); Tsai <i>et al.</i> (2020)
Independent Variable	Smart Tourism Service Integration (STS_Integration)	Tourists' perception of how effectively digital tools (e.g., mobile apps, IoT, sensors) are integrated into the tourism experience	4 items on 5-point Likert scale	Gretzel <i>et al.</i> (2015); Buhalis & Amaranggana (2015)
Independent Variable	Perceived Safety through Smart Technologies (PSS_Technologies)	Tourists' feeling of safety supported by digital tools such as GPS, emergency alerts, and real-time updates	4 items on 5-point Likert scale	Dickinson <i>et al.</i> (2014); Kim <i>et al.</i> (2008)
Independent Variable	Tourist Experience Satisfaction (TE_Satisfaction)	The degree to which tourists' expectations are fulfilled through the adventure experience	4 items on 5-point Likert scale	Pine & Gilmore (1999); Neuhofer <i>et al.</i> (2015)
Independent Variable	Destination Attractiveness and Innovativeness (DA_Innovativeness)	The extent to which the destination is seen as modern, unique, and technologically advanced	4 items on 5-point Likert scale	Ahn & Seo (2018); Wang <i>et al.</i> (2020)
Independent Variable	Engagement with Local Culture and Nature (ELC_Nature)	Tourists' interaction with local communities and appreciation of natural surroundings	4 items on 5-point Likert scale	Kolar & Zabkar (2010); Pomeroy (2017); Tussyadiah (2020)
Independent Variable	Digital Cultural Interpretation (DC_Interpretation)	Use of AR, digital storytelling, or geolocation	4 items on 5-point Likert scale	Tussyadiah <i>et al.</i> (2018); Han <i>et al.</i> (2023)

				apps to understand local culture and heritage			
Independent Variable	Perceived Value (PV_Money)	Value for Money		The perceived fairness and worth of adventure experiences relative to cost	4 items on 5-point scale	Likert	Zeithaml (1988); Chen & Tsai (2007)

2.10 Population and sample

The population for the study comprised tourists who participated in adventure tourism activities in smart tourism destinations. Because the study focused on technology-mediated adventure experiences, the sample was defined as people who had previously experienced digital devices while participating in adventure travel (e.g., mobile apps, GPS trackers, AR-based cultural interpretation).

A purposive sampling method was used to guarantee the relevance and quality of the responses. The data were collected using a hybrid or a combination of an online and an offline (paper) survey, which was distributed by adventure tour operators, digital tourism platforms, and adventure travel groups on social media. To facilitate variation among respondent demographics, we attempted to reach respondents across different age attributes, genders, and nationalities.

The final valid sample consisted of 300 respondents and was above the nominal minimum sample size for factor analysis and structural equation modeling (Hair *et al.*, 2019). The sample size was sufficient to allow statistical power and generalization to be confident in the findings, as the proposed measurement model also included a degree of complexity. Table 2 highlights some demographic characteristics of the respondents, including gender, age, highest level of education, nationality, and frequency of adventure travel.

Table 2*Demographic Profile of Respondents*

Category	Frequency (n)	Percentage (%)
Gender		
Male	150	50.0
Female	150	50.0
Age Group		
Under 25	60	20.0
25–34 years	120	40.0
35–44 years	80	26.7
45 years and above	40	13.3
Education Level		
High School	30	10.0
Undergraduate	160	53.3
Postgraduate	110	36.7
Nationality		
Domestic tourists	180	60.0
International tourists	120	40.0
Frequency of Adventure Travel		
First-time travelers	90	30.0
Occasional travelers (1–2 trips/year)	140	46.7
Frequent travelers (3+ trips/year)	70	23.3

2.11 Scale validation and pre-testing

Content validity of the questionnaire was established through a panel of three tourism academics and two practitioners before the plunge into data collection. A pilot test was then carried out with 30 respondents. Pre-analysis of reliability indicated all constructs achieved the minimal recommended level of Cronbach's alpha of 0.70 and were therefore deemed to display acceptable levels of internal consistency (Nunnally & Bernstein, 1994).

The internal consistency was assessed using Cronbach's alpha. Cronbach's alpha is a statistic that indicates the degree of positive intercorrelation among items thought to measure the same latent construct. A Cronbach's alpha score above 0.70 is typically considered acceptable, while overall scores between 0.60 and 0.70 could be acceptable, depending on the context of the research (Fornell & Larcker, 1981; Santos *et al.*, 2019). Overall scores less than .60 are typically considered to lack sufficient reliability (Cortina, 1993).

Composite Reliability (CR) was also estimated to assess the proportion of shared variance for items representing each construct, allowing a more thorough evaluation of internal consistency, especially in contexts of structural equation modeling (Bagozzi &

Yi, 1988; Hair *et al.*, 2019). A CR value of greater than 0.70 is acceptable for research purposes (Franco *et al.*, 2024; Henson & Roberts, 2006).

Convergent validity was evaluated using the Average Variance Extracted (AVE) statistic, which is the proportion of variance captured by the construct to variance that is due to measurement error. AVE values of 0.50 and higher are generally recommended for demonstrating adequate convergent validity (Fornell & Larcker, 1981; Hair *et al.*, 2019).

Table 3 presents the results of the reliability and validity tests. All constructs had Cronbach's alpha and CR values of well over 0.70, while the AVE values were close to or over the acceptable value of 0.50. Some constructs had minimum AVE values that were below 0.50. However, this is acceptable in the social sciences when Composite Reliability is above 0.70, which indicates that there was enough convergent validity (Malhotra, 1996).

Table 3

Summary of Reliability

Scales	Number variables observed	of Reliability coefficients (Cronbach's Alpha)	Composite Reliability (CR)	Average variance extracted (AVE)
<i>AT_Demand</i>	4	0.795	0.762	0.445
<i>STS_Integration</i>	4	0.770	0.797	0.497
<i>PSS_Technologies</i>	4	0.763	0.776	0.465
<i>TE_Satisfaction</i>	4	0.764	0.769	0.455
<i>DA_Innovativeness</i>	4	0.772	0.771	0.457
<i>ELC_Nature</i>	4	0.739	0.766	0.451
<i>DC_Interpretation</i>	4	0.775	0.774	0.463
<i>PV_Money</i>	4	0.768	0.740	0.416

2.11.1 Factor analysis

In the social and behavioral sciences, factor analysis is a widely popular statistical approach to uncover latent factors or dimensions among a set of observed variables. The goal of factor analysis is to simplify the complexity of data by uncovering patterns of intercorrelation among variables and grouping related variables together into a smaller number of unexplained constructs or factors (Gorsuch, 1997). The decision about the number of factors to extract is usually made by examining scree plots and eigenvalues (Fabrigar *et al.*, 1999). The findings from a factor analysis can help the researcher refine

research questions, hypotheses, and theoretical models, as well as provide additional constructs for various relationships (Hair *et al.*, 2010; Chen, 2008).

Exploratory factor analysis (EFA) was performed using Principal Component Analysis (PCA) as the extraction method, with Varimax rotation with Kaiser normalization for interpretability. The data are presented in Table 4. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was 0.902, above the recommended minimum of 0.5, suggesting that the data was acceptable for factor analysis. Bartlett's Test of Sphericity was statistically significant ($\chi^2 = 3334.819$, $df = 496$, $p < 0.001$), suggesting that correlations among variables existed at a level acceptable to perform factor extraction.

Factor loadings for every remaining item in the analysis exceeded 0.50, which is standard for practical significance in a social sciences study (Hair *et al.*, 2019; Tabachnick & Fidell, 2019). In practice, factor loadings are categorized as follows: minimum = 0.30, important = 0.40, and practical significance maximum = 0.50 or higher. The extracted factors explained 57.635% of the total variance (and typically, a threshold of 50% is a reasonable objective for behavioral research). In addition, all the factors retained in the analysis had initial eigenvalues greater than 1.00 (Eigenvalues > 1.00).

Table 4

Result of factor analysis

	Rotated Component Matrix ^a							
	Component							
	1	2	3	4	5	6	7	8
AT_Demand1	.745							
AT_Demand3	.721							
AT_Demand4	.709							
AT_Demand2	.640							
DC_Interpretation3		.731						
DC_Interpretation4		.724						
DC_Interpretation2		.713						
DC_Interpretation1		.645						
PV_Money2			.748					
PV_Money3			.736					
PV_Money4			.715					
PV_Money1			.633					
STS_Integration1				.737				
STS_Integration2				.723				
STS_Integration4				.664				
STS_Integration3				.615				
TE_Satisfaction3					.773			
TE_Satisfaction2					.741			
TE_Satisfaction4					.690			

TE_Satisfaction1	.666	
DA_Innovativeness 2		.742
DA_Innovativeness 4		.728
DA_Innovativeness 3		.700
DA_Innovativeness 1	.664	
PSS_Technologies1		.718
PSS_Technologies2		.717
PSS_Technologies4		.688
PSS_Technologies3		.652
ELC_Nature4		.744
ELC_Nature2		.695
ELC_Nature3		.657
ELC_Nature1		.625
Extraction Method: Principal Component Analysis.		
Rotation Method: Varimax with Kaiser Normalization.		
a.	Rotation converged in 6 iterations.	
b.	Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO)=0.902	
c.	Bartlett's Test of Sphericity (Chi-Square=3334.819, df=496, sig.=0.000)	
d.	Extraction Sums of Squared Loadings = 1.226; Initial Eigenvalues =1.226	

2.11.2 Structural equation modeling

Structural equation modeling (SEM) is one of the most popular multivariate statistical methods used in the social sciences for testing intricate relationships with observed and latent variables (Byrne, 2013). It can be considered a combination of regression analysis, factor analysis, and path modeling because it analyzes a measurement model and structural relationships simultaneously within a theoretical framework (Kline, 2023). The SEM approach represents the relationships among variables through a system of equations that estimates the strength and direction of effects, including the influence of latent constructs on observed indicators (Hair *et al.*, 2006; Arbuckle, 2013).

One notable advantage of SEM is its capacity to predict changes in one variable as a result of changes in other variables - we can take a comprehensive view of theory testing and model validation (Fornell & Larcker, 1981). In addition, SEM can account for direct and indirect (mediating) effects in the models we examined and provide additional insight into the mechanisms of complex systems (Bartholomew *et al.*, 2011; Kenny, 2015). As Jöreskog and Sörbom (1993) pointed out, results generated through SEM can help refine theoretical models and assist in understanding causal pathways.

The results of the SEM analysis for this study can be found in Table 4. In total, seven hypothesized relationships between constructs were examined. The estimates,

standard errors, critical ratios (C.R.), and significance levels for the relationships are presented in Table 4. Smart Tourism Service Integration (STS_Integration) was significantly predicted by Digital Cultural Interpretation ($p = 0.040$), Destination Attractiveness and Innovativeness ($p = 0.002$), Perceived Safety via Smart Technologies ($p = 0.013$), and Engagement with Local Culture and Nature ($p = 0.017$). Adventure Tourism Demand (AT_Demand) was largely influenced by STS_Integration ($p < 0.001$).

Table 5

Regression Weights

			Estimate	S.E.	C.R.	P	Decision
STS_Integration	<---	DC_Interpretation	.161	.078	2.054	.040	Accepted
STS_Integration	<---	PV_Money	.078	.056	1.403	.161	Not Accepted
STS_Integration	<---	TE_Satisfaction	.096	.059	1.609	.108	Not Accepted
STS_Integration	<---	DA_Innovativeness	.191	.062	3.079	.002	Accepted
STS_Integration	<---	PSS_Technologies	.188	.076	2.490	.013	Accepted
STS_Integration	<---	ELC_Nature	.182	.077	2.382	.017	Accepted
AT_Demand	<---	STS_Integration	.877	.118	7.422	***	Accepted

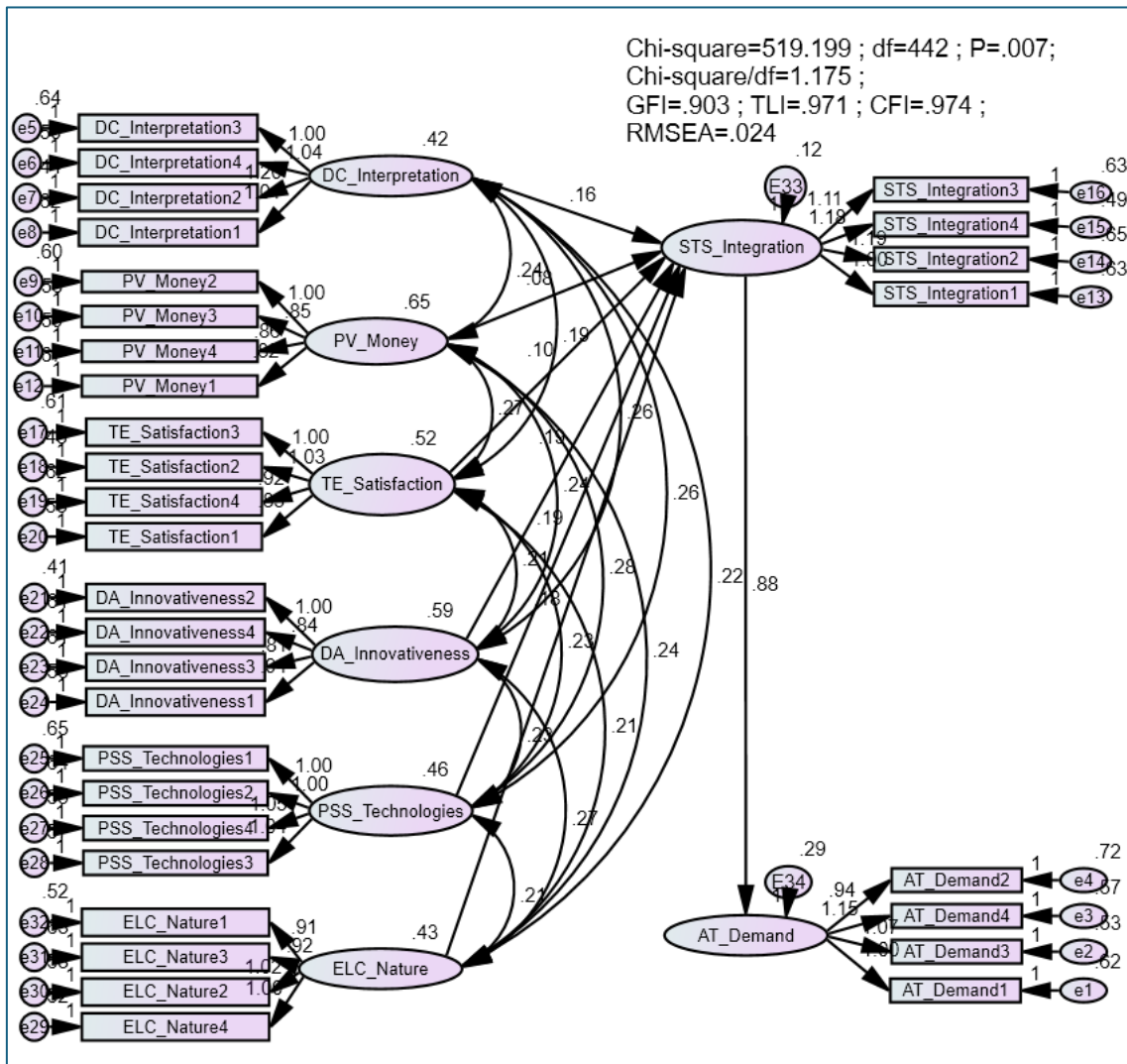
The goodness-of-fit of the structural model was evaluated using multiple fit indices, including the Chi-square (χ^2) statistic, Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Tucker-Lewis Index (TLI), and Comparative Fit Index (CFI). According to conventional guidelines, acceptable model fit is indicated by CFI and TLI values ≥ 0.900 , and RMSEA and SRMR values ≤ 0.08 (Hair *et al.*, 2019).

The model exhibited strong fit to the data:

- χ^2 (df = 394) = 494.613, $p < 0.001$,
- χ^2/df ratio = 1.255,
- Goodness of Fit Index (GFI) = 0.868 (approaching the 0.90 threshold),
- TLI = 0.944,
- RMSEA = 0.036.

These results confirm that the proposed SEM model adequately fits the empirical data and provides robust support for the hypothesized relationships among constructs, as illustrated in Figure 2.

Figure 1
SEM analysis results



3 RESULTS AND DISCUSSION

3.1 Results

According to the results from the structural equation modeling analysis, the proposed hypotheses had mixed results, with five hypotheses accepted and two rejected. H1, which stated that the Perceived Safety from Smart Technologies positively and significantly relates to Smart Tourism Service Integration, was accepted ($\beta = 0.188$, $p = 0.013$). The results show that tourists' perceptions of improved safety from smart technologies (e.g., GPS tracking, emergency alerts, real-time information) explicitly

influence tourists' overall judgments about technology-integrated tourism services. Furthermore, H3 stated Destination Attractiveness and Innovativeness positively influence Smart Tourism Service Integration, was supported ($\beta = 0.191$, $p = 0.002$). The results strengthen the idea that destinations seen as modern, distinctive, and technologically improved are more conducive to positive tourists' evaluations of smart tourism environments.

H4, that Engagement with Local Culture and Nature is positively related to Smart Tourism Service Integration ($\beta = 0.182$, $p = 0.017$), was also accepted. This was significant as a consistent finding that goes beyond account alive; when tourists qualified their assessments of smart-enabled tourism experiences, cultural and ecological immersion was an important part of that assessment. H5, that Digital Cultural Interpretation would have a positive relationship to Smart Tourism Service Integration, was accepted ($\beta = 0.161$, $p = 0.040$). Taken together, the results indicate that some of the most important technological tools that tourists use to evaluate well-integrated services were digital storytelling platforms, augmented reality apps, and geolocation services. Similarly, H7, that Smart Tourism Service Integration would have a positive relationship with Adventure Tourism Demand, was reinforced with a strong relationship ($\beta = 0.877$, $p < 0.001$). This useful effect indicates that when smart technologies are integrated into adventure tourism services, tourists' behavioral intentions to engage with those services are much higher.

Conversely, H2, which offered a positive relationship linking Tourist Experience Satisfaction and Smart Tourism Service Integration, was unsupported ($\beta = 0.096$, $p = 0.108$). Satisfaction is traditionally an important predictor of loyalty and revisit intentions, and while this was true, it simply did not influence tourism service integration perceptions in this study. One potential interpretation is that while tourists may feel satisfied overall with their adventure experience, satisfaction alone may not improve tourism service integration perceptions unless safety, cultural engagement, or innovativeness is also contained. Therefore, H6, which predicted a positive relationship between Perceived Value for Money and Smart Tourism Service Integration, was also disapproved ($\beta = 0.078$, $p = 0.161$). This could mean that while tourists' assessments of fair pricing and cost-benefit trade-off are determining general satisfaction or loyalty, it does not independently determine their perceptions of how well technology is integrated within the travel experience.

In sum, the findings support that functional and experiential dimensions such as technological safety, cultural immersion, and destination innovativeness are key determinant dimensions to influence tourist satisfaction perceptions of smart tourism service integration. In contrast, outcomes such as overall satisfaction and perceived value do not necessarily influence perceptions of threats in technological-oriented environments in adventure tourism contexts. Overall, these findings provide valuable implications for destination managers, service designers, and the public sector to further enhance tourist smart experience journeys and stimulate demand for adventure tourism in smart tourism environments.

3.2 Discussion

This research examined the determinants of adventure tourism demand in smart tourism destinations, and specifically examined the extent to which technological integration, cultural involvement, perceived safety, innovativeness, satisfaction, and value perceptions led to tourists' behavioral intentions. The implications of the findings contribute to the expanding literature on smart tourism by helping to answer how adventure travelers respond to technology-enabled service delivery while engaging the complexities between functional, experiential, and psychological factors.

The study results, to begin with, support the vital importance of Perceived Safety through Smart Technologies for Smart Tourism Service Integration, as it is consistent with prior research highlighting that risk reduction is a required element in high-involvement tourism environments (Tussyadiah, 2020; Dickinson *et al.*, 2014). Adventure tourism is viewed as an inherently risky situation. By employing smart safety gear like GPS trackers, emergency responder systems, or health monitoring devices, the tourists can build their trust in the destination infrastructure, ultimately leading to increases in their perceptions of Smart Tourism Service Integration.

In an identical way, Destination Attractiveness and Innovativeness emerged as one of the relevant predictors of Smart Tourism Service Integration and support prior studies (Sigala, 2018; Wang *et al.*, 2020) and the trait that technological modernity and creative service innovation affect tourists' evaluations of their experience. Today's travelers are demanding seamless technological experiences within their adventure

activities, and when tourists believe their destination is technologically modern, it is a viable path towards meeting their evolving expectations.

Involvement with Local Culture and Nature also had a substantial positive influence on Smart Tourism Service Integration, further emphasizing the importance of engagement in the local culture and natural environment in relation to the value proposition of smart-enabled adventure tourism (Richards, 2011; Kolar & Zabkar, 2010). The findings suggest that the use of digital tools to mediate authentic cultural and nature experiences, i.e., AR cultural trails, virtual storytelling, or biodiversity apps, greatly enhances tourists' experiences of smart service ecosystems.

Here, the encouragement of Digital Cultural Interpretation's influence on Smart Tourism Service Integration underscores the significance of technology-mediated storytelling that adds value to the tourists' stories. As Tussyadiah *et al.* (2018) and Han *et al.* (2019) show, digital interpretation technologies represent significant cognitive and emotional gateways to tourism destinations, providing tourists with an opportunity to go beyond simply visiting a destination, to experience a more personal engagement approach.

Most importantly, Smart Tourism Service Integration was found to have a significant positive effect on Adventure Tourism Demand. This finding further supports the core argument of this study and accords with prior research indicating that smart technologies increase satisfaction and facilitate behavioral intentions in tourism (Neuhofer *et al.*, 2014; Gretzel *et al.*, 2015). By developing personalized, safe, and immersive adventure experiences facilitated by smart systems, destinations are legitimizing a significant increase in tourists' willingness to undertake adventure.

That said, it is also interesting to note that whilst Tourist Experience Satisfaction and Perceived Value for Money were found to be unrelated to perceptions of Smart Tourism Service Integration, the findings are a bit odd given the vast literature on satisfaction and value perceptions leading to positive behavioral outcomes (Yoon & Uysal, 2005; Chen & Tsai, 2007). One plausible explanation could be that in adventure tourism, the adoption and integration of technologies are assessed through functional and emotional dimensions, such as safety, engagement, and innovativeness, rather than overall value or satisfaction from an outcome or cost-benefit perspective. In other words, even though tourists' perceptions of satisfaction and value may be generally high, they

are unlikely to determine how tourists assess the integration of smart technologies unless tourists themselves prioritize safety, novelty, and cultural immersion.

Ultimately, these findings contribute to theoretical knowledge in showing that not all traditional and important constructs (e.g., satisfaction and perceived value) map directly onto positive perceptions of smart service integration in adventure tourism. In particular, functional assurances (safety), experiential engagement (culture and nature), and perceptions of technological innovativeness are stronger influences in that specific tourism context.

The implications for destination managers and policymakers can be gleaned from the research. It is important that investments in smart safety technologies, culturally adaptive digital storytelling instruments, and tech-savvy infrastructure are also critical stakeholders in providing tourists with transformative experiences. Additionally, destination marketing communications need to market specific smart technological safety features, culturally immersive tourism opportunities, and contemporary experiences for tech-savvy adventure tourists.

4 CONCLUSION

This study looked into the drivers of adventure tourism demand within the context of smart tourism destinations and focused on smart technology integration, perceived safety, cultural engagement, destination innovativeness, satisfaction, and perceived value. Using structural equation modeling, this study provides empirical evidence for a modified theoretical model that incorporates the functional, emotional, and technological dimensions of tourist behavior in the digital tourism landscape.

These findings highlight the vital role that smart technologies can play in the tourist experience and in shaping tourist behavioral intentions. Specifically, Perceived Safety via Smart Technologies, Destination Attractiveness and Innovativeness, Engagement with Local Culture and Nature, and Digital Cultural Interpretation showed all had a positive and significant effect on Smart Tourism Service Integration. This indicated that the accurate addition of advanced technology features, such as real-time safety tracking, augmented reality storytelling, and seamless digital services, improves tourists' perception of the destination's quality and sophistication, and improves the demand for an adventure-based experience.

In particular, Smart Tourism Service Integration was a robust explanatory factor of Adventure Tourism Demand and reinforces the fundamental importance of a technology-enabled service ecosystem in promoting participation in high-involvement tourism activities. It supports and extends prior research on smart tourism by showing that in adventure contexts, where risk, spontaneity, and emotional engagement are prevalent, smart technologies are not supplementary enhancements; rather, they are fundamental mediators of tourists' decision-making and behavior.

On the other hand, the non-significant effects of Tourist Experience Satisfaction and Perceived Value for Money on Smart Tourism Service Integration suggest key boundary conditions on the applicability of traditional satisfaction-value models in tourism. Even though satisfaction with an experience and associated value perceptions are important to overall tourism-related outcomes, they seem to be less informative in terms of smart service ecosystems unless it is framed within distinctive technological, safety, and cultural engagement items. This difference really illustrates that tourist expectations are changing in the digital age, with functional assurances in experiences and experiential depth becoming more important than summed generic outcome evaluations.

In theory, this research contributes to the expanding literature on smart tourism and adventure travel by understanding how technology, culture, and service innovation interact with and inform tourist experiences and intentions. It considers smart service integration as a key mediating construct in the adventure tourism context and questions the completeness of traditional satisfaction-based models.

The results have practical implications for destination managers, destination marketers, and policymakers. Managers in the tourism industry must invest in smart safety infrastructure, digital cultural interpretation, as well as future-proof service design and innovations as a means of enhancing destination competitiveness. The marketing strategies crafted by destination marketers should promote technological preparedness, cultural authenticity, and experiential richness, while the three stakeholders should aim to attract the digitally literate adventure travelers seeking experience.

This study can provide research opportunities that could extend this study by examining moderating variables such as the tourists' technology readiness, their cultural background, or their prior adventure tourism experience. Cross-cultural comparative studies of smart service expectations and adventure behaviour across different tourism

markets would provide further clarity. Longitudinal designs could provide further understanding of the tourists' views of smart tourism and how it changes over time and in relation to the different stages of the travelling experience.

To sum up, the present study makes a contribution to theory and practice regarding smart tourism and adventure tourism. It demonstrates how technology is transforming the experience of tourism and lays the groundwork for future research into the evolving relationship between digital disruption, cultural participations, and tourists in the dynamic, complex, and competitive global tourism marketplace.

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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