

Green Mice and Smart Tourism Development Model to Support Competitive and Sustainable Tourism in Batam City

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Abstract

This study investigates the structural relationships between Green MICE, Smart Tourism, Destination Sustainability, and Destination Competitive Advantage in Batam City, a strategic cross-border MICE hub. Utilizing a quantitative design with Partial Least Squares Structural Equation Modeling (PLS-SEM), empirical data were collected from 170 qualified supply-side MICE practitioners, including venue managers, hotel executives, and event organizers. The structural path analysis reveals that Green MICE does not exert a direct significant effect on destination sustainability due to municipal infrastructure bottlenecks and early-stage operational adoption. However, Green MICE significantly enhances destination competitive advantage by serving as a key strategic market differentiator. Conversely, Smart Tourism demonstrates a strong, positive, and significant impact on both destination sustainability and competitive advantage, acting as an indispensable dual-engine catalyst. Theoretically, this research highlights digital capability as the vital operational foundation needed to convert pro-environmental commitments into actual destination sustainability within emerging border regions. Practically, local authorities and industry actors in Batam must establish standardized green policies, upgrade eco-friendly infrastructure, and synthesize smart technology applications to secure long-term competitiveness.

Keywords: Green Mice, Smart Tourism, Destination Sustainability, Competitive Advantage, Cross-Border Mice

Introduction

In the post-COVID-19 era, the global tourism industry has demonstrated a significant recovery trajectory (Higgins-Desbiolles et al., 2022). Within this recovery, the Meetings, Incentives, Conferences, and Exhibitions (MICE) sector has emerged as one of the most rapidly growing, yet resource-intensive, segments (Buathong & Lai, 2017). MICE tourism is prioritized strategically due to its capacity to generate substantial economic impacts for host

destinations (An et al., 2021) by catalyzing secondary sectors, including transportation, food and beverage services, and venue providers (Anas et al., 2020).

However, this rapid expansion sits at the center of a critical debate within the social sciences: the inherent tension between capitalistic economic maximization and socio-ecological resilience. Large-scale MICE operations generate considerable environmental drawbacks, serving as major contributors to carbon emissions, resource depletion, and waste accumulation (Neugebauer et al., 2020; Mannheim & Lovasné Avató, 2025; Li et al., 2025).

Consequently, the "Green MICE" concept has emerged as a vital framework to reconcile the surging demand for event hosting with environmental stewardship. Yet, current literature often critiques pro-environmental tourism initiatives as performative or fragmented—failing to achieve systemic sustainability unless actively supported by integrated technological infrastructures (Neugebauer et al., 2020). Therefore, contemporary discourse emphasizes synthesizing Green MICE with Smart Tourism. Smart tourism technologies offer data-driven operational efficiencies that not only minimize ecological footprints but also create distinctive competitive advantages (Li et al., 2025). The explicit research problem lies in understanding how the structural interplay between green practices and smart technology adoption translates into tangible destination sustainability and competitiveness, moving beyond theoretical assumptions into practical execution.

In the Southeast Asian context, Indonesia's MICE competitiveness still lags behind neighboring countries such as Singapore, Malaysia, and Thailand (Buathong & Lai, 2017; Anas et al., 2020). While the Indonesian government aims to develop strategic MICE flagship cities to boost regional competitiveness, domestic academic research remains overwhelmingly focused on established, mature tourism hubs like Jakarta (Gultom et al., 2025) and Bali (Nurany et al., 2021). Although Batam City is officially designated as a primary MICE destination due to its immediate geographical proximity to advanced cross-border economies like Singapore and Malaysia, it remains severely under-researched.

A review of academic literature over the past decade reveals a stark disproportion, with only two empirical studies explicitly investigating Batam's MICE sector. Specifically, Krisnadi and Dewantara (2018) conducted a weighting analysis of the variables supporting MICE development, while Fahlevi et al. (2025) examined the effects of service quality and price fairness on the satisfaction and loyalty of MICE venue users. Notably, neither of these studies addressed the intersection of environmental sustainability and digital transformation. This acute scarcity of relevant empirical research stands in sharp contrast to Batam's national strategic importance, underscoring a profound academic gap.

Furthermore, the current policy trajectory of local authorities highlights a critical imbalance that this study seeks to address. In 2025, the Batam City Government (Pemko Batam) introduced a five-pillar MICE development strategy, focusing primarily on investment deregulation, smart technological infrastructure for hybrid meetings, workforce competency, tax relief, and professional certification (Pemko Batam, 2025). While the emphasis on digital infrastructure provides a strong empirical rationale for integrating Smart Tourism within Batam's development model, the glaring absence of explicit environmental sustainability mandates within these foundational pillars exposes a significant policy gap. The government's

current strategy remains heavily skewed toward economic expansion and technological readiness, potentially side-lining the socio-ecological resilience required for long-term competitiveness.

The significance and urgency of this research are explicitly tied to resolving these academic and policy gaps. Emerging cross-border destinations like Batam face unique socio-economic pressures; they must compete with the superior infrastructure of neighboring countries while avoiding the trap of becoming mere low-value transit hubs. By empirically examining Batam City, this study proposes a comprehensively integrated model where Green MICE and Smart Tourism act collectively to balance economic ambitions with ecological preservation. Ultimately, this study aims to contribute theoretically to the ongoing social science debates on sustainable transitions in asymmetric border economies, while practically equipping local policymakers and industry practitioners with an evidence-based model to optimize sustainable event management.

Literature Review

Green MICE and Sustainable MICE Destination

Destination sustainability relies fundamentally on the commitment of tourism actors to internalize environmental and social values into their operational practices (Kusumo et al., 2026). Within the MICE sector, the adoption of green practices serves as an operational bridge to manifest these values, transitioning from passive awareness to active environmental stewardship. Pro-environmental tourism businesses must transcend superficial claims, moving beyond mere slogans to implement concrete eco-friendly practices, such as reducing carbon emissions and minimizing environmental degradation (Adepoju & Yesilada, 2026).

When MICE providers, venues, and event organizers systematically embed green practices (such as waste reduction, energy efficiency, and sustainable sourcing), they directly mitigate the ecological footprint of large-scale events. Consequently, the genuine implementation of Green MICE initiatives fosters double-bottom-line outcomes, reinforcing financial viability for businesses while ensuring long-term environmental protection and socio-ecological resilience for the destination (Adepoju & Yesilada, 2026; Kusumo et al., 2026). Based on these logical relationships, the following hypothesis is proposed:

H1: Green MICE has a positive and significant effect on Sustainable MICE Destination.

Smart Tourism and Sustainable MICE Destination

Digital technology offers substantial opportunities to enhance production efficiency and competitive positioning across the tourism value chain (Agerskans, 2026). Within smart destinations, cutting-edge technologies and data-driven insights are leveraged to enrich visitor experiences, optimize resource utilization, and mitigate the adverse impacts of tourism activities on local communities and ecosystems (Akbaba, 2024). The strategic adoption of digital applications (ranging from transportation and accommodation systems to integrated tourism services) acts as a primary driver for optimizing tourism structures, thereby fostering long-term economic sustainability (Li et al., 2026).

Beyond economic advantages, digital solutions support operational and cultural preservation while serving as powerful tools for virtual itineraries and internet research, which significantly minimize environmental and ecological risks (Gonçalves et al., 2022). Consequently, Smart

Tourism functions as a holistic mechanism for destination regeneration, offering data-backed solutions that ensure ecological preservation, economic viability, and social cohesion (Akbaba, 2024; Gonçalves et al., 2022; Li et al., 2026). Based on these theoretical insights, the following hypothesis is formulated:

H2: Smart Tourism has a positive and significant effect on Sustainable MICE Destination.

Green MICE and Destination Competitive Advantage

In the modern tourism ecosystem, consumer preferences have shifted significantly toward environmentally responsible choices, making sustainability a decisive factor in purchasing decisions (Adepoju & Yesilada, 2026). Within the MICE industry, the availability and operationalization of eco-friendly venues have become vital indicators for fostering destination competitiveness, serving as a globally recognized benchmark for event selection (Kaewsangorn et al., 2025). Destinations that actively incorporate pro-environmental standards (such as low carbon emissions and heightened environmental awareness) demonstrate stronger market positioning and distinct competitive advantages over conventional alternatives (Li et al., 2025).

Furthermore, adopting Green MICE practices enhances destination appeal, stimulates event planners' purchasing intention, and secures long-term business sustainability by aligning destination offerings with international green compliance standards (Adepoju & Yesilada, 2026; Kaewsangorn et al., 2025; Li et al., 2025). Consequently, the integration of Green MICE initiatives acts as a strategic differentiator that elevates a destination's global standing and market share. Based on these logical arguments, the following hypothesis is formulated:

H3: Green MICE has a positive and significant effect on Destination Competitive Advantage.

Smart Tourism and Destination Competitive Advantage

The integration of advanced digital infrastructure and smart technologies serves as a fundamental determinant in strengthening a destination's overall competitive position (Khelashvili & Okroshidze, 2025). In established MICE hubs, robust physical infrastructure must be coupled with continuous technological and logistical enhancements to sustain market leadership and operational efficiency (Tirtawati et al., 2024). Smart tourism applications, including Augmented Reality (AR) and Virtual Reality (VR), significantly elevate the visitor experience by providing immersive interactions, thereby enriching the destination's value proposition and competitive appeal (Gonçalves et al., 2022).

However, the adoption of information technology also presents strategic nuances for business and MICE tourism; virtual meeting platforms and digital exhibitions can exert a substitution effect, potentially reducing the demand for traditional physical business travel (Gössling, 2021; Lee et al., 2021). To mitigate this substitution threat and convert digital tools into a competitive edge, destinations must leverage smart tourism not merely as a replacement for physical travel, but as an integrative ecosystem that enhances seamless logistics, onsite event delivery, and hybrid experiences (Khelashvili & Okroshidze, 2025; Tirtawati et al., 2024). Consequently, destinations that effectively synthesize smart technological capabilities with physical MICE operations achieve superior market differentiation and long-term competitive advantage. Based on these theoretical dynamics, the following hypothesis is advanced:

H4: Smart Tourism has a positive and significant effect on Destination Competitive Advantage.

Research Methodology

This study adopts a quantitative research design utilizing Partial Least Squares Structural Equation Modeling (PLS-SEM) to empirically analyze the structural relationships among Green MICE, Smart Tourism, Destination Sustainability, and Destination Competitive Advantage. To capture accurate operational and strategic insights, the target population comprises supply-side MICE actors in Batam City, specifically Event venue managers, Convention hotel executives, Professional Conference Organizers (PCOs), Event Organizers (EOs), and Local tourism authorities. Data were collected using a purposive sampling technique, combined with a randomized selection of qualified participants, to ensure that every surveyed respondent possessed the requisite expertise and background to evaluate destination-level operational dynamics accurately.

A total of 170 valid respondents were successfully surveyed based on predetermined inclusion criteria: having direct professional experience in organizing or managing MICE events in Batam City and demonstrating a comprehensive understanding of venue operations and event management protocols. Applying these strict screening criteria ensured that only qualified industry practitioners evaluated the actual implementation of green practices and smart technology integration, thereby significantly reducing response bias and enhancing data validity (Hair & Alamer, 2022). Data collection was executed using structured questionnaires featuring multi-item measurement scales adapted from validated literature to measure professional evaluations from an operational perspective.

Following the methodological recommendations of Hair & Alamer (2022), the empirical analysis was conducted through a systematic PLS-SEM evaluation process, comprising both measurement (outer) and structural (inner) model assessments. The measurement model was evaluated for convergent validity using the Average Variance Extracted ($AVE \geq 0.50$) and for construct reliability using Cronbach's Alpha and Composite Reliability (> 0.70). Subsequently, the structural model assessment examined the explanatory power via the Coefficient of Determination (R^2) of the endogenous constructs, while path coefficients (β), t-statistics, and p-values were derived using bootstrapping procedures (Hair & Alamer, 2022). Furthermore, to ensure model robustness and eliminate potential confounding effects among the hypothesized structural paths, PLS-based model selection principles were applied to account for alternative explanatory mechanisms within the conceptual framework (Sharma et al., 2019).

Results and Discussion

Result

Demographic Profile of Respondents

The empirical evaluation begins with a demographic profile analysis of the 170 surveyed MICE practitioners and decision-makers in Batam City. Table 1 outlines the complete distribution across age, gender, and functional positions within the industry.

Table 1

Demographic Profile of Respondents

Variable	Category	Frequency (n)	Percentage (%)
Age	Over 40 years	63	37.06%
	30–40 years	51	30.00%
	26–30 years	35	20.59%
	17–25 years	21	12.35%
Gender	Female	88	51.76%
	Male	82	48.24%
Functional Position	Professional Conference Organizers (PCOs)	71	41.76%
	Event Organizers (EOs)	43	25.29%
	Convention Hotel Executives	32	18.82%
	Event Venue Managers	22	12.94%
	Local Tourism Authorities	2	1.18%

Based on the demographic analysis of 170 MICE practitioners and stakeholders in Batam City, the sample is dominated by respondents aged over 40 years (37.06%, $n = 63$), reflecting a high level of professional maturity and industry experience. The gender distribution is relatively balanced, with female respondents accounting for a slightly higher proportion (51.76%, $n = 88$) than male respondents (48.24%, $n = 82$). In terms of functional position, the majority of respondents are Professional Conference Organizers (PCOs) at 41.76% ($n = 71$), followed by Event Organizers (EOs) at 25.29% ($n = 43$). The combined dominance of PCOs and EOs (67.05%) ensures that the empirical data is derived from key operational actors directly responsible for planning and executing MICE events in Batam City.

Measurement Model Assessment (Outer Model)

The measurement model was evaluated to establish construct validity and reliability, as summarized in Table 2.

Table 2

Measurement Model Assessment

Construct	AVE	Cronbach's α	Assessment
Destination Competitiveness	0.648	0.955	Valid & Reliable
Green MICE	0.607	0.900	Valid & Reliable
MICE Destination Sustainability	0.661	0.964	Valid & Reliable
Smart Tourism	0.600	0.910	Valid & Reliable

The measurement model (outer model) evaluation confirms robust convergent validity and internal consistency reliability across all latent constructs. As shown in Table 2, the Average Variance Extracted (AVE) values range from 0.600 to 0.661, comfortably exceeding the recommended benchmark threshold of 0.50 (Hair & Alamer, 2022). This indicates that each construct accounts for more than 60% of the variance in its respective indicators. Furthermore, internal consistency reliability is strongly established, with Cronbach's Alpha values ranging between 0.900 and 0.964, well above the standard threshold of 0.70 (Hair & Alamer, 2022). These empirical metrics demonstrate that the measurement model possesses

high statistical soundness, providing a valid and reliable foundation for evaluating the structural model parameters.

Coefficient of Determination (R^2).

Table 3

Coefficient of Determination (R^2)

Endogenous Construct	R^2	Adjusted R^2	Interpretation
Destination Competitiveness	0.730	0.727	Strong
MICE Destination Sustainability	0.710	0.705	Strong

The evaluation of the structural model (inner model) begins with assessing the Coefficient of Determination (R^2) to determine the predictive power of the conceptual model on the endogenous constructs. As presented in Table 3, the R^2 value for MICE Destination Sustainability is 0.710 (Adjusted R^2 = 0.705), indicating that 71.0% of the variance in MICE destination sustainability in Batam City is substantially explained by Green MICE practices and Smart Tourism integration. Furthermore, Destination Competitiveness achieves an R^2 value of 0.730 (Adjusted R^2 = 0.727), demonstrating that 73.0% of the variance in Batam's competitive advantage as a MICE hub is accounted for by the exogenous predictors. Following the criteria of Hair & Alamer (2022), R^2 values exceeding 0.70 represent a strong explanatory capability, confirming that the structural model possesses high predictive validity in explaining destination dynamics within a cross-border context.

Hypothesis Testing (Path Coefficients)

In Partial Least Squares Structural Equation Modeling (PLS-SEM), hypothesis testing is evaluated by examining the direction, magnitude, and statistical significance of the estimated path coefficients derived through bootstrapping. A direct relationship is considered statistically significant if the empirical t-statistic exceeds the critical threshold of 1.96 at a two-tailed 5% significance level, accompanied by a p-value below the standard benchmark of 0.05 ($p < 0.05$). Path estimates meeting these statistical criteria provide empirical support for the hypothesized theoretical relationships, whereas paths failing to reach these cut off values indicate an absence of direct structural effect among the latent constructs.

Table 4

Hypothesis Testing

Path	β	t-statistic	p-value	Result
Green MICE → Sustainable MICE Destination	-0.039	0.489	0.312	Not Supported
Smart Tourism → Sustainable MICE Destination	0.442	4.418	0.000	Supported
Green MICE → Destination Competitive Advantage	0.442	5.950	0.000	Supported
Smart Tourism → Destination Competitive Advantage	0.458	6.386	0.000	Supported

The structural path coefficient analysis reveals that three out of the four direct hypotheses are statistically supported. Specifically, Green MICE exerts no significant direct effect on Sustainable MICE Destination (β = -0.039, t = 0.489, p = 0.312), leading to the rejection of H1

and suggesting that green practices alone, without digital integration or structural enforcement, have not yet translated directly into destination-level sustainability in Batam. Conversely, Smart Tourism demonstrates a strong, positive, and significant impact on Sustainable MICE Destination ($\beta = 0.442$, $t = 4.418$, $p = 0.000$), supporting H2 and highlighting technology as a primary operational catalyst for destination sustainability.

Furthermore, both Green MICE ($\beta = 0.442$, $t = 5.950$, $p = 0.000$) and Smart Tourism ($\beta = 0.458$, $t = 6.386$, $p = 0.001$) significantly drive Destination Competitiveness, thereby accepting H3 and H4. These findings confirm that while both green standards and smart digital infrastructure are essential for positioning Batam as a competitive cross-border MICE hub, digital capability serves as the foundational driver for achieving actual ecological and operational sustainability.

Discussion

H1: Green MICE has a positive and significant effect on Sustainable MICE Destination.

The rejection of H1 highlights a gap between conceptual expectations and practical outcomes in Batam's current MICE landscape, contrasting with the foundational premise that green practices inherently foster destination sustainability (Kusumo et al., 2026). As emphasized in the literature, achieving true destination sustainability (encompassing both socio-ecological resilience and long-term economic viability) requires tourism actors to transcend preliminary awareness and implement concrete operational measures (Adepoju & Yesilada, 2026).

In Batam City, while practitioners demonstrate an initial commitment to pro-environmental values, many green initiatives remain at an early, ceremonial phase rather than progressing into fully integrated operational standards. Rather than reflecting an intentional lack of commitment, this situation arises because individual event organizers and venue providers face systemic structural limitations, such as a lack of eco-friendly public transportation, dedicated green venue certifications, and city-wide integrated waste management systems. Consequently, without fully developed municipal infrastructure and standardized policy support to translate pro-environmental values into complete life-cycle execution, isolated Green MICE practices remain insufficient to generate comprehensive ecological and economic sustainability at the destination level (Adepoju & Yesilada, 2026; Kusumo et al., 2026).

H2: Smart tourism has a positive and significant effect on Sustainable MICE Destination.

The acceptance of H2 confirms that Smart Tourism serves as a pivotal operational catalyst for driving destination sustainability in Batam City, aligning seamlessly with established theoretical frameworks (Agerskans, 2026; Akbaba, 2024). As articulated in the literature, digital technology enhances production efficiency and provides data-driven insights that optimize resource utilization while mitigating the environmental and ecological risks associated with tourism activities (Akbaba, 2024; Gonçalves et al., 2022).

In Batam's MICE ecosystem, the adoption of smart digital infrastructure—ranging from integrated registration systems and virtual/hybrid event solutions to digital mobility and accommodation platforms—effectively addresses both dimensions of sustainability.

Economically, smart applications streamline event logistics and operational structures, driving long-term financial viability for local businesses (Li et al., 2026). Environmentally, the digital transformation of event processes minimizes physical resource consumption, paper waste, and transport-related emissions (Gonçalves et al., 2022). Consequently, unlike isolated green practices, Smart Tourism offers a structured, data-backed operational framework that enables Batam to achieve holistic destination regeneration, balancing ecological preservation with economic growth (Akbaba, 2024; Li et al., 2026).

H3: Green MICE has a positive and significant effect on Destination Competitive Advantage.

The acceptance of H3 empirically confirms that Green MICE adoption acts as a strategic differentiator that significantly elevates Batam's destination competitive advantage, supporting the core theoretical arguments in the literature (Adepoju & Yesilada, 2026; Kaewsangorn et al., 2025; Li et al., 2025). As established in the conceptual framework, modern MICE consumers and international event planners exhibit heightened environmental awareness, making eco-friendly standards a decisive factor in venue selection and purchasing decisions (Adepoju & Yesilada, 2026).

In the context of Batam as a cross-border MICE hub, the operationalization of green practices (such as eco-friendly venue management, energy efficiency, and waste reduction) provides a globally recognized benchmark that enhances the destination's market positioning relative to regional competitors (Kaewsangorn et al., 2025; Li et al., 2025). Although H1 demonstrated that green practices in Batam have not yet fully achieved destination-level sustainability due to municipal infrastructure bottlenecks, the acceptance of H3 highlights that pro-environmental commitments immediately translate into market appeal, corporate reputation, and brand differentiation. Consequently, embedding Green MICE standards enables Batam to capture environmentally conscious market segments, thereby strengthening its long-term competitive positioning in the regional MICE market (Adepoju & Yesilada, 2026; Kaewsangorn et al., 2025).

H4: Smart tourism has a positive and significant effect on Destination Competitive Advantage.

The acceptance of H4 demonstrates that Smart Tourism integration directly strengthens Batam's destination competitive advantage, providing robust empirical support for the conceptual framework (Gonçalves et al., 2022; Khelashvili & Okroshidze, 2025; Tirtawati et al., 2024). As outlined in the literature, leveraging digital infrastructure, smart logistics, and interactive technologies enhances visitor engagement and operational seamlessness, creating a strong market value proposition (Gonçalves et al., 2022; Khelashvili & Okroshidze, 2025).

While theoretical debates suggest that virtual technologies might exert a substitution effect on traditional physical business travel (Gössling, 2021; Lee et al., 2021), the empirical findings in Batam prove that smart tourism acts as an indispensable complement rather than a substitute. In a cross-border context, smart applications (such as digital event platforms, real-time logistics management, and smart hospitality services) optimize event execution efficiency and elevate the overall attendee experience (Tirtawati et al., 2024). Consequently, by successfully synthesizing advanced technological capabilities with physical event

infrastructure, Batam effectively mitigates substitution risks, achieves distinct market differentiation, and consolidates its competitive edge against neighboring regional MICE destinations (Khelashvili & Okroshidze, 2025; Tirtawati et al., 2024).

Conclusion

This study empirically validates the structural interplay between Green MICE, Smart Tourism, Destination Sustainability, and Destination Competitive Advantage within the strategic cross-border context of Batam City. The findings demonstrate that while Green MICE does not exert a direct impact on destination sustainability due to systemic infrastructure bottlenecks and early-stage operational adoption, it serves as a powerful strategic differentiator that significantly drives destination competitive advantage.

Conversely, Smart Tourism emerges as a critical dual-engine catalyst, significantly enhancing both destination sustainability (by optimizing resource utilization and operational efficiency) and competitive advantage through seamless digital event delivery. Theoretically, this research enriches the MICE and border-tourism literature by revealing that digital technology capability acts as the primary operational foundation required to translate pro-environmental commitments into tangible destination sustainability.

Practically, the study provides strategic insights for local policymakers and industry actors in Batam, underscoring the urgent necessity to establish standardized municipal green policies, invest in eco-friendly transport and venue infrastructure, and further synthesize smart tourism applications to secure long-term market leadership and sustainable growth in the regional MICE landscape.

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