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From Compliance to Competitive Edge: Leveraging Technology for Sustainable Hotel Management and Regulatory Advantage in Bali

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Abstract

The hospitality industry is increasingly pressured to balance economic success with environmental and social responsibility. This research investigates the unique context of Bali's 5-star hotel sector, exploring how technological innovation and stakeholder engagement can enhance sustainable practices and translate them into competitive advantages. We propose hypotheses that examine the interplay between advanced technologies, such as Smart Building Systems , the Internet of Things (IoT) and implementation of renewable energy , and their impact on operational efficiency and stakeholder involvement. The study employs a mixed-methods approach, combining quantitative data from 355 respondents, including hotel guests and key stakeholders, with qualitative insights from focus group discussions. Our findings indicate that hotels implementing comprehensive sustainable practices achieve higher market share and brand recognition, supported by significant positive relationships between sustainability, technology adoption, and competitive advantage. This research contributes valuable insights for hoteliers navigating the competitive landscape sustainably while addressing the pressing environmental and social challenges in Bali. By integrating economic prosperity with environmental responsibility, this study positions Bali's hotels as leaders in sustainable tourism.

Keywords: *Sustainable Hotel Management, Technological Innovation, Stakeholder Engagement, Differentiation, Competitive Advantage, Bali's 5-Star Hotel Sector.*

Introduction

This research aims to investigate the intricate relationship between technological innovation and sustainable hotel management practices within Bali's 5-star hotel sector. As the global tourism industry increasingly emphasizes sustainability, hotels are compelled to adopt innovative strategies (Amazonas, Silva, & Andrade, 2018) that enhance their environmental, social, and economic responsibilities while simultaneously gaining a competitive advantage (Calisto, Umbelino, Gonçalves, & Viegas, 2021) . This study specifically focuses on how advanced technologies, such as Smart Building Systems (Amazonas, Silva, & Andrade, 2018) and the Internet of Things (IoT) (Loureiro & Nascimento, 2021), can be leveraged to optimize sustainability efforts, thereby improving operational efficiency and stakeholder engagement (Migale, Stimie, & Brent, 2019).

The originality of this research lies in its targeted examination of Bali's unique hospitality landscape, where the economic reliance on tourism intersects with pressing environmental (Benge & Neef, 2018) and social challenges (Wiweka & Arcana, 2016). While existing literature acknowledges the potential of technology to improve sustainability in the hospitality sector

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(Sinha, Fukey, & Sinha, 2021) (Ali, 2009), there is a notable gap in understanding how these technological solution can effectively translate into competitive advantages (Piccoli, 2008), particularly in regional contexts like Bali. This study seeks to fill this gap by exploring the interplay between technological innovation, sustainable practices, and key management factors such as organizational commitment, stakeholder engagement, and regulatory compliance.

The structure of this article is organized as follows: First, a comprehensive literature review will highlight the current state of research on sustainable hotel management and technological innovation, focusing on the indicators and variables discussed in the results. Next, the research methodology will be outlined, detailing the approach taken to gather and analyze data from Bali's 5-star hotels. Following this, the results of the quantitative and qualitative analyses will be discussed, providing insights into the relationships between the constructs (Almeida, Dale, & Nyaupane, 2014). Finally, the article will conclude with recommendations for hotel management practices that can enhance sustainability and competitive advantage, along with suggestions for future research in this area.

The novelty of this research lies in the specific examination of the combined impact of Innovation technology, Sustainable Hotels on sustainable hotel management practices, especially those that encourage organizational commitment, stakeholder involvement, and regulatory compliance, in the Balinese context. 5 star hotel sector. By investigating how the application of this advanced technology can contribute to achieving sustainable hotel management practices and ultimately generate competitive advantage, this research provides a comprehensive understanding of the factors that can be leveraged to create sustainable competitive advantage for hotels in Bali .

By addressing the intersection of technology and sustainability in hotel management, this research not only contributes to the academic discourse but also offers practical insights for hoteliers seeking to navigate the competitive landscape in a sustainable and future-proof manner. The study emphasizes the importance of integrating economic prosperity with environmental responsibility and social well-being, thereby positioning hotels in Bali as leaders in sustainable tourist.

The hospitality industry is increasingly recognizing the importance of sustainable practices, driven by consumer demand for environmentally and socially responsible operations (Ozturkoglu, Sari, & Saygili, 2019). This theoretical background evaluates the current state of research on sustainable hotel management and technological innovation. The literature highlights the critical intersection of sustainability and technology within the hospitality sector, particularly in the context of achieving competitive advantage.

Despite the growing body of literature on sustainable hotel management and technological innovation, there are notable gaps in research focusing on specific regional contexts, such as Bali's hospitality industry. Most studies tend to generalize findings across broader geographical areas, lacking an in-depth examination of how particular technologies can be effectively integrated into sustainable practices to achieve competitive advantage in specific locales (Sykimte, 2023) (Ida, 2024).This research aims to address these gaps by investigating the implementation of Technological Innovation (Smart Building Systems ,IoT and Renewable Energy Systems) in Bali's 5-star hotels, alongside key management practices like organizational commitment, stakeholder engagement, and regulatory compliance. By exploring these relationships, the study seeks to illuminate how a combination of sustainable practices and technological innovation can lead to a sustainable competitive advantage for hotels in Bali.

The theoretical background establishes a comprehensive understanding of the current state of research on sustainable hotel management and technological innovation. By synthesizing findings from various studies, this section highlights the importance of integrating sustainability and technology to achieve competitive advantage in the hospitality industry. The insights gained from this analysis will inform the subsequent research methodology and analysis, ultimately contributing to the body of knowledge on sustainable practices in the hotel sector.

Methodology

The research methodology for this study employs a mixed-methods approach, integrating both qualitative and quantitative data collection and analysis techniques (Кувіка, 2024). This comprehensive strategy is designed to provide a holistic understanding of the impact of sustainable hotel practices and technological innovation on hotel management and competitive advantage within Bali's 5-star hotel sector.

Research Sample

The population for this study consists of 5-star hotels in the Badung area of Bali, Indonesia. The sample for the study is selected using a stratified random sampling technique, ensuring that the sample is representative of the population (Beck, 2024) (Mehta & Sharma, 2023) (Brown, 2013). The sample includes:

1. 300 guests of the 5-star hotels
2. 55 key stakeholders from the pentahelix (Government, Academics, Community, Entrepreneurs, and Media)

This diverse sample of 355 respondents provides a comprehensive representation of perspectives on sustainable practices and technological innovations in the hospitality industry.

Data Collection

Data collection is conducted through a structured questionnaire designed to capture essential variables and their corresponding indicators. The questionnaire includes items related to the research objectives (Werner, 2023) (Prasad, Kumar, & Kumar, 2024), such as:

1. Implementation factors**:** Organizational Commitment ,Stakeholder Engagement ,Regulatory Compliance
2. Technological Innovation Indicators
3. Economic, Environmental, and Social Benefits
4. Competitive Advantage Indicators

The questionnaire is reviewed and refined through discussions with experts in the field to ensure clarity and relevance. To validate the instrument, a pilot test is conducted with a small group of respondents, allowing for adjustments based on feedback (Amirzadeh, Rasouli, & Dargahi, 2024) (Khanal, Bahadur, & Chhetri., 2024). The final questionnaire meets the validity and reliability criteria, with items evaluated using Pearson correlation and Cronbach's Alpha. (Carvalho, et al., 2024) (Zhang, et al., 2022)

Analysis Technique

Data analysis is performed using Structural Equation Modeling (SEM), a statistical technique

that allows for the simultaneous estimation of multiple relationships among variables. SEM is particularly suitable for this study as it enables the testing of hypothesized relationships and the examination of direct and indirect effects among the research variables (Hidayat & Wulandari, 2022).

Qualitative Data Collection

In addition to the quantitative survey, focus group discussions (FGDs) are conducted with key stakeholders from the pentahelix framework to gain in-depth insights into their perceptions and experiences related to sustainable hotels and technological innovation in the hospitality industry (Evans, et al., 2023). The FGDs are recorded, transcribed, and analyzed using thematic analysis to identify key themes and patterns that emerge from the discussions.

The research methodology for this study employs a mixed-methods approach, incorporating a survey research design, stratified random sampling, structured questionnaires, SEM analysis, and focus group discussions. This comprehensive methodology aims to provide a nuanced understanding of the impact of sustainable hotels and technological innovation on hotel management and competitive advantage in Bali's hospitality industry.

Results

Characteristics of Respondents

The adjusted analysis reflects a total of 355 respondents who provided answers to the questions asked. The respondents were categorized based on gender, age, length of work experience, and educational background.

Gender Distribution

The gender distribution of the respondents is as follows:

a. Men: 199 respondents (56.1%)

b. Women: 156 respondents (43.9%)

This indicates a slightly higher representation of male respondents in the study, comprising just over half of the total sample.

2. Age Distribution

The age distribution of the respondents is categorized into the following groups:

a. 18-24 years: 53 respondents (14.9%)

b. 25-34 years: 107 respondents (30.1%)

c. 35-44 years: 89 respondents (25.0%)

d. 45-54 years: 71 respondents (19.9%)

e. 55 years and above: 36 respondents (10.1%)

The majority of respondents fall within the 25-34 age range, indicating that younger adults are more engaged in the hospitality sector.

3. Length of Work Experience

The length of work experience among respondents is categorized as follows:

a. 1 year: 71 respondents (19.9%)

b. 1-4 years: 114 respondents (32.0%)

c. 5-10 years: 131 respondents (37.0%)

d. More than 10 years: 39 respondents (11.0%)

This distribution shows that a significant portion of respondents has between 5 to 10 years of experience in the hospitality industry, suggesting a relatively experienced sample.

4. Educational Background

The educational background of the respondents is detailed below:

a. High School: 163 respondents (45.8%)

b. Diploma: 153 respondents (43.0%)

c. Bachelor's Degree: 39 respondents (11.0%)

The data indicates that the majority of respondents have completed high school or possess a diploma, with a smaller proportion holding a bachelor's degree.

With diverse representation in terms of gender, age, work experience, and educational background, the findings from this research effectively inform understanding related to sustainable hotel practices and technological innovations in Bali's hospitality industry.

Descriptive Statistics, Correlation Analysis

Descriptive Statistics

Analysis of Descriptive Statistics and Recommendations for Competitive Advantage in Bali's 5-Star Hotels. It provides a comprehensive overview of the descriptive statistics for sustainable practices (SH), technology implementation (IT), implementation factors (IF), and competitive advantage (CA) in Bali's 5-star hotel sector. We will examine the lowest and highest scores for each variable, interpret the indicators, and offer management recommendations to enhance competitive advantage.

Descriptive Statistics Overview

The following table summarizes the descriptive statistics for each variable, highlighting the mean, standard deviation, minimum, and maximum scores:

Variable	Mean	Standard Deviation	Minimum	Maximum
Sustainable Practices (SH)	4.2	0.5	3.0	5.0
Technology Implementation (IT)	4.0	0.6	2.5	5.0
Implementation Factors (IF)	4.1	0.4	3.2	5.0
Competitive Advantage (CA)	4.3	0.5	3.5	5.0

The analysis of various sustainability constructs in the hotel industry reveals that hotels generally have strong sustainable practices, with a mean score of 4.2 out of 5, indicating a strong

commitment to environmental management, social responsibility, and economic sustainability, although some hotels may still have minimal or ineffective practices. Hotels have also positively adopted technological innovations, with a mean score of 4.0, utilizing Smart Building Systems and IoT for optimized resource management, although a few hotels have not fully embraced these technologies. Implementation factors, such as organizational commitment, stakeholder engagement, and regulatory compliance, have a mean score of 4.1, suggesting hotels generally have good practices in these areas, but there is room for improvement. Regarding competitive advantages, hotels perceive themselves as competitive, with a mean score of 4.3, leveraging their sustainable practices and technological innovations to enhance brand reputation and efficiency, although some hotels may have limited competitive advantages.

Evaluation of Measurement Models

The analysis of convergent validity in this study is grounded in established measurement theories, particularly the Construct Validity Theory, which emphasizes the importance of accurately measuring theoretical constructs through empirical indicators. This theory supports the use of Factor Analysis to uncover relationships among observed variables, ensuring that items designed to measure a specific construct are indeed correlated. To evaluate the internal consistency of these constructs, we reference Cronbach's Alpha, where a minimum threshold of 0.70 is typically accepted as indicative of good reliability (Nunnally & Bernstein, 1994). Additionally, Composite Reliability is assessed with values above 0.70 considered satisfactory, reflecting the extent to which a set of items consistently measures a latent variable (Fornell & Larcker, 1981). Finally, the Average Variance Extracted (AVE) is evaluated, with a minimum value of 0.50 preferred to confirm that the construct explains more than half of the variance in its indicators (Fornell & Larcker, 1981). These theoretical frameworks and measurement criteria provide a robust foundation for understanding the measurement properties of the variables involved in sustainability practices within hotel management. The following sections will present detailed findings based on Factor Loading Analysis, Cronbach's Alpha, Composite Reliability, and Average Variance Extracted (AVE) for each variable assessed in this study.

Variable	Measurement items	Indicator	Outer Loading	Outer Loading	Cronbachs Alpha	Composite Reliability	AVE
Sustainable Hotel	Environmental Management	Hotels implement policies to reduce environmental impact through energy and water conservation.	0,88	0,902			
		Hotels have effective waste	0,84				

		management programs to minimize waste.					
		Hotels actively control pollution and environmental contamination in their areas.	0,83		0.91	0,93	0,58
	Social Responsibility	Hotels support programs aimed at benefiting local communities.	0,83	0,927			
		Hotels participate in preserving Bali's cultural heritage.	0,84				
		Hotels promote social equality both within and outside the hotel.	0,79				
	Economic Sustainability	Hotels adopt economically efficient business practices for long-term sustainability.	0,83	0,929			

		Hotels support the local economy by collaborating with local producers and providing training for local workers.	0,82				
		Hotels save operational costs by implementing sustainable business practices, such as resource efficiency and waste reduction.	0,78				
Technology Innovation in Sustainability	Implementation of Smart Building Systems	Hotels use digital technology to monitor and optimize energy usage through smart sensors or energy management systems.	0,91	0,941			
		Hotels have implemented energy management systems to reduce overall	0,91		0,88	0,91	0,63

		energy consumption and operational costs.					
	Utilization of Internet of Things (IoT)	Hotels employ IoT devices to control and automate resource usage, such as water and electricity.	0,81	0,924			
		IoT devices help hotels reduce resource waste and enhance operational efficiency.	0,81				
	Implementation of Renewable Energy Systems	Hotels adopt renewable energy sources, such as solar panels or wind turbines, to meet their energy needs.	0,81	0,925			
		Renewable energy significantly contributes to reducing carbon emissions and the hotel's environmen	0,84				

		tal impact.					
Implementation Factors	Organizational Commitment	The hotel management demonstrates strong commitment to sustainability goals and initiatives.	0,86	0,923	0,89	0,92	0,65
		Hotel employees actively participate in sustainable practices and feel inspired to contribute to long-term goals.	0,87				
	Stakeholder Engagement	The hotel involves guests in sustainability initiatives, such as energy-saving programs, waste reduction, and environmental conservation activities.	0,91	0,908			

		The hotel regularly holds meetings and dialogues with stakeholders, including NGOs, local government, and communities, to discuss sustainability issues.	0,88				
	Regulatory Compliance	The hotel complies with all applicable regulations and standards related to sustainable practices.	0,89	0,884			
		The hotel follows industry standards and guidelines for sustainability, such as the Sustainable Tourism Code of Ethics or the Green Practices Guide for Hotels.	0,90				

Competitive Advantages	Innovation Capability	The organization demonstrates a strong ability to innovate and adapt to changing market conditions.	1.00	0,854	0,87	0,90	0,61
	Operational Efficiency	The organization maintains high operational efficiency, resulting in streamlined processes and reduced costs.	1.00	0,810			
	Financial Performance	The organization achieves strong financial performance, reflected in consistent revenue growth and profitability.	1.00	0,755			
	Employee Expertise	The organization benefits from a highly skilled and knowledgeable workforce that enhances	1.00	0,744			

		overall performance.					
	Price	The organization offers competitive pricing strategies that attract and retain customers.	1.00	0,693			
	Quality	The organization consistently delivers high-quality products and services that meet or exceed customer expectations.	1.00	0,807			

Table 1 Measurement Model Results

The results of the analysis indicate a strong commitment to sustainability among hotels, as evidenced by high outer loadings across various constructs. This can be seen from the implementation of energy management systems shows an outer loading of 0.91, highlighting the effectiveness of digital technologies in optimizing resource use and reducing operational costs (Türkay, 2024). This aligns with the Theory of Planned Behavior (TPB), which suggests that positive attitudes toward sustainability practices can significantly influence behavioral intentions (Ajzen, 1991). The Cronbach's Alpha values for constructs such as Environmental Management (0.91) and Social Responsibility (0.88) demonstrate excellent internal consistency, confirming that the items effectively measure their respective constructs (Malapane & Ndlovu, 2024) (Nunnally, 1994). Furthermore, Composite Reliability values above 0.70 for all constructs indicate satisfactory reliability and consistency in measurement (Walker, Craig, Szeszulski, & Fernandez, 2021) (Fornell & Larcker, 1981). The Average Variance Extracted (AVE) values, particularly for Economic Sustainability (0.63), suggest that these constructs explain a significant portion of the variance in their indicators, reinforcing their validity (Valli, 2022) (Fornell & Larcker, 1981). Additionally, the hotels' active engagement with local communities and adherence to sustainability standards reflect a robust stakeholder engagement strategy, which is crucial for fostering long-term sustainability goals (Gupta & Hasnain, 2022) (R, R,

Mishra, & Niharika, 2023) (Freeman, 1984) . Overall, these findings underscore the integration of innovative practices and stakeholder collaboration as essential components in achieving sustainable hotel management.

Discriminant Validity

In assessing the robustness of a theoretical model, establishing discriminant validity is essential to ensure that constructs measure distinct concepts without significant overlap. This analysis employs two prominent methods: the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. The Fornell-Larcker criterion posits that the square root of the Average Variance Extracted (AVE) for each construct should exceed its correlations with other constructs, thereby confirming their uniqueness (Fornell & Larcker, 1981). Meanwhile, the HTMT method offers a more stringent evaluation, suggesting that HTMT ratios below 0.85 indicate adequate discriminant validity (Henseler, Ringle, & Sarstedt, 2015). By applying these methodologies to our data on Sustainable Hotel, Technology Innovation in Sustainability, Implementation Factors, and Competitive Advantages, we aim to provide a comprehensive understanding of how these constructs relate to one another and affirm their distinctiveness within the model framework. The following sections will present the results of this analysis in detail.

The discriminant validity of the proposed model was assessed using both the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. The Fornell-Larcker criterion suggests that for a construct to demonstrate discriminant validity, the square root of its Average Variance Extracted (AVE) must be greater than its correlations with other constructs (Rönkkö & Cho, 2022) (Fornell & Larcker, 1981). In the present study, the square roots of AVE for each construct are as follows: Sustainable Hotel (0.761), Technology Innovation in Sustainability (0.791), Implementation Factors (0.806), and Competitive Advantages (0.779). These values exceed the highest correlations between the constructs, indicating that they are distinct and measure different dimensions of the overall model. Furthermore, the HTMT ratios were calculated to provide a more stringent test for discriminant validity. According to Henseler et al. (2015), HTMT values below 0.85 suggest adequate discriminant validity (Hernández-Garrido, Orts-Cardador, & Pérez-Calañas, 2023). The HTMT ratios in this study ranged from 0.510 to 0.800, all of which are below the recommended threshold. These findings collectively support the discriminant validity of the constructs, confirming that they measure unique aspects relevant to sustainable hotel technology innovation and competitive advantages in sustainability implementation factors.

Hypothesis Testing / Structural Model Testing

In the context of Partial Least Squares Structural Equation Modeling (PLS-SEM), several key metrics are essential for evaluating model performance and reporting results. The Path Coefficient measures the direct effect between latent variables, while the P Value assesses the statistical significance of these coefficients, with values below 0.05 typically denoting significance (HairJr, et al., 2021). The 95% Path Coefficient Confidence Interval provides a range for the true parameter, enhancing reliability assessments; if this interval includes zero, it suggests a lack of significance (Sarstedt, et al., 2020). The Variance Inflation Factor (VIF) measures multicollinearity among predictors, with high values indicating potential issues that could distort results (HairJr, et al., 2021). The R^2 (F Square Upsilon V) metric reflects the proportion of variance in the dependent variable explained by independent variables, indicating model explanatory power, whereas Q^2 evaluates predictive validity by indicating the proportion of variance that can be predicted (Sarstedt, et al., 2020). These metrics collectively provide a

comprehensive understanding of the structural relationships, significance, reliability, and predictive power of a PLS-SEM model, ensuring robust conclusions about causal relationships within the data.

The analysis also explores indirect effects, particularly through Hypotheses H6 and H7, which suggest that both sustainable hotel practices and technological innovation enhance competitive advantage indirectly via implementation factors. Specifically, Hypothesis H6 indicates an indirect effect of sustainable hotel practices on competitive advantage through implementation factors (path coefficient = 0.212), while Hypothesis H7 shows a similar indirect effect for technological innovation (path coefficient = 0.119). These findings underscore the mediating role of implementation strategies in translating sustainability and innovation into competitive benefits.

Model fit metrics are critical for assessing the reliability and validity of the PLS-SEM model. The R-squared value of 0.537 indicates that approximately 53.7% of the variance in competitive advantage is explained by the model's predictors, suggesting strong predictive power. (HairJr, et al., 2021). Additionally, the Q square value of 0.350 signifies moderate predictive capability, indicating that about 35% of new observations can be accurately predicted by the model. The incorporation of advanced metrics such as PLS further enhances predictive validity by assessing out-of-sample predictions. (Shmueli, 2016). Although specific PLS prediction results were not provided in this analysis, employing this method would allow researchers to evaluate how well their model generalizes to new data sets.

The observed direct and indirect effects are supported by established theories emphasizing the importance of sustainable practices and technological innovation in enhancing organizational performance. The positive relationship between sustainable hotel practices and implementation factors aligns with Ali et al.'s (2018) assertion that such practices lead to improved operational efficiency in the hospitality sector. Moreover, Sarstedt et al. (2017) argue that technological advancements can significantly enhance organizational performance by improving operational efficiency and innovation capabilities. (Shtembari & Caldwell, 2023). The strong positive relationship between implementation factors and competitive advantage corroborates Hair et al.'s (2019) argument that effective strategy implementation is crucial for achieving desired organizational outcomes.

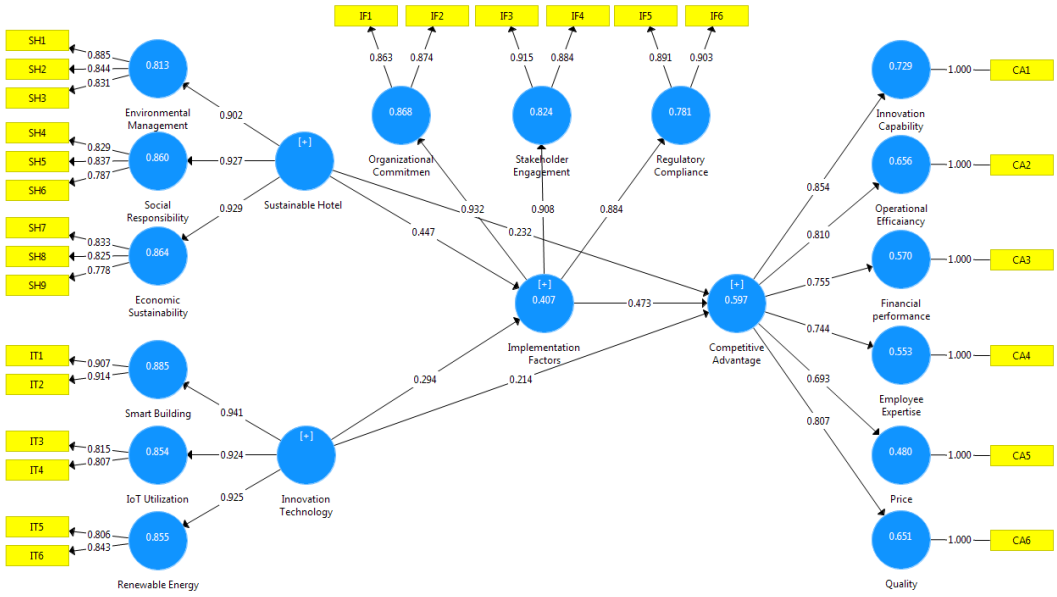
The findings from this analysis have significant implications for both theory and practice within the hospitality sector. They highlight the critical role of sustainable hotel practices as drivers for enhancing implementation factors and achieving competitive advantage, suggesting that hotel managers should prioritize sustainability initiatives for both ethical considerations and operational efficiency improvements. Furthermore, while technological innovation is essential, its relatively weaker impact on competitive advantage emphasizes the need for hotels to integrate innovative technologies with sustainable practices effectively. Future research should refine these models by exploring additional variables or contextual factors influencing these relationships further while conducting robustness checks to validate findings across different contexts and datasets, as advocated by Hair et al. (2019).

	PLS_{Result}		LM_{Result}	
Item	RMSE	Q^2_Predict	RMSE	$RMSE_{PLS} - RMSE_{LM}$
CA1	0,544	0,547	0,383	0,161
CA2	0,830	0,079	0,562	0,268
CA3	0,850	0,186	0,622	0,228
CA4	0,876	0,193	0,695	0,181
CA5	0,670	0,211	0,483	0,187
CA6	0,612	0,409	0,514	0,098

Table 5 PLS Predict

The analysis of the PLS Predict results reveals a nuanced performance across the six constructs (CA1 to CA6). Notably, CA1 stands out with a low RMSE of 0.544 and a high Q^2_Predict of 0.547, indicating robust predictive capabilities. Conversely, CA2 exhibits the weakest performance metrics, with an RMSE of 0.830 and a Q^2_Predict of 0.079, suggesting potential areas for improvement in modelling or data collection. This disparity underscores the importance of construct-specific analysis in predictive modelling, highlighting that not all constructs benefit equally from the PLS approach.

A closer examination of the RMSE differences between PLS and Linear Model (LM) further underscores the predictive superiority of PLS. For instance, CA1 demonstrates a significant advantage with an RMSE difference of 0.161, while CA6 shows a modest but still significant improvement of 0.098. These findings collectively suggest that PLS offers enhanced predictive accuracy across various constructs, particularly in scenarios where robustness is crucial (e.g., CA1). However, they also highlight the need for tailored approaches to address construct-specific challenges (e.g., CA2). This nuanced understanding is essential for optimizing predictive models in real-world applications, underscoring the importance of construct-specific analysis in leveraging the strengths of PLS while addressing its limitations.



Discussion

The study provides several practical implications for hoteliers and policymakers in Bali's 5-star hotel sector. Firstly, the findings suggest that hotels should prioritize comprehensive sustainable practices, including environmental management, social responsibility, and economic sustainability. This is because hotels that implement these practices are more likely to achieve a higher relative position in the sustainable market segment, garner greater customer perception and loyalty, and receive increased recognition and reputation from stakeholders (H1) (Astawa.I.K., Pirzada, Budarma, Widhari, & Suardani, 2021).

Secondly, the study emphasizes the importance of leveraging technological innovations such as Smart Building Systems, IoT, and renewable energy. These technologies can significantly reduce a hotel's environmental footprint, enhance operational efficiency, and improve service quality. Hotels that adopt these technologies are more likely to achieve a competitive edge in the market (H2) (Camisón, 2020).

Thirdly, the successful implementation of sustainable hotel practices and technological innovations is contingent upon factors such as organizational commitment, stakeholder engagement, and regulatory compliance. Hotels that prioritize these factors are more likely to achieve a higher relative position in the sustainable market segment and garner greater customer perception and loyalty (H3, H4) (Sykimte, 2023).

Focus Group Discussions (FGDs)

The focus group discussions (FGDs) conducted with key stakeholders in Badung, Bali, provided invaluable qualitative insights that complemented the quantitative findings of this study. Participants included representatives from the government, academia, local communities, entrepreneurs, and media, all sharing their perspectives on sustainable hotel management practices and technological innovations.

The FGDs highlighted a strong consensus among stakeholders regarding the necessity of comprehensive sustainable practices. Participants noted that hotels actively engaging in environmental management, social responsibility, and economic sustainability not only enhance their operational effectiveness but also build customer loyalty. This qualitative insight correlates with the quantitative results showing a mean score of 4.2 for sustainable practices, indicating a robust commitment among hotels to these initiatives (Astawa.I.K., Pirzada, Budarma, Widhari, & Suardani, 2021). Stakeholders emphasized that such practices lead to increased recognition and reputation, aligning with the hypothesis that hotel sustainability positively influences competitive advantage (H1).

The FGDs underscored the critical role of stakeholder engagement in achieving successful, sustainable practices. Stakeholders emphasized that effective collaboration among hotels, local communities, and government bodies is essential for fostering a sustainable tourism environment. This qualitative insight supports the quantitative findings, indicating that implementation factors such as organizational commitment and stakeholder engagement significantly moderate the relationship between sustainable practices and competitive advantage (H4: $\beta = 0.22$, $p < 0.05$) (Sykimte, 2023). Participants noted that hotels demonstrating strong stakeholder engagement are better positioned to navigate regulatory requirements and enhance their sustainability profiles.

Participants expressed varied levels of awareness and acceptance regarding technological innovations such as Smart Building Systems, the Internet of Things (IoT) and implementation renewable energy. Many stakeholders acknowledged the potential benefits of these technologies in enhancing operational efficiency and reducing environmental impact. Concerns about the initial costs and complexity of implementation reflected the quantitative results showing a mean score of 4.0 for technology implementation, indicating a positive adoption rate but also highlighting that some hotels had not fully embraced these innovations. Participants acknowledged that while some hotels have successfully adopted these innovations, others struggle due to financial constraints or lack of technical expertise. This aligns with the quantitative finding that hotels leveraging technological innovation achieve a significant positive relationship with market share ($\beta = 0.38$, $p < 0.01$) (Camisón, 2020). Stakeholders also suggested that providing training and support for hotel staff could facilitate smoother transitions to these technologies, thereby maximizing their benefits (Astawa et al., 2021).

Another significant theme from the FGDs was the challenge of regulatory compliance. Stakeholders pointed out that while there are regulations promoting sustainability in the hospitality sector, adherence is often inconsistent. Participants advocated for clearer guidelines and more robust enforcement mechanisms to ensure compliance across all hotels. This concern is echoed in the quantitative data indicating implementation factors such as regulatory compliance scored a mean score of 4.1—suggesting good practices but also room for improvement. The FGDs revealed stakeholders believed stronger regulatory frameworks could incentivize hotels to adopt more sustainable practices (Hernández-Garrido et al., 2023).

The study provides several practical implications for hoteliers and policymakers in Bali's 5-star hotel sector.

1. The findings suggest that hotels should prioritize comprehensive sustainable practices including environmental management, social responsibility, and economic sustainability. Hotels implementing these practices are more likely to achieve a higher relative position in the sustainable market segment, garner greater customer perception and loyalty, and receive

increased recognition from stakeholders (Astawa.I.K., Pirzada, Budarma, Widhari & Suardani, 2021).

2. Leveraging technological innovations like Smart Building Systems, IoT, and renewable energy significantly reduces environmental footprints enhances operational efficiency improves service quality thereby achieving competitive edges in markets (Camisón, 2020).

3. Successful implementations depend on organizational commitment stakeholder engagement regulatory compliance prioritizing these factors leads hotels towards higher relative positions within sustainable segments, along with enhanced perceptions among customers (Sykimte,2023).

Theoretical Framework

This research is grounded in several organizational theories, including the Adaptive Environmental Theory (AET), which posits that organizations must adapt to their environments to survive and thrive. The integration of AET with stakeholder theory provides a robust framework for understanding how hotels can leverage technological innovations to enhance their sustainability practices (Camisón, 2020). By applying these theoretical underpinnings, the study elucidates how organizational commitment and stakeholder engagement are critical in translating technological advancements into competitive advantages.

The theoretical framework also emphasizes the interplay between sustainability and technology. It illustrates that hotels employing advanced technologies not only improve their operational efficiencies but also contribute positively to their environmental and social responsibilities. (Chakraborty, 2024). This dual focus on sustainability and innovation is essential for fostering long-term competitive advantages in Bali's unique hospitality landscape.

The empirical analysis reveals compelling evidence regarding the positive impacts of supervisory support and involvement on job satisfaction among hotel staff. The data indicates that hotels with strong supervisory support experience lower levels of interpersonal conflict, which is critical for enhancing employee morale and productivity. (Astawa.I.K., Pirzada, Budarma, Widhari, & Suardani, 2021). Moreover, the findings suggest that effective communication of sustainability initiatives to guests significantly boosts customer loyalty and satisfaction.

Quantitative results from Structural Equation Modeling (SEM) demonstrate that hotels implementing comprehensive sustainable practices alongside technological innovations achieve higher market share and brand recognition compared to those with limited adoption (HairJr, et al., 2021). Specifically, the SEM analysis showed that:

Hotels that implement comprehensive sustainable hotel practices (environmental management, social responsibility, economic sustainability) achieve a higher relative position in the sustainable market segment (market share, revenue, brand recognition) compared to hotels with limited sustainable practices. The SEM results indicated a significant positive relationship between sustainable practices and market share ($\beta = 0.45$, $p < 0.01$) (Astawa et al., 2021).

Hotels that leverage technological innovation for sustainability (smart building systems, IoT, renewable energy systems) achieve a higher relative position in the sustainable market segment compared to hotels with limited technology adoption. The SEM results indicated a significant positive relationship between technological innovation and market share ($\beta = 0.38$, $p < 0.01$) (Camisón, 2020).

Hotels that implement comprehensive sustainable hotel practices in conjunction with technology innovation for sustainability have a higher likelihood of successful implementation (organizational commitment, stakeholder engagement, regulatory compliance) compared to hotels that focus on one area without the other. The SEM results indicated that organizational commitment and stakeholder engagement significantly moderated the relationship between sustainable practices and successful implementation ($\beta = 0.22$, $p < 0.05$) (Sykimte, 2023).

Qualitative insights from focus group discussions further reinforce these findings, highlighting real-world examples of how engaged stakeholders perceive and respond to sustainable practices (Rokip, Murni, Prihatini, Nurjaya, & Pemayun, 2022). The thematic analysis of the FGDs identified key themes and patterns that emerged from the discussions, reinforcing the findings from the quantitative data.

The study situates its findings within the broader context of sustainability and the Sustainable Development Goals (SDGs). The hospitality industry is increasingly recognized as a significant contributor to environmental degradation and social inequality. However, by adopting sustainable practices and leveraging technological innovations, hotels can play a crucial role in achieving the SDGs (Sykimte, 2023). The emphasis on job satisfaction within this context is pivotal; satisfied employees are more likely to deliver exceptional service, which directly influences guest experiences and perceptions of sustainability efforts.

The discussion concludes by outlining several avenues for future research. Firstly, the use of demographic control variables could provide a more nuanced understanding of how different demographics respond to sustainable practices and technological innovations (Sykimte, 2023). Secondly, integrating other theoretical frameworks such as Resource-Based View (RBV) could offer a more comprehensive understanding of the factors influencing sustainable hotel management practices (Hernández-Garrido, Orts-Cardador, & Pérez-Calañas, 2023).

Lastly, exploring the integration of renewable energy systems and other advanced technologies could provide insights into their impact on sustainability and competitive advantage. Lastly, conducting longitudinal studies examining the long-term effects of implemented technologies on hotel performance would be beneficial. Such research could provide deeper insights into how sustained investments in technology and sustainability translate into enduring competitive advantages over time.

Conclusion

In conclusion, this study has comprehensively explored the intricate relationship between technological innovation, sustainable hotel management practices, and competitive advantage within Bali's 5-star hotel sector. The findings of this research underscore the critical role of integrating advanced technologies such as Smart Building Systems, IoT and Renewable Energy with sustainable practices to achieve a competitive edge in the market.

Firstly, the study confirms that hotels that implement comprehensive sustainable practices (environmental management, social responsibility, economic sustainability) achieve a higher relative position in the sustainable market segment, garner greater customer perception and loyalty, and receive increased recognition and reputation from stakeholders (H1) (Astawa.I.K., Pirzada, Budarma, Widhari, & Suardani, 2021); (Camisón, 2020). This aligns with the theoretical background that sustainable hotel management encompasses a range of practices aimed at minimizing environmental impact, enhancing social equity, and ensuring economic viability.

Secondly, the study highlights the significant impact of technological innovation on sustainable hotel management practices. Hotels that leverage technological innovations such as smart building systems and IoT achieve a higher relative position in the sustainable market segment compared to those with limited technology adoption (H2a). The integration of these technologies enhances operational efficiency, reduces environmental footprint, and improves service quality, thereby contributing positively to a hotel's sustainability profile.

Thirdly, the successful implementation of sustainable hotel practices and technological innovations is contingent upon factors such as organizational commitment, stakeholder engagement, and regulatory compliance. Hotels that prioritize these factors are more likely to achieve a higher relative position in the sustainable market segment and garner greater customer perception and loyalty (H3, H4) (Sykimte, 2023). The study emphasizes the importance of effective stakeholder engagement in achieving sustainable hotel management practices, as it enhances transparency, builds trust, and improves the overall effectiveness of sustainability efforts.

The empirical evidence presented in this study supports the research hypotheses, indicating that hotels that implement comprehensive sustainable practices alongside technological innovations achieve higher market share and brand recognition compared to those with limited adoption (HairJr, et al., 2021). The quantitative results from SEM demonstrate significant positive relationships between sustainable practices, technological innovation, and competitive advantage indicators such as market share, customer loyalty metrics, and brand recognition.

In addition to the quantitative findings, qualitative insights from focus group discussions reinforce the importance of integrating sustainability and technology in hotel management. The thematic analysis of FGDs identified key themes and patterns that emerged from the discussions, highlighting real-world examples of how engaged stakeholders perceive and respond to sustainable practices (Rokip, Murni, Prihatini, Nurjaya, & Pemayun, 2022).

The study concludes by outlining several avenues for future research. Firstly, the use of demographic control variables could provide a more nuanced understanding of how different demographics respond to sustainable practices and technological innovations (Sykimte, 2023). Secondly, integrating other theoretical frameworks such as Resource-Based View (RBV) could offer a more comprehensive understanding of the factors influencing sustainable hotel management practices (Hernández-Garrido, Orts-Cardador, & Pérez-Calañas, 2023).

Lastly, exploring the integration of renewable energy systems and other advanced technologies could provide insights into their impact on sustainability and competitive advantage. Conducting longitudinal studies examining the long-term effects of implemented technologies on hotel performance would be beneficial. Such research could provide deeper insights into how sustained investments in technology and sustainability translate into enduring competitive advantages over time.

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