

## Eco-innovation strategies in hospitality: A case study of star-rated hotels in Batam



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### ABSTRACT

*This study examines the influence of eco-innovation on the sustainable performance of hotels in Batam, a destination characterized by a rapidly growing tourism and hospitality sector. Given the substantial environmental footprint of hotel operations through energy consumption and waste generation, understanding the effectiveness of different eco-innovation strategies is essential for advancing sustainability within the industry. Employing a quantitative research design, data were collected through surveys administered to managers of hotels that had been operating for at least ten years. A total of 120 valid responses were analyzed using Structural Equation Modeling with the Partial Least Squares approach through SmartPLS. The study evaluated four dimensions of eco-innovation: eco-product, eco-process, eco-organizational, and eco-marketing innovation. The findings reveal that eco-process, eco-organizational, and eco-marketing innovations exert significant positive effects on sustainable hotel performance, highlighting the importance of environmentally efficient operational practices, sustainability-oriented organizational systems, and green marketing initiatives in enhancing economic, environmental, and social outcomes. In contrast, eco-product innovation was not found to significantly influence sustainable performance, suggesting that environmentally friendly products alone may be insufficient to generate substantial sustainability improvements without complementary organizational and operational changes. These findings contribute to the literature on sustainable tourism and hospitality management by demonstrating the differentiated effects of eco-innovation dimensions on organizational sustainability. The study further suggests that future research should incorporate additional factors, such as green human resource management, green competitive advantage, and tourism development, to provide a more comprehensive understanding of sustainability drivers within the hotel industry.*

**Keywords:** Eco-Innovation; Sustainable Performance; Marketing Innovation; Organizational Innovation; Hospitality



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## INTRODUCTION

Tourism significantly contributes to the financial of numerous nations (Sihombing et al., 2024). Tourism-related establishments, including hotels, produce a large amounts of waste and need large quantities of energy to run smoothly (Adnyana, 2020). Hotels raise specific environmental management worries given their environmental effects, most notably regarding high waste production and use of natural resources (Caron & Markusen, 2024). Considering the established evidence of environmental harm resulting from hotels, it is imperative for these establishments to implement sustainable performance practices to ensure balance between environmental, social, and economic performance (Braik et al., 2023). Authorities acknowledge that without sustainability will not yield widespread advantages for all stakeholders. Therefore, the idea of sustainable development is increasingly becoming a major focus in the tourism sector, especially considering its core appeal lies in scenic landscapes (Widari, 2020).

The hospitality industry has faced increasing environmental challenges, with eco-innovations seen as a corporate strategy to help reduce the negative ecological impact of its services (Freund & Hernandez-Maskivker, 2021). Eco-innovation has become a crucial and relevant issue in recent years, especially with the push towards sustainable development and global commitment to achieving the Sustainable Development Goals (SDGs). Research related to eco-innovation is still relatively new and prominent in Indonesia, considering that governmental mandates and the manufacturing realm are also consistently evolving to comply with international sustainability standards. Specifically for hotels, the Global Code of Ethics was issued by the United Nations World Tourism Organisation (UNWTO) (UN Tourism, 2020). In Indonesia, (Minister of Tourism and Creative Economy Regulation No. 9 of 2021 concerning Guidelines for Sustainable Tourism Destination, 2021) contains regulations governing sustainable tourism destinations.

This research aims to investigate the impact of various forms of eco-innovations, including eco-process innovation, eco-product innovation, eco-organizational innovation, and eco-marketing innovation, on the sustainable performance of hotels. This research provides useful perspectives to assist hotels in boosting their edge in the market by using eco-innovations, potentially lowering running expenses, improving output, and conforming to worldwide sustainability movement.

In addition, this research could enable hotels to draw in ecologically conscious guests, boosting customer loyalty, and enhance the hotel's brand image (Ahmed et al., 2023). This research also helps to pinpoint challenges that come up when putting eco-innovations into practice and offers guidance for further research. Considering the details presented above, it is important to do research on how well the hospitality industry in Batam City does at being sustainable.

## LITERATURE REVIEW, RESEARCH FRAMEWORK, AND HYPOTHESIS

### Sustainable Performance

Sustainable performance represents a developmental strategy that ensures upcoming generations can meet their requirements, intergrating considerations for economic, social and, environmental aspects (Zalfa & Novita, 2023). In addition to strengthening competitiveness, sustainable performance also influences investor decisions and company market performance (Ahmad & Soepriyanto, 2022; Rama & Wulung, 2025).

### **Eco-Product Innovation**

Hendriawan et al., (2022) states that product innovation is the result of interconnected and interdependent processes, not merely new discoveries or ideas. Eco-product innovation work towards producing items that support environmental protection while increasing efficiency and market reach (Conti et al., 2024). In the hospitality sector, the development of eco-product innovation has been proven effective in reducing adverse effects on the environment and increasing the operational effectiveness of companies (Lopes & Basso, 2023).

### **Eco-Process Innovation**

Eco-process innovation employs advanced methods and strategies to boost how well services work, including handling waste, using resources efficiently, and decreasing the load of operations (Alinda et al., 2024). Artola (2024) states that businesses that put money into improving their processes might see greater long-term benefits and become more competitive. It's vital for those in charge within the hospitality field to understand what makes things run smoothly, as this can help increase revenue (Sihombing & Hellen, 2021). This kind of innovation has been shown to help companies to perform better in a sustainable way, considering their economic, social, and environmental impacts (Oduro, 2024).

### **Eco-Organizational Innovation**

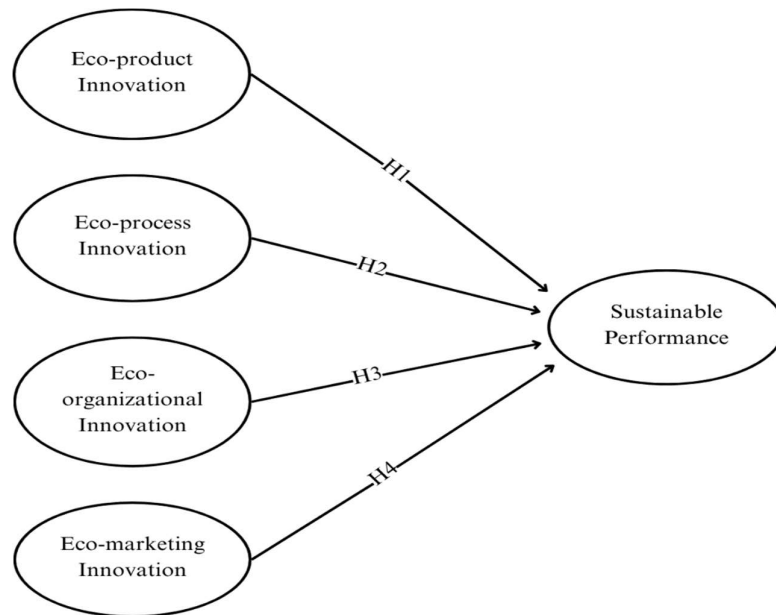
Eco-organizational innovation includes using new strategies when it comes to running a company, modifying how the company is set up, and establishing decision-making processes that help protect and improve the state of our environment (Rodríguez-Rebés et al., 2024). This innovation is still improving with changes in the manufacturing world, and it can be used in many different sectors (Judijanto & Muhtadi, 2024). A workplace that encourages this kind of innovation has a considerable effect on strengthening different parts of sustainability within hotel establishments (Stoffers et al., 2021).

### **Eco-Marketing Innovation**

Chen et al (2024) and Aly (2023) state that eco-marketing innovation is a communication approach that intergrates sustainability principles into every aspect of marketing, not only to promote eco-friendly products but also to illustrate the company's dedication to community welfare. Furthermore, eco-marketing innovation also influences consumer perceptions and guides corporate strategic policies (Nguyen-Viet, 2023). This approach plays a role in improving the perception of a brand, growing markets that are aware of the environment, and improving long-term operational cost efficiency (Muchlisin, 2025).

### **Research Framework**

The model used in this research is as follows:



Source: Constructed for this research, 2025

**Figure 1**  
**Research Framework**

### Hypothesis

Based on the research model mentioned above, the hypothesis model can be formulated as follows:

- H1: Eco-product innovation has a significant effect on sustainable performance in the hospitality sector.*
- H2: Eco-process innovation has a significant effect on sustainable performance in the hospitality sector.*
- H3: Eco-organizational innovation has a significant effect on sustainable performance in the hospitality sector.*
- H4: Eco-marketing innovation has a significant effect on sustainable performance in the hospitality sector.*

### METHOD

This research utilises a quantitative method. A quantitative approach is a method that uses numbers, statistical data, and calculations to conduct analysis (Akhwan et al., 2021). The respondents in this research are hotel managers in Batam City. According to information sourced from the Riau Islands Provincial Statistics Agency, Directory of Hotels and Other Accommodation Services (2024), the Table 1 shows the number of star-rated hotels in each district or city.

**Table 1**  
**Number of hotels in Riau Islands**

Regency/City	Star-rated hotels
Karimun	6
Bintan	33
Natuna	1
Lingga	0
Kep. Anambas	0
Batam	90
Tanjungpinang	9
Total	139

Source: Riau Islands Provincial Statistics Agency, 2024

The sampling method applied in this research was non-probability sampling, which indicates that there were specific criteria in the sample selection process (Rahman, 2023). Respondents in this research were selected using the Slovin formula, with a margin of error of 5% (Aidil et al., 2021), as shown in the following formula (Budi, 2024):

$$n = \frac{N}{1 + Ne^2}$$

Explanation:

n: Sample size (total respondents)

N: Population size

E: maximum percentage error in sampling (E = 0,05)

$$n = \frac{139}{1 + 139(0.05)^2}$$

$$n = \frac{139}{1.3475}$$

$$n = 103.15 \text{ Rounded to } 103 \text{ respondents}$$

Within the scope of this research, data from 139 hotels with star ratings that were officially listed in 2024. Based on the calculations made, the minimum number of respondents obtained was 103 managers. The technique used to collect information or data was questionnaire via Google Form, which was distributed to obtain field information to support the research, which will be presented in the form of figures, tables and statistical analysis (Nursalam & Djaha, 2023).

Data analysis was performed using SmartPLS 3 software with Partial Least Square Structural Equation Modeling (PLS-SEM) approach. This method was selected because it is especially suitable for the study of complex relationships between latent variables and for dealing with predictive research models with small to medium size sample sizes. The analysis procedure was to evaluate the measurement model (outer model) and the structural model (inner model). To assess the measurement model, the reliability and validity of the constructs were examined by means of measures of factor loadings,

composite reliability, Cronbach's alpha and average variance extracted (AVE). Thereafter, the structural model was assessed in terms of coefficients of determination ( $R^2$ ). The significance of the proposed relationships among study variables was tested using the bootstrapping procedure (Hair et al., 2022).

## RESULTS AND DISCUSSION

### Data Analysis

Data collection was conducted using Google Forms distributed via Instagram and WhatsApp, with hotel managers as respondents. This information gathering process lasted for two months (December 2024-January 2025) and yielded 120 respondents.

This study has summarized the demographic characteristics of the respondents to describe the characteristics of the study participants. The features described in table 2 are gender, age, yearly operating income and the work location. These demographic details are provided to indicate the background of the respondents and the distribution of the research sample.

The demographics of the respondents is summed up in the Table 2.

**Table 2**  
**Respondents Demography**

Description	Respondent	Percentage
<b>Gender</b>		
Female	70	57,9%
Male	50	42,1%
<b>Age</b>		
25-34 years old	38	31,4%
35-44 years old	60	49,6%
45-54 years old	20	16,5%
>55 years old	2	2,5%
<b>Annual Operating Income</b>		
< Rp10.000.000	1	1,7%
Rp10.000.000 – Rp20.000.000	26	21,5%
Rp20.000.000 – Rp100.000.000	39	32,2%
Rp100.000.000 – Rp400.000.000	38	31,4%
>Rp400.000.000	16	13,2%
<b>Work Location</b>		
3-star hotel	30	25,6%
4-star hotel	55	45,5%
5-star hotel	35	28,9%

Source: Primary data processed, 2025

The analysis reveals that the number of women working in the hospitality sector is higher compared to men. According to Freund & Hernandez-Maskivker (2021), this is because women are better at providing services, empathising, and communicating. Women in leadership roles usually use a democratic style, promoting teamwork, and are known for traits like bravery, honesty, and creativity (Styles et al., 2024). Furthermore, most workers in the hospitality industry are between the ages of 35 and 44, combining experience and a vital work ethic for operational decision-making. This age group is also typically more adaptable to flexible work schedules and are physically fit (Abdullah, 2022).

The majority of those surveyed earn between Rp20.000.000 and Rp100.000.000 each year, which includes 39 individuals or (32,2%). The data indicates that the most

participants belong to the middle-income group. The income range in the hospitality industry is influenced by the size of the hotel, the position held, and the location of the workplace (BPS, 2024). Most participants were involved in the hospitality industry at 4-star hotels, reaching 55 individuals or (45,5%) of the total. Four-star hotels provide high-quality services that remain affordable for the middle class, thus requiring a large number of employees (Kholina, 2025).

### Validity

Validity test is a method employed to determine how well a research instrument accurately measures the construct and effectively represents the concept being studied (Lim, 2026). It is used to evaluate the extent to which various indicators of the same construct are highly correlated (Cheung et al., 2024). Outer loadings values and average variance extracted (AVE) values were used in this research to evaluate validity. According to Hair et al. (2014), indicators are deemed accurate when their outer loadings values are higher than 0.70, while their average variance extracted (AVE) values are higher than 0.50. Thus, indicators that have outer loading values above 0.70 and average variance extracted (AVE) above 0.50 are retained for further analysis, whereas indicators with values below the threshold should be considered for removal.

The findings of the validity analysis are presented in Table 3.

**Table 3**  
**Validity Test Result**

Variables	Indicators	Outer Loadings	AVE
Eco-product Innovation	EPDI1	0.86	0.75
	EPDI2	0.89	
	EPDI3	0.84	
	EPDI4	0.87	
Eco-process Innovation	EPCI1	0.91	0.78
	EPCI2	0.89	
	EPCI3	0.87	
	EPCI4	0.88	
Eco-organizational Innovation	EOI1	0.88	0.79
	EOI2	0.90	
	EOI3	0.87	
	EOI4	0.90	
Eco-marketing Innovation	EMI1	0.90	0.78
	EMI2	0.86	
	EMI3	0.86	
	EMI4	0.90	
Sustainable Performance	SP1	0.84	0.76
	SP2	0.88	
	SP3	0.86	
	SP4	0.88	
	SP5	0.88	
	SP6	0.85	
	SP7	0.87	
	SP8	0.88	
	SP9	0.90	
	SP10	0.86	

Source: Primary data processed, 2025

All indicators show outer loading > 0.70 and average variance extracted (AVE) > 0.50, which means that the questions can be declared valid, in accordance with the criteria specified by Hair et al. (2014). In addition, these variables can be relied upon for further analysis.

### Reliability

Reliability test is a fundamental concept in evaluation that plays an essential role in ensuring the consistency and stability of measurement instruments in representing the research variables (Arbeni et al., 2025). The purpose is to determine whether the questionnaire's indicators consistently assess the target construct and produce dependable results (Haji-othman et al., 2022). Cronbach's Alpha and Composite Reliability (CR) values were used in this research to evaluate reliability. When the Composite Reliability (CR) value is greater than 0.70 and the Cronbach's Alpha value is greater than 0.60, it indicates an acceptable level of consistency among the indicators used for measurement (Hair et al., 2017). When the acquired values fulfill these requirements, the measurement construct is considered reliable and can be used for further analysis.

The findings of the reliability analysis are presented in Table 4.

**Table 4**  
**Reliability Test Result**

Variables	Composite Reliability	Cronbach's Alpha
Eco-product Innovation	0.92	0.89
Eco-process Innovation	0.94	0.91
Eco-organizational Innovation	0.94	0.91
Eco-marketing Innovation	0.93	0.90
Sustainable Performance	0.97	0.96

Source: Primary data processed, 2025

The reliability of the variable has also been fulfilled, with Cronbach's Alpha values > 0.60 and Composite Reliability > 0.70, in accordance with the criteria specified by Hair et al., (2017). Therefore, these variables are considered valid and reliable and can be used for further testing.

### The Coefficients of Determination (R<sup>2</sup>)

The coefficients of determination (R<sup>2</sup>) serves as a statistical measure that demonstrates how much of the variation in a dependent variable is explained by the independent variables included in a model and it is used to evaluate the explanatory power of the structural model and determine how well the independent variables explain the endogenous variable.(Lin & Huynh, 2024). According to Hair et al., (2017), R-Square values are categorized as substantial (0.75), moderate (0.50), and weak (0.25), a higher R-Square value indicates that the model has a greater ability to explain endogenous variable.

The findings of the R-Square analysis are presented in Table 5.

**Table 5**  
**R-Square Test Result**

Variable	R-Square
Sustainable Performance	0.93

Source: Primary data processed, 2025

An R-Square value of 0.93 indicates that 93% of the variation in sustainable performance can be explained by the independent variables, while the remaining 7% is influenced by other aspects. Hair et al., (2017) state that if the R-Square exceeds 0.75, it can be classified as strong, indicating that the model has an excellent level of explanation.

### Hypothesis

According to Raji (2026), hypothesis testing is a method in statistics employed to evaluate observable evidence and facilitate decision-making regarding a proposed hypothesis based on sample data. In PLS-SEM, the purpose of hypothesis testing is to evaluate whether the proposed relationships among constructs are supported by empirical data (Sarstedt et al., 2024). To achieve this, the bootstrapping method is applied to determine the importance of the structural relationships by generating t-statistics and p-values (Hair et al., 2017). Following (Hair et al., 2017), a relationship is deemed significant when the t-statistic exceeds 1.96 and the p-value is less than 0.05. therefore, hypothesis are accepted if both conditions are fulfilled; otherwise, the hypothesis is rejected.

The findings of the Hypothesis analysis are presented in Table 6.

**Table 6**  
**Hypothesis Test Result**

Path	T-Statistics	P-Values	Conclusion
EPDI -> SP	1.43	0.08	Not Significant
EPCI -> SP	2.42	0.01	Significant
EOI -> SP	7.98	0.00	Significant
EMI -> SP	2.37	0.01	Significant

Source: Primary data processed, 2025

Based on Table 6, the signfinance results of the proposed hypothesis are as follows:

### The Effect of Eco-product Innovation on Sustainable Perfomance

Based on the results of testing the direct effect of Eco-product Innovation on Sustainable Performance (EPDI → SP), a t-statistic value of 1.43 with p-value 0.08 was obtained. This finding indicates that the relationship is not statistically significant because it is > 0.05 (Hair et al., 2017), so Hypothesis 1 cannot be accepted. From the hotel's point of view, eco-product innovations often do not have a signicant impact on sustainable performance due to various strategic and operational factors.

This finding is supported by research Barry & Rametsteiner (2024) highlighting a frequent observation among hotels: investments in eco-product advancements like soap dispensers that can be filled, cleaning solutions made from organic materials, or packing that breaks down naturally do not always lead to a fast return of the money invested. Furthermore, according to Purnama et al. (2021), it is essential for eco-product innovations to have strong and clear communication so that people know about it. These results show that the two relationships are not significant, contrary to research by

Eusebio (2025) that suggests eco-product advancements have an associated link to sustainable performance.

### **The Effect of Eco-process Innovation on Sustainable Performance**

Based on the results of testing the direct effect of Eco-process Innovation on Sustainable Performance (EPCI → SP), a t-statistic value of 2.42 with p-value 0.01 was obtained. This finding indicates that the relationship is statistically significant, so Hypothesis 2 can be accepted. Eco-process innovation is important for sustainable performance since it can make workflow procedures better, making them more productive and lessening harm to the environment.

This is in line with research by Szab & Tajti (2023) noting that process innovation leverages technology to lower energy use, resources, and waste, helping companies cut expenses and boost output. Additionally, Moise et al. (2020) contend that process innovation greatly enhances sustainable effectiveness and boosts both cost management and production levels. These results show that both relationships are significant, in line with research by Oduro (2024), showing that using eco-process innovation considerably influences economic, environmental, and societal achievements.

### **The Effect of Eco-organizational Innovation on Sustainable Performance**

Based on the results of testing the direct effect of Eco-organizational Innovation on Sustainable Performance (EOI → SP), a t-statistic value of 7.98 with p-value 0.00 was obtained. This finding indicates that the relationship is statistically significant, so Hypothesis 3 can be accepted. Eco-organizational innovation, involving the adoption of internal guidelines promoting sustainable concepts, leads to improved sustainable outcomes.

In line with the research by Thi et al., (2024), it is evident that eco-organizational innovation and transformational leadership enhance sustainable performance, owing to leadership's role in cultivating an environment conducive to the creation and execution of innovations focused on sustainable performance. Consistent with the research by Pascasarjana et al. (2025), organizational innovation, when fostered by transformational leadership, can bolster sustainable performance. These findings show that both relationships are significant, in accordance with the research by Widyastuti et al., (2024), which demonstrates that eco-organizational innovation significantly impacts sustainable performance.

### **The Effect of Eco-marketing Innovation on Sustainable Performance**

Based on the results of testing the direct effect of Eco-marketing Innovation on Sustainable Performance (EMI → SP), a t-statistic value of 2.37 with p-value 0.01 was obtained. This finding indicates that the relationship is statistically significant, so Hypothesis 4 can be accepted. Eco-marketing improvements can bring added advantages to enterprises and cater to consumer desires, which are becoming more and more aware of ecological problem.

In line with research by Aly (2023), it has been shown that eco-marketing innovation have the ability to enhance a hotel's reputation. Furthermore, Zheng et al. (2025) established that eco-marketing development is important in boosting societal and ecological achievements. These discoveries imply that both of these connections coincide with research done by Syamsul Hidayat et al. (2021), stating that eco-marketing modifications have a considerable impact on long-term achievements.

## CONCLUSION AND SUGGESTION

This research explores how eco-innovations affect the sustainable performance on hotels in Batam City. The findings indicate that product innovation does not matter much, mainly because consumer are not interest in these products. Furthermore, the results of this research are in line with Chege & Wang (2020); Asiedu et al. (2025), which is that just creating eco-products is not enough to make big difference in how sustainable a company is, since competitors can easily copy these eco-friendly products. In contrast, eco-process innovation, eco-organizational innovation, and eco-marketing innovation show a significant effect towards sustainable performance and in line with research by (Langgat et al., 2023; Oduro, 2024). Rather than just concentrating on eco-product innovation, employing a thorough strategy encompassing eco-process, eco-organizational, and eco-marketing innovation yields substantially greater results in boosting sustainable performance.

This research has some limits because it only covers hotels in Batam City, so the findings might not work the same way in other locations. In addition, this research only examined four forms of innovations affecting hotel sustainable performance. Previous research has identified several other factors that could also affect sustainable performance. For example, some research, like that by Njonge (2023); Alfadel et al., (2025); Islamic (2025), highlighted the role of green human resource management (G-HRM), while Nainggolan & Murwaningsari (2024), Pratiwi & Rodiah (2024) emphasized the importance of green competitive advantage. Furthermore, Bachri (2024) found that tourism development can contribute to sustainable performance. Therefore, future research is encouraged to incorporate these factors into the research model to provide a more comprehensive understanding of the factors influencing hotel sustainable performance.

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