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Green Building as a Strategy for Operational Cost Reduction and Customer Satisfaction

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Abstract: Research Objective: To determine the relationship between Green Building and Strategy Operational Cost Reduction and Customer Satisfaction. Research Type: Quantitative research with a descriptive analysis approach. Findings: Green building is an approach that is increasingly being adopted by many organizations as a primary strategy in reducing operational costs while increasing customer satisfaction. This strategy focuses on efficient use of resources, reducing environmental impacts, and creating a better customer experience. Green building integrates energy-efficient and environmentally friendly technologies and designs, Customer satisfaction is one of the important benefits of implementing green buildings. Customers are now increasingly aware of the importance of sustainability and tend to choose companies that care about the environment; a close relationship between reducing operational costs and customer satisfaction through the implementation of green buildings. Theoretical Contribution/Originality: Implementation of green buildings to increase customer satisfaction with cost reduction strategies Practitioner/policy Implications: Green building is an approach that is increasingly being adopted by many organizations as a primary strategy in reducing operational costs while increasing customer satisfaction. Research Limitation/Implications: This article offers a green building concept with a Strategy for Operational Cost Reduction to increase Customer Satisfaction.

Keyword: Green Building, Operational Cost Reduction, Energy Efficiency, Customer Satisfaction.

INTRODUCTION

Climate change and global warming have triggered serious natural, social, and economic disasters (Vyas, 2019). Human and business activities often neglect these environmental issues, even though their impacts are increasingly felt in daily life and economic activities. Excessive exploitation of unavoidable energy also damages the environment (Nadira, 2022). Buildings have become one of the main contributors to global warming. Data from the World Green Building Council Indonesia shows that each building contributes 33% of CO_2 emissions, consumes 17% of clean water, 25% of wood products, 30-40% of raw materials, and 40-50%

of energy for construction and operation. Therefore, sustainability efforts in construction and building management are very important (Siti Zubaidah 2022).

In addition to the challenge of climate change, the world's population is projected to reach around 9 billion by 2050. The increase in the population will significantly raise the consumption of energy and other resources (Lee Felix, 2024). To address global warming, an international agreement was reached through the Kyoto Protocol under the United Nations Framework Convention on Climate Change (UNFCCC). This agreement also includes developing countries, which are experiencing accelerated industrialization and becoming major contributors to greenhouse gas emissions. The Kyoto Protocol encourages the development of environmentally friendly emission trading mechanisms, allowing countries to meet their emission quotas by purchasing carbon credits from countries with surpluses. Indonesia, one of the developing countries with rapid industrial growth, has great opportunities in this mechanism, both as a provider of carbon credits and as a country facing challenges in managing its emissions. This agreement is an important step in the global effort to curb the pace of climate change.

Attention to the environment and climate change is not only carried out at the international level (Erfan, 2024), but also in Indonesia. The government has established various environmental regulations, such as the green banking roadmap developed by Bank Indonesia and the Financial Services Authority to regulate environmentally friendly banking. The Ministry of State-Owned Enterprises (BUMN) has also developed a green roadmap for state-owned enterprises. Government pressure and the increasing awareness of stakeholders are pushing companies to adopt green business practices. To realize this, the government and legislature need to design a national green economy roadmap to support sustainability and environmentally friendly development in Indonesia.

The concept of green building

In recent decades, concerns about environmental issues and energy consumption in the building sector have been increasing. Green building, or sustainable construction, has emerged as a response to these challenges. Green building is defined as a high-performance property that considers and reduces its impact on the environment and human health. This concept includes energy efficiency, the use of environmentally friendly materials, and sustainable design (Nadira, 2022). However, the development of green architecture faces various obstacles, including high initial costs, lack of public awareness, and limitations in regulations and supporting technology, which pose major challenges to its widespread implementation.

Not all green buildings meet their performance expectations. Some buildings show energy consumption higher than the initial calculations, even exceeding the energy consumption of conventional buildings (Chunmei, 2024). This raises discussions about the effectiveness of the design and technical solutions implemented, where occupant behavior often becomes a factor that reverses the expected energy performance. For example, residents may not use environmentally friendly facilities as designed or even adopt behaviors that increase energy consumption. This discussion highlights the importance of considering user behavior aspects in the performance systems of energy-efficient buildings. The success of green buildings does not only depend on their construction technology but also on how occupants utilize that technology in their daily lives (Bifeng Zhu, 2023).

In the context of green business, corporate sustainability must be closely linked to the principle of the triple bottom line, which is the balance between economic profit, social impact, and environmental sustainability. Efforts to make a company green are not enough just by

implementing technical solutions or following environmentally friendly standards; there must be a holistic approach that includes user education, sustainable operational management, and adjustments to local needs. Thus, the transformation towards green business and energy-efficient buildings can achieve more significant results and positively impact not only environmental performance but also the overall economic and social sustainability of the company (Elkington, 1998).

Customer Satisfaction

High customer satisfaction with green building aspects can strengthen their loyalty to the brand and enhance the overall value of the green brand. Research by Supadmi (2022) shows that green satisfaction plays a significant mediating role in the relationship between green brand image and green brand equity, highlighting the importance of customer satisfaction in green building strategies.

The implementation of green building not only provides environmental benefits but also enhances customer satisfaction by creating a healthier and more comfortable environment. High customer satisfaction with green building elements can strengthen their loyalty to the brand and enhance the overall value of the green brand. Therefore, companies are advised to integrate green building practices into their strategies to achieve sustainable competitive advantages.

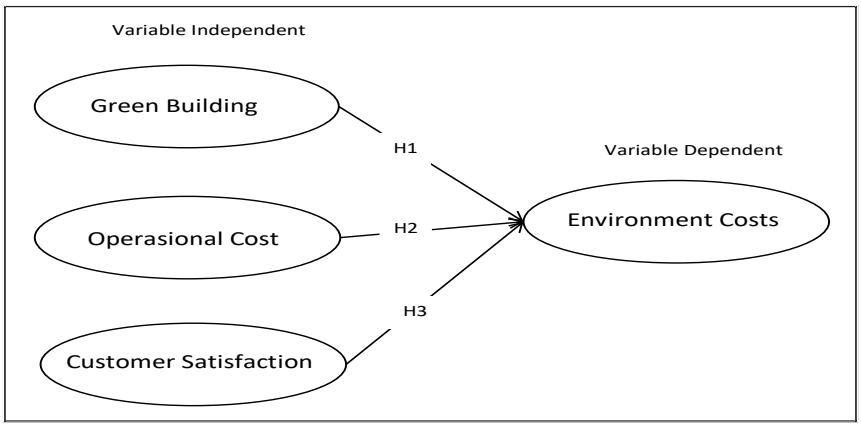
METHOD

Green building offers energy efficiency and other resource efficiencies, although it is often considered an expensive investment. However, the initial construction costs will be offset by operational efficiency (Onishi, 2018). Green building is a sustainable building that can reduce energy consumption and is environmentally friendly. Some of the criteria applied include the provision of green open spaces, adequate air circulation, and design and planning that meet green building standards. In addition, the operation of buildings that follow green building principles can reduce operational management costs, making them more economical compared to conventional buildings in the long run.

To prepare green open spaces requires quite a high cost and is more profitable when optimizing the land for sale or rent as commercial areas. Therefore, the alternative is to use the roof as a landscape and hardscape to meet the appropriate site development. The building's roof can also be used for energy conservation by installing solar panels and saving clean water usage by setting up rainwater harvesting (La Roche & Berardi, 2020). Some methods that can be used for energy and resource efficiency in green buildings include cooling rooms by maximizing air circulation so that the use of air conditioners and lighting devices or lamps can be reduced.

Building prices reflect current policies and expected future policies. Developers may charge higher prices for green buildings due to higher development costs. We also found that buildings with green labels are associated with lower electricity and water consumption after controlling for observed sustainability features. Green labels are determined based on a long list of green building features. Thus, these features that we do not observe in our data have an additional effect on reducing energy and resource consumption. This is one of the few studies on energy consumption.

Based on the description above, here is the proposed framework of thought and hypothesis:



H1: Green Building Significantly Affects Environment Costs
H2: Operational Cost Significantly Affects Environment Costs
H3: Customer Satisfaction Significantly affects Environment Costs

To address the research problem posed, this study employs a research method that involves data exploration from the collected questionnaires, as well as using simple arithmetic techniques and graphical techniques to summarize the observational data. Based on this research model, it is expected to further explain the causal relationship between the analyzed variables and provide research implications that are beneficial for the development of science. The questionnaire was prepared with consultation from green building experts, including property managers and green building consultants who are also green building certificate holders, to ensure the accuracy and relevance of the collected data. Here are the Operational Definitions of the Variables:

Variable	Indikator	Skala Likert
Green Building: (Yoshida et al, 2018)	Energy Efficiency Water Management Environmentally Friendly Material Biodiversity and Landscape Green Building Certification	(1-5) STS- 1, CS-2, N-3,S-4, SS-5
Operasional Cost: (Samosir et al, 2020)	Energy Costs Maintenance Costs Water Consumption Efficiency Waste Management	(1-5) STS- 1, CS-2, N-3,S-4, SS-5
Customer Satisfaction (Diputra, 2021)	Product and Service Quality Customer Expectations Complaint and Problem Resolution Rate Customer Loyalty Recommendation Level Emotional Loyalty Price Satisfaction Customer Experience Perceived Value	(1-5) STS- 1, CS-2, N-3,S-4, SS-5
Environment Costs: (Yumei Wang, 2022)	Carbon Footprint Waste Management Resource Utilization Environmental Mitigation Costs Impact on the Local Ecosystem	(1-5) STS- 1, CS-2, N-3,S-4, SS-5

RESULTS AND DISCUSSION

Descriptive statistics are a summary of respondents' answers to statements in the questionnaire. The scale provided for all variables is 1, which means strongly disagree, to 5, which means strongly agree. Descriptive statistics aim to provide an overview or description of the data reviewed from the average value, minimum value, maximum value, and standard deviation. In the descriptive statistics analysis explained below, the value (Mean) is the average value of all respondents regarding the studied variables, while the standard deviation indicates the variation in respondents' answers. There is no limit on the standard value, but a standard deviation value moving away from zero indicates that the data distribution (respondent answers) varies. The minimum value is the answer (scale), which is the highest chosen by the respondents.

Deskriptif Analisis

Variable	Path Coefficients	Mean
Green Building	0,743	4.035,25
Operasional Cost	0,242	4.554,75
Customer Satisfaction	0,015	4.173,25

Based on the results of the descriptive analysis, Green Building has a high Path Coefficient value of 0.743 with an average mean of 4,035.25, indicating a significant relationship between the implementation of green buildings and the achieved outcomes, such as energy efficiency and sustainability. This reflects that Green Building has a significant positive impact on factors affecting the environment and operational efficiency. Meanwhile, Operational Cost has a Path Coefficient of 0.242 with an average mean of 4.554.75, indicating a moderate influence on the management of lower operational costs. Low operational costs are closely related to the use of efficient technology in green buildings. Customer Satisfaction, with a Path Coefficient of 0.015 and an average mean of 4.173.25, shows a very small influence on customer satisfaction, although the average value still indicates a fairly good level of satisfaction, its effect on other aspects is lower compared to Green Building and Operational Cost.

Discriminant Validity

Variable	Customer Satisfaction (X3)	Environment Costs (Y)	Green Building (X1)	Operasional Cost (X2)
Customer Satisfaction (X3)	0,996			
Environment Costs (Y)	0,779	0,992		
Green Building (X1)	0,719	0,840	0,975	
Operasional Cost (X2)	0,620	0,738	0,879	0,961

Based on the path model above, the loading factor values for each indicator show good results, as all values are above the test standard of 0.700. This indicates that each statement or indicator used in the model has a significant contribution and high relevance to the measured construct. Thus, the model can be considered valid and reliable in measuring the variables being studied, such as Green Building, Operational Cost, and Customer Satisfaction, because its indicators are able to explain the larger constructs with high accuracy.

Construct Reliability and Validity

Variable	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Customer Satisfaction (X3)	0,917	0,919	0,932	0,634
Environment Costs (Y)	0,925	0,927	0,938	0,627
Green Building (X1)	0,904	0,911	0,923	0,600
Operasional Cost (X2)	0,908	0,913	0,925	0,579

Based on the test results, the Cronbach Alpha and Composite Reliability values have each shown values above 0.700, indicating that all indicator components in the research model have a good level of reliability. This means that these indicators are consistent and reliable for measuring the variables being studied, providing confidence that the analysis results can be trusted and used for further research.

Variable Effect

Total Effects

Variable	Environment Costs (Y)
Customer Satisfaction (X3)	0,743
Green Building (X1)	0,242
Operasional Cost (X2)	0,015

1) The analysis results show that the Total Effect of Green Building (X1) on Environment Costs (Y) is 0.242. This means that every one-unit increase in X1 will cause a direct and indirect increase in Y by 24.2%. This effect is positive, meaning that the implementation of Green Building significantly contributes to reducing environmental costs through energy efficiency, resource management, and waste reduction. This effect indicates that investment in Green Buildings not only enhances sustainability but also provides economic benefits by reducing the burden of environmental-related costs. This emphasizes the importance of adopting environmentally friendly buildings.

2) The analysis results show that the Total Effect of Operational Cost (X2) on Environment Costs (Y) is 0.015. This means that each increase of one unit in X2 will cause a direct and indirect increase in Y by 1.5%. Although the value of this influence is relatively small, its positive nature indicates that more efficient operational cost management still contributes to reducing environmental costs. This can occur through the implementation of energy-efficient technologies, better waste management, and optimization of resource use. Although its contribution is not as significant as other factors, this result emphasizes that operational efficiency remains relevant in supporting environmental sustainability and more effective cost management.

3) The analysis results show that the Total Effect of Customer Satisfaction (X3) on Environment Costs (Y) has a value of 0.743. This means that every increase of one unit in X3 will cause a direct and indirect increase in Y by 74.3%. This influence is positive and is the largest compared to other variables. This indicates that customer satisfaction plays a significant role in supporting environmental cost management. When customers feel satisfied, they tend to support environmentally friendly practices, such as choosing more sustainable products or

services and supporting company initiatives related to energy efficiency and waste management. This significant influence also reflects the importance of prioritizing customer satisfaction as the main focus in sustainability strategies. Satisfied customers not only enhance the company's reputation but also exert market pressure to continuously innovate in environmental management. Thus, the company can focus more on policies and measures that not only meet customer needs but also contribute to reducing environmental impact. These results affirm that customer satisfaction is the main catalyst for long-term sustainability, while also motivating companies to continue adopting environmentally friendly practices.

R-Square Test

R Square		
Variable	R Square	R Square Adjusted
Environment Costs (Y)	0,969	0,969

The test results show that the Adjusted R-Square value is 0.969, or equivalent to 96.9%. This means that the variable Environment Costs can be very well explained by the independent variables, namely Green Building, Operational Cost, and Customer Satisfaction. In other words, 96.9% of the variation in Environment Costs is caused by these three variables, while the remaining 3.1% is influenced by factors outside the model.

The high Adjusted R-Square value reflects the model's strength in explaining the relationship between independent and dependent variables, indicating that the model used is highly relevant and accurate. This strong influence indicates that Green Building, Operational Cost, and Customer Satisfaction have a significant contribution to environmental cost management. Thus, the company can focus on these three factors to optimize sustainability strategies and overall environmental cost efficiency.

Analyze the Hypothesis

Hypothesis analysis is conducted after the research model meets the feasibility criteria. Hypothesis testing was conducted through bootstrapping values using the Smart PLS application. These results provide answers to the proposed hypothesis by measuring the significance of the relationships between variables in the model to support or reject the research hypothesis.

Path Coefficients, T-Values, P-Values (Jawaban Hipotesis)				
Variable	Path Coefficients	T Statistics (|O/STDEV|)	P Values	Keterangan
Customer Satisfaction (X3) -> Environment Costs (Y)	0,743	6,242	0,000	Diterima
Green Building (X1) -> Environment Costs (Y)	0,242	6,181	0,000	Diterima
Operasional Cost (X2) -> Environment Costs (Y)	0,015	9,808	0,000	Diterima

H1 Green Building significantly affects Environment Costs

The test results show that the t-statistic value for the significance of Green Building is 6.181 with a P-value of 0.000. The P-value, which is far below the significance threshold of 0.05, indicates that the influence of Customer Satisfaction on the variable Environment Costs is statistically significant. A high t-statistic value indicates a strong and positive relationship between the implementation of Green Building and the reduction of environmental costs. Thus,

the hypothesis stating that the implementation of Green Building has a positive effect on the reduction of Environment Costs is accepted. These findings underscore the importance of implementing Green Building in making a significant contribution to environmental cost efficiency. A study by (Nurhikmah Alam and Agus Suroso, 2024) also supports this finding, stating that the application of the Green Building concept in industrial buildings can optimize project implementation costs through a Value Engineering approach. Additionally, (Sucofindo, 2023) mentions that green buildings can reduce operational costs through energy efficiency and better resource utilization. Therefore, the implementation of Green Building is not only beneficial for the environment but also provides economic advantages through the reduction of operational and environmental costs.

H2 Operational Cost Significantly Affects Environment Costs

The test results show that the t-statistic value for the significance of Operational Cost is 9.808 with a P-value of 0.000. The P-value, which is far below the significance threshold of 0.05, indicates that the influence of Operational Cost on the variable Environment Costs is statistically significant. A high t-statistic value indicates a strong and positive relationship between the disclosure of Operational Cost and Environment Costs. Thus, the hypothesis stating that the disclosure of Operational Costs has a positive impact on Environment Costs is accepted. These findings emphasize the importance of implementing effective operational cost management in making a significant contribution to environmental costs. A study by Sanjaya Aji Mahardhika (2019) supports this finding, stating that operational strategies positively influence environmental waste management costs, meaning that the higher the value of operational strategies, the better the environmental waste management. Furthermore, research by Aliamutu, Bhana, and Suknunan (2023) found that environmental costs significantly affect the financial performance of companies, indicating that effective environmental cost management can enhance profitability. Therefore, efficient management of operational costs is not only beneficial for the environment but also provides economic advantages through the reduction of environmental costs.

H3 Customer Satisfaction Significantly affects Environment Costs

The test results show that the t-statistic value for the significance of Customer Satisfaction is 6.242 with a P-value of 0.000. The P-value, which is far below the significance threshold of 0.05, indicates that the effect of Customer Satisfaction on the variable Environment Costs is statistically significant. A high t-statistic value indicates a strong and positive relationship between Customer Satisfaction and Environment Costs. Thus, the hypothesis stating that Customer Satisfaction has a positive impact on Environment Costs is accepted. These findings underscore the importance of implementing strategies that enhance customer satisfaction, significantly contributing to the management of environmental costs. The study by Tarigan (2023) supports this finding, stating that environmental performance and environmental costs significantly affect the company's financial performance, indicating that good environmental management can enhance customer satisfaction and overall company performance. Therefore, companies are advised to continuously improve the quality of their services and products to achieve higher customer satisfaction, which in turn can help in effectively managing and reducing environmental costs.

CONCLUSION

Green Building as a Strategy for Operational Cost Reduction and Customer Satisfaction

Green building is an approach that is increasingly being adopted by many organizations as a primary strategy to reduce operational costs while simultaneously enhancing customer satisfaction. This strategy focuses on the efficient use of resources, reducing environmental

impact, and creating a better customer experience. Here are the conclusions based on each main variable:

Green Building and Operational Cost Reduction

Green building integrates energy-efficient and environmentally friendly technology and design. With the implementation of technologies such as LED lighting, smart ventilation systems, and solar panels, companies can significantly reduce energy consumption. In addition, efficiency in water and waste management also helps reduce operational expenses.

According to various studies, green buildings can reduce operational costs by 20–30% compared to conventional buildings. This reduction not only comes from energy costs but also from long-term maintenance costs, considering that the materials used are more durable and require less maintenance. Thus, green building has proven to be an effective solution for sustainably reducing operational costs.

Green Building and Customer Satisfaction

Customer satisfaction is one of the important benefits of implementing green building. Customers today are increasingly aware of the importance of sustainability and tend to choose companies that care about the environment. Green building creates a healthier and more comfortable environment for customers with better air quality, natural lighting, and user-friendly design.

In addition, green building also reflects the company's commitment to responsible business practices, which can enhance customer loyalty. When customers feel that the company contributes to environmental preservation, they are more likely to give recommendations and remain loyal to using the company's services or products. Thus, green building not only becomes an operational factor but also a strategic tool to attract and retain customers.

The Relationship Between Reducing Operational Costs and Customer Satisfaction

There is a close relationship between reducing operational costs and customer satisfaction through the implementation of green building. With operational cost efficiency, companies can allocate more resources to improve the quality of their products or services. For example, the savings from energy and water can be used to offer more competitive prices, which is one of the important factors in customer satisfaction.

On the other hand, the sustainability embodied by green buildings enhances customers' positive perception of the company. Customers not only appreciate the products or services offered, but also the added value in the form of a positive impact on the environment. Operational cost efficiency allows companies to maintain their competitiveness, while sustainability elements strengthen the emotional connection between customers and the brand.

Green building is a strategic approach that provides dual benefits, namely the reduction of operational costs and the increase in customer satisfaction. By utilizing environmentally friendly technology, companies can reduce long-term expenses while simultaneously creating added value for customers through sustainability.

Studies show that companies implementing green building not only enjoy cost efficiency but also gain a better reputation in the eyes of customers. Therefore, investing in green building is not only a step towards environmental sustainability but also an effective business strategy to create a competitive advantage in the market.

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