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Development of a Triple Bottom Line-Based Model for Sustainable Warehouse Performance: The Mediating Role of Warehouse Operational Performance in Indonesia's FMCG Distribution Industry

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Abstract: The FMCG distribution industry in Indonesia faces pressure to implement sustainable warehousing. High carbon emissions from warehouse operations and the absence of national standards provide the background for this study. The study aims to examine the effects of Economic, Environmental, and Social factors on Warehouse Operational Performance and Sustainable Warehousing Performance. The study also examines the mediating role of Warehouse Operational Performance. The method used was a quantitative confirmatory approach with a cross-sectional survey. The respondents comprised 150 Warehouse Managers, Warehouse Supervisors, Operations Coordinators, and related staff. The data were analyzed using SEM-PLS with SmartPLS. The results show that all ten hypotheses were supported. Social Factors were the most dominant predictors of Warehouse Operational Performance ($\beta = 0.403$) and Sustainable Warehousing Performance ($\beta = 0.266$). Warehouse Operational Performance had a significant effect on Sustainable Warehousing Performance ($\beta = 0.343$) and served as a partial mediator. The model had strong explanatory power, with $R^2 = 0.739$ and 0.833. The study strengthens the integration of the Resource-Based View, Natural Resource-Based View, Stakeholder Theory, and Dynamic Capability Theory. Practical recommendations are directed at prioritizing social aspects and warehouse operational capabilities.

Keyword: Sustainable Warehousing Performance, Triple Bottom Line, Warehouse Operational Performance, SEM-PLS, FMCG Distribution Industry.

INTRODUCTION

Sustainability has become an important issue in logistics and supply chain management as organizations are increasingly required to balance economic performance, environmental responsibility, and social well-being. This issue is particularly relevant to warehousing because warehouse activities involve substantial consumption of energy, materials, equipment, and labor through storage, material handling, order fulfillment, and distribution processes. Sustainable warehousing therefore requires an integrated approach that considers economic,

environmental, and social dimensions, consistent with the Triple Bottom Line (TBL) framework proposed by Elkington (1997). At the same time, warehouse operations directly affect logistics costs, productivity, resource utilization, and service performance, meaning that sustainability efforts in this sector cannot be separated from operational performance considerations.

The urgency of sustainable logistics is reinforced by continuing global environmental pressures. The Paris Agreement aims to limit the increase in global average temperature to well below 2°C while pursuing efforts to limit it to 1.5°C above pre-industrial levels (UNFCCC, 2015). Nevertheless, global fossil CO_2 emissions remained high, reaching approximately 36.8 $GtCO_2$ in 2023 and increasing to an estimated 37.4 $GtCO_2$ in 2024 (Friedlingstein et al., 2025). Logistics and warehousing are important areas for sustainability improvement because logistics buildings, including warehouses and sorting facilities, contribute significantly to supply chain environmental impacts (Dekker et al., 2012).

This issue is particularly relevant in Indonesia. National logistics costs were estimated at approximately 14.29% of GDP, indicating the importance of improving logistics efficiency (Bappenas, 2023). Indonesia also ranked 61st among 139 countries in the 2023 Logistics Performance Index, with a score of 3.0 (World Bank, 2023). These conditions indicate that sustainability improvement in Indonesian logistics must be accompanied by improvements in operational performance.

This challenge is also reflected at PT Mitra Sarana Purnama. Preliminary observations in 2025 identified product waste as the largest operational environmental burden (45%), followed by forklifts and material handling (25%), lighting energy consumption (15%), cooling and cold storage (10%), and water and sanitation (5%). These findings, spanning global, national, and organizational levels, indicate that warehouse sustainability problems involve interconnected economic, environmental, social, and operational aspects.

Previous studies have established the importance of sustainability in logistics and warehousing. Rao and Holt (2005) found that green supply chain practices can improve competitiveness and economic performance, while Dekker et al. (2012) emphasized the importance of environmental considerations in logistics operations. Faber et al. (2013) highlighted the importance of effective warehouse management in achieving operational performance. Winkelhaus and Grosse (2020) demonstrated that digitalization and automation are important directions in modern logistics systems. More recently, Perotti et al. (2024) conceptualized sustainable warehousing based on economic, environmental, and social dimensions and emphasized the need for further research on sustainability across warehouse processes.

Conceptual gap, previous studies have frequently examined specific aspects of warehouse sustainability, while empirical models integrating the three TBL dimensions within a single Sustainable Warehousing Performance framework remain limited (Dekker et al., 2012; Winkelhaus & Grosse, 2020; Perotti et al., 2024). Empirical gap, existing sustainability-performance studies have largely focused on broader supply chain or organizational contexts rather than simultaneously examining economic, environmental, and social factors at the warehouse level (Rao & Holt, 2005; Narimissa et al., 2020). Methodological gap, although warehouse operational performance is important for productivity, resource utilization, inventory management, and service performance (Faber et al., 2013), its mediating role between TBL dimensions and Sustainable Warehousing Performance remains insufficiently examined. Contextual gap, empirical evidence from developing logistics environments, particularly Indonesia and the FMCG distribution industry, remains limited, despite Indonesia's logistics efficiency challenges (Bappenas, 2023; World Bank, 2023).

To address these gaps, this study develops an empirical TBL-based model integrating economic, environmental, and social factors as determinants of Warehouse Operational

Performance and Sustainable Warehousing Performance. The study further positions Warehouse Operational Performance as a mediating variable to explain how TBL dimensions are translated into sustainable warehouse outcomes. The study also provides empirical evidence from the Indonesian FMCG distribution industry, thereby extending sustainable warehousing research to an emerging logistics context.

Based on these considerations, the objectives of this study are to examine the effects of economic, environmental, and social factors on warehouse operational performance and sustainable warehousing, as well as to examine the effect of warehouse operational performance on sustainable warehousing. Furthermore, this study aims to investigate the mediating role of warehouse operational performance in the relationships between economic, environmental, and social factors and sustainable warehousing. Theoretically, this study contributes to the literature on sustainable warehousing by providing empirical evidence on the integration of economic, environmental, and social dimensions with warehouse operational performance in achieving sustainable warehousing. Practically, the findings are expected to provide valuable insights for logistics industry stakeholders in improving warehouse operational performance and supporting the implementation of more sustainable warehousing practices in Indonesia.

METHOD

This study employs a confirmatory quantitative approach with a cross-sectional survey design to examine the causal relationships among Economic Factors, Environmental Factors, Social Factors, Warehouse Operational Performance, and Sustainable Warehousing Performance in the FMCG distribution industry in Indonesia. Data were collected once via a structured questionnaire to test hypotheses derived from the Triple Bottom Line theory and prior studies. Data were analyzed using PLS-SEM with SmartPLS because it is capable of simultaneously testing relationships among latent constructs, analyzing complex models with mediating variables, supporting predictive research, and providing stable parameter estimates without requiring strict assumptions of multivariate normality.

The study population consists of employees of FMCG distribution companies in Indonesia who perform warehousing activities (managers, supervisors, operations coordinators, warehouse staff, inventory control personnel, and other relevant employees), selected through purposive sampling based on the following criteria: working at an FMCG company with warehousing operations; being directly involved in warehouse operations; having at least one year of work experience; understanding warehouse processes (receiving, storage, inventory control, order picking, packing, and distribution); and being willing to voluntarily complete the questionnaire.

In accordance with PLS-SEM guidelines (5–10 times the number of indicators) and the recommendations of Hair et al. (2021), with 26 research indicators, the minimum sample size required was 130 respondents (26 × 5); this study successfully collected 150 valid responses, exceeding the minimum number and thus providing an adequate sample for PLS-SEM analysis.

Data were collected through a literature review (for the theoretical foundation, conceptual framework, hypotheses, and research indicators) as well as a structured questionnaire using a five-point Likert scale that measured the constructs of Economic Factors, Environmental Factors, Social Factors, Warehouse Operational Performance, and Sustainable Warehousing Performance.

The measurement model was evaluated using convergent validity (outer loadings ≥0.70, AVE ≥0.50), discriminant validity (Fornell–Larcker, cross-loadings, HTMT), and construct reliability (Cronbach's alpha, Composite Reliability, rho_A ≥0.70) (Hair et al., 2022), while the structural model was evaluated using R^2, f^2, Q^2, VIF, and the significance of path coefficients via bootstrapping with 5,000 subsamples, with the hypothesis accepted if the t-

statistic >1.96 and the p-value <0.05. The mediating role of Warehouse Operational Performance was tested through an indirect effect analysis using a similar bootstrapping procedure. The research framework (Figure 1) summarizes the phenomena, gaps, and novelty described earlier.

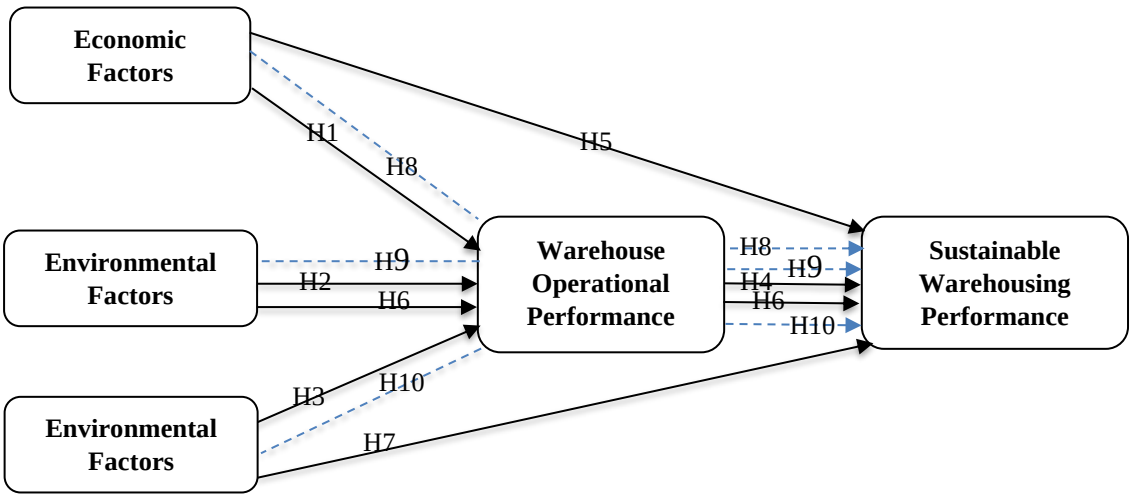

Figure 1. Conceptual Framework

Information:
→ : Direct Influence (H1, H2, H3, H4, H5)
⇢ : The Influence of Mediation (H6, H7)

RESULTS AND DISCUSSION

Result

Respondent Characteristics

The respondents consisted of 150 warehouse operations professionals in Indonesia, the majority of whom were male (92.0%), worked as Warehouse Operations Staff (78.0%), had 1–3 years of experience (68.0%), and held a high school or vocational high school diploma (76.7%). Most came from distribution companies (71.3%) that own their own warehouses (94.7%), employ more than 100 warehouse staff (47.3%), and have monthly revenues exceeding Rp5 billion (72.0%) indicating that the respondents are representative for analyzing the relationship between Economic, Environmental, and Social Factors, Warehouse Operational Performance, and Sustainable Warehousing Performance.

Table 1 Respondent Characteristics (n = 150)

Characteristics	Categories	Frequency	Percentage
Gender	Male	138	92%
	Female	12	8%
Job Title/Position	Warehouse Operations Staff	117	78%
	Warehouse Operations Coordinator	15	10%
	Inventory Control Personnel	12	8%
	Warehouse Manager	3	2%
	Warehouse Supervisor	3	2%
Years of Experience in the Warehousing Industry	1–3 years	102	68%
	3–5 years	44	29,30%
	> 5 years	3	2%
	1–3 years, 3–5 years	1	0,70%
Highest Level of Education	High School/Vocational High School	115	76,70%
	Bachelor's Degree (Bachelor's)	33	22%
	Master's (Master's Degree)	1	0,70%
	Diploma	1	0,70%
Company Category	Distributor	107	71,30%
	FMCG	18	12%

Characteristics	Categories	Frequency	Percentage
	Manufacturing	15	10%
	Other _____	5	3,30%
	Logistics/3PL	2	1,30%
	Retail	2	1,30%
	FMCG, Distributor, Retail	1	0,70%
Warehouse Ownership Status	Owned	142	94,70%
	Leased	7	4,70%
	Combination	1	0,70%
Number of Warehouse Employees	> 100 People	71	47,30%
	51 – 100 People	48	32%
	10–50 people	28	18,70%
	< 10 people, 10–50 people	2	1,30%
	< 10 people	1	0,70%
Scale of Sub-Distributor / Company	Large (revenue > Rp 5 billion/month)	108	72%
	Medium (revenue Rp 1–5 billion/month)	36	24%
	Small (revenue < Rp 1 billion/month)	6	4%
Has the company implemented a sustainability program?	Yes		
	Total Respondents	150	100%

Source: Primary data, processed by the researcher (2026).

Evaluation of the Measurement Model (Outer Model)

Convergent validity analysis was conducted using outer loading values with a criterion of ≥ 0.70 (Hair et al., 2021). The test results showed that all indicators had outer loading values of ≥ 0.70, thus meeting the criteria for convergent validity and effectively representing the latent construct.

Table 2 Outer Loading Results

	Economic Factors	Environmental Factors	Social Factors	Warehouse Operational Performance	Sustainable Warehousing Performance
X1.1	0,943				
X1.2	0,938				
X1.3	0,930				
X1.4	0,935				
X1.5	0,944				
X2.1		0,925			
X2.2		0,933			
X2.3		0,933			
X2.4		0,914			
X2.5		0,943			
X3.1			0,933		
X3.2			0,935		
X3.3			0,932		
X3.4			0,934		
X3.5			0,930		
Y.1					0,958
Y.2					0,960
Y.3					0,955
Y.4					0,955
Y.5					0,956
Z.1				0,936	
Z.2				0,933	
Z.3				0,923	
Z.4				0,956	
Z.5				0,956	
Z.6				0,924	

Source: SmartPLS output, processed by the researcher (2026).

Discriminant validity was evaluated using the Fornell-Larcker criterion, and Table 3 shows that all constructs met the criteria because the square root of AVE was higher than the correlation between variables (Hair et al., 2021).

Table 3 Results of the Fonell-Larcker Validity Test

Variable	Economic Factors	Environmental Factors	Social Factors	Warehouse Operational Performance	Sustainable Warehousing Performance
Economic Factors	0,938				
Environmental Factors	0,472	0,930			
Social Factors	0,555	0,289	0,933		
Warehouse Operational Performance	0,741	0,596	0,698	0,938	
Sustainable Warehousing Performance	0,768	0,641	0,715	0,859	0,957

Source: SmartPLS output, processed by the researcher (2026).

Table 4 Results of the Heterotrait-Monotrait Ratio (HTMT) Validity Test

Variable	Economic Factors	Environmental Factors	Social Factors	Sustainable Warehousing Performance	Warehouse Operational Performance
Economic Factors					
Environmental Factors	0,489				
Social Factors	0,575	0,299			
Sustainable Warehousing Performance	0,790	0,661	0,737		
Warehouse Operational Performance	0,764	0,615	0,721	0,881	

Source: SmartPLS output, processed by the researcher (2026).

Based on the results of the Heterotrait-Monotrait Ratio (HTMT) test, all HTMT values between constructs are below the recommended threshold of 0.90. The HTMT values range from 0.299 to 0.881, with the highest value found in the relationship between Warehouse Operational Performance and Sustainable Warehousing Performance. These results indicate that each construct has good discriminant validity, meaning that each variable is capable of measuring a distinct concept, and the measurement model is considered valid according to the criteria of Hair et al. (2022).

Construct reliability was evaluated using Cronbach's Alpha, rhoA, Composite Reliability, and AVE. A construct is considered reliable if its Composite Reliability value is greater than 0.70 and its AVE is greater than 0.50 (Hair et al., 2021). Table 5 shows that all constructs meet these criteria, with Cronbach's Alpha values ranging from 0.961 to 0.977, rhoA values ranging from 0.961 to 0.977, Composite Reliability values ranging from 0.970 to 0.982, and AVE values ranging from 0.865 to 0.915. Thus, all constructs demonstrate excellent reliability and meet the criteria for convergent validity.

Table 5 Reliability and Average Variance Extracted (AVE)

Variable	Cronbach's Alpha	rho_A	Composite Reliability	(AVE)
Economic Factors	0,966	0,966	0,973	0,880
Environmental Factors	0,961	0,961	0,970	0,865
Social Factors	0,963	0,963	0,971	0,870
Warehouse Operational Performance	0,973	0,973	0,978	0,880

Variable	Cronbach's Alpha	rho_A	Composite Reliability	(AVE)
Sustainable Warehousing Performance	0,977	0,977	0,982	0,915

Source: SmartPLS output, processed by the researcher (2026).

The overall results of the measurement model testing are presented in the figure below in Figure 2

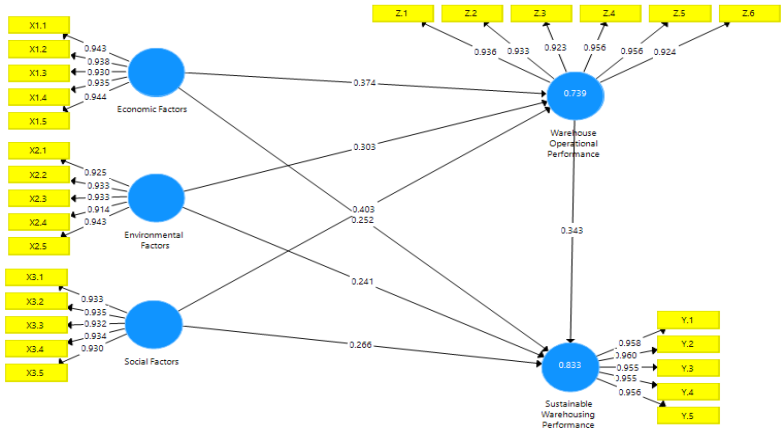

Figure 2 Full Outer Model

From the results of the full outer model shown in the figure, it can be seen that all the outer loading values of the research variables are more than 0.7. So that it can be concluded that all indicators are valid and can be used in the study.

Structural Model Test Results (Inner Model)

The R-squared (R^2) value is used to assess a structural model's ability to explain the dependent variable. According to Hair et al. (2021), an R^2 value of 0.75 indicates excellent explanatory power, a value around 0.50 is considered adequate, and a value around 0.25 is considered weak. The complete results of the analysis are presented in Table 6.

Table 6. R-Square Test Results

Variabel	R Square	R Square Adjusted
Warehouse Operational Performance	0,739	0,734
Sustainable Warehousing Performance	0,833	0,829

Source: SmartPLS output, processed by the researcher (2026).

Based on Table 6, the R^2 value for Warehouse Operational Performance is 0.739 (73.9% explained by economic, environmental, and social factors; 26.1% by other factors), while the R^2 value for Sustainable Warehousing Performance is 0.833 (83.3% explained by economic, environmental, and social factors, as well as Warehouse Operational Performance; 16.7% by other factors). Based on the criteria established by Hair et al. (2022), both of these values indicate that the models possess strong explanatory power.

Table 7. F-Square Test Results

Variabel	Economic Factors	Environmental Factors	Social Factors	Sustainable Warehousing Performance	Warehouse Operational Performance
Economic Factors				0,170	0,315
Environmental Factors				0,212	0,274
Social Factors				0,206	0,429
Sustainable Warehousing Performance					
Warehouse Operational Performance				0,184	

Source: SmartPLS output, processed by the researcher (2026).

The effect size (f^2) test results show that all exogenous variables have moderate to large effects on the endogenous variables. The Economic Factor has a moderate effect on Sustainable Warehousing Performance ($f^2 = 0,170$) and Warehouse Operational Performance ($f^2 = 0,315$). The Environmental Factor also has a moderate effect on Sustainable Warehousing Performance ($f^2 = 0,212$) and Warehouse Operational Performance ($f^2 = 0,274$). The Social Factor has a moderate effect on Sustainable Warehousing Performance ($f^2 = 0,206$) and a large effect on Warehouse Operational Performance ($f^2 = 0,429$). Warehouse Operational Performance has a moderate effect on Sustainable Warehousing Performance ($f^2 = 0,184$). Overall, all variables make meaningful contributions to explaining the endogenous variables. The largest effect comes from the Social Factor on Warehouse Operational Performance.

Hypothesis Testing

Path-coefficient significance was determined by testing with 5,000 resamples using bootstrapping and a level of significance of $p<0.05$ at 95% confidence (Hair et al., 2021). Theresults of the seven direct-effect hypotheses are presented in Table 8 and in Figure 3.

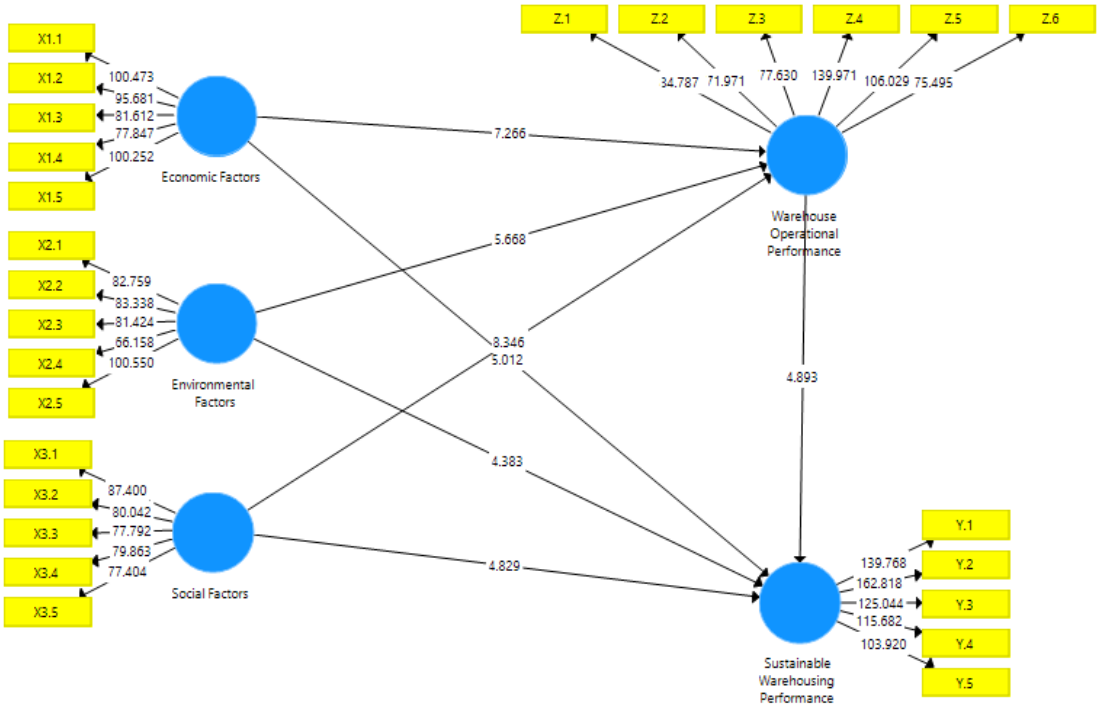

Figure 3. Research Construct Relationship Model Using the Bootstrapping Method

Table 8. Direct and Indirect effect

Path	Original Sample (O)	Sample Mean (M)	STDEV	T Statistics	P Values	Decision
Economic Factors -> Warehouse Operational Performance (H1)	0,374	0,375	0,052	7,228	**0,000**	Supported
Economic Factors -> Sustainable Warehousing Performance (H2)	0,252	0,256	0,051	4,951	**0,000**	Supported
Environmental Factors -> Warehouse Operational Performance (H3)	0,303	0,305	0,051	5,991	**0,000**	Supported
Environmental Factors -> Sustainable Warehousing Performance (H4)	0,241	0,242	0,055	4,402	**0,000**	Supported
Social Factors -> Warehouse Operational Performance (H5)	0,403	0,400	0,048	8,416	**0,000**	Supported
Social Factors -> Sustainable Warehousing Performance (H6)	0,266	0,271	0,055	4,835	**0,000**	Supported
Warehouse Operational Performance -> Sustainable Warehousing Performance (H7)	0,343	0,336	0,069	4,939	**0,000**	Supported

Source: SmartPLS bootstrapping output, processed by the researcher (2026)

The results of the hypothesis testing indicate that all structural paths are significant (t-statistic >1.96; p-value <0.05), with path coefficients ranging from 0.241 to 0.403 and t-statistics ranging from 4.402 to 8.416; thus, H1–H7 are accepted Economic, Environmental, and Social Factors have a positive effect on Warehouse Operational Performance and Sustainable Warehousing Performance, while Warehouse Operational Performance also has a significant positive effect on Sustainable Warehousing Performance ($\beta = 0.343$; $t = 4.939$; $p < 0.001$).

The mediation analysis tested the role of Warehouse Operational Performance (Z) in mediating the relationship between Economic (X1), Environmental (X2), and Social (X3) Factors and Sustainable Warehousing Performance (Y), with the results of the indirect effects presented in Table 9.

Table 9. Mediation Testing - Specific Indirect Effects

Path	Original Sample (O)	Sample Mean (M)	STDEV	T Statistics	P Values
Economic Factors -> Warehouse Operational Performance -> Sustainable Warehousing Performance (8)	0,128	0,126	0,031	4,118	**0,000**
Environmental Factors -> Warehouse Operational Performance -> Sustainable Warehousing Performance (H9)	0,104	0,103	0,028	3,717	**0,000**
Social Factors -> Warehouse Operational Performance -> Sustainable Warehousing Performance (H10)	0,138	0,134	0,032	4,280	**0,000**

Source: SmartPLS bootstrapping output, processed by the researcher (2026).

Based on Table 9, all indirect effects are positive and significant: Economic Factors ($\beta=0.128$; $t=4.118$; $p=0.000$; H8 accepted), Environmental Factors ($\beta=0.104$; $t=3.717$; $p=0.000$; H9 accepted), and Social Factors ($\beta=0.138$; $t=4.280$; $p=0.000$; H10 accepted) on Sustainable Warehousing Performance through Warehouse Operational Performance.

These results indicate that Warehouse Operational Performance acts as a significant mediator, whereby improvements in Economic, Environmental, and Social Factors not only have a direct impact but also enhance warehouse operational performance, which ultimately contributes to improved Sustainable Warehousing Performance.

Discussion

1. The Effect of Economic Factors on Warehouse Operational Performance

The test results show that the Economic Factor has a positive and significant effect on Warehouse Operational Performance ($\beta = 0.374$; $t = 7.228$; $p < 0.001$), thus H1 is accepted. This finding is consistent with the Resource-Based View (RBV), which states that cost efficiency, investment optimization, and resource management are strategic assets capable of enhancing a company's operational capabilities. These results are also consistent with the study by Agyabeng-Mensah et al. (2021), which showed that green warehousing practices provide economic value while improving operational effectiveness. Thus, improvements in economic factors are one of the main drivers in enhancing productivity and warehouse operational performance in the FMCG distribution industry in Indonesia.

2. The Effect of Economic Factors on Sustainable Warehousing Performance

The test results show that Economic Factors have a positive and significant effect on Sustainable Warehousing Performance ($\beta = 0.252$; $t = 4.951$; $p < 0.001$), thus H2 is accepted. This finding supports the Triple Bottom Line concept, which positions the economic dimension as one of the main pillars of organizational sustainability. These results are also consistent with the research by Jum'a et al. (2024) and Agyabeng-Mensah et al. (2021), which show that the economic value of sustainability practices directly contributes to improved sustainability performance. However, the fact that the magnitude of the direct effect is lower than the effect on Warehouse Operational Performance indicates that economic benefits will be optimized when supported by improvements in warehouse operational capabilities.

3. The Effect of Environmental Factors on Warehouse Operational Performance

The test results show that Environmental Factors have a positive and significant effect on Warehouse Operational Performance ($\beta = 0.303$; $t = 5.991$; $p < 0.001$), so H3 is accepted. This finding is consistent with the Natural Resource-Based View (NRBV), which states that environmental management practices, such as energy efficiency and waste management, can enhance a company's operational capabilities. These results are also consistent with the research by Torabizadeh et al. (2020) and Sukjit and Vanichchinchai (2020), which showed that green warehousing practices improve operational performance. Thus, the implementation of sound environmental practices not only reduces environmental impact but also improves warehouse operational efficiency.

4. The Effect of Environmental Factors on Sustainable Warehousing Performance

Environmental factors have a positive and significant effect on Sustainable Warehousing Performance ($\beta = 0.241$; $T = 4.402$; $P = 0.000$), so H4 is accepted. This coefficient value is the smallest among the three TBL factors affecting Sustainable Warehousing Performance, although it remains statistically significant. This finding is consistent with the results reported by (Grosse et al., 2024) and (Meliana & Hasibuan, 2025), which indicate that environmental aspects are a key component of green warehousing, but it indicates that the benefits of environmental aspects on sustainable warehousing performance in the context of this study are realized more indirectly namely, through improvements in Warehouse Operational Performance first as also demonstrated by the results of the mediation test (H9).

5. The Effect of Social Factors on Warehouse Operational Performance

Social factors have a positive and significant effect on Warehouse Operational Performance ($\beta=0.403$; $T=8.416$; $P=0.000$; H5 accepted), the highest value among all structural relationships in the model, indicating that social aspects work safety, competence, and employee well-being are the most dominant contributors to warehouse operational

performance. This finding reinforces Stakeholder Theory and aligns with Loske et al. (2021), who found that ergonomics and workplace safety enhance warehouse workers' productivity. It is also relevant to the characteristics of the respondents, the majority of whom are operational staff with short tenure (1–3 years), making competency development and workplace safety critical determinants of daily operational performance.

6. The Effect of Social Factors on Sustainable Warehousing Performance

Social factors were also found to have a positive and significant effect on sustainable warehousing performance (β = 0.266; T = 4.835; P = 0.000), thus H6 is accepted. These results reinforce the findings of (Ali & Kaur, 2021) and (Jum'a et al., 2024) that the success of sustainable warehousing is strongly influenced by the quality of social aspect management within an organization. Together with the results of the H5 test, these findings confirm that among the three dimensions of the Triple Bottom Line, the social aspect is the dimension that exerts the most consistent and strongest influence, both directly on Sustainable Warehousing Performance and through improvements in Warehouse Operational Performance.

7. The Effect of Warehouse Operational Performance on Sustainable Warehousing Performance

Warehouse Operational Performance has a positive and significant effect on Sustainable Warehousing Performance (β=0.343; T=4.939; P=0.000; H7 accepted), the highest value among all pathways leading to Sustainable Warehousing Performance, exceeding the direct effects of the three TBL factors. This finding aligns with Dynamic Capability Theory where operational capabilities serve as a mechanism for transforming resources into sustainable competitive advantage and reinforces the findings of Faveto et al. (2021) and Laosirihongthong et al. (2018) that operational effectiveness is a key determinant of an organization's sustainability performance, where improvements in efficiency, productivity, inventory accuracy, and warehouse service quality serve as the primary pathways to sustainable warehousing performance.

8. Warehouse Operational Performance Mediates the Effect of Economic Factors on Sustainable Warehousing Performance

The indirect effect analysis (Table 9) indicates that Warehouse Operational Performance significantly mediates the relationship between Economic Factors and Sustainable Warehousing Performance (β = 0.128; t = 4.118; p = 0.000), thereby supporting H8. Since Economic Factors also exert a significant direct effect on Sustainable Warehousing Performance (H2), the mediating role of Warehouse Operational Performance is classified as partial mediation rather than full mediation. This finding extends the study by Agyabeng-Mensah et al. (2021), which examined only the direct relationship and did not explain how economic factors are transformed into sustainable performance through operational capabilities.

9. Warehouse Operational Performance Mediates the Effect of Environmental Factors on Sustainable Warehousing Performance

The indirect effect analysis indicates that Warehouse Operational Performance significantly mediates the relationship between Environmental Factors and Sustainable Warehousing Performance (β = 0.104; t = 3.717; p = 0.000), thereby supporting H9. The mediation is classified as partial mediation, as Environmental Factors also maintain a significant direct effect on Sustainable Warehousing Performance (H4). This finding extends the work of Sukjit and Vanichchinchai (2020), who examined only the direct effect of environmental practices without explaining the underlying mechanism through which these

practices are translated into sustainable performance via warehouse operational capabilities. It also supports the interpretation presented in the discussion of H4, suggesting that the benefits of environmental initiatives are realized predominantly through indirect pathways enabled by enhanced warehouse operational performance.

10. Warehouse Operational Performance Mediates the Effect of Social Factors on Sustainable Warehousing Performance

The indirect effect analysis indicates that Warehouse Operational Performance significantly mediates the relationship between Social Factors and Sustainable Warehousing Performance ($\beta = 0.138$; $t = 4.280$; $p = 0.000$), thereby supporting H10. This indirect effect is the strongest among the three Triple Bottom Line (TBL) dimensions, consistent with the pattern of direct effects, where the social dimension also emerged as the most influential predictor (H5 and H6). These findings suggest that investments in employee competencies, occupational health and safety, and employee well-being generate the greatest multiplier effect on Sustainable Warehousing Performance by strengthening warehouse operational capabilities. Since Social Factors also exert a significant direct effect on Sustainable Warehousing Performance (H6), the mediating role of Warehouse Operational Performance is classified as partial mediation.

This result aligns with the model suggested by Tan et al. (2009), which stresses the necessity of harmonizing warehouse activities across economic, environmental, and social aspects in a cohesive way to attain sustainable outcomes. Additional evidence suggests that the social aspect of warehouse sustainability has been significantly neglected compared to the economic and environmental factors, which in turn hampers long-term operational success due to high employee turnover, low motivation, and reduced productivity. These results strengthen the notion that converting social initiatives into concrete operational skills is a vital route to enhancing Sustainable Warehousing Performance.

CONCLUSION AND SUGGESTIONS

Conclusion

Based on the findings of this study, the following conclusions can be drawn:

1. Economic Factors have a positive and significant effect on Warehouse Operational Performance. This finding indicates that cost efficiency, effective investment management, and optimal resource utilization enhance warehouse operational effectiveness. Consequently, better management of economic resources leads to higher levels of warehouse operational performance.
2. Economic Factors also have a positive and significant effect on Sustainable Warehousing Performance. This result demonstrates that achieving economic efficiency directly contributes to improved warehouse sustainability performance. However, the effect becomes more substantial when supported by improvements in warehouse operational performance.
3. Environmental Factors have a positive and significant effect on Warehouse Operational Performance. The implementation of environmentally sustainable practices, such as energy efficiency, waste management, and emission reduction, enhances the efficiency of warehouse operations, thereby improving overall operational performance.
4. Environmental Factors also have a positive and significant effect on Sustainable Warehousing Performance. These findings suggest that environmental sustainability practices directly improve sustainable warehousing performance, although their effect is relatively smaller than those of the economic and social dimensions.
5. Social Factors have a positive and significant effect on Warehouse Operational Performance. Social aspects, including employee competencies, occupational health and

safety, and employee well-being, represent the most influential determinants of warehouse operational performance. This finding highlights that human resources constitute the most valuable asset for achieving operational excellence in warehouse management.

6. Social Factors also have a positive and significant effect on Sustainable Warehousing Performance. Effective management of social dimensions enhances warehouse sustainability by improving workforce quality, strengthening the safety culture, and increasing employee engagement in sustainability initiatives.
7. Warehouse Operational Performance has a positive and significant effect on Sustainable Warehousing Performance. This finding indicates that improvements in operational efficiency, productivity, inventory accuracy, and service quality are the primary drivers of sustainable warehousing performance. Warehouse operational performance is therefore confirmed as the strongest determinant of successful sustainable warehousing implementation.
8. Warehouse Operational Performance partially mediates the relationship between Economic Factors and Sustainable Warehousing Performance. This result indicates that improvements in economic performance not only exert a direct influence on warehouse sustainability but also enhance sustainable warehousing indirectly by strengthening warehouse operational performance.
9. Warehouse Operational Performance also partially mediates the relationship between Environmental Factors and Sustainable Warehousing Performance. This finding suggests that the benefits of environmental practices are maximized when accompanied by improvements in warehouse operational effectiveness, which serves as the mechanism through which environmental initiatives are translated into sustainability performance.
10. Finally, Warehouse Operational Performance partially mediates the relationship between Social Factors and Sustainable Warehousing Performance. This indirect effect is the strongest among the three Triple Bottom Line (TBL) dimensions, indicating that investments in employee competencies, occupational health and safety, and employee well being generate the greatest contribution to sustainable warehousing by enhancing warehouse operational performance.

Limitations

Nevertheless, these limitations do not diminish the study's contribution in providing an initial overview of the factors influencing Sustainable Warehousing Performance in Indonesia's FMCG distribution industry. The findings remain relevant as a basis for decision-making by practitioners and as a foundation for academics conducting further research. Future research is advised to employ a longitudinal design to capture the dynamics of relationships among variables over time. The addition of contextual variables such as government support, regulatory pressure, and supply chain dynamics would also enrich the understanding of sustainable warehousing more comprehensively. Testing across more diverse industrial sectors would improve the generalizability of the findings.

Recommendation

Future research is recommended to expand the scope to other sectors such as manufacturing, e-commerce, cold chain logistics, and 3PL. The research model could also be developed by adding variables such as WMS, warehouse digitalization, green innovation, organizational culture, supply chain integration, and top management support. In addition, it is recommended to use larger samples, broader geographical coverage, and longitudinal or mixed-method approaches for a more comprehensive understanding. This will strengthen the

generalizability of the findings and provide a more complete overview of sustainable warehousing in Indonesia.

Author Contribution

I handled the research conceptualization, created the theoretical framework, carried out the data collection, data analysis, data interpretation and manuscript writing and revision, and read and approved the manuscript for publication.

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