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Analysis of The Influences of Regulatory Support and Customer Relationship Management on Green Transportation Throught Cost efficiency at PT Pos Indonesia

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Abstract: This study aims to analyze the influence of regulatory support and customer relationship management on green transportation implementation through cost efficiency as a mediating variable at PT Pos Indonesia (Persero). The research is motivated by the increase in logistics activities due to the growth of e-commerce, which drives distribution needs while simultaneously intensifying the challenge of reducing carbon emissions in the transportation sector. The study employs a quantitative approach with descriptive and verificative methods. Data were obtained through questionnaires distributed to 200 employees of PT Pos Indonesia (Persero) in various regions of Indonesia using a purposive sampling technique. Data analysis was conducted using Structural Equation Modeling–Partial Least Squares (SEM-PLS). The results indicate that regulatory support has a positive and significant effect on cost efficiency ($\beta = 0.544$; $t = 12.727$) and green transportation implementation ($\beta = 0.482$; $t = 9.527$). Customer relationship management also has a positive and significant effect on cost efficiency ($\beta = 0.449$; $t = 8.948$) as well as on green transportation implementation ($\beta = 0.333$; $t = 6.780$). In addition, cost efficiency has a positive effect on green transportation implementation ($\beta = 0.288$; $t = 5.935$) and partially mediates the influence of both independent variables on green transportation implementation. This study is expected to serve as a reference for the development of green logistics and the implementation of green transportation at PT Pos Indonesia (Persero).

Keyword: Regulatory Support, Customer Relationship Management, Cost Efficiency, Green Transportation Implementation.

INTRODUCTION

The global logistics and transportation industry has experienced significant growth in line with the expansion of electronic commerce (e-commerce) and the increasing complexity of goods distribution requirements. Globally, the logistics industry is projected to grow at an average rate of 6–8 percent per year, in parallel with the rise in digital trade activities, urbanization, and the demand for fast and efficient delivery services. In Indonesia, the growth of digital trade activities has shown a very rapid upward trend. The Central Statistics Agency (Badan Pusat Statistik) recorded that the value of Indonesian e-commerce transactions in 2024 reached IDR 1,288.93 trillion, an increase of 17.08 percent compared to the previous year. This condition indicates that distribution activities are intensifying and requires logistics companies to develop transportation systems that are more effective, efficient, and responsive to customer needs.

In addition to the growth in digital transactions, the logistics sector also makes a significant contribution to the national economy. Based on data from the Ministry of Transportation of the Republic of Indonesia (2024), the Indonesian logistics sector accounts for around 23 percent of total national distribution costs, a figure that is still relatively high compared to other ASEAN countries. This high logistics cost becomes a major challenge for logistics companies in maintaining operational efficiency while preserving their competitiveness. In this context, PT Pos Indonesia (Persero), as one of the national logistics companies, faces pressure to improve distribution efficiency, accelerate delivery services, and align its operations with the ongoing digitalization of logistics.

On the other hand, the increase in distribution and transportation activities has environmental consequences. The transportation sector is one of the main contributors to global carbon emissions. The Ministry of Energy and Mineral Resources of the Republic of Indonesia states that the transportation sector contributes approximately 44 percent of greenhouse gas emissions from national energy use, primarily due to high fuel consumption by motor vehicles. Furthermore, energy consumption in the transportation sector in Indonesia has grown at an average rate of 6.47 percent per year, with an average increase in carbon dioxide emissions of 5.29 percent per year. These data indicate that the rising intensity of logistics distribution activities has the potential to amplify environmental impacts if it is not accompanied by the implementation of more sustainable transportation systems.

The concept of green transportation has emerged as one of the strategic solutions to address these challenges. Green transportation focuses on energy efficiency, emission reduction, the use of environmentally friendly technologies, and the optimization of distribution systems to create more sustainable operations. The implementation of green transportation is not only aimed at mitigating environmental impacts but also at improving operational efficiency through route optimization, fuel efficiency, and the use of modern transportation technologies. Studies have shown that the implementation of green logistics can reduce operational costs by up to 15–20 percent through distribution digitalization and energy optimization.

In Indonesia, the government continues to promote the implementation of sustainable transportation systems through various policies on carbon emission reduction and energy efficiency. In this context, regulatory support becomes an important factor influencing the success of green transportation implementation. Regulatory support can provide policy direction, operational standards, and incentives for companies to adopt environmentally friendly transportation systems. Such support also plays a role in accelerating the adoption of low-emission vehicles, the digitalization of distribution processes, and the integration of more efficient logistics systems.

In addition to regulatory support, customer relationship management (CRM) is also a strategic factor in supporting green transportation implementation. Changes in customer behavior, with increasing concern for sustainability, encourage logistics companies to improve the quality of their customer relationships through effective communication, service innovation, and distribution transparency. Research by Pham et al. (2023) shows that effective CRM can increase customer loyalty by 28 percent and strengthen customer acceptance of sustainability-based logistics services.

However, the implementation of green transportation often faces major obstacles in the form of high initial investment costs, particularly for the procurement of electric vehicles, distribution digitalization technologies, and the development of green transportation infrastructure. Therefore, cost efficiency becomes a strategic factor that plays an important role in ensuring the success of green transportation implementation. Cost efficiency enables companies to optimize operational resources without reducing the quality of distribution services.

PT Pos Indonesia (Persero), as a national logistics company, has an extensive distribution network with thousands of service points across Indonesia. Based on the company's 2024 annual report, PT Pos Indonesia's shipment volume increased by 12.4 percent compared to the previous year. This increase reflects high transportation operational intensity, which has implications for the need to enhance distribution efficiency, manage operational costs, and adapt to environmental sustainability requirements. Nevertheless, the implementation of green transportation at PT Pos Indonesia still faces challenges in the form of technology investment needs, distribution efficiency improvements, and alignment with continuously evolving environmental regulations.

Although various previous studies have shown that regulatory support and customer relationship management influence the implementation of green logistics and green transportation, there remain several research gaps that need to be explored further. First, from a theoretical perspective, most studies position regulatory support and customer relationship management as independent variables that directly affect green logistics implementation or sustainability performance, without integrating cost efficiency as a mediating variable. Studies conducted by Khan et al. (2022), Pham et al. (2023), and Lee and Kim (2022) demonstrate that both regulatory support and customer relationship management have a positive effect on sustainable transportation implementation. However, these studies have not explained the mechanism through which cost efficiency becomes a pathway that strengthens the influence of these two variables on green transportation implementation. Second, empirically, research findings on the effect of regulatory support on green transportation implementation remain inconsistent. Khan et al. (2022), Lee and Kim (2022), and Nicoletti and Appolloni (2024) found that regulatory support has a positive and significant effect on the success of green transportation implementation. Conversely, Orji et al. (2021) show that the success of green logistics implementation is more strongly determined by operational efficiency and the company's ability to control costs than by regulatory pressure alone. Similar findings are presented by Centobelli et al. (2017), who argue that regulations will only be effective when supported by organizational readiness, technology, and internal company resources. These differences indicate that the influence of regulatory support still requires further empirical validation, particularly by including cost efficiency as a mediating variable.

Third, contextually, most previous studies were conducted in the manufacturing sector, supply chains, or logistics companies in developed countries, such as those by Khan et al. (2022), Centobelli et al. (2017), Orji et al. (2021), and Nicoletti and Appolloni (2024). Studies specifically examining green transportation implementation in state-owned logistics service companies in Indonesia, particularly PT Pos Indonesia (Persero), are still very limited. Therefore, this study is expected to expand empirical evidence in the context of national logistics companies. Fourth, methodologically, most previous research employed multiple linear regression analysis or covariance-based structural equation modeling (CB-SEM), as used by Centobelli et al. (2017) and Lee and Kim (2022). Studies applying Structural Equation Modeling–Partial Least Squares (SEM-PLS) to examine both direct and indirect relationships through mediating variables are still relatively few, especially in the context of green transportation implementation in the Indonesian logistics sector. Hence, this study uses SEM-PLS to enable a more comprehensive and simultaneous examination of the research model.

Based on these conditions, this study is important to conduct in order to analyze the influence of regulatory support and customer relationship management on green transportation implementation through cost efficiency as a mediating variable at PT Pos Indonesia (Persero). This study is expected to provide theoretical contributions to the development of green logistics and sustainable transportation studies, as well as practical contributions for PT Pos Indonesia in enhancing the effectiveness of green transportation implementation amid the intensifying competition in the national logistics industry.

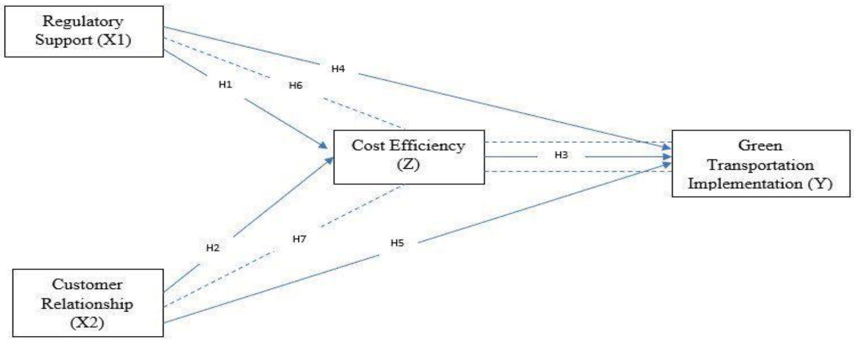


Figure 2. 1 Research Model
Source: Rahman Fathan, 2026

METHOD

Research Type

This study employs a quantitative approach with descriptive and verificative methods. The quantitative approach is selected because the research focuses on measuring relationships among variables using numerical data and statistical analysis. The descriptive method is used to describe the characteristics of respondents and the conditions of the research variables, whereas the verificative method is used to test hypotheses regarding the influence of regulatory support and customer relationship management on green transportation implementation through cost efficiency as a mediating variable.

Population and Sample

The population in this study consists of employees of PT Pos Indonesia (Persero) who are involved in logistics and transportation activities in various regions of Indonesia. The research sample comprises 200 respondents determined using a purposive sampling technique. This technique is chosen because the researcher requires respondents with specific characteristics, namely employees who understand distribution operational processes, company policies related to sustainability, and customer service. The sample size is considered adequate for analysis using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with the assistance of SmartPLS 3.0 (Hair et al., 2021).

Time and Location of the Study

The study was conducted in 2026 with PT Pos Indonesia (Persero) as the research object, representing a national logistics company. Data collection was carried out in several units and branches of PT Pos Indonesia that represent the company's main operational regions. The research period covered the stages of instrument preparation, data collection through questionnaires, and data analysis using SEM-PLS software.

Research Instrument

The research instrument used in this study is a structured questionnaire based on a Likert scale, designed to measure four main variables: regulatory support (X1), customer relationship management (X2), cost efficiency (M), and green transportation implementation (Y). Each variable is elaborated into several indicators adapted from previous studies and literature related to green logistics, transportation sustainability, and customer relationship management. The questionnaire was distributed both directly and online to the predetermined respondents.

Research Procedure

The research procedure began with a literature study to develop the theoretical foundation, conceptual framework, and research model concerning the influence of regulatory support and customer relationship management on green transportation implementation through cost efficiency. Subsequently, the researcher formulated the operationalization of variables and designed the questionnaire based on relevant indicators (Hair et al., 2021). After the instrument was completed, a limited trial was conducted to ensure the clarity of the statement items, followed by the distribution of the questionnaire to 200 respondents in accordance with the purposive sampling criteria. The collected data were then processed and analyzed using SEM-PLS to test validity, reliability, and structural relationships among variables. The final stage consisted of interpreting the analysis results, discussing the findings, and formulating conclusions and recommendations.

Data Analysis Technique

The data analysis technique used in this study is Structural Equation Modeling–Partial Least Squares (SEM-PLS). The analysis consists of two main stages: evaluation of the measurement model (outer model) and evaluation of the structural model (inner model). In the outer model stage, convergent validity, discriminant validity, and construct reliability are assessed using outer loadings, Average Variance Extracted (AVE), and composite reliability. In the inner model stage, path coefficients, t-statistics, p-values, and R-square values are examined to evaluate the direct and indirect effects of regulatory support and customer relationship management on cost efficiency and green transportation implementation. The SEM-PLS approach is chosen because it can simultaneously test models with mediating variables and is suitable for the characteristics of research data based on respondents' perceptions (Hair et al., 2021).

RESULTS AND DISCUSSION

Respondent Characteristics

The respondents in this study total 200 individuals who are employees of PT Pos Indonesia. The characteristics of the respondents are grouped based on gender, age, length of employment, and department/division. The following is a summary of the respondents' characteristics.

Table 1 Respondents Characteristics

No	Characteristic	Category	Number (Persons)	Percentage (%)
1	Gender	Male	115	57,50%
		Female	85	42,50%
2	Age	< 25 years	17	8,50%
		26–35 years	76	38,00%
		36–45 years	87	43,50%
		>46 years	20	10,00%
3	Length of Employment	<5 years	15	7,50%
		6–15 years	63	31,50%
		16-25 years	89	44,50%

No	Characteristic	Category	Number (Persons)	Percentage (%)
		>26 years	33	16,50%
4	Department/Division	Business	28	14,00%
		Courier Operations	93	46,50%
		Service Operations	55	27,50%
		Finance	20	10,00%

Sourch: (Author, 2026)

Research Findings

This study examines both the outer model and the inner model. The outer model, or measurement model, explains the relationship between latent variables and the indicators used to measure them. Latent variables are variables that cannot be directly measured, so they require several indicators or questionnaire items as measurement tools. Therefore, the outer model is used to assess whether these indicators are valid and reliable in representing the latent variables. Meanwhile, the inner model, or structural model, describes the relationships among latent variables in the study. The inner model is used to test hypotheses and to determine the extent to which one latent variable influences other latent variables within the research model. Thus, the outer model focuses on the quality of variable measurement, whereas the inner model focuses on the structural relationships among variables in the research model (Hair et al., 2021).

Evaluation of the Outer Model

The convergent validity test aims to determine the extent to which indicators are able to accurately measure the construct under investigation. An indicator is declared valid if it has a loading factor value of at least 0.70, in accordance with the recommendation of Hair et al. (2021).

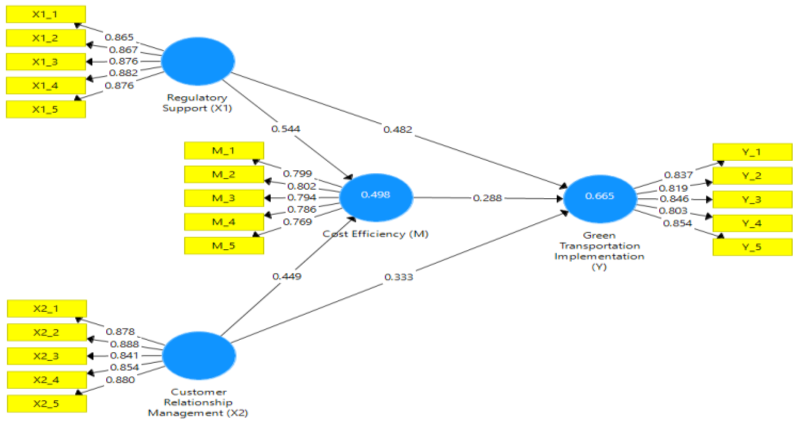


Figure 4. 1 PLS Algoritma Result
Source: (Data Processing, 2026)

The results of the outer loading test can be seen in Table 4.2.

Table 4. 2 Results of the Outer Loading Validity Test

Variable	Indicator	Loading Factor	Cronbach's Alpha	rho_A	Reliabilitas Komposit	(AVE)
Cost Efficiency (M)			0.849	0.850	0.892	0.624
M_1		0.799				
M_2		0.802				
M_3		0.793				
M_4		0.786				
M_5		0.769				

Customer Relationship Management (X2)		0.919	0.929	0.939	0.754
X2_1	0.879				
X2_2	0.890				
X2_3	0.842				
X2_4	0.850				
X2_5	0.879				
Green Transportation Implementation (Y)		0.889	0.889	0.918	0.692
Y_1	0.833				
Y_2	0.823				
Y_3	0.846				
Y_4	0.803				
Y_5	0.854				
Regulatory Support (X1)		0.922	0.925	0.941	0.763
X1_1	0.861				
X1_2	0.865				
X1_3	0.880				
X1_4	0.882				
X1_5	0.878				

Source: (Data Processing, 2026)

Based on the outer loading validity test results in the Structural Equation Modeling–Partial Least Squares (SEM-PLS) analysis, this test aims to assess the extent to which each indicator is able to reflect or explain the latent variable being measured. The outer loading value indicates the strength of the relationship between an indicator and its construct. In PLS-based research, an indicator is considered to meet convergent validity if it has an outer loading value of at least 0.70. The higher the outer loading value, the stronger the indicator represents the latent construct being measured.

For the Regulatory Support variable (X1), all indicators show high outer loading values, namely X1.1 of 0.861, X1.2 of 0.865, X1.3 of 0.880, X1.4 of 0.882, and X1.5 of 0.878. All of these values are above the minimum threshold of 0.70, indicating that all indicators in this variable have good capability in representing the Regulatory Support construct. In addition, a Cronbach's Alpha value of 0.922, rho_A of 0.925, Composite Reliability of 0.941, and Average Variance Extracted (AVE) of 0.763 show that this variable is not only valid but also has a very high level of reliability, since all reliability values meet the required criteria.

For the Customer Relationship Management variable (X2), the outer loading values for indicators X2.1 to X2.5 are 0.879, 0.890, 0.842, 0.850, and 0.879, respectively. All of these values exceed the minimum threshold of 0.70, so they can be declared valid in measuring the Customer Relationship Management construct. The Cronbach's Alpha value of 0.919, rho_A of 0.929, Composite Reliability of 0.939, and AVE of 0.754 indicate that the indicators in this variable have very good internal consistency and are able to explain the variance of the construct strongly.

For the mediating variable Cost Efficiency (M), the outer loading values of indicators M1 to M5 are 0.799, 0.802, 0.793, 0.786, and 0.769, respectively. All of these values are above the minimum standard of 0.70, so the indicators are declared convergently valid in measuring the Cost Efficiency variable. The Cronbach's Alpha value of 0.849, rho_A of 0.850, Composite Reliability of 0.892, and AVE of 0.624 further confirm that this construct has good reliability and validity in the research model.

For the Green Transportation Implementation variable (Y), the outer loading values of indicators Y1 to Y5 are 0.833, 0.823, 0.846, 0.803, and 0.854, respectively. These values indicate strong relationships between the indicators and the construct being measured, so all indicators can be concluded to be valid in representing the Green Transportation Implementation variable. This conclusion is also supported by a Cronbach's Alpha value of 0.889, rho_A of 0.889, Composite Reliability of 0.918, and AVE of 0.692, all of which are above the recommended standards.

Evaluation of Indicator Correlation

Discriminant validity in this study is evaluated using the Fornell–Larcker criterion. Based on Table 4.3, all constructs are found to satisfy this criterion, because the square root of the Average Variance Extracted (AVE) for each construct is greater than the correlations between that construct and other constructs (Hair et al., 2021). Thus, each construct has good discriminant validity and is able to distinguish itself adequately from other constructs in the research model.

Table 4. 3 Fornell–Larcker Validity Test Results

	(M)	(X2)	(Y)	(X1)
Cost Efficiency (M)	0.790			
Customer Relationship Management (X2)	0.451	0.868		
Green Transportation Implementation (Y)	0.702	0.463	0.832	
Regulatory Support (X1)	0.546	0.001	0.640	0.873

Source: (Data Processing, 2026)

For the Cost Efficiency variable (M), the square root of AVE is 0.790, which is greater than its correlations with Customer Relationship Management (X2) of 0.451, Green Transportation Implementation (Y) of 0.702, and Regulatory Support (X1) of 0.546. This indicates that the Cost Efficiency construct has good discriminant validity and can be clearly distinguished from the other constructs.

For the Customer Relationship Management variable (X2), the square root of AVE is 0.868, which is higher than its correlations with Cost Efficiency (M) of 0.451, Green Transportation Implementation (Y) of 0.463, and Regulatory Support (X1) of 0.001. This condition shows that the Customer Relationship Management construct has very strong discriminant ability and can be clearly differentiated from the other constructs.

For the Green Transportation Implementation variable (Y), the square root of AVE is 0.832, which is greater than its correlations with Cost Efficiency (M) of 0.702, Customer Relationship Management (X2) of 0.463, and Regulatory Support (X1) of 0.640. This indicates that the Green Transportation Implementation construct satisfies the discriminant validity criterion and has a clear distinction from the other constructs in the model.

For the Regulatory Support variable (X1), the square root of AVE is 0.873, which is higher than its correlations with Cost Efficiency (M) of 0.546, Customer Relationship Management (X2) of 0.001, and Green Transportation Implementation (Y) of 0.640. Thus, the Regulatory Support construct also satisfies the discriminant validity criterion.

Reliability of Variables and Average Variance Extracted

Convergent validity in this study is evaluated based on the Average Variance Extracted (AVE) value. A construct is considered to meet convergent validity if it has an AVE value greater than 0.50, which indicates that the construct is able to explain more than 50 percent of the variance of its indicators (Hair et al., 2021).

Furthermore, construct reliability testing is carried out through internal consistency reliability measurement using Cronbach's Alpha and Composite Reliability values. A construct is declared reliable if it has Cronbach's Alpha and Composite Reliability values of at least 0.70, in accordance with the recommendations of Hair et al. (2021).

Tabel 4. 4 *Reability* AVE Test Results

	Cronbach's Alpha	rho_A	Reliabilitas Komposit	(AVE)
Cost Efficiency (M)	0.849	0.850	0.892	0.624
Customer Relationship Management (X2)	0.919	0.929	0.939	0.754
Green Transportation Implementation (Y)	0.889	0.889	0.918	0.692
Regulatory Support (X1)	0.922	0.925	0.941	0.763

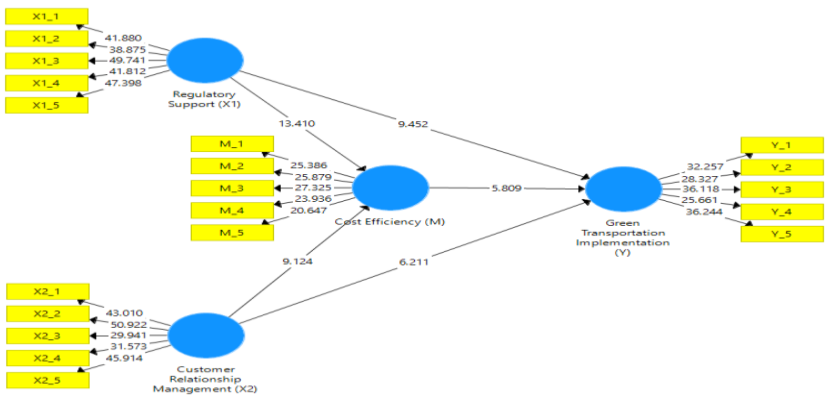
Source: (Data Result, 2026)

Inner Model Evaluation

In the SEM-PLS approach, the inner model (structural model) describes the causal relationships among latent variables in the study. The evaluation of the inner model is conducted after the measurement model (outer model) has been confirmed to be valid and reliable. This evaluation aims to assess the direction of relationships, the strength of effects, and the level of significance among latent variables through path coefficient values and bootstrapping results (Hair et al., 2021).

One of the criteria used in evaluating the structural model is the R-square (R^2) value. The R^2 value indicates the extent to which independent variables are able to explain the variance of the dependent variables in the research model. The higher the R^2 value, the greater the predictive capability of the model.

According to Hair et al. (2021), an R^2 value of 0.75 is categorized as having a substantial explanatory power, a value of around 0.50 is considered moderate, and a value of around 0.25 is classified as weak. Thus, the interpretation of the R^2 value is used to assess how well exogenous constructs are able to explain endogenous constructs in the research model.



Figur 4. 2 Bootstrapping PLS Result
Source: (Data Processing, 2026)

Table 4. 5 R-Square Test Result

	R Square	Adjusted R Square
Cost Efficiency (M)	0.498	0.493
Green Transportation Implementation (Y)	0.665	0.660

Source: (Pengolahan Data, 2026)

Based on Table 4.5, the R^2 value for the Green Transportation Implementation variable (Y) is 0.665 or 66.5 percent, with an Adjusted R^2 of 0.660. Meanwhile, the Cost Efficiency variable (M) has an R^2 value of 0.498 or 49.8 percent and an Adjusted R^2 of 0.493. These results indicate that the structural model has strong explanatory power.

Significance Testing of Path Coefficients

Significance testing of the path coefficients is conducted to evaluate the direction and strength of the influence of independent variables on dependent variables in the structural model. This testing is carried out using the bootstrapping procedure in SEM-PLS to obtain t-statistics and p-values as the basis for decision-making.

A relationship between variables is considered significant if it meets the criteria of p-value less than 0.05 or t-statistics greater than 1.96 at a 5 percent significance level (95 percent confidence level), as recommended by Hair et al. (2021). These values are used as the basis for determining whether the research hypotheses are accepted or rejected. The detailed results of hypothesis testing are presented in Table 4.6, while the complete visualization of the bootstrapping results can be seen in the Appendix.

Tabel 4. 6 Direct Effect Hypothesis Test

	Original Sample (O)	Sample Mean (M)	Standard Deviation	T Statistic (|O/STDEV|)	P Values
(M) -> (Y)	0.288	0.288	0.049	5.935	0.000
(X2) -> (M)	0.449	0.450	0.050	8.948	0.000
(X2) -> (Y)	0.333	0.334	0.049	6.780	0.000
(X1)-> (M)	0.544	0.542	0.043	12.727	0.000
(X1) -> (Y)	0.482	0.483	0.051	9.527	0.000

Source: (Data Processing, 2026)

The results of the direct effect hypothesis testing presented in Table 4.6 are as follows.

1. Regulatory Support (X1) has a positive and significant effect on Cost Efficiency (M) with $\beta = 0.544$, $t = 12.727$, and $p < 0.05$. Thus, H1 is accepted.
2. Customer Relationship Management (X2) has a positive and significant effect on Cost Efficiency (M) with $\beta = 0.449$, $t = 8.948$, and $p < 0.05$. Thus, H2 is accepted.
3. Cost Efficiency (M) has a positive and significant effect on Green Transportation Implementation (Y) with $\beta = 0.288$, $t = 5.935$, and $p < 0.05$. Thus, H3 is accepted.
4. Regulatory Support (X1) has a positive and significant effect on Green Transportation Implementation (Y) with $\beta = 0.482$, $t = 9.527$, and $p < 0.05$. Thus, H4 is accepted.
5. Customer Relationship Management (X2) has a positive and significant effect on Green Transportation Implementation (Y) with $\beta = 0.333$, $t = 6.780$, and $p < 0.05$. Thus, H5 is accepted.

Phase II hypothesis testing concerns the examination of indirect effects (mediation), which evaluates whether Cost Efficiency (M) mediates the influence of Regulatory Support (X1) and Customer Relationship Management (X2) on Green Transportation Implementation.

Table 4. 7 Hypothesis Testing of Indirect Effects

	Original Sample (O)	Sample Mean (M)	Standard Deviation	T Statistic (|O/STDEV|)	P Values
(X2) -> (M) -> (Y)	0.129	0.129	0.026	4.912	0.000
(X1) -> (M) -> (Y)	0.157	0.155	0.027	5.833	0.000

Source: (Data Processing, 2026)

The study results indicate a positive and significant effect, as the t-statistic values exceed 0.67 and the p-values are lower than 0.050, in line with the criteria suggested by Hair et al. (2021).

Discussion of Research Findings

The findings for H1 show that Regulatory Support (X1) has a positive and significant effect on Cost Efficiency (M), with a path coefficient (β) of 0.544, a t-statistic of 12.727, and a p-value of 0.000 (< 0.05). This result indicates that the better the regulatory support provided by the company and the government whether in the form of policies, operational standards, or infrastructure support the higher the level of operational cost efficiency that can be achieved. Clear regulations guide companies in optimizing resource utilization, reducing distribution costs, and improving the effectiveness of logistics operations. These findings are consistent with Khan et al. (2022), who state that regulatory support plays an important role in enhancing operational efficiency in sustainable logistics systems.

The findings for H2 show that Customer Relationship Management (X2) has a positive and significant effect on Cost Efficiency (M), with a path coefficient (β) of 0.449, a t-statistic of 8.948, and a p-value of 0.000 (< 0.05). This indicates that effective management of customer relationships through responsive services, good communication, and optimal management of customer information can enhance the company's operational cost efficiency. Strong customer relationships help reduce distribution errors, improve service accuracy, and minimize unnecessary operational costs. These results support Pham et al. (2023), who found that customer relationship management makes a significant contribution to operational efficiency in the logistics industry.

The findings for H3 show that Cost Efficiency (M) has a positive and significant effect on Green Transportation Implementation (Y), with a path coefficient (β) of 0.288, a t-statistic of 5.935, and a p-value of 0.000 (< 0.05). This result suggests that operational cost efficiency is a crucial factor in supporting the successful implementation of green transportation. The more efficient the management of distribution costs and energy use, the greater the opportunity for companies to adopt environmentally friendly transportation technologies and sustainable distribution systems. These findings are in line with Orji et al. (2021), who emphasize that cost efficiency is a key factor in the implementation of green transportation.

The findings for H4 indicate that Regulatory Support (X1) has a positive and significant effect on Green Transportation Implementation (Y), with a path coefficient (β) of 0.482, a t-statistic of 9.527, and a p-value of 0.000 (< 0.05). This result shows that regulatory support directly promotes the implementation of green transportation through policies that encourage energy efficiency, emission reduction, and the use of low-carbon technologies. Strong regulations provide an essential foundation for companies to develop more environmentally friendly transportation systems. These findings support Centobelli et al. (2017), who argue that regulation is a strategic factor in driving the success of green logistics.

The findings for H5 show that Customer Relationship Management (X2) has a positive and significant effect on Green Transportation Implementation (Y), with a path coefficient (β) of 0.333, a t-statistic of 6.780, and a p-value of 0.000 (< 0.05). This indicates that strong customer relationships can directly enhance the implementation of green transportation. This occurs because customers are increasingly concerned about sustainability aspects in the logistics services they use, which encourages companies to adopt environmentally oriented service innovations. These findings are consistent with Pham et al. (2023), who state that effective customer relationship management can increase the adoption of green logistics practices.

The findings for H6 show that Customer Relationship Management (X2) has a positive and significant effect on Green Transportation Implementation (Y) through the mediation of Cost Efficiency (M), with an indirect path coefficient (β) of 0.129, a t-statistic of 4.912, and a p-value of 0.000 (< 0.05). This result indicates that the effect of customer relationship management on green transportation implementation occurs not only directly but is also strengthened through improvements in operational cost efficiency. In other words, effective customer relationship management enhances the efficiency of logistics processes, which in turn supports the successful implementation of green transportation. These findings reinforce Stakeholder Theory, which emphasizes the important role of customers as key stakeholders in promoting corporate sustainability.

The findings for H7 show that Regulatory Support (X1) has a positive and significant effect on Green Transportation Implementation (Y) through the mediation of Cost Efficiency (M), with an indirect path coefficient (β) of 0.157, a t-statistic of 5.833, and a p-value of 0.000 (< 0.05). This result suggests that strong regulatory support can enhance green transportation implementation through improvements in operational cost efficiency. Regulations that encourage efficient energy use, emission reduction, and distribution optimization help create operational systems that are more cost-effective and sustainable. Theoretically, these findings strengthen the Resource-Based View (RBV), which posits that regulatory support and operational efficiency are strategic resources for achieving long-term competitive advantage.

Overall, the hypothesis testing results show that all relationships among variables in the research model are positive and significant. This indicates that Regulatory Support and Customer Relationship Management play important roles in enhancing Cost Efficiency and Green Transportation Implementation at PT Pos Indonesia (Persero). In addition, Cost Efficiency is proven to function as a significant mediating variable in explaining the relationships between exogenous and endogenous variables, demonstrating that the research model has strong empirical power in explaining the implementation of green transportation in a national logistics company.

CONCLUSION

Based on the research findings and discussion regarding the influence of Regulatory Support and Customer Relationship Management on Green Transportation Implementation through Cost Efficiency at PT Pos Indonesia (Persero), several conclusions can be drawn as follows.

1. Regulatory Support has a positive and significant effect on Cost Efficiency. This indicates that the stronger the regulatory support both in the form of internal policies, operational standards, and compliance with environmental regulations the higher the operational cost efficiency that can be achieved by the company. Clear regulatory support helps the company optimize resource utilization and reduce distribution costs.
2. Customer Relationship Management has a positive and significant effect on Cost Efficiency. This finding shows that effective management of customer relationships, through improved service quality, good communication, and a strong understanding of customer needs, can enhance the company’s operational efficiency. Strong customer relationships help minimize distribution errors and improve service effectiveness.
3. Cost Efficiency has a positive and significant effect on Green Transportation Implementation. This result indicates that operational cost efficiency becomes an important factor in driving the successful implementation of green transportation. The more efficient the management of operational costs and energy use, the greater the opportunity for the company to adopt more environmentally friendly transportation systems.
4. Regulatory Support has a positive and significant effect on Green Transportation Implementation. This indicates that regulations supporting the use of low-emission technologies, energy efficiency, and the reduction of environmental impacts can directly increase the implementation of green transportation in company operations.

5. Customer Relationship Management has a positive and significant effect on Green Transportation Implementation. This result shows that changes in customer preferences, which increasingly emphasize sustainability aspects, encourage companies to develop more environmentally friendly distribution systems.
6. Customer Relationship Management has a positive and significant effect on Green Transportation Implementation through Cost Efficiency. This indicates that operational cost efficiency acts as a mediating mechanism that strengthens the influence of customer relationship management on the successful implementation of green transportation.
7. Regulatory Support has a positive and significant effect on Green Transportation Implementation through Cost Efficiency. This finding shows that operational cost efficiency is an important pathway in explaining how regulatory support can enhance green transportation implementation more effectively.

Overall, this study demonstrates that Regulatory Support and Customer Relationship Management are strategic factors that contribute to enhancing Green Transportation Implementation, both directly and indirectly through Cost Efficiency. Thus, the research model provides an empirical picture of the factors that influence the success of green transportation implementation in a national logistics company.

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