

STRUCTURAL MODEL OF THE EFFECT OF TRANSPORTATION VENDORS AND WAREHOUSES ON HUMANITARIAN LOGISTICS DISTRIBUTION PERFORMANCE WITH TRANSPORTATION AS A MEDIATING VARIABLE (STUDY ON ROHINGYA REFUGEES IN PIDIE)

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ABSTRACT

This study aims to examine and analyze the effect of Transportation Vendor and Warehouse on the Distribution Performance of Humanitarian Logistics, with Transportation serving as a mediating variable in the context of ready-to-eat food distribution for Rohingya refugees in Pidie, Aceh. The study involved 179 respondents from multiple stakeholders, including IOM, UNHCR, government agencies, NGOs, and volunteers, with a sample size of 124 determined using the Slovin formula (5% margin of error).

The results of the descriptive analysis indicate that the mean values of Transportation Vendor (2.94), Warehouse (2.88), Transportation (2.99), and Distribution Performance (3.04) are all below 3.40, suggesting that the overall conditions are fairly good but not yet optimal. The measurement model evaluation confirms that all constructs meet the criteria for convergent validity (outer loadings > 0.70; AVE > 0.50), discriminant validity (Fornell–Larcker criterion satisfied), and reliability (Cronbach’s Alpha and Composite Reliability > 0.70).

The structural model results show that Transportation is significantly influenced by Transportation Vendor and Warehouse, as reflected in the equation $Y = 0.390X_1 + 0.433X_2$. Furthermore, Transportation has a significant positive effect on Distribution Performance ($\beta = 0.627$). Hypothesis testing demonstrates that all direct and indirect relationships are positive and statistically significant (t-statistics > 1.96; p-values < 0.05), confirming the validity of all proposed hypotheses (H1–H7).

The coefficient of determination indicates that Transportation Vendor and Warehouse explain 40.20% of the variance in Transportation (Adjusted $R^2 = 0.402$), while Transportation explains 64.90% of the variance in Distribution Performance (Adjusted $R^2 = 0.649$). These findings highlight the strong explanatory power of the model.

Overall, the results confirm the critical role of Transportation as a mediating variable in strengthening the relationship between operational factors (Transportation Vendor and Warehouse) and Distribution Performance. The study emphasizes the importance of integrated logistics management, particularly transportation optimization, warehouse improvement, and vendor performance enhancement, in improving the effectiveness of humanitarian logistics distribution.

Keywords: Humanitarian Logistics, Distribution Performance, Transportation, Transportation Vendor, Warehouse

1. INTRODUCTION

The International Organization for Migration (IOM) is an international organization within the United Nations (UN) system that has played a crucial role in ensuring safe, orderly, and humane migration since its establishment in 1951. In its operations, IOM holds a strategic role in humanitarian logistics, defined as the management of the flow of goods, information, and resources to effectively meet humanitarian needs through multi-stakeholder coordination (Kembro, 2024). These activities include planning, procurement, storage, and distribution of aid to vulnerable populations.

In Indonesia, IOM operates in various regions, including Aceh, particularly in addressing the needs of Rohingya refugees. In Pidie Regency, IOM collaborates with multiple stakeholders such as UNHCR, Local government, National Agencies, LazisNU, LazisMU, MDMC, Yayasan Mina Raya, and volunteers, with a total operational population of 179 individuals. One of the primary activities is the distribution of ready-to-eat meals to Rohingya refugees across four locations: Yayasan Mina Raya, Leun Tanjung, Blang Raya Village, Kulee Village, and Kulem Village, with a distribution frequency of three times per day.

The International Organization for Migration (IOM) has established a logistics performance standard that limits the acceptable error rate in its operations to 3% (IOM, 2026). However, empirical evidence reveals that the actual error rate in the distribution of ready-to-eat meals between 2022 and 2025 ranged from 13.61% to 16.26%, significantly exceeding this threshold. These errors—comprising delivery delays, damaged goods, quantity discrepancies, and instances of food spoilage (Akan et al., 2024)—indicate substantial deficiencies in the effectiveness and reliability of the current humanitarian logistics distribution system. This persistent gap between expected and actual performance underscores a critical operational problem that requires further investigation.

From an operational perspective, food distribution is further constrained by geographical challenges, including distances of up to 56 km and inadequate road conditions, which contribute to delivery delays and suggest inefficiencies within the transportation component. Despite its importance, the role of transportation in influencing distribution performance remains

inconclusive in existing literature. While some studies find that transportation has a significant effect on distribution performance (Chauhan et al., 2023), others report no such relationship (Nugroho et al., 2025), thereby indicating a clear research gap.

Moreover, IOM's reliance on external transportation vendors renders distribution performance highly dependent on vendor capabilities and service quality. Prior studies provide conflicting evidence regarding the impact of transportation vendors on logistics outcomes. Some researchers argue that vendor performance significantly affects both transportation efficiency and overall distribution performance (Tumanggor et al., 2024; Chairunnisa et al., 2026), whereas others find no statistically significant relationship (Sumarna & Sulistiyaningsih, 2024; Festus, 2021). These inconsistencies highlight a lack of consensus in the literature and emphasize the need for a more comprehensive and systematic examination of how transportation factors and vendor performance interact to influence humanitarian logistics distribution.

In addition, issues are also evident in the warehousing component, as indicated by occurrences of food spoilage. Warehousing has been identified as a factor that may influence both transportation efficiency and overall distribution performance (Chauhan et al., 2023). However, empirical findings remain inconsistent, with some studies reporting no significant effect of warehousing on distribution outcomes (Rahmawati, 2024). Furthermore, studies examining indirect relationships—particularly those involving transportation as a mediating variable—also produce conflicting results (Jean, 2024; Wen et al., 2025). These inconsistencies further underscore the need for an integrated analysis of warehousing, transportation, and vendor performance in shaping the effectiveness of humanitarian logistics distribution systems.

Based on these empirical conditions and inconsistencies in prior research findings, there is a clear need for further investigation into the factors influencing humanitarian logistics performance. Specifically, this study aims to examine the effects of transportation vendors and warehousing on distribution performance, while considering transportation as a mediating variable in the context of ready-to-eat food distribution for Rohingya refugees in Pidie, Aceh.

2. LITERATURE REVIEW

Humanitarian logistics refers to the management of the flow of goods, information, and resources in emergency situations to ensure the effective and timely fulfilment of humanitarian needs (Kembro et al., 2024). In this study, the focus is on the distribution of ready-to-eat food to Rohingya refugees in Pidie, Aceh, as a critical component of humanitarian logistics operations. The transportation vendor variable is conceptualized as an external service provider responsible for delivering transportation services in an adaptive, efficient, and reliable manner (Queiroz et al., 2022). This variable is commonly measured through several key dimensions, including capability, responsiveness, and reliability. These dimensions are reflected in indicators such as fleet availability, the ability to meet delivery requirements, responsiveness

to operational demands, capacity to handle emergency situations, delivery accuracy, and overall service quality (Ivanov, 2023; Kovács & Falagara Sigala, 2022; Aguezzoul, 2025).

In this study, warehousing is defined as a logistics facility that supports the storage, control, and efficient distribution of goods within the supply chain (Zhen & Li, 2022). It encompasses activities related to inventory management, storage conditions, and the coordination of inbound and outbound flows. The key dimensions of warehousing include capability, responsiveness, and reliability. These dimensions are reflected in indicators such as effective storage management, optimal capacity utilization, smooth inbound and outbound processes, accuracy in handling requests, inventory record accuracy, and distribution accuracy (Khan et al., 2024; Dehghan et al., 2023).

Transportation, on the other hand, refers to the process of moving humanitarian aid in a manner that is rapid, flexible, and reliable, particularly under emergency conditions (Kovács & Falagara Sigala, 2022). In this study, transportation is conceptualized through the dimensions of efficiency, responsiveness, and reliability. These dimensions are measured using indicators such as fleet optimization, reduction of distribution time, delivery speed, responsiveness to emergency situations, route flexibility, and the smooth execution of transportation operations (Queiroz et al., 2022; Ivanov, 2023).

Furthermore, the distribution performance of humanitarian logistics is defined as the extent to which aid is delivered effectively, efficiently, responsively, and reliably to beneficiaries (Akan et al., 2024). This construct comprises dimensions such as efficiency, responsiveness, effectiveness, and reliability, which are operationalized through indicators including resource optimization, waste minimization, delivery speed, accuracy of delivered quantities, fulfillment of beneficiaries' needs, and timeliness of distribution (Delshad et al., 2024; Sentia et al., 2023).

Despite the recognized importance of these variables, prior studies have produced inconsistent findings regarding their relationships. Transportation vendors have been shown to significantly influence transportation performance in several studies (Tumanggor et al., 2024; Ramadhani, 2024), while other research reports no significant effect (Ramadhandi, 2024). Similarly, warehousing has been found to influence transportation performance (Krnjaic et al., 2022; Lesch et al., 2023; Mohd Fathi et al., 2022), yet contradictory evidence indicates no significant relationship (Batarlienė & Jarašūnienė, 2024).

In addition, transportation has been identified as a significant determinant of distribution performance in some studies (Chauhan et al., 2023; Rahmawati, 2024), whereas others report non-significant effects (Nugroho et al., 2025; Poliak et al., 2023). The role of transportation vendors and warehousing in directly influencing distribution performance also remains inconclusive. Several studies highlight their significant contributions (Chairunnisa et al., 2026; Darmono, 2023; Chauhan et al., 2023; Tanjung et al., 2024), while others find no statistically significant impact (Festus, 2021; Wen et al., 2025; Rahmawati, 2024). Moreover, studies examining indirect relationships—particularly those involving transportation as a mediating

variable—also demonstrate inconsistent results (Jean, 2024; Wen et al., 2025; Herdianzah et al., 2022).

These inconsistencies in prior research findings indicate a clear research gap in understanding the relationships among transportation vendors, warehousing, transportation, and distribution performance in humanitarian logistics. Therefore, further investigation is required to analyze the effects of transportation vendors and warehousing on the distribution performance of humanitarian logistics, with transportation acting as a mediating variable. This study focuses on the case of ready-to-eat food distribution for Rohingya refugees in Pidie, Aceh, to provide empirical insights into this context.

3. METHODS

This study adopts an explanatory quantitative approach to investigate the causal relationships among variables within the context of humanitarian logistics (Sugiyono, 2023). Data analysis is conducted using Structural Equation Modeling based on Partial Least Squares (SEM-PLS), which enables the examination of complex relationships among latent variables. SEM-PLS is particularly suitable for this study as it does not require strict assumptions of data normality and allows for the simultaneous assessment of both the measurement model and the structural model (Ghozali, 2023). Furthermore, this method is appropriate for analyzing models that incorporate mediating variables, making it well-suited to the research framework employed in this study.

The research model comprises exogenous variables, namely Transportation Vendor (X1) and Warehouse (X2), an intervening (mediating) variable, Transportation (Y), and an endogenous variable, Distribution Performance of Humanitarian Logistics (Z). The model is designed to examine both the direct and indirect relationships among these variables, based on the research gaps identified in prior studies. The hypotheses proposed in this study are as follows:

- H1: Transportation Vendor has a positive and significant effect on Transportation.
- H2: Warehouse has a positive and significant effect on Transportation.
- H3: Transportation has a positive and significant effect on Distribution Performance of Humanitarian Logistics.
- H4: Transportation Vendor has a positive and significant effect on Distribution Performance of Humanitarian Logistics.
- H5: Warehouse has a positive and significant effect on Distribution Performance of Humanitarian Logistics.
- H6: Transportation Vendor has a positive and significant indirect effect on Distribution Performance of Humanitarian Logistics through Transportation.

H7: Warehouse has a positive and significant indirect effect on Distribution Performance of Humanitarian Logistics through Transportation.

This study employs a purposive sampling technique, in which respondents are selected based on specific criteria relevant to the research objectives. The criteria include individuals who are directly involved in humanitarian logistics activities related to the distribution of ready-to-eat food in Pidie, Aceh, and who possess sufficient knowledge and experience in logistics operations.

Purposive sampling is chosen because it enables the selection of respondents who are most capable of providing accurate and relevant information regarding the variables under study. This approach is particularly appropriate for this research, as it focuses on stakeholders such as staff from IOM, UNHCR, government agencies, non-governmental organizations, and volunteers who are actively engaged in humanitarian logistics processes.

The sample size was determined using the Slovin formula with a margin of error of 5%, as follows:

$$n = N / (1 + N(e^2))$$

$$n = 179 / (1 + 179(0.05^2))$$

$$n = 179 / (1 + 179(0.0025))$$

$$n = 179 / 1.4475 = 123.66 \approx 124 \text{ respondents}$$

Based on this calculation, the required sample size for this study is 124 respondents.

Data for this study were collected using a structured questionnaire administered to respondents involved in humanitarian logistics activities in Pidie, Aceh. The respondents comprised personnel from the International Organization for Migration (IOM), the United Nations High Commissioner for Refugees (UNHCR), local government agencies, social services, non-governmental organizations (LazisNU, LazisMU, and MDMC), foundations, and volunteers.

The questionnaire was developed based on the study variables, namely Transportation Vendor (X1), Warehouse (X2), Transportation (Y), and Distribution Performance of Humanitarian Logistics (Z). Measurement items for each construct were operationalized using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

The data collection process was conducted through direct field distribution of questionnaires, supported by coordination with relevant institutions to ensure respondent accessibility and participation. A total of 124 questionnaires were distributed, all of which were returned and deemed valid for analysis, consistent with the sample size determined using the Slovin formula.

Prior to analysis, the collected data were subjected to a screening process to ensure completeness and consistency. The results indicated no significant missing data, and all

responses met the requirements for subsequent analysis using Structural Equation Modeling with Partial Least Squares (SEM-PLS).

4. RESULTS AND DISCUSSION

4.1. Numerical Result

4.1.1. Descriptive Analysis

The descriptive analysis indicates that the mean scores for Transportation Vendor (2.94), Warehouse (2.88), Transportation (2.99), and Distribution Performance (3.04) fall within the “fairly good” category, yet remain below the optimal threshold (Sugiyono, 2023). These findings suggest that the current condition of humanitarian logistics operations in Pidie, Aceh, is moderate but still characterized by notable inefficiencies. In relation to the proposed hypotheses, the suboptimal condition of transportation vendors and warehousing may help explain variations in transportation performance (H1 and H2), as limitations in vendor capability and warehouse management can directly affect the efficiency and reliability of transportation processes. Furthermore, the relatively moderate score of transportation indicates potential constraints in delivery timeliness and flexibility, which may subsequently influence distribution performance (H3).

In addition, the findings imply that both transportation vendors and warehousing may have direct implications for distribution performance (H4 and H5), given their roles in ensuring service quality, inventory accuracy, and the condition of goods delivered. The presence of inefficiencies across these variables also supports the assumption of indirect effects, where transportation acts as a mediating variable (H6 and H7). In this context, inadequate vendor performance and suboptimal warehouse management may first affect transportation processes, which in turn influence overall distribution outcomes. Therefore, while the descriptive results indicate a moderate level of performance, they also reinforce the need for further hypothesis testing using inferential analysis (SEM-PLS) to determine the significance and strength of both direct and indirect relationships among the variables.

Table 1. Descriptive Analysis Results

No	Variables	Mean	Decision
1	Transportation vendor.	2.94	Fairly Good
2	Warehouse.	2.88	Fairly Good
3	Transportation.	2.99	Fairly Good
4	Distribution Performance of Humanitarian of Logistics Goods	3.04	Fairly Good
Total Sample (n)		124	

Source: Questionnaire data processed using Microsoft Excel (2026).

Note: The category classification is based on a five-point Likert scale. The interpretation of mean scores is as follows: 1.00–1.80 = Very Poor; 1.81–2.60 = Poor; 2.61–3.40 = Fairly Good; 3.41–4.20 = Good; and 4.21–5.00 = Very Good (Sugiyono, 2023).

4.1.2 Convergent Validity

The results of the convergent validity test, as presented in Table 2, indicate that all indicators exhibit outer loading values exceeding the recommended threshold of 0.70, thereby satisfying the criteria for convergent validity (Ghozali, 2023). This finding suggests that each construct can adequately explain the variance of its respective indicators. Consequently, all measurement items demonstrate sufficient convergent validity and are deemed appropriate for inclusion in further analysis using the SmartPLS software.

Table 2. Outer Model Values

No	Variables	Outer Loading	Decision
1	Transportation vendor.	0,762-0,826	Valid
2	Warehouse.	0,824- 0,888	Valid
3	Transportation.	0,795-0,882	Valid
4	Distribution Performance of Humanitarian of Logistics Goods	0,707-0,854	Valid

Source: Questionnaire data processed using SmartPLS 3 software (2026).

4.1.3 Discriminant Validity (Fornell-Larcker)

The results of the discriminant validity test assessed using the Fornell–Larcker criterion, show that the square root of the Average Variance Extracted (AVE) for each construct exceeds the corresponding inter-construct correlations. For instance, the Transportation Vendor construct exhibits a $\sqrt{\text{AVE}}$ value of 0.805, which is higher than its highest correlation with other constructs (0.482), thereby confirming adequate discriminant validity.

Overall, these findings demonstrate that each construct in the model possesses strong conceptual distinctiveness, with no significant overlap among variables. This indicates that each construct captures and explains a unique aspect of the phenomena within the context of humanitarian logistics performance.

Table 3. Discriminant Validity

	Distribution Performance of Humanitarian Logistics Goods	Transportation	Transportation Vendor	Warehouse
Distribution Performance of Humanitarian Logistics Goods	0.781			
Transportation	0.701	0.841		
Transportation Vendor	0.489	0.482	0.805	
Warehouse	0.526	0.516	0.212	0.858

Source: Questionnaire data processed using SmartPLS 3 (2026).

These results indicate that each construct in the model exhibits strong conceptual distinctiveness, with no evidence of significant overlap among the variables. This suggests that

each construct represents a unique dimension and contributes to explaining different aspects of humanitarian logistics performance.

4.1.4 Reliability Test

The results of the reliability and convergent validity tests indicate that all constructs exhibit strong internal consistency. Specifically, Cronbach's Alpha, rho_A, and Composite Reliability values for all variables exceed the recommended threshold of 0.70, while the Average Variance Extracted (AVE) values are all above 0.50 (Ghozali, 2023).

These findings confirm that the measurement model is both reliable and valid, indicating that the constructs are consistently measured and capable of adequately capturing the variance of their respective indicators. Therefore, all variables are considered suitable for further analysis in the structural model.

Table 4. Construct Reliability and Validity Results

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Distribution Performance of Humanitarian Logistics Goods	0.908	0.915	0.926	0.610
Transportation	0.931	0.931	0.944	0.707
Transportation Vendor	0.892	0.907	0.917	0.648
Warehouse	0.929	0.941	0.944	0.736

Source: Questionnaire data processed using SmartPLS 3 (2026).

These findings confirm that the measurement model is both reliable and valid, indicating that the constructs are consistently measured and capable of adequately capturing the variance of their respective indicators. Therefore, all variables are considered suitable for further analysis in the structural model.

4.1.5 Structural Model (Path Analysis)

The structural model is analyzed using path analysis to examine the relationships among the study variables. The relationship between Transportation Vendor (X1), Warehouse (X2), and Transportation (Y) is expressed in the following multiple regression equations:

$$Y = \beta_1 X_1 + \beta_2 X_2$$

Where:

- Y = Transportation
- β_1 = Path coefficient of Transportation Vendor

- X_1 = Transportation Vendor
- β_2 = Path coefficient of Warehouse
- X_2 = Warehouse

Based on the results presented in Figure 2, the estimated equation is: $Y = 0.390X_1 + 0.433X_2$

This equation indicates that both Transportation Vendor and Warehouse have positive effects on Transportation. Specifically, a one-unit increase in the Transportation Vendor variable is associated with an increase of 0.390 in Transportation, while a one-unit increase in the Warehouse variable contributes 0.433 to Transportation, assuming other variables remain constant.

Furthermore, the effect of Transportation (Y) on Distribution Performance of Humanitarian Logistics (Z) is represented by the following simple regression equation: $Z = \beta_3 Y$

Where:

- Z = Distribution Performance of Humanitarian Logistics
- β_3 = Path coefficient of Transportation
- Y = Transportation

Based on the analysis results, the estimated equation is: $Z = 0.627Y$

This result indicates that Transportation has a positive effect on Distribution Performance of Humanitarian Logistics. In particular, a one-unit increase in Transportation leads to an increase of 0.627 in Distribution Performance, indicating that improvements in transportation efficiency and reliability contribute significantly to enhancing overall distribution performance.

4.1.6 Explanation of Hypothesis Testing

Table 5. Hypothesis Test Results

Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values	Decision
Transportation → Distribution Performance of Humanitarian Logistics Goods	0.627	0.625	0.066	9.519	0.000	Accepted

Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values	Decision
Transportation Vendor → Distribution Performance of Humanitarian Logistics Goods	0.151	0.153	0.066	2.280	0.023	Accepted
Transportation Vendor → Transportation	0.390	0.388	0.066	5.912	0.000	Accepted
Warehouse → Distribution Performance of Humanitarian Logistics Goods	0.170	0.174	0.061	2.780	0.006	Accepted
Warehouse → Transportation	0.433	0.436	0.071	6.141	0.000	Accepted

Source: Questionnaire data processed using SmartPLS 3 (2026).

The results of the structural model analysis indicate that all hypothesized relationships are positive and statistically significant, as evidenced by T-statistic values greater than 1.96 and p-values below 0.05.

First, Transportation Vendor has a positive and significant effect on Transportation ($\beta = 0.390$; $t = 5.912$; $p < 0.001$), indicating that improvements in vendor capability, responsiveness, and reliability enhance transportation effectiveness. This finding is consistent with previous studies (Tumanggor et al., 2024; Ramadhani, 2024).

Second, Warehouse also demonstrates a positive and significant effect on Transportation ($\beta = 0.433$; $t = 6.141$; $p < 0.001$), suggesting that effective warehouse management supports smoother and more efficient transportation processes. This result aligns with earlier findings (Krnjaic et al., 2022; Lesch et al., 2023; Mohd Fathi et al., 2022).

Third, Transportation has a strong positive and significant influence on Distribution Performance of Humanitarian Logistics ($\beta = 0.627$; $t = 9.519$; $p < 0.001$), confirming its critical role as a key determinant of effective aid distribution. This finding supports prior research (Chauhan et al., 2023; Rahmawati, 2024).

Fourth, Transportation Vendor directly affects Distribution Performance ($\beta = 0.151$; $t = 2.280$; $p = 0.023$), indicating that vendor performance contributes not only indirectly through

transportation but also directly to distribution outcomes. This is consistent with the findings of Chairunnisa et al. (2026) and Darmono (2023).

Fifth, Warehouse has a positive and significant direct effect on Distribution Performance ($\beta = 0.170$; $t = 2.780$; $p = 0.006$), demonstrating that effective storage and inventory management contribute directly to improved logistics performance, in line with Chauhan et al. (2023) and Tanjung et al. (2024).

Furthermore, the mediation analysis indicates that Transportation serves as a significant intervening variable. Transportation Vendor exerts a significant indirect effect on Distribution Performance through Transportation ($t = 4.913$; $p < 0.001$), while Warehouse also shows a significant indirect effect via Transportation ($t = 4.865$; $p < 0.001$). These results confirm the mediating role of Transportation in strengthening the relationship between operational factors and distribution outcomes, consistent with previous studies (Jean, 2024; Wen et al., 2025; Herdianzah et al., 2022).

Overall, these findings highlight the strategic importance of Transportation as a central mechanism linking Transportation Vendor and Warehouse to Distribution Performance. Therefore, optimizing transportation systems is essential for improving the overall effectiveness and efficiency of humanitarian logistics distribution.

4.1.7 Coefficient of Determination (R-Square Test)

Table 6. Adjusted R-Square Test Results (Coefficient of Determination Test)

Variable	R Square	Adjusted R Square
Distribution Performance of Humanitarian Logistics Goods	0.657	0.649
Transportation	0.411	0.402

Source: Questionnaire data processed using SmartPLS 3 (2026).

The coefficient of determination (R-square) test is employed to evaluate the explanatory power of exogenous (independent) variables on endogenous (dependent) variables within the structural model. The R-square value indicates the proportion of variance in the endogenous variables that can be explained by the exogenous variables included in the model (Ghozali, 2023). Based on the results of data processing using the SEM-PLS approach, the adjusted R-square values demonstrate the following:

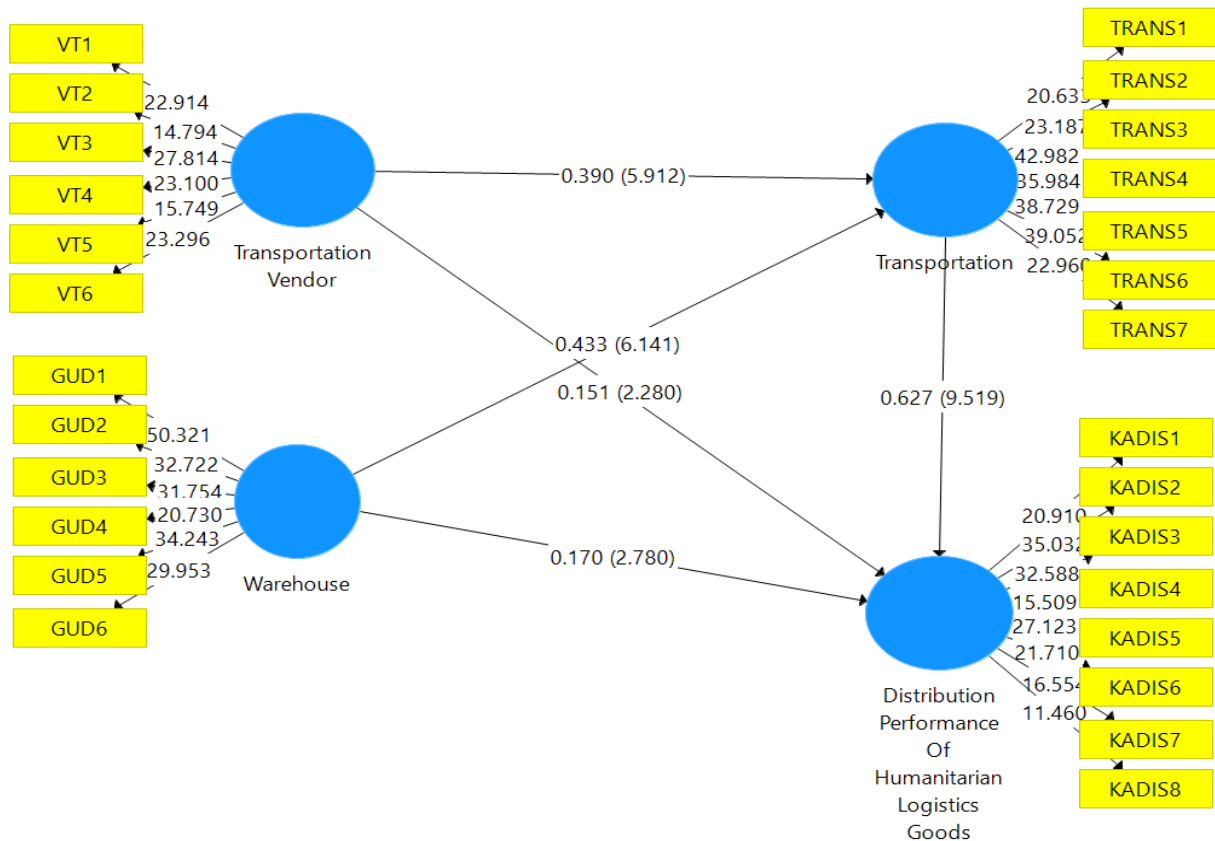
First, the Transportation variable has an adjusted R-square value of 0.402, indicating that 40.20% of the variance in Transportation can be explained by the Transportation Vendor and Warehouse variables. The remaining 59.80% of the variance is influenced by factors not examined in this study. These omitted variables may include transportation infrastructure, information systems, information technology utilization, transportation planning, fleet capacity and availability, transportation costs, coordination among involved organizations, and inter-organizational collaboration in addressing the needs of Rohingya refugees in Pidie.

Second, the Distribution Performance of Humanitarian Logistics Goods variable shows an adjusted R-square value of 0.649. This implies that 64.90% of its variance can be explained by the Transportation variable. Meanwhile, the remaining 35.10% is attributed to other variables not included in the model. Such variables may encompass information quality, logistics information systems, human resource competency, logistics infrastructure, response speed, risk and uncertainty management, government policies and regulations, refugee settlement locations, and accessibility to these locations.

Overall, these findings indicate that the model exhibits moderate to strong explanatory power, particularly for the Distribution Performance of Humanitarian Logistics Goods variable.

5.2. Graphical Result

Figure 2. Path Coefficients and T-Statistics Values of the Research Results



Source : Source: Questionnaire data processed using SmartPLS 3 application (2026).

Figure 2 presents the structural model illustrating the relationships among Transportation Vendor (X1), Warehouse (X2), Transportation (Y), and Distribution Performance of Humanitarian Logistics (Z). The model provides a comprehensive overview of both direct and indirect relationships among the variables.

The results indicate that Transportation Vendor and Warehouse exert direct effects on Transportation, with path coefficients of 0.390 and 0.433, respectively. This suggests that both variables significantly contribute to improving Transportation performance, with Warehouse demonstrating a slightly stronger influence compared to Transportation Vendor.

Furthermore, Transportation has a direct and substantial effect on Distribution Performance of Humanitarian Logistics, underscoring its critical role as a key determinant in enhancing humanitarian logistics outcomes. In addition to this indirect pathway, both Transportation Vendor and Warehouse also exhibit direct relationships with Distribution Performance, highlighting the importance of operational factors in determining the effectiveness of distribution activities.

The model also confirms the presence of mediating effects. Specifically, Transportation functions as an intervening variable in the relationships between Transportation Vendor and Distribution Performance, as well as between Warehouse and Distribution Performance. This finding emphasizes the strategic role of Transportation in linking operational inputs to overall logistics performance.

In terms of explanatory power, the adjusted R-square value for Transportation is 0.402, indicating that 40.20% of its variance is explained by Transportation Vendor and Warehouse. Meanwhile, the adjusted R-square for Distribution Performance of Humanitarian Logistics is 0.649, implying that 64.90% of its variance is accounted for by the model. These values suggest that the model demonstrates moderate explanatory power for Transportation and strong explanatory power for Distribution Performance.

All structural relationships in the model are statistically significant, as evidenced by t-statistic values exceeding the threshold of 1.96 and p-values below 0.05. These results confirm that all proposed hypotheses are supported.

Overall, the graphical model reveals a well-structured and robust set of relationships among the variables, highlighting the pivotal role of Transportation in enhancing the effectiveness and performance of humanitarian logistics distribution.

5. CONCLUSION AND LIMITATION

Based on the research findings, the distribution performance of humanitarian logistics in Pidie, Aceh, is not yet optimal. This is evidenced by error rates ranging from 13.61% to 16.26%, which significantly exceed the acceptable tolerance limit of 3%. These results indicate the presence of substantial inefficiencies in transportation, warehouse management, and vendor performance.

The structural model analysis reveals that Warehouse has a stronger influence on Transportation (path coefficient = 0.433) compared to Transportation Vendor (0.390). Furthermore, Transportation plays a pivotal role in improving distribution performance, both as a direct determinant and as a mediating variable. This finding underscores the importance of

prioritizing transportation system optimization, supported by improvements in warehouse operations and vendor performance. To address these issues, several strategic recommendations are proposed:

1. Transportation Optimization.

Enhancing route planning through flexible and adaptive routing systems is essential to minimize delays, particularly given the 56 km distance and existing road constraints. The implementation of real-time monitoring systems is also recommended to improve delivery timeliness and operational visibility.

2. Warehouse Management Enhancement

Strengthening warehouse operations is necessary to prevent damage and spoilage of goods, especially ready-to-eat food. This can be achieved through improved inventory control systems, temperature monitoring, and strict implementation of the first-in-first-out (FIFO) method.

3. Vendor Performance Improvement

Establishing more rigorous vendor selection and evaluation mechanisms based on key performance indicators—such as timeliness, service quality, and emergency responsiveness—is critical. The adoption of performance-based contracts can further enhance accountability and service reliability.

4. Integration and Coordination Systems

Improving coordination among key stakeholders (e.g., IOM, UNHCR, local government, and NGOs) through integrated information systems is essential. Such systems enable real-time data sharing and support faster, more effective decision-making processes.

Overall, these strategies are expected to reduce logistical errors and enhance the overall effectiveness and efficiency of humanitarian logistics distribution.

However, this study has several limitations. The model explains 40.20% of the variance in Transportation and 64.90% in Distribution Performance, suggesting that other relevant factors—such as infrastructure, information systems, and regulatory conditions—remain unexamined. Moreover, the study's focus on a single geographical context may limit generalizability. Future research is encouraged to incorporate broader variables and diverse contexts, as well as mixed-method approaches, to enhance the comprehensiveness of humanitarian logistics analysis.

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