UNPACKING THE NEXUS BETWEEN AGILE LEADERSHIP, CROWD LOGISTICS, AND LAST-MILE DELIVERY EFFICIENCY: INSIGHTS FROM PT POS INDONESIA

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Abstract. *The logistics industry is undergoing substantial changes due to the growth of e-commerce and digital transformation, which demands increased last-mile delivery (LMD) efficiency. PT Pos Indonesia faces challenges in maintaining competitiveness during global competition and complex infrastructure. Agile Leadership and Crowd Logistics are two approaches that can improve operational flexibility and distribution efficiency. However, the relationship between the two in the context of LMD is still not widely explored empirically. This research aims to evaluate the influence of Agile Leadership on LMD efficiency at PT Pos Indonesia and analyze the role of Crowd Logistics in improving distribution effectiveness. This research uses a quantitative approach with a survey method on managers and operational staff of PT Pos Indonesia. Data analysis was carried out using the Variance-based Partial Least Squares Structural Equation Modeling (PLS-SEM) method to test the relationship between the research variables. The results show that Agile Leadership has a positive and significant influence on LMD efficiency through increased responsiveness and operational flexibility. In addition, Crowd Logistics contributes to speeding up delivery and reducing distribution costs by leveraging community participation. The interaction between Agile Leadership and Crowd Logistics creates synergies that strengthen PT Pos Indonesia's competitiveness in facing logistical challenges. Theoretically, this research enriches the literature on logistics management and agile leadership in the context of distribution. From a practical perspective, the results of this research provide recommendations for logistics companies to adopt more adaptive and community-based strategies to improve operational efficiency.*

Keywords: *Agile Leadership; Crowd Logistics; Last-Mile Delivery; Logistics Efficiency; PT Pos Indonesia.*

1. INTRODUCTION

The logistics industry is undergoing a major transformation due to digital innovations that bring opportunities as well as challenges, especially in last-mile delivery (LMD). In Indonesia, the rapid growth of e-commerce is increasing pressure for logistics providers to improve the efficiency of LMDs to ensure customer satisfaction. PT Pos Indonesia faces stiff competition from local and global players, so it needs to adapt and innovate to improve its operational performance (Busse & Weidner, 2020; Zhu et al., 2023). Challenges such as limited infrastructure and variations in demand between regions increasingly demand strategies that are more efficient and responsive to market dynamics (Zhu et al., 2023).

Agile Leadership is becoming an increasingly recognized strategy in overcoming LMD challenges. This approach allows leaders to build an adaptive, collaborative work culture as well as the ability to make quick decisions—a critical factor in a dynamic logistics landscape (Macfarlane et al., 2024; Yamin et al., 2024). The implementation of Agile Leadership allows PT Pos Indonesia to better respond to market changes, customer feedback, and operational disruptions. Studies show that agility-based leadership strategies can improve supply chain resilience and operational responsiveness, thus having a positive impact on overall logistics effectiveness (Thakkar, 2024; Kittichat,

2024). Therefore, the integration of Agile Leadership is a necessity for logistics companies to maintain competitiveness.

In addition to leadership, Crowd Logistics is also an innovative strategy in increasing LMD's capacity and efficiency. By involving the community and independent workers, this approach reduces operational costs compared to traditional distribution methods (Zhang et al., 2019). The integration of Crowd Logistics provides flexibility in resource allocation and increases the adaptability of distribution networks to fluctuations in demand, especially in Indonesia, which has diverse geographical conditions (Kara & Yalçın, 2022). Empirical studies show that the Crowd Logistics platform can improve logistics performance through alignment between demand and resources and the implementation of more agile operational practices (Zhang et al., 2019; Durugbo et al., 2021).

The literature on last-mile delivery (LMD) focuses more on technological and infrastructure advancements, while the role of Agile Leadership in improving operational efficiency still receives less attention. Although agile methodologies are increasingly recognized in logistics management, their relevance to improving LMD performance is still limited (Moncef & Dupuy, 2021). In addition, although Crowd Logistics has been widely analyzed in a platform-based framework, research on its integration with Agile Leadership in traditional logistics, especially in Indonesia, is still minimal (Leyerer et al., 2020). This gap shows the need for empirical research that examines the impact of Agile Leadership and Crowd Logistics on LMD efficiency, especially in Indonesia, which has unique geographical challenges (Sultan et al., 2023). This research answers the question: how does Agile Leadership improve the efficiency of LMD at PT Pos Indonesia? To what extent does Crowd Logistics streamline distribution and reduce costs? Is there a synergistic effect of the two?

Thus, this research aims to evaluate the influence of Agile Leadership on the efficiency of last-mile delivery at PT Pos Indonesia, given its role in improving operational flexibility and responsive decision-making. In addition, this research also examines the contribution of Crowd Logistics in smoothing the distribution process and reducing operational costs through the use of logistics resources based on community participation. Furthermore, this research analyzes how the interaction between Agile Leadership and Crowd Logistics can create synergies that have an impact on improving the efficiency of last-mile delivery. By highlighting these dynamics in the context of PT Pos Indonesia, this research is expected to provide deeper insights into managerial and operational strategies that can be applied to optimize delivery services in the midst of complex logistics challenges.

This research presents a novelty by exploring the role of Agile Leadership in improving the efficiency of last-mile delivery, an aspect that is still rarely discussed in the context of Indonesian logistics. By integrating Agile Leadership and Crowd Logistics as operational strategies, the research offers an innovative approach to addressing distribution challenges in the final stages of delivery. The combination of these two concepts is expected to create a more adaptive and efficient model in responding to market dynamics and customer needs. In addition, this research provides evidence-based insights that can be utilized by PT Pos Indonesia and the logistics industry more broadly to increase competitiveness through leadership optimization and community-based logistics innovation.

2. LITERATURE REVIEW

2.1 The Role of Agile Leadership in Achieving Last-Mile Delivery Efficiency

The relationship between Agile Leadership and Last-Mile Delivery (LMD) Efficiency is increasingly becoming a focus in the logistics literature, especially in improving operational resilience in a dynamic environment. Agile Leadership, which emphasizes flexibility, responsiveness, and collaboration, is a key factor in addressing LMD challenges, such as fluctuating demand and operational uncertainty (Nguyen et al., 2024; Dey et al., 2023). Agile leadership encourages innovation and rapid decision-making,

enabling logistics organizations to respond more effectively to change (Porkodi, 2024; Yamin et al., 2024).

In the context of LMD, Agile Leadership can be measured through several key indicators. Collaboration is an important aspect in creating solid teamwork to solve problems collectively (Oliveira et al., 2021; Park, 2021). Speed of decision-making also plays a role in determining operational efficiency, especially in the face of rapid changes in the supply chain (Karia, 2023; Yamin et al., 2024). In addition, team empowerment allows for decentralization of authority, encouraging autonomy in more responsive decision-making (Karia, 2023; Motwani & Katatria, 2024). Furthermore, the promotion of innovation by leaders creates an environment that encourages creativity and new solutions in facing logistical challenges (Oliveira et al., 2021; Permana, 2022). Responsiveness to feedback is also an important factor in improving operational effectiveness by adjusting strategies based on input from employees and stakeholders (Nguyen et al., 2024; Dey et al., 2023).

The efficiency of LMD, which reflects the effectiveness of the final stage of delivery to customers, is influenced by a variety of factors. Delivery speed is a key indicator in assessing logistics performance, as customers increasingly demand faster and more reliable services (Miko & Abbas, 2023; Zainuddin et al., 2022). Delivery accuracy also plays an important role in ensuring customer satisfaction, as errors in delivery can lead to complaints and increase operational costs (Suguna et al., 2021; Zainuddin et al., 2022). Cost-effectiveness is a crucial aspect in balancing operational efficiency with business sustainability, so cost optimization without sacrificing service quality is necessary (Durugbo et al., 2021; Zainuddin et al., 2022).

In addition, customer satisfaction is a fundamental element in assessing the success of LMD. Customers who are satisfied with the speed, accuracy, and reliability of the service tend to be more loyal to the delivery service provider (Durugbo et al., 2021; Suguna et al., 2021). Service reliability is also an important factor, considering that consistency in delivery can build a positive reputation for the company and increase customer trust (Miko & Abbas, 2023; Zainuddin et al., 2022).

Empirical support shows that the application of Agile Leadership in logistics can improve LMD efficiency by accelerating decision-making, improving coordination, and driving innovation (Hofman et al., 2023; Nguyen et al., 2024). Agile leadership allows companies to adapt quickly to changing market demands, optimize resource use, and improve customer satisfaction. Therefore, logistics organizations, including PT Pos Indonesia, can adopt agile leadership strategies to optimize distribution processes and increase competitiveness in the industry. Thus: H1: Agile Leadership has a positive and direct effect on Last-Mile Delivery Efficiency.

2.2 The Role of Crowd Logistics in Achieving Last-Mile Delivery Efficiency

Crowd Logistics is gaining more and more attention in modern logistics research because of its potential to improve last-mile delivery (LMD) efficiency. This concept refers to the integration of crowdsourcing and community collaboration in the logistics process to improve the effectiveness of the supply chain (Kara & Yalçın, 2022; Zainudin et al., 2022). By utilizing a flexible workforce, this strategy is able to overcome various traditional logistics challenges such as high operational costs, fluctuations in demand, and geographical barriers (Bin et al., 2020). In developing countries such as Indonesia, the implementation of Crowd Logistics is an innovative solution to improve delivery efficiency, especially in areas with limited infrastructure (Zhang et al., 2019).

The success of Crowd Logistics' implementation in improving LMD efficiency can be measured through several key indicators. First, User Participation, which is the level of involvement of crowdsourcing contributors in logistics activities. The higher the user participation, the greater the potential for increased delivery efficiency (Kara & Yalçın, 2022; Hajiagha et al., 2023). Second, Task Allocation Efficiency, which measures the effectiveness of task distribution among crowd participants to maximize logistics output.

Optimal task allocation can speed up the delivery process and reduce resource waste (Motwani & Katatria, 2024).

In addition, the sustainability of the Crowd Logistics system depends on Feedback Mechanisms, which is a feedback system that allows participants to provide evaluations of logistics operations. This mechanism encourages continuous improvement in the delivery system and minimizes operational errors (Dey et al., 2023; Motwani & Katatria, 2024). The effectiveness of crowd-based logistics is also determined by Resource Utilization, which is the optimization of the use of crowdsourcing-based routes and resources. This more efficient utilization contributes to reduced operational costs and improved delivery performance (Dey et al., 2023; Zainudin et al., 2022). Finally, Time Savings is an important indicator in assessing the success of this strategy. With better planning and the use of digital technology, Crowd Logistics is able to cut delivery times significantly, improving customer satisfaction and the company's competitiveness (Miko & Abbas, 2023; Zainudin et al., 2022).

Empirical research shows that the implementation of Crowd Logistics significantly increases productivity and reduces lead time in LMD systems (Akyüz et al., 2022). Another research also revealed that Crowd Logistics-based platforms improve logistics performance, especially in urban areas that face complex challenges (Song et al., 2021). In Indonesia, PT Pos Indonesia has adopted a hybrid model that combines this strategy with traditional logistics systems to improve delivery efficiency (Tao & Wang, 2022). This model proves that the combination of digital innovation and flexible labor can be an effective solution in meeting the increasingly dynamic market demand.

By considering the various literature that has been studied, it can be concluded that Crowd Logistics has a direct and positive effect on the efficiency of Last-Mile Delivery. Therefore, the hypothesis proposed is: H2: Crowd Logistics has a direct and positive effect on Last-Mile Delivery Efficiency.

Next, we present a robust conceptual research model (see Figure 1), which was developed based on an extensive literature review. The model is also based on rigorous hypothesis testing in various previous studies to ensure its validity and relevance.

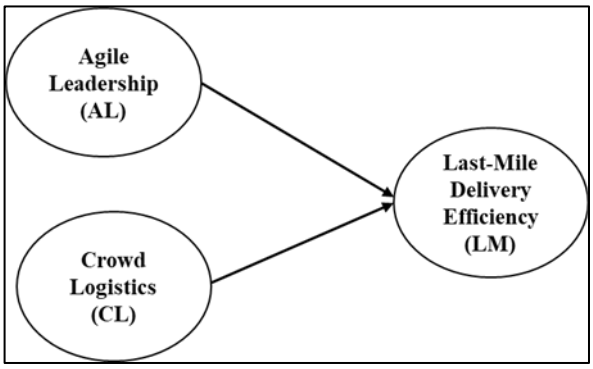

Figure 1. Research Model

3. RESEARCH METHODS

3.1 Research Design

This research uses the explanatory method, which is often referred to as causal or verifiable research, with the main goal of understanding the cause-and-effect relationship between the various variables studied. This approach aims to identify and ascertain how one variable can affect other variables. In addition, the explanatory method is also used in the process of testing theories and hypotheses, so that it can provide evidence that strengthens or even doubts pre-existing theories. In this research, an explanatory survey was applied to analyze the extent to which independent variables had an effect on the dependent variables. This process involves the formulation of a hypothesis and its testing through appropriate statistical analysis techniques. The selection of this method is based on its ability to explain causal relationships and evaluate the influence of the independent

variable (X) on the bound variable (Y) more systematically and measurably (Sari et al., 2022).

In addition, the research applied a cross-sectional research design, which allows the observation of the relationship between risk factors and their consequences in a given time period. In contrast to the longitudinal method that requires observation over a long period of time, the cross-sectional approach focuses on collecting data at one time simultaneously. In this research, a cross-sectional survey method was used to obtain data from respondents of leaders in 4 regions of PT Pos Indonesia. Data was collected by distributing questionnaires to respondents in a short period of time and carried out simultaneously. This technique allows for quick and efficient information acquisition for further analysis in research (Abduh et al., 2022).

3.2 Data Sources and Sampling Techniques

Prior to the survey, a questionnaire containing 15 questions had been designed. This instrument adopts a semantic differential scale with seven levels and is arranged based on three main variables contained in the conceptual model of the research. To ensure that all respondents can understand the content of the questionnaire well, questions that were originally in foreign languages are translated into Indonesian to make them easier to understand.

The survey was conducted online and involved 180 leaders from various regions, namely Regional 2 Jakarta, Regional 3 Bandung, Regional 4 Semarang, and Regional 5 Surabaya. The regional selection is based on the high intensity of logistics business activity in the area. Respondents who participated in the survey included various levels of management, ranging from Senior Vice President, Executive Vice President, Vice President, Manager, to Assistant Manager. They were chosen because they had experience that was relevant to the variables that were the focus of the research. Of the total 180 questionnaires submitted, 147 responses were declared complete and met the criteria for further analysis.

This research applies the Variance-based Partial Least Squares Structural Equation Modeling (PLS-SEM) method as the main analysis technique. The PLS-SEM model is used to explore the relationship between the variables studied. In addition, the evaluation of the measurement model was carried out using SmartPLS 3.0 software to ensure the validity and reliability of the research construct. Although the data obtained is not normally distributed, the application of PLS-SEM is still used to validate the conceptual model that has been developed (Hair et al., 2021).

4. RESULTS AND DISCUSSION

4.1 Data Analysis Techniques

In this research, the PLS-SEM method is used to test and evaluate the research model consisting of two main parts, namely the measurement model (external) and the structural model (internal). External model evaluation aims to ensure the validity and reliability of the constructs used in the research. The validity of convergence is assessed based on the factor load with a minimum value of 0.7 and the average value of the extracted variance (AVE) of at least 0.5. In addition, the validity of discrimination is tested using the Fornell-Larcker method, where the correlation between latent constructs must be greater than the square root of the AVE to ensure clear distinctions between constructs. The reliability test of the model was carried out by measuring the reliability value of composite and Cronbach's alpha, with the minimum value to be achieved is 0.70.

Internal model evaluation is carried out to analyze the relationship between latent variables and measure the level of influence between the factors studied. This process involves measuring the statistical value of T, P-value, and the coefficient of determination (R-squared). In this context, an R-squared value of 0.75 indicates a strong influence, 0.50 indicates a moderate influence, while 0.25 indicates a weak influence of exogenous variables on endogenous variables. Based on guidance from Hair et al. (2021), the

relationship between variables in the research is considered significant at a confidence level of 5% if the T value is greater than 1.65 and the P-value is less than 0.05. With this approach, the research can ensure the validity of the conceptual model tested and obtain more accurate conclusions regarding the relationship between variables.

4.2 Outer Structural Model Results

Based on the results of the analysis presented in Table 1, all indicators meet the convergent validity requirements with a Factor Loading value above 0.7 and an Average Variance Extracted (AVE) of more than 0.5. This criterion indicates that each indicator has a significant contribution in explaining the constructed being measured. Therefore, these results are the main basis for evaluating the measurement model or outer model to ensure that the instrument used is valid and can accurately represent the concept being studied.

In addition to convergent validity, the validity of discrimination has also been tested through the Fornell-Larcker approach, as shown in Table 2. The results of the analysis showed that the square root of the AVE was greater than the correlation between the latent constructs, which confirmed that each construct had a clear difference from the other. In addition, this model also shows a good level of reliability, with Composite Reliability and Cronbach's Alpha values of more than 0.70 each. This proves that the research instrument has high internal consistency and meets the reliability standards that have been set.

Table 4.1. Validity and Reliability of The Research Variables

Vabl	Indt	FLo	Cr_α	Cops_Re	A-VE
Agile Leadership **(AL)**			0.956	0.966	.0.852
A1	Collaboration	0.930			
A2	Decision-Making Agility	0.964			
A3	Empowerment	0.952			
A4	Innovation Promotion	0.816			
A5	Feedback Responsiveness	0.944			
Crowd Logistics **(CL)**			0.966	0.974	0.881
C1	User Participation	0.942			
C2	Task Allocation Efficiency	0.946			
C3	Feedback Mechanisms	0.933			
C4	Resource Utilization	0.936			
C5	Time Savings	0.935			
Last-Mile Delivery Efficiency **(LM)**			0.973	0.979	0.902
L1	Delivery Speed	0.945			
L2	Delivery Accuracy	0.947			
L3	Cost-Effectiveness	0.955			
L4	Customer Satisfaction	0.952			
L5	Service Reliability	0.948			
Vabl = Variables, Indt = Indicators; FLo = Factor Loading; Cr_α = Cronbach's alpha; Cops_Re = Composite Reliability; A-VE = AVE					

Table 4.2. Fornell-Larcker Criterion (Discriminant Validity)

	AL	CL	LM
AL	0.923		
CL	0.996	0.939	
LM	0.996	0.994	0.949

4.3 Inner Structural Model Results

The analysis of the inner model was carried out by paying attention to three main parameters, namely the determination coefficient (R-squared), the statistical T value, and

the P-value. Based on the data listed in Table 3, the R-squared value obtained exceeds the number of 0.5. This shows that the independent variables, namely Agile Leadership (AL) and Crowd Logistics (CL), have a significant influence on the bound variable, namely Last-Mile Delivery Efficiency (LM). Thus, it can be concluded that the model used is able to explain the relationship between variables with an adequate degree of accuracy.

Table 4.3. R-Square (Determinant Coefficient)

	R. Sq	R. Sq A
LM	0.993	0.993
R_Sq = R Square; R_Sq_A = R Square Adjusted		

To determine the significance of the relationship between variables at a confidence level of 5%, the criteria of a T value of more than 1.65 and a P-value of less than 0.05 were used. Based on the results of the analysis obtained from Table 4 and Figure 2, all hypotheses were declared valid. This indicates a significant positive relationship, both directly and indirectly.

Table 4.4. Conclusion of Hypothesis Testing for all Hypotheses

Hypothesis	β	O	SDD	T_Sta	P_Va	Hy_TC
Hyp1 : AL → LM	0.712	0.712	0.088	8.115	.000	Accepted
Hyp2 : CL → LM	0.286	0.286	0.088	3.246	.001	Accepted
Hypo = Hypothesis; β = Path Coefficients; O = Original Sample; SDD = Standard Deviation; T_Sta = T Statistics; P_Va = P Value; Hy_TC = Hypothesis Testing Conclusion.						

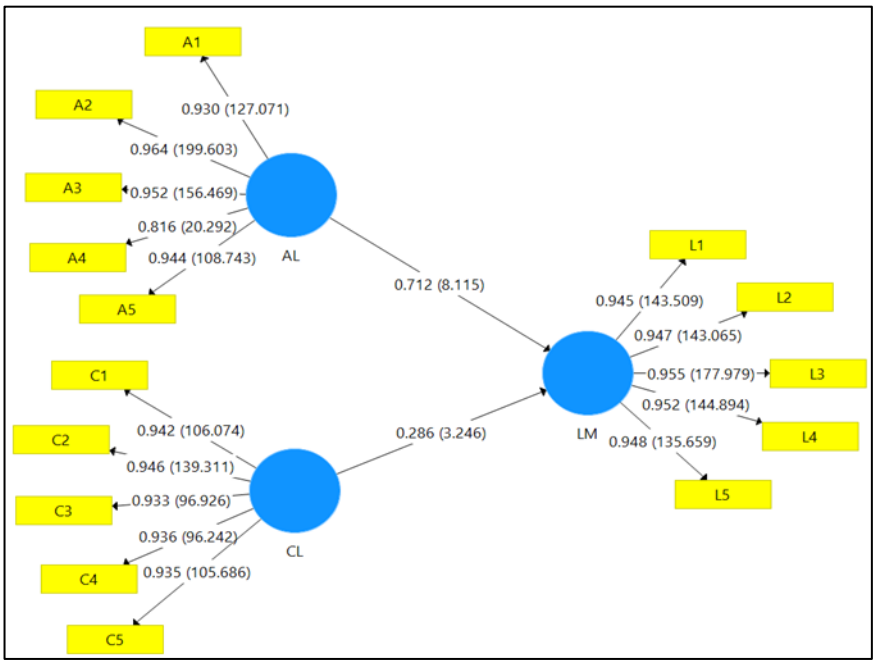

Figure 2. Model Summary of Bootstrapping Results, Path Coefficient, Factor Loading and T-Values

CONCLUSION

Based on the results of the research, the main objective of this research to evaluate the influence of Agile Leadership and Crowd Logistics on last-mile delivery (LMD) efficiency at PT Pos Indonesia has been achieved. Key findings show that Agile Leadership contributes significantly to improving LMD efficiency through operational flexibility, accelerated decision-making, and more effective communication. In addition, the implementation of Crowd Logistics has proven to strengthen distribution efficiency by utilizing community-based delivery networks, increasing delivery speeds, and optimizing

operational costs. Thus, both independent variables have a direct and positive effect on the efficiency of LMD, which confirms the importance of agility-based managerial strategies and public participation in the logistics industry.

This research enriches the literature on Agile Leadership and Crowd Logistics in logistics, especially in Indonesia. Practically, these findings help PT Pos Indonesia and other logistics companies in designing adaptive strategies. The implications of the research point to the need for the integration of Agile Leadership and community-based approaches. Agile Leadership can be strengthened through training, digitalization, and increased collaboration, while Crowd Logistics can be optimized by expanding its partner network, leveraging technology, and developing incentive policies. However, this research is limited to one company and has not considered external factors such as government policies and infrastructure readiness. Further research can expand the scope of the industry and examine more advanced technologies. Globally, the research highlights the importance of innovation and community-based approaches in addressing distribution challenges in the digital age, which can serve as a model for other countries with similar logistical challenges.

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