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Determinants of Parcel Locker Adoption in Last-Mile Delivery with Emphasis on Logistics Value, Consumer Orientation, Value Co-Creation, and Green Awareness

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ABSTRACT

This study aims to identify the key factors that influence consumers' intention to adopt parcel locker services in last-mile delivery, using Service-Dominant Logic to explain how value is created between consumers and service providers. The research was conducted in Jakarta using a quantitative approach. Data were collected from 412 e-commerce users through a structured survey using stratified random sampling across five administrative cities. The Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with appropriate statistical software. The study concludes that consumer adoption of parcel lockers depends more on collaborative experiences and personalized interactions than on environmental concerns. Value Co-Creation plays a central role as the main pathway driving adoption.

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INTRODUCTION

The rapid expansion of e-commerce accelerated by globalization, urbanization, and the COVID-19 pandemic has reshaped consumer behavior, particularly in developing economies, younger users, and small businesses [1] . Online shopping has further reduced dependence on traditional retail channels [2]. Indonesia, now the largest e-commerce market in Southeast Asia valued at USD 65 billion and projected to reach USD 150 billion by 2030 [3]. Indonesia faces increasing pressure on last-mile delivery (LMD), which is projected to expand by 78% by 2030. E-commerce users are forecasted to reach 221 million by 2025. Supported by rising internet penetration at 79.5% in 2024[6].Despite transaction values reaching IDR 1,100.87 trillion in 2023 [4].

LMD remains the most inefficient part of the logistics chain, characterized by high costs, frequent delivery failures, and with 90% of complaints linked to delays or poor tracking information. Even with 10.3% industry growth, performance issues persist, as 36% of customers report dissatisfaction and complaints continue to center on delayed or poorly communicated deliveries [5].

The rapid rise of e-commerce—accelerated by globalization, urbanization, and the COVID-19 pandemic—has transformed consumer behavior, especially in developing markets, younger demographics, and small businesses. Online shopping has increasingly reduced reliance on physical retail channels. Indonesia, as Southeast Asia's largest e-commerce market valued at USD 65 billion and projected to reach USD 150 billion by 2030, faces growing pressure on last-mile delivery (LMD), which is expected to expand by 78% by 2030. With e-commerce users forecasted to reach 221 million by 2025 and internet penetration reaching 79.5% in 2024, transaction values climbed to IDR 1,100.87 trillion in 2023. Despite this growth, LMD remains the most inefficient logistics stage—characterized by high costs, delivery failures, and persistent performance issues, with 36% of customers dissatisfied and around 90% of complaints related to delays or poor tracking information [6].

LMD has become a crucial element of consumer experience, where utilitarian orientation emphasizes efficiency, cost reduction, and speed, while hedonic orientation highlights convenience and enjoyable service interactions [7]. LMD exerts economic, environmental, and social pressures, accounting for 41% of logistics costs and up to 75% in e-commerce shipments [8],[9],[10]. These challenges demand more sustainable and efficient solutions. Innovative consumer-oriented methods, such as parcel lockers, collection points, click-and-collect, and crowdshipping, have emerged as alternatives to traditional home delivery collection. The choice of the LMD method is shaped by convenience, cost, environmental awareness, and service attributes, while technologies such as predictive analytics and real-time tracking enhance transparency, efficiency, and consumer trust [11].

In 2023, more than half of Indonesian e-commerce businesses delivered directly to consumers, 39.78% used collection points, 8.51% relied on third-party couriers, and only 0.84% offered download links. [8]. Despite its popularity, home delivery remains inefficient due to failed deliveries, congestion, and environmental impacts [12], [13], [14]

In response, parcel lockers have emerged as a promising LMD solution. These automated units, strategically placed in public spaces, operate 24/7 and reduce delivery failures while offering convenience and flexibility [8].

Studies highlight their potential as a more efficient last-mile delivery solution, supported by dense shipment consolidation and reduced delivery failures [15],[3]. Research highlights that consumer attitudes toward parcel lockers are strongly shaped by convenience and flexibility in pickup times[3]. Parcel lockers also reduce delivery costs, shorten courier travel distances by up to 30%, and minimize risks of theft and failed deliveries, while enhancing safety and privacy[16].

Beyond efficiency, parcel lockers enhance consumer convenience by allowing package retrieval at preferred times and locations. Empirical evidence also shows cost reduction, shorter courier travel distances, and efficiency gains of up to 30% [1],[17]. Moreover, they help mitigate risks of theft and failed deliveries while improving customer safety, privacy, and overall satisfaction [18], [19]. These advantages underscore parcel lockers as a strategic innovation in sustainable urban logistics[20].

In Indonesia, parcel lockers have been introduced since 2015 by PopBox Asia and Paxel Box, with over 460 units installed in strategic urban locations. However, adoption remains low, with only 2.59% of consumers reporting usage. Barriers include low awareness, preference for home delivery, and uneven distribution of locker infrastructure. These challenges suggest strong potential for parcel locker adoption, requiring strategies that integrate consumer participation, service personalization, and sustainability considerations. [21],[22].

The Service-Dominant Logic (SDL) framework positions consumers as active *co-creators of value* by integrating their knowledge, skills, and experiences within the service ecosystem [23]. This perspective contrasts with the *goods-dominant logic* (GDL), which traditionally views consumers as passive recipients of value. Within the context of last-mile delivery, consumer intention emerges as a critical determinant influencing engagement in *value co-creation* and the adoption of innovative solutions such as parcel lockers [24].

The accelerating growth of e-commerce further highlights the strategic role of efficient LMD, where consumer involvement in selecting delivery modes, scheduling, and self-collection contributes to enhanced flexibility and satisfaction. Additionally, logistics value, defined by dimensions such as speed, accessibility, tracking, flexibility, and return convenience, plays a fundamental role in shaping consumer experiences [25]. Evidence indicates that value co-creation enhances satisfaction, loyalty, customer citizenship behavior, efficiency, cost savings, and sustainable innovation. Therefore, embedding value co-creation in LMD through parcel lockers provides a strategic avenue to boost competitiveness and sustainability in the digital economy [26].

Based on the proposed conceptual framework, this study formulates nine hypotheses. First, logistics value is expected to positively influence value co-creation within consumer logistics (H1). Second, consumer orientation is also hypothesized to have a positive effect on value co-creation (H2). Third, value co-creation is proposed to

positively affect consumers' intention to adopt parcel locker services (H3). Furthermore, logistics value is hypothesized to exert a direct positive effect on the intention to adopt parcel lockers (H4), while consumer orientation is likewise expected to directly enhance adoption intention (H5). In addition, logistics value is predicted to have an indirect effect on adoption intention through value co-creation as a mediating mechanism (H6).

Similarly, consumer orientation is hypothesized to indirectly influence adoption intention via value co-creation (H7). The study also posits two moderating effects: green awareness is expected to moderate the relationship between value co-creation and adoption intention (H8), and it is further hypothesized to moderate the relationship between consumer orientation and value co-creation (H9). Thus, the proposed conceptual framework of this study is formulated in Figure 1.

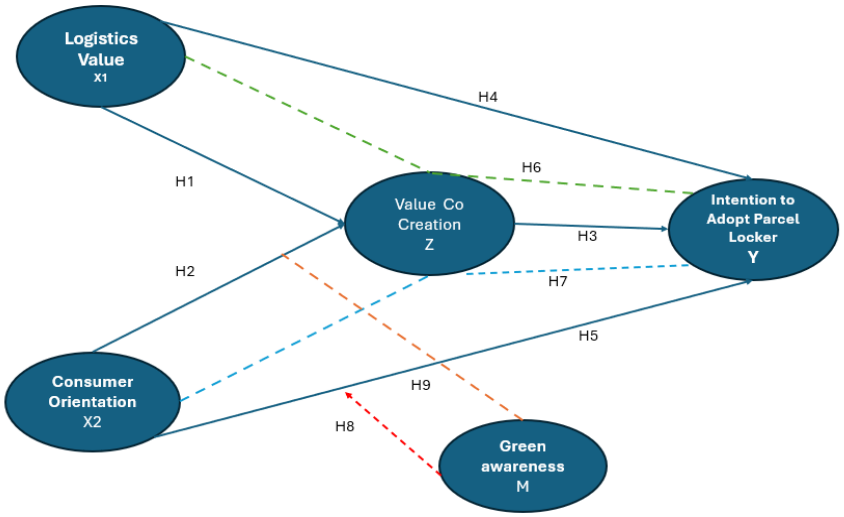

Figure 1. Conceptual framework

Loading Evaluation Indicator

Confirmatory Composite Analysis (CCA), indicators are considered valid when their standardized loadings reach at least 0.708 with a t-value of ±1.645 (one-tailed) at $\alpha = 0.05$ (Hair et al., 2020). As shown in Table 1, all indicators met this requirement and were significant at $p < 0.01$. The strongest loading was found in ADOPT.3 (0.899), indicating that consumers' readiness to use parcel lockers is the most influential component of adoption intention. The lowest loading, though still acceptable, was CCB.3 (0.716), which measures tolerance for delivery delays. This implies that consumers value cooperative behaviors such as giving feedback or helping other users more than being patient with delays. Overall, all indicators are valid and suitable for inclusion in the measurement model, even though their contribution strengths differ. These variations in loading values suggest that certain aspects play a more prominent role in shaping the construct, while others provide complementary support. Nevertheless, the consistency of significant loadings across all indicators reinforces the robustness and reliability of the measurement model in capturing the underlying constructs.

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Table 1. PLS Confirmatory Composite Analysis Result (Outer Model Analysis)

	loadings	t-value	P values	Cr.a	Rho-A	AVE	Ket
First-order construct							
Accept				0.804	0.810	0.718	Valid
ACCEPT1	0.840	47.922	0.000				
ACCEPT2	0.825	41.780	0.000				
ACCEPT3	0.876	73.296	0.000				
Intention to adopt				0.871	0.875	0.795	Valid
ADOPT.1	0.880	67.703	0.000				
ADOPT.2	0.897	76.814	0.000				
ADOPT.3	0.899	69.742	0.000				
Customer citizenship behavior				0.814	0.826	0.642	Valid
CCB.1	0.833	50.596	0.000				
CCB.2	0.851	52.592	0.000				
CCB.3	0.716	23.553	0.000				
CCB.4	0.799	37.548	0.000				
Communication of delivery status				0.827	0.831	0.657	Valid
COM1	0.828	45.724	0.000				
COM2	0.812	42.470	0.000				
COM3	0.778	30.830	0.000				
COM4	0.824	40.773	0.000				
Customer participation behavior				0.861	0.863	0.707	Valid
CPB.1	0.825	44.343	0.000				
CPB.2	0.843	50.908	0.000				
CPB.3	0.889	79.802	0.000				
CPB.4	0.803	33.196	0.000				
Green Awareness				0.843	0.849	0.761	Valid
GA.1	0.826	31.097	0.000				
GA.2	0.893	64.622	0.000				
GA.3	0.897	70.150	0.000				
Hedonic				0.776	0.776	0.691	Valid
HEDON.1	0.803	38.333	0.000				
HEDON.2	0.864	54.511	0.000				
HEDON.3	0.826	44.981	0.000				
Retur				0.860	0.859	0.704	Valid
RETUR1	0.803	41.177	0.000				
RETUR2	0.843	43.813	0.000				
RETUR3	0.853	56.526	0.000				
RETUR4	0.856	49.308	0.000				

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	loadings	t-value	P values	Cr.a	Rho-A	AVE	Ket
Utilitarian				0.759	0.767	0.674	Valid
UTI.1 <- UTI.	0.795	35.179	0.000				
UTI.2 <- UTI.	0.811	38.530	0.000				
UTI.3 <- UTI.	0.856	62.088	0.000				
Second-order construct	Loadings	t-value	P values	Cr.a	Rho-A	AVE	
Logistics value				0.817	0.826	0.731	Valid
LV scores Accept	0.842	55126	0.000				Valid
LV scores Com	0.796	36.842	0.000				Valid
LV scores Retur	0.865	64.073	0.000				
Consumer Orientation				0.806	0.833	0.836	
LV scores Utilitarian	0.895	67.598	0.000				
LV scores Hedonic	0.933	172.971	0.000				
Value co-creation				0.865	0.868	0.881	
LV scores CPB	0.934	122.926	0.000				

Source: Data Analysis processed

Reliability Evaluation with Cronbach's Alpha (Cr.a) and Composite Reliability (CR)/Rho_A)

Reliability testing ensures internal consistency of indicators in measuring each construct. This study applied Cronbach's Alpha (Cr.a) and Rho_A, with the threshold of ≥0.70 indicating adequate reliability [27]. All constructs, both first-order and second-order, achieved values above the minimum requirement, confirming reliability. Among first-order constructs, Intention to Adopt showed the highest reliability (Cr.a = 0.871), reflecting strong consistency among its indicators, while Utilitarian Orientation recorded the lowest yet acceptable reliability (Cr.a = 0.759). Other constructs, such as Convenience of Receipt (0.804), Customer Citizenship Behavior (0.814), Communication of Delivery Status (0.827), Customer Participation Behavior (0.861), Green Awareness (0.843), Hedonic Orientation (0.776), and Convenience of Return (0.860), also demonstrated satisfactory reliability levels. For second-order constructs, reliability was also established with Logistics Value (0.817), Consumer Orientation (0.806), and Value Co-Creation (0.865), confirming consistent measurement across dimensions. Overall, the results highlight that all constructs possess sufficient internal consistency, ensuring that the applied indicators are reliable for capturing their respective latent variables. Consequently, the measurement model can be considered robust, supporting further PLS-SEM analysis in this study.

Convergent Validity Test

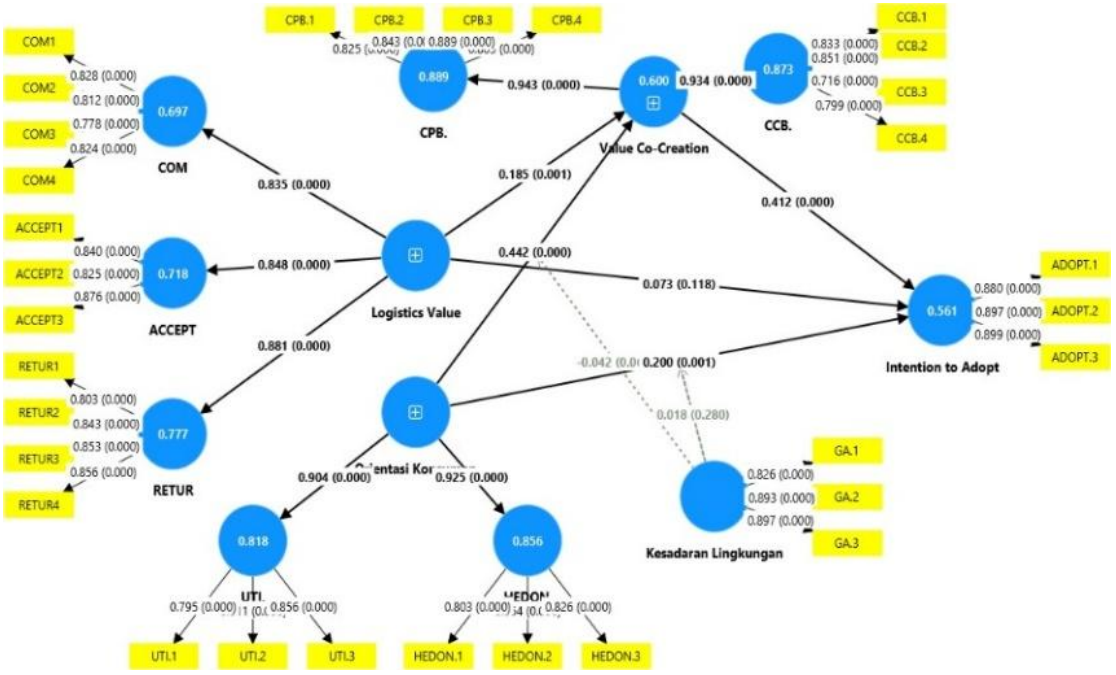
Was assessed using Average Variance Extracted (AVE), with a threshold of ≥ 0.50 [74]. Results in Table IV.10 show that all constructs, both first-order and second-order, exceeded this criterion. For first-order constructs, AVE values ranged from 0.642 (Customer Citizenship Behavior) to 0.761 (Green Awareness), while second-order constructs also showed strong validity with Value Co-Creation (0.881), Consumer Orientation (0.836), and Logistics Value (0.731). These results confirm that all constructs are valid and meet the requirements for further PLS-SEM analysis.

Discriminant Validity Test

Was assessed to ensure that each construct is empirically distinct and represents a unique phenomenon[27]. The results of HTMT's analysis showed that all constructs met the criteria for discriminant validity,

both according to the conservative (0.85) and liberal (0.90) thresholds. This indicates that each construct can be empirically differentiated and that the research instrument has measured the different concepts validly and reliably. It can be shown in figure 2.

Figure 2. Bootstrap Measurement (Outer) Model Analysis Summary



In addition, the evaluation of the outer model also shows that the convergent and discriminant validity have been met, both through the Fornell-Larcker and HTMT approaches. Thus, the measurement model is declared valid and reliable, so it is feasible to proceed to the internal model analysis stage in PLS-SEM. The results indicate that each construct has adequately captured the variance of its respective indicators, as reflected by satisfactory average variance extracted (AVE) values. Furthermore, the Fornell-Larcker criterion confirms that each construct shares more variance with its own indicators than with other constructs in the model. This is further supported by the HTMT ratios, which remain below the recommended threshold, indicating the absence of discriminant validity issues. The consistency between these two approaches strengthens confidence in the distinctiveness of each latent variable. Additionally, composite reliability and Cronbach's alpha values demonstrate strong internal consistency across all constructs. These findings in table 2 collectively suggest that the indicators are both reliable and valid measures of their respective constructs.

Table 2. Discriminant Validity Analysis with HTMT

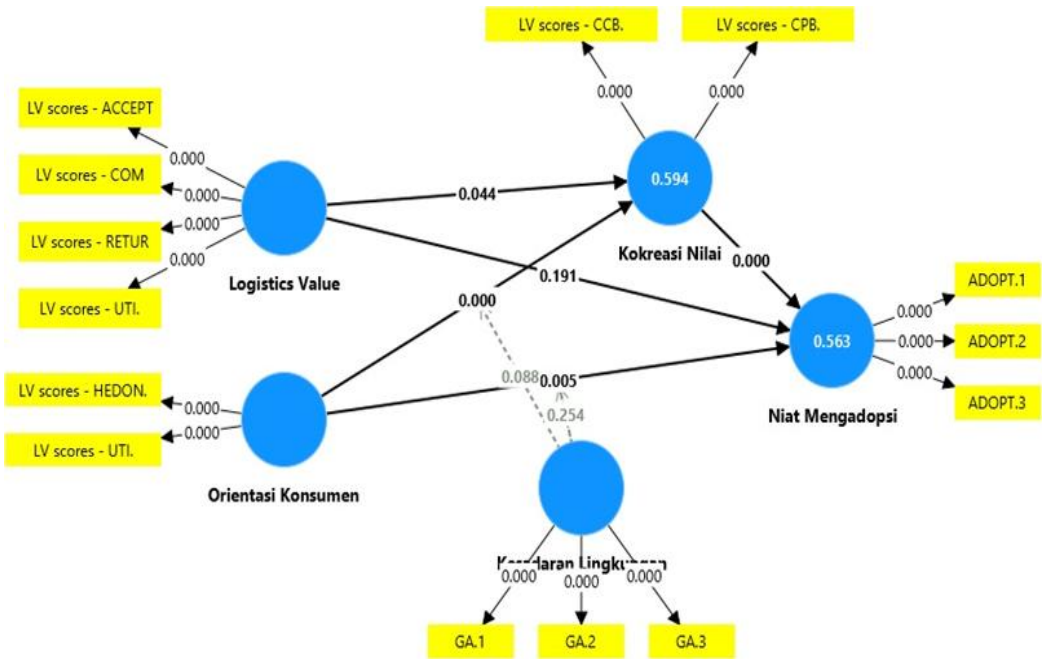
	First Order Construct	1	2	3	4	5	6	7	8	9
1	ACCEPT									
2	CCB.	0.664								
3	COM	0.692	0.580							
4	CPB.	0.732	0.898	0.525						
5	HEDON.	0.780	0.817	0.618	0.878					
6	*Intention to adopt*	0.658	0.834	0.546	0.715	0.776				
7	*Green Awareness*	0.508	0.713	0.546	0.618	0.533	0.643			
8	RETUR	0.768	0.656	0.678	0.599	0.737	0.555	0.519		
9	UTI.	0.721	0.685	0.698	0.640	0.868	0.642	0.634	0.834	

Source: Processed data by Smart PLS 4.0 (2025)

Reflective Second Order Construct Validation (Logistic value, Consumer orientation, value co-creation)

To validate the Logistic value, Consumer orientation, and Value co-creation as a reflective-reflective higher order construct (HOC) is carried out using the repeated indicator approach method [76]. All variances of *Logistic value*, *Consumer orientation,* and *Value Co Creation* will be explained by the indicators in the *lower order construct* (LOC) as follows in figure 3.

Figure 3. The Validation of second-order variables



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The test results in Table 3 show that all second-order reflective constructs in the model—namely Logistics Value, Consumer Orientation, and Value Co-Creation—meet the criteria of convergent validity and construct reliability. All forming dimensions show a loading value above 0.700 and are significant at a p< level of 0.01, which indicates that each dimension statistically contributes significantly to its main construct. Thus, all second-order constructs are proven to be valid and reliable, and can be used legitimately for the next structural analysis of the model.

Table 3. Second-order construct validation

Second-order construct	Loadings	t-value	P values	Cr.a	Rho-A	AVE	Note
Logistics value				0.817	0.826	0.731	
LV scores Accept	0.842	55126	0.000				Valid & Significant
LV scores Com	0.796	36.842	0.000				Valid & Sigificant
LV scores Retur	0.865	64.073	0.000				Valid & Sigificant
Consumer orientation				0.806	0.833	0.836	
LV scores Utilitarian	0.895	67.598	0.000				Valid & Sigificatn
LV scores Hedonic	0.933	172.971	0.000				Valid & Sigificant
Value co-creation behavior				0.865	0.868	0.881	
LV scores CPB	0.934	122.926	0.000				Valid & Sigificant
LV scores CCB	0.943	165.069	0.000				Valid & Sigificant

Source: Processed data by Smart PLS 4.0 (2025)

Multicollinearity Assessment Among Independent Variables

Was assessed using the Variance Inflation Factor (VIF), with a recommended threshold of less than 3.0 to avoid biased estimation[77]. As presented in Table 4, all independent variables exhibit VIF values ranging from 2.438 to 2.925, indicating that each predictor contributes uniquely to explaining the endogenous construct, without redundancy. This confirms that the model is free from multicollinearity issues, ensuring that the path coefficient estimates are reliable, valid, and unbiased. In the context of parcel locker adoption in last-mile delivery, this finding suggests that the independent constructs—such as Logistics Value, Consumer Orientation, Value Co-Creation, and Green Awareness- each provide distinct explanatory power in predicting consumers' intention to adopt the service. It can be shown that in table 4.

Table 4. Structural (Inner Model) Analysis Result

Hypothesis Testing **Direct effects (2)**	**Path Coefficient (β)**	**std-dev**	**t-value**	**p-value**	**f^2 (4)**	**Effects (4)**	**VIF**
Logistics Value -> Value Co-Creation (H1)	0.185	0.058	3.203	0.001	0.035	small	2.444
Consumer orientation -> Value Co-Creation (H2)	0.442	0.053	8.279	0.000	0.200	large	2.438
Value Co-Creation -> *Intention to adopt* (H3)	0.412	0.061	6.806	0.000	0.155	large	2.498
Logistics Value -> *Intention to adopt* (H4)	0.073	0.062	1.186	0.118	0.005	No effect	2.529
Consumer orientation -> *Intention to adopt* (H5)	0.200	0.066	3.019	0.001	0.031	small	2.925
Indirect effects (2)							
Logistics Value -> Value Co-Creation -> *Intention to adopt* (H6)	0.076	0.025	3.071	0.001			
Consumer orientation -> Value Co-Creation -> *Intention to adopt* (H7)	0.182	0.036	5.003	0.000			
Moderasi Kesadaran Lingkungan x *Consumer orientation* -> *Intention to adopt* (H8)	0.018	0.031	0.584	0.280	0.001	No effect	
Kesadaran Lingkungan x *Consumer orientation* -> Value Co-Creation (H9)	-0.042	0.028	1.493	0.068	0.005	No effect	
R Square (dependent variable)							
Intention to adopt	0.561						
Value Co-Creation	0.600						

Source: Processed data by Smart PLS 4.0 (2025)

The direct effects among constructs were examined using PLS-SEM to determine the magnitude, direction, and statistical significance of each hypothesized relationship. The analysis of Table 5 shows that four hypotheses were supported (H1, H2, H3, H5), while one was not (H4). Logistics Value significantly enhances Value Co-Creation (β = 0.185; t = 3.203; p = 0.001), and Consumer Orientation emerges as the strongest determinant of Value Co-Creation (β = 0.442; t = 8.279; p < 0.001). Value Co-Creation also has a substantial positive effect on Intention to Adopt (β = 0.412; t = 6.806; p < 0.001), reinforcing its central mediating role. However, Logistics Value does not directly influence adoption intentions (β = 0.073; t = 1.186; p = 0.118), indicating its contribution occurs indirectly through Value Co-Creation. By contrast,

Consumer Orientation directly increases Intention to Adopt (β = 0.200; t = 3.019; p = 0.001), suggesting that consumer

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preferences and experience-driven expectations meaningfully shape adoption behavior. Overall, the findings align with the principles of Service-Dominant Logic, emphasizing that value emerges through collaborative processes rather than through goods only [33][78] and affirm the centrality of co-created value in driving the adoption of innovative last-mile logistics services.

The findings indicate that Value Co-Creation serves as a primary pathway driving consumers' intention to adopt technology-based logistics services. Notably, Consumer Orientation emerges as the most dominant factor, influencing both Value Co-Creation and Intention to Adopt. This aligns with prior studies [28] emphasizing that consumers are not merely recipients but active co-creators of value within the Service-Dominant Logic

framework. Although Logistics Value does not directly affect adoption intention (H4 not supported), it remains relevant through its indirect effect via Value Co-Creation. This highlights the importance of fostering strong perceptions of logistics value to encourage active consumer participation. Overall, the results reinforce the conceptual model, confirming that co-created value is crucial for transitioning consumers toward innovative service adoption, driven by both perceived logistics value and consumer orientation.

Moderation Analysis

The moderating role of Green Awareness was examined to assess whether it influences the relationship between Consumer Orientation and the two dependent variables: Intention to Adopt and Value Co-Creation. Results are summarized in Table 5 below.

Table 5. Hypothesis Moderation Path

Hypothesis	Path	β	t-value	p-value	Outcome
H1	Logistics Value → Value Co-Creation	0.185	3.203	0.001	Supported
H2	Consumer Orientation → Value Co-Creation	0.442	8.279	0.000	Supported
H3	Value Co-Creation → Intention to Adopt	0.412	6.806	0.000	Supported
H4	Logistics Value → Intention to Adopt	0.073	1.186	0.118	Not Supported
H5	Consumer Orientation → Intention to Adopt	0.200	3.019	0.001	Supported

Source: Processed data by Smart PLS 4.0 (2025)

The study tested nine hypotheses, including direct effects, indirect effects, and the moderating role of Green Awareness on the relationship between Consumer Orientation and both Intention to Adopt and Value Co-Creation. The moderation analysis (Table 6) revealed that Green Awareness did not significantly moderate either relationship. For H8 (Green Awareness × Consumer Orientation → Intention to Adopt), the interaction coefficient was 0.018 (t = 0.584; p = 0.280; f^2 = 0.001), while for H9 (Green

Awareness × Consumer Orientation → Value Co-Creation), the coefficient was −0.042 (t = 1.493; p = 0.068; f^2 = 0.005). Both effects were negligible, indicating that environmental awareness neither strengthens nor weakens the impact of Consumer Orientation on adoption intention or co-creation engagement.

The overall hypothesis shows that seven out of nine hypotheses were supported, including the direct effects of Consumer Orientation and Value Co-Creation, as well as their mediated effects on Intention to Adopt. The two unsupported hypotheses involve the moderating role of Green Awareness (H8 and H9). Notably, Consumer Orientation and Value Co-Creation emerged as the key drivers of adoption intention, while Logistics Value and environmental awareness had no significant direct or moderating effects.

Overall, these results highlight that active consumer engagement in Value Co-Creation is critical for promoting the adoption of technology-based logistics services, whereas environmental awareness is not yet a significant determinant among respondents. Practically, this underscores the importance of designing parcel locker services that are not only efficient but also encourage consumers to participate actively in creating value and enhancing their experience.

In-Sample Predictive Explanatory Power (R^2)

The explanatory power of the model was evaluated using the coefficient of determination (R^2), which measures how well the endogenous constructs are predicted by the exogenous variables. R^2 reflects the combined impact of exogenous latent variables on each endogenous construct and serves as an indicator of predictive accuracy within the sample. While R^2 values for naturally Predictable phenomena can be very high (up to 0.90), models predicting attitudes, perceptions, or intentions typically exhibit lower values.

Table 6. Evaluation of effect size value f2

Direct effects (2)	Path coefficients	f square	Effects
Logistics Value -> Value Co-Creation	0.185	0.035	small
Consumer orientation -> Value Co-Creation	0.442	0.200	large
Value Co-Creation -> Intention to adopt (Niat mengadopsi)	0.412	0.155	large
Logistics Value -> Intention to adopt	0.073	0.005	no
Consumer orientation -> Intention to adopt	0.200	0.031	small

Source: Processed data by Smart PLS 4.0 (2025)

As shown in Table 6, the effect size (f^2) results highlight Consumer Orientation as the most dominant predictor of Value Co-Creation, with a path coefficient of 0.442 and f^2 = 0.200, indicating a large effect. Consumer Orientation also directly influences Intention to Adopt (β = 0.200; f^2 = 0.031, small effect) and exerts a notable indirect effect through Value Co-Creation as a mediator. Value Co-Creation itself plays a

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critical mediating role, bridging the impact of exogenous constructs on adoption decisions. Its path to Intention to Adopt is strong (β = 0.412; f^2 = 0.155, large effect), demonstrating that active consumer engagement in co-creation significantly drives adoption of parcel locker services.

In contrast, Logistics Value shows a negligible direct effect on Intention to Adopt (β = 0.073; f^2 = 0.005), though it contributes indirectly through Value Co-Creation (indirect effect = 0.076), indicating its relevance when integrated into the co-creation process. Finally, Green Awareness, tested as a moderator, exhibited minimal effect sizes on both Intention to Adopt (f^2 = 0.001) and Value Co-Creation (f^2 = 0.005), confirming that it does not significantly strengthen or weaken the relationships among the main constructs in the model.

Table 7. Latent Variable Prediction Summary

Variable Dependency	Q^2predict	RMSE	MAE
Value Co-creation	0,587	0,645	0,488
Intention to adopt	0,479	0,724	0,544

Source: Processed data by Smart PLS 4.0 (2025)

In addition in table 7 shown to in-sample predictive metrics (R^2 and f^2), out-of-sample predictive power was assessed to determine the model's ability to predict new, unseen data. This was done using PLSpredict within PLS-SEM, where the Q^2 Predict statistic evaluates the predictive relevance of endogenous constructs. A Q^2 Predict value greater than 0 indicates that the model has adequate predictive capability for new observations. In this study, Q^2 Predict was calculated for the endogenous constructs Value Co-Creation and Intention to Adopt, confirming that the model is suitable for predicting outcomes beyond the original sample and validating its applicability for future data.

The Q^2 Predict results indicate that all manifest indicators in the model have positive predictive relevance (Q^2 > 0), demonstrating that the PLS-SEM model can reliably forecast key dimensions such as utilitarian perception (UTIL3 = 0.672), hedonic orientation (HEDON1 = 0.623), adoption intention (ADOPT2 = 0.531), and return intention (RETURN2 = 0.535). Some consumer co-creation indicators, such as CCB3 (0.218) and CCB4 (0.220), show lower predictive power, suggesting the need for refinement of these items or stronger theoretical grounding.

Comparative RMSE analysis shows that the PLS-SEM model generally outperforms linear regression, capturing the complex relationships among latent constructs better, although a few indicators (e.g., ADOPT2 = 0.795, ADOPT3 = 0.790, CCB3 = 0.817) display higher prediction errors, indicating gaps between predicted and actual values. Despite this, all Q^2 values remain positive, confirming overall predictive relevance.

Overall, the results demonstrate that the PLS-SEM model provides sufficient predictive validity, particularly for indicators

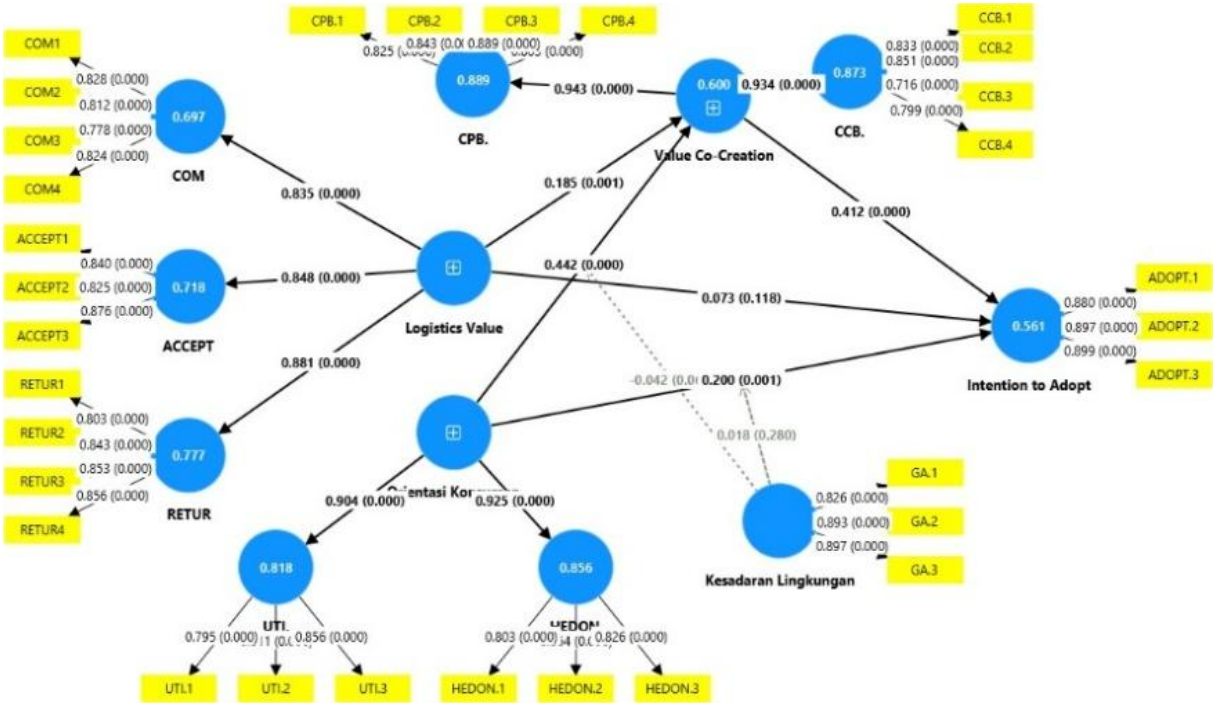
related to Logistics Value, Consumer Orientation, and Intention to Adopt, supporting the reliability of the theoretical framework for understanding consumer adoption of parcel locker services in Indonesia.

Out-of-Sample Predictive Validity (Q2)

The results indicate that most indicators have positive Q^2 Predict values, reflecting adequate predictive capability. Specifically, Q^2 Predict values above 0.35 suggest strong predictive power, while indicators such as ADOPT1 (Q^2 Predict = 0.531, RMSE PLS = 0.585, LM = 0.588) and RETURN1–RETURN4 demonstrate robust predictive validity.

Some consumer co-creation indicators, like CCB3 (RMSE PLS = 0.817, LM = 0.818), show similar predictive performance to the benchmark, indicating careful interpretation is needed. Overall, no indicators show substantially worse performance in PLS-SEM compared to LM, confirming adequate out-of-sample predictive validity. These findings demonstrate that the PLS-SEM structural model reliably forecasts consumer adoption and return intentions for parcel locker services. This supports the model's practical relevance and aligns with the predictive-oriented approach advocated in Service-Dominant Logic research that shown in figure 4.

Figure 4. The summary of structural analysis results



CONCLUSION

This study investigates factors influencing consumer adoption of parcel lockers as a technology-based last-mile delivery solution, applying the Service-Dominant Logic framework. The findings reveal that Consumer Orientation and Logistics Value significantly affect adoption intentions, with Value Co-Creation serving as a crucial mediator, while Green Awareness does not significantly moderate these relationships, indicating a value-action gap among urban consumers. The research highlights that successful adoption relies not only on operational efficiency but also on active consumer participation, positioning consumers as co-creators of value rather than passive recipients. Theoretically, the study extends SDL to technology-driven consumer logistics, integrating functional, psychological, and sustainability dimensions. Practically, it suggests that service providers should enhance logistics value to encourage co-creation through interactive platforms, real-time tracking, and gamification, segment consumers by utilitarian and hedonic preferences, foster active participation in service development, implement green marketing emphasizing personal benefits, and pursue strategic partnerships to increase accessibility. Policymakers are encouraged to support inclusive, decentralized parcel locker systems, provide incentives for low-emission logistics solutions, and promote smart logistics infrastructure. The study is limited to Jakarta, and future research should expand to other urban and non-urban areas and consider cross-national comparisons to better understand adoption patterns, co-creation behaviors, and sustainability integration, providing broader theoretical and practical insights for adaptive, collaborative, and sustainable logistics services.

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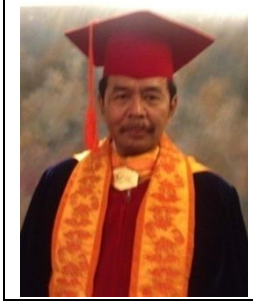

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