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Logistics Service Cost as a Moderator of the Effects of Real-Time Tracking and Delivery Timeliness on Shopee Customer Satisfaction

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***Keywords**: Logistics Service Quality; Real-Time Tracking; Delivery Timeliness; Logistics Service Cost; Customer Satisfaction; PLS-SEM.*

Abstract

***Purpose**: This study aims to examine the effect of logistics service quality on customer satisfaction in the Shopee e-commerce platform, with a particular focus on the moderating role of Logistics Service Cost. The dimensions of logistics service quality investigated include Real-Time Tracking, Delivery Timeliness, and Logistics Service Cost. **Methods**: A quantitative descriptive approach was employed using an online questionnaire distributed through Google Forms. Of the 219 initial responses, 175 valid samples met the inclusion criteria after the screening process. The data were analyzed using Partial Least Squares-Structural Equation Modeling (PLS-SEM) with SmartPLS 4 software. **Results**: The structural model evaluation ($R^2 = 0.758$) indicates that 75.8% of the variance in customer satisfaction is explained by the proposed model. The findings reveal that Real-Time Tracking, Delivery Timeliness, and Logistics Service Cost each have a positive and significant direct effect on customer satisfaction. Among these variables, Logistics Service Cost emerged as the strongest predictor of customer satisfaction. However, the moderation analysis showed that Logistics Service Cost does not significantly moderate the relationships between Real-Time Tracking and customer satisfaction or between Delivery Timeliness and customer satisfaction. **Implications**: The findings indicate that, in a mature e-commerce market, Logistics Service Cost functions as an independent determinant of customer satisfaction rather than as a moderating factor. This suggests that consumers increasingly perceive logistics costs and information transparency as autonomous dimensions of service quality that constitute the minimum expected standard. The study contributes to the logistics service quality literature by providing empirical evidence on the changing role of logistics cost efficiency in shaping customer satisfaction within digital commerce.*

INTRODUCTION

The rapid development of the e-commerce industry in Indonesia over the past several years has radically transformed consumer purchasing patterns, shifting from conventional shopping toward digital consumption. Giant e-commerce platforms such as Shopee continue to dominate the market by offering transaction convenience, product diversity, and time efficiency (Hartono et al., 2021). This dynamic has directly generated a significant impact on the third-party logistics (3PL) industry, which serves as the backbone of product distribution from sellers to buyers (Pratama & Utami, 2024). The success of digital transactions is no longer determined solely by the quality of products displayed on e-commerce applications but also depends heavily on the performance of physical delivery services in the field, particularly last-mile delivery (Wardhana et al., 2024).

In highly competitive e-commerce business environment, information transparency has become one of the key determinants of consumer convenience. On the Shopee platform, this is facilitated through the provision of the Real-Time Tracking (RTT) feature, which enables customers to monitor the location and movement status of their packages directly over time (Chandramouli, 2023; Kalkha et al., 2023). Through this digital visibility, consumers feel that they have greater psychological control over the goods they have purchased, which in turn can reduce anxiety during the delivery waiting period (Kurniawan & Sari, 2022). Therefore, the sophistication of digital tracking systems has become one of the essential pillars influencing customers' initial perceptions of logistics service quality (Saputro & Hidayat, 2023).

However, technological advantages in information systems will have limited value if they are not accompanied by reliable physical operations in the field. Delivery Accuracy, which encompasses compliance with estimated delivery times, accuracy of destination addresses, and assurance of the physical integrity of packages, remains a fundamental pillar of logistics service reliability. The quality of logistics services is largely determined by the extent to which service providers are able to fulfill their promised delivery time (fulfillment timeliness) (Mentzer et al., 2001; Bienstock et al., 2008). Operational failures, such as delayed packages, incorrect addresses, or damaged goods upon receipt, can immediately undermine consumer trust (Yan, 2024; Lande et al., 2024). Therefore, physical delivery accuracy serves as a crucial final determinant of whether the service promises displayed within the e-commerce application are actually fulfilled in practice (Nugroho & Wijaya, 2023).

The accumulation of digital experiences while tracking the location of goods and physical experiences when receiving packages directly constitutes a fundamental basis for shaping Customer Satisfaction. Customer satisfaction is essentially the level of a person's feelings after comparing perceived performance or outcomes with their expectations (Expectancy Disconfirmation Theory) (Oliver, 1980, 2010; Prasetyo, 2025). In the context of the Shopee ecosystem, satisfaction is no longer viewed as the result of fulfilling a single service dimension but rather as a comprehensive post-purchase evaluation by consumers of the entire supply chain involved in the delivery of goods (Parasuraman et al., 1988, 2005; Mantri, 2024). When logistics service providers are able to provide transparent information while delivering goods accurately, consumer expectations will be met or even exceeded. Achieving a high level of customer satisfaction is therefore crucial, as it serves as an indicator of the successful integration between information management systems and operational management of logistics companies (Komara & Fathurahman, 2024).

Although digital information quality (Real-Time Tracking) and physical performance (Delivery Accuracy) make significant contributions, customer evaluations in the logistics industry cannot be separated from cost considerations. Within the Shopee ecosystem, the logistics service cost perceived by consumers—particularly through free-shipping promotions or low delivery charges—constitutes a highly sensitive determining factor (Lestari & Ramadhan, 2022; Rahman & Siregar, 2024). This phenomenon is consistent with the concepts of perceived value theory and consumer price evaluation (Zeithaml, 1988; Lichtenstein et al., 1993; Xia et al., 2004). Such economical logistics cost policies often create a perceived trade-off among customers (Fitriani et al., 2025):

1. Expectation Adjustment: There is a psychological tendency for consumers who benefit from free shipping to become more tolerant and lower their expectations regarding delivery accuracy or the speed of tracking system updates. As explained by the concept of the zone of tolerance, the boundaries of consumers' service expectations may become more flexible when the financial sacrifice they make is minimal (Alfarizi & Putri, 2023).
2. Price-Sensitivity Surge: Conversely, when the logistics cost paid is perceived as expensive, consumers' tolerance tends to decrease sharply. The higher the cost incurred by customers, the higher the performance standards they expect, thereby increasing their sensitivity to tracking quality and delivery accuracy (Zeithaml et al., 2018; GS & Istanti, 2022).

Although previous studies have extensively demonstrated the direct effects of information tracking quality and physical delivery accuracy on customer satisfaction, the interaction mechanism involving logistics service cost as a moderating variable remains relatively underexplored, particularly within the context of the Shopee ecosystem in Indonesia. Most existing studies continue to position cost as a separate independent variable, thereby failing to capture the trade-off or psychological compromise experienced by logistics consumers. Therefore, this thesis aims to address this research gap by empirically examining the role of Logistics Service Cost in moderating the effects of Real-Time Tracking and Delivery Accuracy on Shopee Customer Satisfaction. Through a quantitative approach that integrates technological aspects and consumer expectations (Davis, 1989; Yalçın & Çatlı, 2024), this study is expected to provide meaningful theoretical contributions to the field of logistics while offering strategic recommendations for the 3PL industry.

MATERIAL

Real-Time Tracking (RTT)

Real-Time Tracking (RTT) in modern logistics refers to the capability of information systems to provide continuous and real-time updates regarding the location, status, and movement

of delivered goods throughout supply chain nodes. In the context of Supply Chain 4.0, RTT represents an integrated logistics information capability that captures, processes, and communicates shipment status and estimated arrival times to customers in a timely manner (Bienstock et al., 2008; Yalçın & Çatlı, 2024). Beyond its technological function, RTT serves as an informational bridge between logistics providers and customers by reducing psychological distance and transaction uncertainty during the waiting period.

In Shopee e-commerce ecosystem, RTT has become an essential service feature that enables customers to monitor their orders, estimate delivery times, and gain greater control over the purchasing experience. The effectiveness of RTT is generally evaluated through several dimensions, including information accessibility, update frequency, data accuracy, and courier information transparency. Information accessibility refers to the ease with which customers can access shipment tracking features and visualize delivery progress within the application (Yalçın & Çatlı, 2024). Update frequency reflects the system's ability to provide timely status changes without significant data delays (GS & Istanti, 2022). Data accuracy represents the consistency between digital tracking information and the actual physical location of the shipment (Komara & Fathurahman, 2024). Meanwhile, courier information transparency refers to the availability of relevant information regarding the logistics provider or courier responsible for the last-mile delivery process (Chandramouli, 2023).

Delivery Accuracy

Delivery Accuracy is a fundamental operational dimension of Logistics Service Quality (LSQ) that reflects the reliability of logistics providers in fulfilling physical delivery processes (Mentzer et al., 2001). While Real-Time Tracking represents the informational quality of logistics services, delivery timeliness represents the actual physical fulfillment of the transaction commitment between e-commerce platforms and customers.

In Shopee e-commerce ecosystem, delivery timeliness demonstrates the effectiveness of last-mile logistics partners in meeting customer expectations through reliable and accurate delivery performance. This dimension includes the ability of couriers to deliver packages within the promised estimated time, to the correct destination, and in proper physical condition. Delivery failures, such as delays, incorrect deliveries, or damaged packages, may negatively affect customer trust and satisfaction.

Based on previous logistics studies, delivery timeliness can be assessed through several key indicators. Timeliness refers to the ability of logistics providers to complete deliveries within the promised Service Level Agreement (SLA) or estimated delivery period (GS & Istanti, 2022). Order

condition reflects the assurance that customers receive packages in intact, undamaged, and acceptable conditions without quality degradation during the transportation process (Yalçın & Çatlı, 2024). Destination accuracy indicates the ability of couriers to deliver shipments to the correct address without misdelivery incidents (Yan, 2024). Furthermore, courier professionalism represents the competency, reliability, and appropriate interaction of couriers during the last-mile delivery process (Hermawan et al., 2024). Thus, delivery timeliness serves as a critical determinant of logistics service performance because it directly represents the successful execution of delivery promises and contributes to customer satisfaction in e-commerce services.

Logistics Service Cost (LSC)

Logistics Service Cost (LSC) from consumer perspective refers to total monetary sacrifice incurred by customers to obtain delivery services (Zeithaml, 1988). In e-commerce context, LSC is not limited to the basic shipping fee but also includes perceived cost efficiency obtained through promotional incentives, shipping subsidies, discounts, and free-shipping programs. In Shopee ecosystem, logistics cost has become a dynamic marketing instrument that influences consumers' evaluation of transaction value.

From a consumer behavior perspective, LSC affects customer perceptions through the mechanisms of price fairness and perceived value (Lichtenstein et al., 1993; Xia et al., 2004). Customers continuously compare the financial costs they pay with the quality and reliability of the logistics services received, creating an evaluation of value-for-money. Therefore, a lower perceived logistics cost may enhance customers' acceptance of service performance, while higher costs may increase expectations toward delivery reliability and service quality.

In quantitative logistics service research, LSC can function not only as a direct predictor of customer satisfaction but also as a contextual variable that influences the strength of relationships between service quality dimensions and customer evaluations (Ramadhan & Siregar, 2023). As a moderating variable, LSC may strengthen or weaken the effects of logistics service attributes, such as Real-Time Tracking and Delivery Timeliness, on customer satisfaction by shaping consumers' expectations and tolerance levels toward service performance.

Thus, Logistics Service Cost represents an important dimension in e-commerce logistics because it captures the economic value perceived by customers and provides a broader understanding of how cost considerations interact with logistics service quality in forming customer satisfaction.

Customer Satisfaction

Customer Satisfaction refers to customers' overall evaluation of service performance based on the comparison between their expectations and the actual experience received (Oliver, 2010; Zeithaml et al., 2018). In e-commerce logistics, customer satisfaction reflects the outcome of both digital service experiences, such as Real-Time Tracking, and physical delivery performance, including delivery reliability and cost efficiency. Key indicators of customer satisfaction include overall satisfaction, confirmation of expectations, repurchase intention, and word-of-mouth intention (Dewi & Ginting, 2022; Susanti & Kristiana, 2021; Hartono et al., 2021). Therefore, customer satisfaction represents an essential measure of logistics service effectiveness in creating positive and sustainable customer experiences.

RESEARCH GAPS

Based on previous studies, research on Logistics Service Quality (LSQ) in e-commerce context has developed significantly by examining various service dimensions, including information quality, delivery performance, logistics cost, and customer satisfaction. Saputro and Hidayat (2023) demonstrated that Real-Time Tracking has a positive effect on customer satisfaction by improving information transparency and reducing uncertainty during the delivery process. Similarly, previous studies have highlighted that operational dimensions, such as delivery timeliness, order condition, and delivery accuracy, are important factors influencing customers' evaluations of logistics services (Mentzer et al., 2001; Wardhana et al., 2024). However, most existing studies still analyze digital and operational service dimensions separately. Research on tracking systems primarily focuses on digital information quality, whereas studies on delivery performance emphasize the physical reliability of courier services (Nugroho & Wijaya, 2023). In modern e-commerce ecosystem, customer experience is shaped by the combination of digital visibility and successful physical fulfillment. Therefore, a contextual research gap remains regarding how the integration of Real-Time Tracking and Delivery Timeliness simultaneously influences customer satisfaction, particularly among Shopee users in Indonesia.

Furthermore, previous studies reveal limitations in understanding the role of Logistics Service Cost as a moderating variable. Lestari and Ramadhan (2022) and Rahman and Siregar (2024) found that shipping costs, particularly through free-shipping subsidies and price sensitivity mechanisms, significantly influence consumers' perceived value and satisfaction. Fitriani et al. (2025) also identified a trade-off phenomenon between shipping cost and delivery speed, indicating that consumers have different tolerance levels toward service performance depending on the costs incurred. However, most existing studies treat logistics cost as an independent variable or a determinant of consumer preference rather than examining its ability to influence the strength of

relationships between logistics service quality dimensions and customer satisfaction. Therefore, this study addresses this gap by investigating Logistics Service Cost as a moderating variable to determine whether logistics cost strengthens or weakens the effects of Real-Time Tracking and Delivery Timeliness on customer satisfaction.

From a methodological perspective, previous research has frequently employed linear regression, descriptive analysis, or comparative approaches, which provide limited explanations of complex relationships among latent constructs. Although several recent studies have applied Structural Equation Modeling (SEM) in analyzing Logistics Service Quality and customer satisfaction (Prasetyo, 2025; Pratama & Utami, 2024), investigations regarding the moderating effect of logistics cost within e-commerce logistics services remain limited. This study contributes methodologically by applying Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS 4 to simultaneously examine direct relationships and moderation effects. This approach provides a more comprehensive understanding of customer satisfaction formation through the interaction of digital technology, operational performance, and perceived economic value in e-commerce logistics services.

METHODS

Research Approach

This study employs a quantitative approach with a causal research design to examine cause-and-effect relationships among variables. The quantitative method was selected to objectively test empirical hypotheses through statistical measurement and numerical analysis. Causal design aims to evaluate the direction, strength, and significance of the direct effects of independent variables (Real-Time Tracking and Delivery Timeliness) on dependent variable (Customer Satisfaction), while also examining the moderating effect of Logistics Service Cost in strengthening or weakening these structural relationships.

Population and Sample

The population of this study consists of active Shopee users in Indonesia who have made online purchases and used logistics delivery services within the last three months. Since the exact population size cannot be determined, it is considered an infinite population.

This study applies a non-probability sampling technique using purposive sampling based on specific criteria: respondents must be at least 17 years old, have an active Shopee account, have completed at least two transactions within the last three months, and have experienced both Real-

Time Tracking features and variations in shipping costs (e.g., free-shipping promotions and regular delivery fees).

The minimum sample size for the PLS-SEM analysis follows the rule of thumb proposed by Hair et al. (2017), which recommends a sample size of 5–10 times the number of indicators. With 16 indicators in the research model, the required minimum sample ranges from 80 to 160 respondents. From 219 collected questionnaires, 175 valid responses remained after the screening process and were used for further analysis. This sample size meets the recommended criteria for PLS-SEM and is considered adequate for testing the proposed structural model.

Research Instruments

Variable operationalization was developed as a practical framework to translate abstract theoretical concepts into measurable indicators that can be empirically assessed through a questionnaire (see table 1).

Table 1. Operational Variable

Variable	Operational Variable	Question Indicators	Measurement
Real-Time Tracking (X1)	Customers' perceptions of the quality, transparency, and speed of package location tracking information provided through the Shopee application (Chandramouli, 2023; Kalkha et al., 2023).	1. Ease of accessing the tracking menu (Yalçın & Çatlı, 2024). 2. Accuracy of the package location status displayed (Chandramouli, 2023; Komara & Fathurahman, 2024). 3. Speed of tracking data updates (Saputro & Hidayat, 2023). 4. Clarity of information regarding the courier carrying the package (Chandramouli, 2023).	Likert Scale (1-5)
Delivery Accuracy (X2)	Customers' assessment of the reliability of courier performance in physically delivering packages in the field (Mentzer et al., 2001; Bienstock et al., 2008).	1. The package arrives according to the promised estimated delivery time (Mentzer et al., 2001; GS & Istanti, 2022). 2. The package is received in intact and undamaged physical condition (Bienstock et al., 2008; Lande et al., 2024; Yalçın & Çatlı, 2024). 3. The package is delivered accurately to the intended destination address (Yan, 2024). 4. The courier's identity matches the information provided when the package is handed over (Hermawan et al., 2024).	Likert Scale (1-5)
Logistics Service Cost (Z)	Consumers' perceived sensitivity to and efficiency of logistics costs, both in terms of regular delivery rates and the benefits obtained through free-shipping subsidies (Zeithaml, 1988; Lestari & Ramadhan, 2022).	1. Affordability of standard delivery charges (GS & Istanti, 2022; Rahman & Siregar, 2024). 2. Availability of free-shipping promotions/vouchers (Lestari & Ramadhan, 2022; Fitriani et al., 2025). 3. Perceived suitability between the cost paid and the quality of the delivery service (value for	Likert Scale (1-5)

		money) (Zeithaml, 1988; Lichtenstein et al., 1993). 4. Ease of claiming delivery cost discounts (Xia et al., 2004; Alfarizi & Putri, 2023).	
Customer Satisfaction (Y)	Customers' overall emotional evaluation and sense of satisfaction after receiving logistics services through Shopee (Oliver, 1980, 2010; Parasuraman et al., 1988, 2005).	1. Satisfaction with the overall delivery service (Hartono et al., 2021; Mantri, 2024; Dewi & Ginting, 2022). 2. The logistics service received meets or exceeds expectations (Oliver, 1980, 2010; Susanti & Kristiana, 2021; Prasetyo, 2025). 3. The decision to continue choosing the delivery option is considered appropriate (Parasuraman et al., 1988, 2005; Hartono et al., 2021). 4. Willingness to recommend Shopee's logistics service to others (Dewi & Ginting, 2022; Yalçın & Çatlı, 2024).	Likert Scale (1-5)

Source : Literature Review, 2026.

Framework Model

This study develops a conceptual framework to examine how digital aspects (Real-Time Tracking) and physical aspects (Delivery Accuracy) influence Shopee Customer Satisfaction, with Logistics Service Cost serving as a moderating variable (strengthening or weakening) these two relationships. Schematically, model of relationships among the variables in this study is illustrated in Figure 1 below:

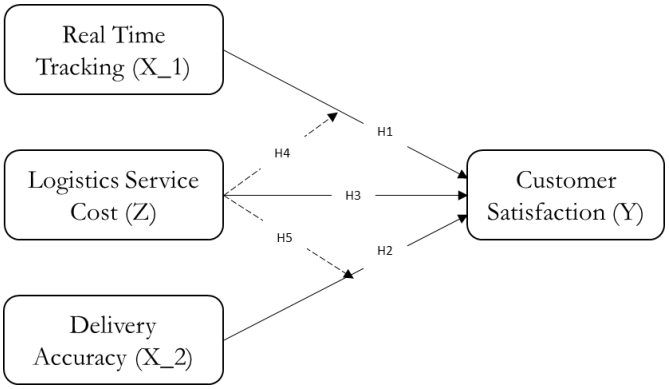

Figure 1. Framework Model

Research Hypotheses

H1 : Real-Time Tracking has a positive and significant effect on Shopee Customer Satisfaction

H2 : Delivery Punctuality has a positive and significant effect on Shopee Customer Satisfaction

H3 : Logistics Service Cost has a positive and significant effect on Shopee Customer Satisfaction

H4 : Logistics Service Cost moderates the effect of Real-Time Tracking on Shopee Customer Satisfaction

H5 : Logistics Service Cost moderates the effect of Delivery Punctuality on Shopee Customer Satisfaction

DATA ANALYSIS TECHNIQUES

Validity Test

The validity test aims to determine whether the questionnaire items accurately measure the research constructs. In SEM-PLS analysis, validity testing consists of two stages:

1. Convergent Validity: Evaluated based on the indicator loading factor and Average Variance Extracted (AVE). An indicator is considered valid when the loading factor value is > 0.70 and the AVE value of each construct is > 0.50.
2. Discriminant Validity: Ensures that each latent construct is empirically distinct from other constructs. This test is assessed using the Fornell-Larcker Criterion (the square root of AVE must be higher than the correlation with other constructs) or the Heterotrait-Monotrait Ratio (HTMT) with a value < 0.90.

Reability Test

The reliability test evaluates the consistency and stability of the questionnaire instruments. In SmartPLS analysis, reliability is assessed using:

1. Composite Reliability (CR): Indicates the internal consistency of a construct, with an acceptable value > 0.70.
2. Cronbach's Alpha: Measures the lower bound of internal reliability, where a value > 0.70 indicates that the instrument is reliable for further structural model analysis.

Outer Model Evaluation (Measurement Model)

The outer model evaluation aims to assess the validity and reliability of the measurement instruments. The tests include:

1. Convergent Validity: Assessed through loading factor (>0.70) and AVE (>0.50).
2. Discriminant Validity: Evaluated using the Fornell-Larcker Criterion or HTMT ratio (<0.90).
3. Reliability Test: Examined using Composite Reliability and Cronbach's Alpha, with acceptable values above 0.70.

Inner Model Evaluation (Structural Model) and Hypothesis Testing

After the measurement model meets the validity and reliability requirements, the structural model is evaluated to test the proposed hypotheses (H1–H5). The evaluation includes:

1. Coefficient of Determination (R^2): Measures the proportion of variance in Customer Satisfaction (Y) explained by the independent and moderating variables.
2. Path Coefficient and Bootstrapping Test: Examines the direction and significance of relationships between constructs. A hypothesis is supported when the t-statistic value is >1.96 or the p-value is <0.05 at a 5% significance level.
3. Moderation Effect Test: Evaluates whether Logistics Service Cost significantly moderates the relationships between Real-Time Tracking → Customer Satisfaction and Delivery Accuracy → Customer Satisfaction using the interaction term approach.

RESULTS AND DISCUSSION

Measurement Model Evaluation

Evaluation of measurement model (outer model) is intended to ensure that research instruments used meet the criteria for validity and reliability before structural equation modeling is conducted. The PLS-SEM model results are presented below (see figure 2).

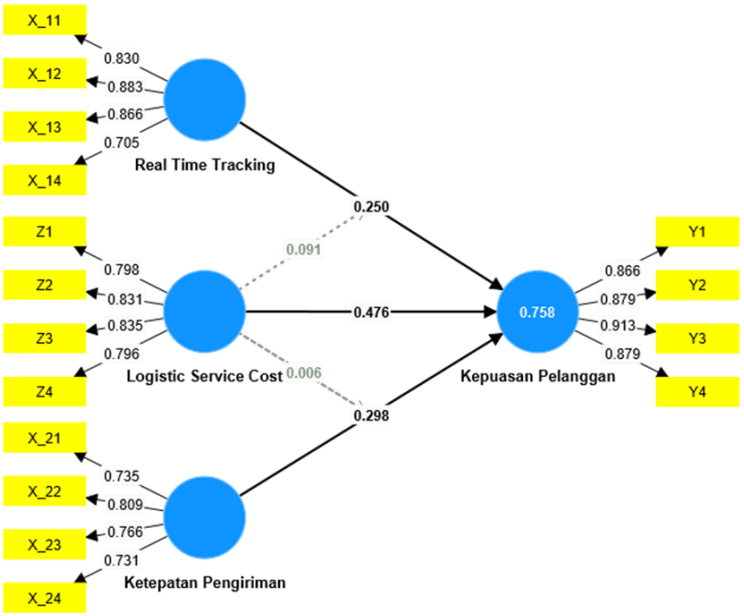

Figure 2. PLS-SEM Model

From Figure 2 above, the detailed results for validity and reliability is detailed in table 1:

Table 1. Validity and Reliability Results

Variable	Indicators	FLo	Cr_α	Cops_Re	A-VE
Real-Time Tracking **(X_1)**			0.839	0.849	0.679
X_11	Ease of accessing the tracking menu.	0.830			
X_12	Accuracy of the displayed package tracking status.	0.883			
X_13	Speed of tracking information updates.	0.866			
X_14	Clarity of information regarding the courier delivering the package.	0.705			

Logistics Service Cost ***(Z)***			0.832	0.836	0.665
Z1	Affordability of standard shipping fees.	0.866			
Z2	Availability of free shipping promotions/vouchers.	0.879			
Z3	Compatibility between the shipping cost paid and the delivery service quality received (value for money).	0.913			
Z4	Ease of claiming shipping cost discounts.	0.879			
Delivery Accuracy **(X_2)**			0.757	0.756	0.579
X_21	The package arrives according to the promised estimated delivery time.	0.735			
X_22	The package is received in intact and undamaged condition.	0.809			
X_23	The package is delivered to the correct destination address.	0.766			
X_24	The courier's identity matches the information provided during delivery.	0.731			
Customer Satisfaction **(Y)**			0.907	0.909	0.782
Y1	Satisfaction with the overall delivery service.	0.798			
Y2	The logistics service received meets or exceeds customer expectations.	0.831			
Y3	The decision to continue choosing the delivery option is appropriate.	0.835			
Y4	Willingness to recommend Shopee logistics services to others.	0.796			

Source : Output SmartPLS 4, 2026.

Description of table 1:

1. Analysis of Outer Loading Values

   Based on the Outer Loadings matrix output from SmartPLS 4, as presented in Figure 2 and table 1 about PLS-SEM Algorithm Calculation (2026), all measurement indicators show loading factor values above the recommended threshold of 0.70. The indicators of Real-Time Tracking (X_11–X_14) range from 0.705 to 0.883, Delivery Accuracy (X_21–X_24) ranges from 0.731 to 0.809, Logistics Service Cost (Z1–Z4) ranges from 0.866 to 0.913, and Customer Satisfaction (Y1–Y4) ranges from 0.796 to 0.835. These results indicate that all indicators have adequate convergent validity and are capable of representing their respective latent constructs.

2. Analysis of Average Variance Extracted (AVE) Values

   Based on Table 4.3, the AVE values obtained for each construct are 0.782 for Customer Satisfaction, 0.579 for Delivery Accuracy, 0.665 for Logistics Service Cost, and 0.679 for Real-Time Tracking. Since all latent variables have AVE values greater than 0.50, the requirement for convergent validity is fully satisfied. This indicates that each construct is able to explain more than 50% of the variance of its measurement indicators.

Discriminant Validity

The test of discriminant validity in this study follows the Fornell-Larcker criteria approach. A construct (shown in the bold diagonal cell) must be greater than the correlation coefficient between that construct and any other construct in the model (see table 2).

Table 2. Discriminant Validity Comparison Matrix

Laten Variable	Customer Satisfaction	Delivery Acurracy	Logistic Service Cost	Real Time Tracking
Customer Satisfaction	0,884			
Delivery Acurracy	0,726	0,761		
Logistic Service Cost	0,776	0,594	0,815	
Real Time Tracking	0,704	0,623	0,584	0,824

Source : Output SmartPLS 4, 2026.

Based on table 2 above, diagonal values for Customer Satisfaction (0.884), Delivery Punctuality (0.761), Logistics Service Cost (0.815), and Real-Time Tracking (0.824) are consistently higher than the inter-construct correlation values in the row below them. These results confirm that each latent variable has a unique empirical specification that distinguishes it from other constructs.

Construct Reliability

Based on table 1, all research constructs recorded a Cronbach's Alpha value > 0.757 and a Composite Reliability (p_c) value > 0.846. The results of these tests conclude that all instruments used are reliable and provide consistent measurement accuracy.

STRUCTURAL MODEL EVALUATION (INNER MODEL)

Coefficient of Determination (R-square)

Coefficient of determination (R^2) indicates predictive power of the structural model, representing the percentage of variation in dependent variable that can be predicted simultaneously by independent variables.

Table 3. R-square

	R^2	R^2 adjusted
Customer Satisfaction	0,758	0,751

Source : Output SmartPLS 4, 2026.

The R^2 value of 0.758 in Table 3, indicates that the variables Real-Time Tracking, Delivery Accuracy, and Logistics Service Cost, along with their moderating interactions, collectively account

for 75.8% of the variation in the exogenous variable Customer Satisfaction on the Shopee platform. The remaining 24.2% of variation is explained by other external variables not accounted in structural model of this study.

Effect Size (f^2)

The f² value is used to analyze the practical significance or effect size of each predictor's contribution to the variance structure of the dependent variable (>0.02 is small effect, >0.15 is moderate effect, >0.35 is large effect).

1. Logistic Service Cost recorded an f² value of 0.518 (a large contribution).
2. Delivery Accuracy recorded an f² value of 0.190 (moderate contribution).
3. Real-Time Tracking recorded an f² value of 0.136 (contributing to a small-to-moderate extent).
4. Both moderation interaction effects were close to zero (0.022 and 0.000), confirming the absence of effects of practical significance.

HYPOTHESIS TESTING

The test for causality between constructs was based on a nonparametric resampling method using the bootstrapping procedure with 5,000 subsamples. The decision criteria for a two-tailed test at a 5% significance level (α = 0.05) stipulate that the hypothesis will be accepted if the T-statistic is greater than 1.96 and the P-value is less than 0.05.

A complete summary of the statistical values of the hypothesis test parameters based on the results of the bootstrapping procedure is presented in Table 4 below.

Table 5. Direct Effect

Hypothesis	Path Relationship	Original Sample (O)	T-Statistics	P-Values	Conclusion
H1	Real Time Tracking → Customer Satisfaction	0,250	3,542	0,000	Accepted (Significant)
H2	Delivery Accuracy → Customer Satisfaction	0,298	5,056	0,000	Accepted (Significant)
H3	Logistic Service Cost → Customer Satisfaction	0,476	8,005	0,000	Accepted (Significant)
H4	Logistic Service Cost × Real Time Tracking → Customer Satisfaction	0,091	1,550	0,121	Rejected (Not Significant)
H5	Logistic Service Cost × Delivery Accuracy → Customer Satisfaction	0,006	0,118	0,906	Rejected (Not Significant)

Source : Ourput SmartPLS 4, 2026.

Direct Effect

Based on the empirical evidence presented in Table 5, the three main dimensions of logistics service quality were found to have a positive and statistically significant direct effect on customer satisfaction on the Shopee platform ($P < 0.05$).

To interpret the strength of the relationships between variables in the structural model, the Original Sample (O) or Path Coefficient is used. According to Hair et al. (2017), the path coefficient represents the magnitude and direction of the effect of an independent variable on a dependent variable. In general, the coefficient can be interpreted as follows: values indicating a meaningful effect, values indicating a weak but relevant effect, values indicating a moderate effect, and values indicating a strong effect.

The Effect of Real-Time Tracking on Customer Satisfaction (H1)

The information transparency dimension represented by the Real-Time Tracking feature (X_1) has a positive and significant effect on customer satisfaction, with a coefficient of 0.250 (*Original Sample* (O) = 0.250). This coefficient indicates a moderate positive effect. The integration of courier delivery-time fulfillment and accurate package location tracking confirms the theoretical foundation of e-commerce logistics, in which digital information quality can reduce information asymmetry and consumers' *waiting anxiety*. This finding is fully supported by Bienstock et al. (2008) and Chandramouli (2023), who argue that interactive, accurate, and continuously updated *multichannel* tracking systems enhance the *perceived usefulness* (PU) of the tracking system. Consequently, the functional integration between the sophistication of digital tracking applications and the operational reliability of couriers in the field represents a crucial prerequisite for achieving holistic customer satisfaction.

The Effect of Delivery Timeliness on Customer Satisfaction (H2)

Furthermore, the Delivery Timeliness variable consistently demonstrates a positive effect on customer satisfaction, with a coefficient of 0.298 (Original Sample (O) = 0.298). This coefficient indicates a moderate positive effect. The finding emphasizes that courier reliability in delivering packages on time and maintaining the physical condition of packages intact constitutes a crucial form of physical fulfillment. This result confirms the classic argument of Mentzer et al. (2001) regarding Logistics Service Quality (LSQ), in which the dimensions of timeliness and order condition serve as fundamental elements in fulfilling actual service promises. Empirically, this finding is also supported by Yan (2024) and Lande et al. (2024), who state that reducing package

delivery errors during the last-mile delivery stage can substantially minimize customer dissatisfaction and complaints while strengthening user retention on digital platforms.

The Effect of Logistics Service Cost on Customer Satisfaction (H3)

The Logistics Service Cost variable (Z) was identified as the most dominant predictor of customer satisfaction, as indicated by the highest path coefficient of 0.476. With a coefficient of 0.476, this variable can be categorized as having a moderate-to-strong positive effect. This finding indicates that logistics cost-setting mechanisms, such as the availability of shipping discount vouchers and free-shipping promotions, play a crucial role in shaping consumers' perceptions of value and satisfaction.

The dominance of the cost factor is consistent with Zeithaml's (1988) perceived value theory and is further supported by the findings of Yalçın and Çatlı (2024) in a global digital market study, which demonstrate that shipping cost efficiency is a key determinant that directly mitigates consumers' financial risk in e-commerce transactions. Furthermore, Kalkha et al. (2023), in their study of smart e-commerce logistics, found that monetary incentives in the form of shipping subsidies exert a stronger psychological influence in confirming customer satisfaction expectations (positive disconfirmation) than non-monetary service attributes.

Inderect Effect

The primary analytical focus of this study is directed toward testing the moderating interaction effects proposed in the fourth (H4) and fifth (H5) hypotheses. The structural analysis reveals an empirical finding that contrasts with the initial expectations, as both moderation hypotheses were rejected.

1. Rejection of Hypothesis 4 (H4)

The interaction path between Logistics Service Cost and Real-Time Tracking produces a coefficient of 0.091 (Original Sample (O) = 0.091), with a P-value of 0.121 (> 0.05). The relatively low path coefficient of 0.091, which is close to zero, indicates that the interaction effect is weak and statistically insignificant. These statistical results demonstrate that *Logistics Service Cost* does not function as a moderator in the relationship between the Real-Time Tracking feature and customer satisfaction. Theoretically, the absence of a moderating effect is supported by Gao et al. (2024), who argue that tracking-data transparency has shifted toward becoming a "basic requirement" or hygiene factor, rather than an additional service attribute that is highly sensitive to cost considerations.

2. Rejection of Hypothesis 5 (H5)

The interaction path between Logistics Service Cost and Delivery Timeliness produces a coefficient of 0.006 (Original Sample (O) = 0.006), with a P-value of 0.906 (> 0.05). Statistically, this result demonstrates that Logistics Service Cost does not function as a moderating variable in the relationship between courier delivery timeliness and customer satisfaction. The coefficient of 0.006, which is extremely close to zero, confirms the absence of a meaningful interaction effect. This phenomenon suggests that modern consumers evaluate the physical reliability of courier services, particularly delivery accuracy and timeliness, independently of logistics cost considerations (Morgado & Silva, 2023).

The rejection of both moderating interaction effects raises an interesting theoretical argument concerning digital consumer behavior. The insignificant role of Logistics Service Cost (Z) as a conditioning variable or buffering effect indicates that cost-related attributes and operational performance attributes are evaluated as relatively independent constructs by e-commerce platform users. This finding is supported by the empirical study of Gao et al. (2024), which suggests that in mature marketplace ecosystems, expectations regarding courier reliability (Delivery Accuracy) and the transparency of application-based tracking systems have shifted from being "value-added services" to becoming basic requirements or hygiene factors.

In other words, whether shipping costs are low or high—including whether consumers receive free-shipping vouchers—does not eliminate their fundamental expectation that their orders will arrive on time and can be tracked accurately. This explanation is consistent with Herzberg's Two-Factor Theory, as adapted to the digital context by Morgado and Silva (2023), in which failures in physical delivery or disruptions to digital tracking systems can automatically generate substantial dissatisfaction (dissatisfaction), regardless of whether consumers receive free-shipping subsidies.

From a global perspective, research by Li and Wang (2025), published in a leading international logistics journal, further emphasizes that consumers in the modern digital economy demonstrate a high sensitivity to the utility of time (time-utility sensitivity). Disruptions in tracking information or damage to delivered goods cannot be fully compensated for or overlooked merely through shipping-cost reductions. Therefore, Logistics Service Cost fails to function as a conditioning variable that determines consumers' tolerance threshold or zone of tolerance. The reliability of physical courier operations and the transparency of digital tracking systems represent fundamental service expectations that cannot be substituted or offset by monetary incentives alone.

THEORETICAL AND MANAGERIAL CONTRIBUTIONS

Theoretically, this study contributes to the digital logistics and e-commerce literature by demonstrating the absence of a monetary buffering effect on operational service quality. The findings extend the integration of the Technology Acceptance Model (TAM) and Expectancy Disconfirmation Theory (EDT) by showing that digital convenience and operational reliability represent fundamental customer expectations rather than compensable attributes.

From a managerial perspective, e-commerce platforms and third-party logistics providers (3PLs) should prioritize last-mile delivery reliability and tracking system improvement rather than relying solely on free-shipping promotions. Strategic investment should focus on improving package handling standards, delivery accuracy, and GPS-based tracking precision to enhance customer experience.

LIMITATION AND FUTURE RESEARCH

This study is limited to a single e-commerce platform, Shopee, which may restrict the generalizability of the findings to other marketplace platforms with different business models. Furthermore, the cross-sectional design conducted between May and July 2026 captures customer perceptions at a specific period and does not fully represent changes in consumer behavior over time. The study also focuses on regular delivery services and does not examine specific logistics contexts such as same-day delivery or cold-chain logistics.

Future studies are recommended to expand the research scope through comparative analysis across multiple e-commerce platforms in Indonesia to validate the robustness of the proposed model. Longitudinal studies should also be considered to examine changes in customer expectations over time. Further research may incorporate external factors, such as regional infrastructure disparities and logistics tariff regulations. In addition, distinguishing tracking technologies, such as IoT-based tracking and manual checkpoint updates, may provide more precise insights for decision-making in Logistics 4.0.

REFERENCE

Bienstock, C. C., Royne, M. B., Sherrell, D. L., & Stafford, T. F. (2008). An expanded model of logistics service quality: Incorporating technology and consumer-to-consumer delivery. International Journal of Physical Distribution & Logistics Management, 38(3), 205-222. https://doi.org/10.1108/09600030810866986

Chandramouli, S. (2023). Multichannel tracking systems in logistics management and retail optimization. International Journal of Applied Science and Technology, 11(2), 145-159. https://doi.org/10.31219/osf.io/preprints/chandramouli-2023

Fitriani, S., Ramadhani, H., & Utomo, B. (2025). The Trade-Off Between Shipping Cost and Delivery Speed in Indonesian E-Commerce. International Journal of E-Commerce Studies, 19(1), 78–92. https://sciencedirect.com

GS, A. D., & Istanti, E. (2022). Business model canvas, service frequency, and logistics efficiency for MSMEs. International Journal of Economics and Management Research, 1(2), 36-48. https://ijemr.asia/index.php/ijemr/article/view/36

Hartono, S., Wijaya, T., & Gunawan, R. (2021). Pengaruh kualitas layanan e-commerce terhadap kepuasan dan loyalitas pelanggan di Indonesia. Jurnal Manajemen dan Pemasaran, 14(1), 55-68. https://doi.org/10.25105/jmp.v14i1.8902

Hermawan, A., Pratama, R., & Setiawan, B. (2024). Analisis umpan balik pengguna aplikasi e-commerce terhadap kinerja kurir pihak ketiga. Jurnal Transportasi dan Logistik, 8(2), 112-125. https://doi.org/10.25124/jtl.v8i2.6102

Kalkha, H., Khiat, A., Bahnasse, A., & Ouajji, H. (2023). The rising trends of smart e-commerce logistics. IEEE Access, 11, 33839-33857. https://doi.org/10.1109/ACCESS.2023.3263152

Komara, E., & Fathurahman, F. (2024). Research of e-service quality and data accuracy on digital transactions. Research of Business and Management, 2(1), 12-25. https://garuda.kemdiktisaintek.go.id/author/view/1740630

Lande, M., Sharma, S., & Kumar, R. (2024). Quality perception and problem handling in third-party logistics. Journal of Operations and Logistics, 17(1), 89-104. https://doi.org/10.1016/j.jol.2023.100201

Lestari, M. E., & Ramadhan, F. (2022). Peran Gratis Ongkir sebagai Strategi Promosi Logistik E-Commerce. Jurnal Distribusi & Logistik, 8(1), 45–56. https://jurnal.ulbi.ac.id

Lichtenstein, D. R., Ridgway, N. M., & Netemeyer, R. G. (1993). Price perceptions and consumer shopping behavior: A field study. Journal of Marketing Research, 30(2), 234-245. https://doi.org/10.2307/3172830

Nugroho, A., & Wijaya, K. (2023). Integrasi Kualitas Informasi Digital dan Performa Operasional Kurir 3PL. International Journal of Logistics, 26(4), 312–329. https://sciencedirect.com

Oliver, R. L. (1980). A cognitive model of the antecedents and consequences of satisfaction decisions. Journal of Marketing Research, 17(4), 460-469. https://doi.org/10.2307/3150499

Oliver, R. L. (2010). Satisfaction: A behavioral perspective on the consumer (2nd ed.). M.E. Sharpe.

Prasetyo, H. (2025). Modelling Customer Behavior in Digital Logistics: TAM and EDT Integration. Jurnal Sistem Informasi Logistik, 4(1), 12–27. https://jurnal.ulbi.ac.id

Pratama, R., & Utami, S. (2024). Analisis Kualitas Layanan Logistik Pihak Ketiga (3PL) pada Platform Digital. Jurnal Sains Logistik, 11(2), 89–101. https://jurnal.ulbi.ac.id

Rahman, T., & Siregar, M. H. (2024). Sensitivitas Harga Ongkos Kirim terhadap Loyalitas Pelanggan Shopee. Jurnal Perilaku Konsumen, 12(3), 174–188. https://ejournal.undip.ac.id

Saputro, B., & Hidayat, R. (2023). The Impact of Real-Time Tracking on E-Commerce Customer Satisfaction. Jurnal Logistik Indonesia, 7(2), 105–118. https://ojs.stiami.ac.id

Wardhana, A., Sukma, T., & Amelia, R. (2024). Analisis Ketepatan Pengiriman Last-Mile Delivery Terhadap Kepuasan Konsumen. Jurnal Manajemen Transportasi, 11(1), 34–45. https://journal.itltrisakti.ac.id

Xia, L., Monroe, K. B., & Cox, J. L. (2004). The many faces of price unfairness. Journal of Marketing, 68(4), 1-15. https://doi.org/10.1509/jmkg.68.4.1.42732

Yalçın, A., & Çatlı, Ö. (2024). A study on the electronic service quality of digital marketplaces. International Journal of Business and Economic Studies, 6(2), 110-128. https://doi.org/10.54821/uiecd.1489012

Yan, H. (2024). Error reduction and complaint management in e-commerce fulfillment services. Journal of Global Supply Chain, 22(1), 40-55. https://doi.org/10.1016/j.jgsc.2023.11.002

Zeithaml, V. A. (1988). Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. Journal of Marketing, 52(3), 2-22. https://doi.org/10.1177/002224298805200302

Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. (2018). Services marketing: Integrating customer focus across the firm (7th ed.). McGraw-Hill Education. https://www.mheducation.com/highered/product/services-marketing-integrating-customer-focus-across-firm-zeithaml-bitner/M9780078112102.html