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EXPLORING THE ROLE OF REAL-TIME TRACKING AND DELIVERY ACCURACY IN ENHANCING E-COMMERCE CUSTOMER SATISFACTION: AN EMPIRICAL STUDY ON COURIER SERVICES IN INDONESIA

[1]Andi Bintang,*[2]Agus Purnomo

[1,2]Master of Logistics Management Program, Universitas Logistik dan Bisnis Internasional Bandung, Indonesia

Author's email:
[1]andi.bintang@posindonesia.co.id; [2] aguspurnomo@ulbi.ac.id

**Corresponding author: aguspurnomo@ulbi.ac.id*

Abstract. *The rapid growth of e-commerce in Indonesia has not only increased transaction volumes but also intensified the demand for courier services that are fast, accurate, and transparent. In this context, Real-Time Tracking (RTT) technology and delivery accuracy have become two critical factors that shape the customer experience. This study aims to examine the influence of Real-Time Tracking (RTT) and delivery accuracy on e-commerce customer satisfaction, both individually and simultaneously. A quantitative research approach was employed by using a survey method to collect data from 100 active e-commerce consumers in urban areas of Indonesia. The data were analyzed using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. The findings indicate that both independent variables contribute positively and significantly to customer satisfaction. Delivery accuracy exhibits the strongest influence; however, the support of real-time tracking technology further enhances customers' positive perceptions. These results highlight the importance of integrating digital innovation with operational reliability to create logistics services that are responsive, adaptive, and customer-oriented. Practically, the study provides a foundation for formulating competitive delivery service strategies within the rapidly evolving e-commerce landscape.*

Keywords: *Customer Satisfaction; Delivery Accuracy; Digital Logistics; E-Commerce; PLS-SEM; Real-Time Tracking.*

1. INTRODUCTION

The rapid expansion of the e-commerce sector in major urban areas such as Jabodetabek, Surabaya, and Greater Bandung has driven a significant surge in demand for delivery services that are fast, accurate, and supported by digital technologies. According to the e-Conomy SEA report (Google, Temasek & Bain, 2023), Indonesia's e-commerce transaction value is projected to reach USD 95 billion by 2025. This growth not only reflects the accelerated digitalization of commerce but also intensifies pressure on logistics infrastructure, particularly in terms of speed, accuracy, and transparency of delivery services.

As transaction volumes continue to rise, customer expectations regarding logistics services have also evolved substantially. Today's consumers seek not only fast delivery but also greater control and full visibility over the movement of their shipments. In this context, Real-Time Tracking (RTT) has emerged as a key innovation that addresses these needs. This technology enables customers to monitor the status and location of their packages in real time through various channels such as mobile applications, SMS, or email (Yalçın & Çatlı, 2024; Komara & Fathurahman, 2024). Accurate and regularly updated tracking information is considered effective in reducing uncertainty and enhancing customer trust in logistics service providers (GS & Istanti, 2022; Kalkha et al., 2023).

However, the implementation of digital features such as RTT does not automatically guarantee customer satisfaction if it is not accompanied by reliable delivery performance. In this regard, delivery accuracy—which includes timeliness, correctness of contents, and accuracy of destination—plays an essential role in shaping customers' perceptions of service quality. Hermawan et al. (2024) found that delivery errors, even when occurring only once or twice, can significantly reduce customer trust. A Deloitte (2023) study reinforces this insight by noting that two delivery errors are sufficient to prompt customers to abandon an e-commerce platform. Furthermore, the speed at which delivery issues are resolved also serves as a key indicator influencing customer loyalty (Lande et al., 2024).

Within Indonesia's dynamic and complex logistics landscape, the integration of digital innovations such as RTT with operational reliability—including delivery accuracy—has become increasingly crucial. Purnomo et al. (2024) emphasize that a sustainable logistics system requires synergy between technological sophistication and operational efficiency to achieve competitive advantage. Syafrianita et al. (2025) also note that digital-based logistics visibility significantly contributes to strengthening customer satisfaction and enhancing industry competitiveness. Nevertheless, most previous studies have examined these aspects separately, indicating the need for research that simultaneously investigates their interrelationship in shaping e-commerce customer satisfaction.

Based on this background, a central question emerges: to what extent do Real-Time Tracking and Delivery Accuracy, both individually and collectively, influence E-Commerce Customer Satisfaction, particularly within the context of courier services in Indonesia's urban areas?

Specifically, this study is directed toward examining three key issues. First, it investigates the effect of Real-Time Tracking (RTT) on consumer satisfaction levels in e-commerce delivery services. Second, it evaluates the contribution of delivery accuracy in shaping customer perceptions. Third, it assesses the combined influence of RTT and delivery accuracy on the overall satisfaction experienced by customers.

This study is designed to generate four key contributions. Theoretically, it addresses a gap in the literature by examining the simultaneous relationship between two logistics variables that are highly relevant yet seldom analyzed together. Practically, the findings have the potential to serve as strategic guidance for courier service providers and e-commerce operators in designing more integrated tracking and delivery systems. A contextual contribution emerges from the study's focus on densely populated urban regions such as Jabodetabek and Greater Bandung, which exhibit distinctive logistics characteristics. Lastly, from a policy perspective, this research aligns with the direction of national logistics transformation and supports the attainment of SDG 9 (industry, innovation, and infrastructure) and SDG 11 (sustainable cities and communities) by strengthening distribution systems that are efficient, transparent, and sustainable.

2. LITERATURE REVIEW

2.1 Real-Time Tracking in E-Commerce Logistics Services

Real-Time Tracking (RTT) refers to a tracking technology that enables customers to monitor the position and status of their shipments in real time through digital systems. Within the modern e-commerce ecosystem, RTT has become a critical element for enhancing information transparency, strengthening customer security perceptions, and building trust in service providers. This technology plays a strategic role in shaping a delivery experience that is responsive and personalized.

According to Yalçın and Çatlı (2024), high accessibility to tracking information significantly influences customers' perceptions of service quality. GS and Istanti (2022) further emphasize that frequent updates throughout the delivery process enhance customer trust and satisfaction. The accuracy of tracking data also represents a key dimension. Komara and Fathurahman (2024) found that precise tracking of shipment location and estimated arrival time reinforces consumer

loyalty. In addition, Chandramouli (2023) notes that the availability of multichannel tracking—via SMS, email, and mobile applications—improves user engagement. Meanwhile, Kalkha et al. (2023) highlight that intuitive and user-friendly tracking interface designs directly contribute to a positive digital experience.

From a theoretical perspective, RTT can be examined through the framework of the Technology Acceptance Model (TAM), which posits that technology adoption is influenced by perceived usefulness and perceived ease of use. In the logistics context, RTT creates added value through perceived control, thereby strengthening trust in the system (Syafrianita et al., 2025). This indicates that RTT is not only a functional innovation but also shapes customers' emotional perceptions of digital logistics service quality.

2.2 Delivery Accuracy and Its Relevance to Customer Satisfaction

Delivery accuracy refers to the degree of alignment between the expected and actual delivery time, destination, and shipment contents. In the competitive e-commerce environment, delivery accuracy is not merely a matter of operational efficiency; it serves as a fundamental determinant of customer satisfaction and loyalty. Deloitte (2023) reports that repeated delays or delivery errors are among the primary reasons customers switch platforms. This is further supported by Hermawan et al. (2024), who demonstrate that successful delivery in meeting expectations regarding timing and shipment integrity has a direct impact on customer loyalty.

Error rates and the effectiveness of issue resolution also form part of the indicators of delivery accuracy. Lande et al. (2024) highlight that prompt resolution of customer complaints reflects a company's commitment to customer comfort and service quality. Within the framework of Expectancy Disconfirmation Theory (EDT), accurate delivery performance generates positive confirmation of customer expectations, ultimately leading to satisfaction.

Prof. Purnomo and his team (2024) further argue that within the context of sustainable logistics in Indonesia, delivery accuracy represents a form of green operational excellence capable of creating competitive advantage, particularly when supported by process efficiency and the implementation of an integrated delivery reporting system.

2.3 E-Commerce Customer Satisfaction as the Dependent Variable

E-commerce customer satisfaction reflects users' subjective perceptions of the quality of services they receive throughout the shopping process, including digital transactions, delivery, and post-purchase services. According to Mantri (2024), a pleasant shopping experience—encompassing ease of access, data security, and delivery speed—directly influences customer loyalty and repurchase intention.

Hartono et al. (2021) note that perceived quality of logistics services in e-commerce is shaped by a combination of affective factors (customers' emotions) and cognitive factors (rational evaluations of service performance). In addition, the Net Promoter Score (NPS), which assesses customers' likelihood of recommending the service to others, serves as a key indicator for measuring satisfaction (Yan, 2024). The frequency and intensity of customer complaints regarding delivery services also provide an indication of actual satisfaction levels.

Within the SERVQUAL framework developed by Parasuraman et al. (1988), the dimensions of reliability, responsiveness, assurance, tangibles, and empathy are highly relevant for assessing service quality in e-commerce. In the context of this study, RTT reflects the dimensions of responsiveness and assurance, while delivery accuracy represents reliability—each of which collectively contributes to overall customer satisfaction.

2.4 The Role of Real-Time Tracking in Influencing E-Commerce Customer Satisfaction

The literature on real-time tracking (RTT) highlights the importance of information

transparency in creating a satisfying customer experience within digital logistics services. RTT refers to a monitoring system that enables customers to access real-time information regarding the location and status of their shipments through various digital channels, including mobile applications, SMS, and email. In the e-commerce environment, this technology has evolved from merely an added feature to a key component in customers' decision-making processes, particularly in matters related to trust and perceptions of service quality (Yalçın & Çatlı, 2024).

Enhanced access to tracking information is believed to strengthen customers' perceived control, which psychologically reduces uncertainty and increases trust in logistics service providers. GS and Istanti (2022) assert that real-time shipment status updates are positively correlated with higher user loyalty, particularly in fast delivery or last-mile services. Research by Komara and Fathurahman (2024) likewise demonstrates that the accuracy and reliability of tracking data have a direct impact on customer satisfaction and repurchase intention. Furthermore, a study by Kalkha et al. (2023) emphasizes the importance of interface design and navigation ease within tracking features, both of which contribute to a positive digital experience.

From a theoretical standpoint, the influence of RTT on customer satisfaction can be explained through the Technology Acceptance Model (TAM). According to TAM, users' perceptions of a technology's ease of use and usefulness determine their level of acceptance. User-friendly, accurate, and multi-channel RTT systems provide added value in the form of information efficiency and convenience, ultimately contributing to higher levels of customer satisfaction (Syafrianita et al., 2025; Chandramouli, 2023).

Nonetheless, a research gap remains—particularly in developing countries such as Indonesia—regarding the extent to which RTT directly influences customer perceptions and satisfaction within a logistics environment characterized by complexity and variability. Against this backdrop, the present study formulates the following first hypothesis:

H1:Real-Time Tracking has a positive and significant effect on E-Commerce Customer Satisfaction.

2.5 The Role of Delivery Accuracy in Influencing E-Commerce Customer Satisfaction

Delivery accuracy represents a key operational dimension that determines the quality of logistics services. It encompasses on-time delivery performance, correctness of recipient address, accuracy of package contents, and the effectiveness of problem resolution when complaints or disruptions arise. In e-commerce systems that rely heavily on logistics operations, even minor errors in the delivery process can have substantial consequences for the overall customer experience.

Hermawan et al. (2024) argue that delivery inaccuracy is one of the primary sources of customer complaints and a major driver of product returns. Findings from Deloitte (2023) reinforce this view, noting that customers tend to abandon a platform after experiencing more than one delivery error. Lande et al. (2024) further emphasize that the speed at which complaints are resolved serves as a critical indicator determining whether consumers will continue using the service in the future.

Theoretically, the relationship between delivery accuracy and customer satisfaction is grounded in the Expectancy Disconfirmation Theory (EDT). This theory posits that satisfaction arises from the discrepancy between customers' initial expectations and the actual performance of the service. When deliveries are completed accurately and within the promised timeframe, customers experience a "positive disconfirmation," which ultimately enhances satisfaction and may foster loyalty (Oliver, 1980).

Although numerous studies highlight the importance of delivery accuracy, research that specifically examines its effect on customer satisfaction within the context of urban logistics in Indonesia remains limited. This gap is noteworthy given the high operational complexity and the

growing demand for rapid deliveries in metropolitan areas.

Based on the theoretical framework and empirical findings discussed above, the second hypothesis of this study is formulated as follows:

H2:Delivery Accuracy has a positive and significant effect on E-Commerce Customer Satisfaction.

2.6 The Combined Influence of Real-Time Tracking and Delivery Accuracy on Customer Satisfaction

Customer experience in e-commerce logistics is not shaped by a single element; rather, it emerges from the interaction of multiple digital and operational factors. The integration of Real-Time Tracking, which enhances information transparency, with Delivery Accuracy, which ensures service reliability, is believed to create a comprehensive and positive customer experience.

Purnomo et al. (2024) emphasize the importance of synergy between digital innovations and operational efficiency in achieving logistical excellence in the era of digital transformation. In their study on green operational excellence, these two components jointly contribute to building a customer-oriented competitive advantage. This study seeks to examine the simultaneous effects of both variables, an area that has received limited empirical attention within the Indonesian research context.

Considering the theoretical foundation and the identified research gap, the third hypothesis is formulated as follows:

H3:Real-Time Tracking and Delivery Accuracy jointly exert a positive and significant influence on E-Commerce Customer Satisfaction.

Based on the preceding explanation, the conceptual framework of this study is outlined as follows:

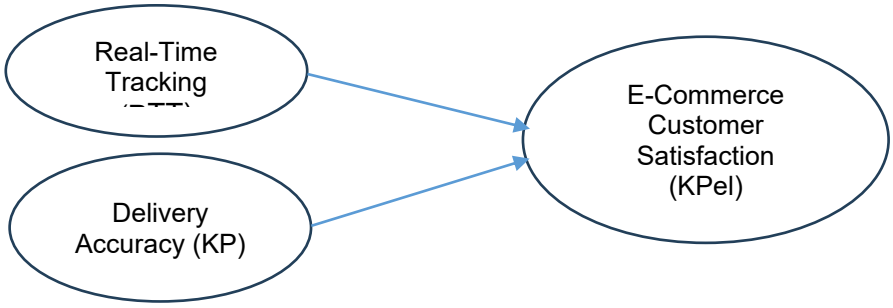

Figure 1. Research Model Source: Andi Bintang, 2025

3. RESEARCH METHODS

Research Design. This study employs a quantitative explanatory approach using a cross-sectional survey design to examine the causal interactions between two independent variables—Real-Time Tracking and Delivery Accuracy—and the dependent variable, namely E-Commerce Customer Satisfaction. The explanatory approach is selected to illustrate the extent to which the independent variables influence the dependent variable based on field data and to test the hypotheses developed from prior theoretical foundations (Sari et al., 2022). Meanwhile, the cross-sectional design enables data collection within a single period, making it efficient and suitable for the dynamic nature of e-commerce service environments.

Data Sources and Sampling Technique. Primary data collection in this research was conducted using an online questionnaire developed based on indicators defined for each construct. The questionnaire consists of 15 closed-ended statements rated on a five-point Likert scale ranging from “Strongly Disagree” (1) to “Strongly Agree” (5). Each construct—Real-Time

Tracking (RTT), Delivery Accuracy (KP), and E-Commerce Customer Satisfaction (KPel)—is represented by five indicators derived from recent literature (Yalçın & Çatlı, 2024; Hermawan et al., 2024; Komara & Fathurahman, 2024).

The respondents of this study consisted of e-commerce consumers who had made online purchases within the past three months and had used shipment tracking services. A purposive sampling technique was applied with the following criteria: respondents must reside in urban areas of Indonesia, actively engage in online shopping, and have prior experience in tracking and receiving delivered goods. A total of 150 questionnaires were disseminated online through social media platforms, shopping community groups, and courier partner networks. Of these, 100 questionnaires were returned fully completed and deemed suitable for analysis.

The determination of the minimum sample size refers to the "10-times rule" commonly applied in PLS-SEM methodology (Hair et al., 2022), which requires a minimum sample equal to ten times the largest number of indicators associated with a single construct. Since each construct in this study comprises five indicators and there are a maximum of two structural paths leading to the dependent variable, the minimum required sample size is calculated as max(10×5, 10×2) = 50 respondents. With a total of 100 valid responses, the sample used in this study adequately meets the minimum threshold for structural analysis.

Prior to distribution, the questionnaire underwent two stages of preliminary validation. First, content validity was assessed by consulting three experts in logistics and research methodology to evaluate the alignment of the instrument with its underlying theoretical constructs. Second, a pretest was administered to ten respondents with similar characteristics to ensure clarity of wording and comprehensibility of the items. The validation results were subsequently used to refine the structure and language of the instrument to enhance its readability and suitability for the final respondents.

Data Collection and Processing Techniques. The data collection process was carried out over a one-month period using two approaches: an online survey distributed via Google Forms and limited offline distribution through physical questionnaires at selected logistics locations, such as drop points or courier outlets. Respondents received a brief explanation regarding the purpose of the study, their data confidentiality rights, and instructions for completing the instrument. The researcher also provided on-site clarification assistance during the completion process to minimize perceptual bias and technical ambiguity.

Data Analysis Techniques. The collected data were analyzed using the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique, supported by SmartPLS software. PLS-SEM was selected because it is suitable for models with moderate complexity and small-to-medium sample sizes, and it is capable of accommodating reflective latent variables (Hair et al., 2021).

Data analysis was conducted to evaluate both the measurement model (outer model) and the structural model (inner model):

- Convergent validity was assessed by examining factor loadings, which were required to exceed 0.70, and the Average Variance Extracted (AVE), which had to be greater than 0.50.
- Discriminant validity was evaluated using the Fornell–Larcker criterion.
- Construct reliability was examined through Composite Reliability and Cronbach's Alpha, both of which were required to exceed the threshold of 0.70.
- For the structural model, relationships between variables were tested using T-statistics greater than 1.65 and P-values below 0.05, along with the coefficient of determination (R^2) to assess explanatory power.

4. RESULTS AND DISCUSSION

Respondent Demographics

Table 1. Demographic Characteristics of Respondents

Category	Criteria	F	%
Gender	Male	58	58%
	Female	42	42%
Age	< 20 years	4	4%
	21–30 years	21	21%
	31–40 years	38	38%
	> 40 years	37	37%
Current Domicile	Greater Jakarta (Jakarta, Bogor, Depok, Tangerang, Bekasi)	51	51%
	Greater Bandung (Bandung City, Cimahi City, Bandung Regency, West Bandung, Sumedang)	41	41%
	Greater Surabaya (Surabaya, Sidoarjo, Gresik)	8	8%
Most Frequently Used E-Commerce Platform	Shopee	66	66%
	TikTok Shop	19	19%
	Tokopedia	14	14%
	Lazada	1	1%
Monthly Online Shopping Frequency	< 2 times	47	47%
	3–5 times	39	39%
	> 5 times	14	14%
Most Frequently Used Courier Service	Pos Indonesia	38	38%
	SPX	28	28%
	J&T Express	19	19%
	JNE	9	9%
	SiCepat	4	4%
	IDExpress	1	1%
	Anteraja	1	1%
Use of Delivery Tracking Feature	Yes	98	98%
	No	2	2%

Source: Andi Bintang, 2025

This study involved 100 respondents who are active users of e-commerce services in urban areas of Indonesia, particularly Greater Jakarta (Jabodetabek), Greater Bandung, and Greater Surabaya. The majority of respondents were male (58%), with a predominance of individuals in the productive age group above 30 years old (75%).

Most respondents reported shopping online between one and five times per month and identified Shopee (66%) as their primary e-commerce platform. In terms of courier services, Pos Indonesia (38%) and Shopee Express (28%) were noted as the most frequently used delivery providers. Furthermore, 98% of respondents had utilized delivery tracking features, indicating a very high level of adoption of tracking technology.

These characteristics demonstrate that the respondents are well-aligned with the research focus and provide valid insights into real-time tracking, delivery accuracy, and e-commerce customer satisfaction.

Results of the Outer Structural Model

Validity and Reliability of the Measurement Model (Outer Model)

Based on the outer model analysis (Table 2), all latent constructs—Real-Time Tracking (RTT), Delivery Accuracy (KP), and E-Commerce Customer Satisfaction (KPel)—exhibited factor loading values above 0.7, internal consistency levels indicated by Composite Reliability (CR) exceeding 0.9, and AVE values surpassing the minimum threshold of 0.7. These results confirm that all indicators satisfy the requirements for convergent validity, demonstrating that each indicator significantly and accurately reflects the construct it is intended to measure (Yalçın & Çatlı, 2024; GS & Istanti, 2022; Lande et al., 2024).

Discriminant validity was also assessed using the Fornell–Larcker Criterion (Table 3). The analysis shows that the square root of the AVE for each construct is greater than its correlations with other constructs. This indicates that each construct is empirically distinct and clearly differentiated from the others, thereby reinforcing the discriminant validity of the measurement model.

Additionally, the model demonstrates strong reliability, as evidenced by Cronbach's Alpha and Composite Reliability values both exceeding 0.90. This confirms that the measurement instruments used in this study are internally consistent and meet the established reliability standards.

Table 2. Validity and Reliability of Research Variables

Vabl	Indtr	FLo	Cr_α	Cops_Re	A-VE
Real-Time Tracking **(RTT)**			0.900	0.927	0.719
RTT1	Information Accessibility (Yalçın & Çatlı, 2024)	0.893			
RTT2	Update Frequency (GS & Istanti, 2022)	0.835			
RTT3	Data Accuracy (Komara & Fathurahman, 2024)	0.865			
RTT4	Multichannel Tracking (Chandramouli, 2023)	0.733			
RTT5	User Interface Quality (Kalkha et al., 2023)	0.900			
Delivery Accuracy **(KP)**			0.906	0.931	0.729
KP1	Timeliness (GS & Istanti, 2022)	0.848			
KP2	Order Accuracy (Yalçın & Çatlı, 2024)	0.879			
KP3	Delivery Errors (Yan, 2024)	0.901			
KP4	User Feedback (Hermawan et al., 2024)	0.868			
KP5	Issue Handling (Lande et al., 2024)	0.766			
E-Commerce Customer Satisfaction **(KPel)**			0.922	0.941	0.763
Kpel1	Customer Loyalty (Hartono et al., 2021)	0.910			
Kpel2	Net Promoter Score (Yalçın & Çatlı, 2024)	0.847			
Kpel3	Complaint Management (Yan, 2024)	0.822			
Kpel4	Perceived Quality (Lande et al., 2024)	0.863			
Kpel5	Shopping Experience (Mantri, 2024)	0.923			

Source: Andi Bintang, 2025

Notes:
Vabl = Variables, Indtr = Indicators, FLo = Factor Loading, Cr_α = Cronbach's Alpha,
Cops_Re = Composite Reliability, A-VE = AVE

Tabel 3. Fornell-Larcker Criterion (Discriminant Validity)

	Kpel	KP	RTT
Kpel	0.874		
KP	0.884	0.854	
RTT	0.829	0.829	0.848

Sumber: Andi Bintang, 2025

Inner Structural Model Results

The analysis of the structural model was conducted by examining the R-square values as measures of explanatory power and by evaluating the significance of the path coefficients between the variables. The results presented in Table 4 indicate that the R-square value for the E-Commerce Customer Satisfaction variable is 0.811. This means that 81.1% of the variance in customer satisfaction can be explained jointly by the influence of Delivery Accuracy and Real-Time Tracking. These findings demonstrate that the model possesses a strong predictive capability.

Table 4. R-Square (Determinant Coefficient)

	R. Sq	R. Sq A
Kpel	0.811	0.807

R_Sq = R Square; R_Sq_A = R Square Adjusted
Source: Andi Bintang, 2025

Table 5. Summary of Hypothesis Testing for All Hypotheses

Hypothesis	β	O	SDD	T_Sta	P_Va	Hy_TC
Hyp1 : KP → Kpel	0.631	0.631	0.087	7.255	0.000	Accepted
Hyp2 : RTT → Kpel	0.306	0.306	0.094	3.251	0.001	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.
Source: Andi Bintang, 2025

The hypothesis testing results presented in Table 5 indicate that:

Hypothesis 1 (H1): Delivery Accuracy → Customer Satisfaction yields a path coefficient of β = 0.631, a T-statistic of 7.255, and a p-value of 0.000.

These results demonstrate statistical significance at the 95% confidence level. Therefore, the first hypothesis (H1) is accepted.

Hypothesis 2 (H2): Real-Time Tracking → Customer Satisfaction shows a path coefficient of β = 0.306, a T-statistic of 3.251, and a p-value of 0.001, indicating statistical significance. Consequently, the second hypothesis (H2) is accepted.

Both relationships are statistically significant, with delivery accuracy exerting a stronger effect. This finding suggests that while technological features such as real-time tracking are valuable, the actual service experience—particularly the timely and accurate receipt of goods—remains the primary determinant of customer satisfaction.

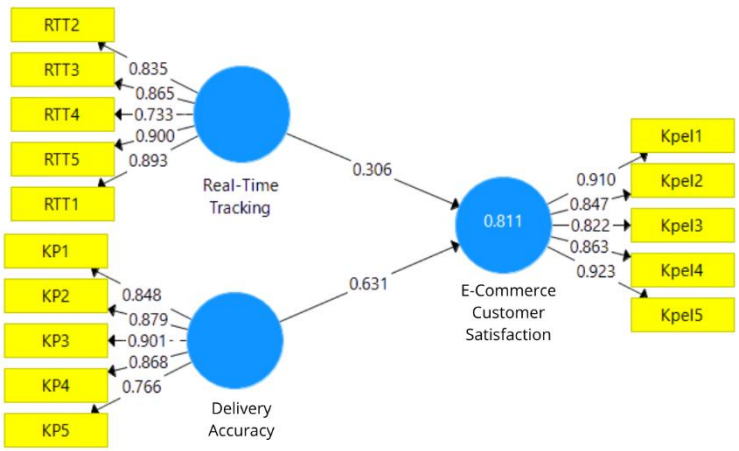

Figure 2. PLS Algorithm Calculation Source: Andi Bintang, 2025

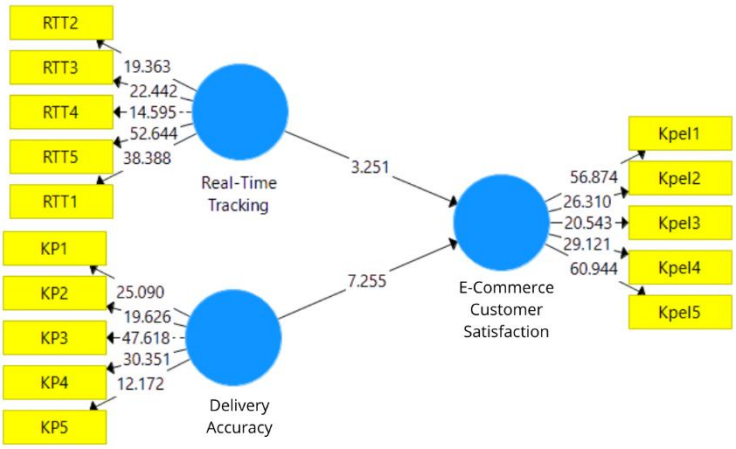

Figure 3. Bootstrapping Calculation Source: Andi Bintang, 2025

The visualization of the structural model estimation results is presented in Figures 2 and 3, which display the path coefficients, factor loadings, and bootstrapping outcomes.

Figure 2 illustrates the results generated using the PLS algorithm, showing that Delivery Accuracy exerts the most substantial influence on E-Commerce Customer Satisfaction, with a path coefficient of 0.631, followed by Real-Time Tracking with a coefficient of 0.306. Furthermore, the R-square value of 0.811 for the customer satisfaction construct indicates that the model demonstrates strong predictive power.

Meanwhile, Figure 3 presents the results of the bootstrapping procedure, highlighting the T-statistic values for each structural path. The path from Delivery Accuracy to Customer Satisfaction records a T-statistic of 7.255, while the path from Real-Time Tracking to Customer Satisfaction shows a T-statistic of 3.251. Both values exceed the threshold of 1.65, confirming statistical significance at the 95% confidence level.

Accordingly, this visualization reinforces the earlier analytical findings, confirming that the combination of real-time tracking features and accurate delivery performance plays a crucial role in shaping user perceptions and overall satisfaction among e-commerce customers in Indonesia.

Discussion

The results of this study confirm that Real-Time Tracking (RTT) and Delivery Accuracy (KP) exert positive and significant effects on E-Commerce Customer Satisfaction (KPel), with delivery accuracy demonstrating the more dominant influence. The structural model assessment indicates that all proposed hypotheses are statistically supported. The following discussion elaborates on each inter-variable relationship:

The test of the first hypothesis demonstrates that Real-Time Tracking (RTT) contributes positively and significantly to E-Commerce Customer Satisfaction. With a T-statistic of 7.255, which exceeds the critical value of 1.96, and a p-value below 0.05, this hypothesis is therefore accepted.

These findings indicate that customers who have access to real-time delivery information—whether through mobile applications, SMS, or email notifications—tend to report higher levels of satisfaction with the services they use. This supports the framework of the Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use are key determinants of user attitudes and satisfaction (Davis, 1989; Yalçın & Çatlı, 2024).

The study by Komara and Fathurahman (2024) further demonstrates that accuracy and regularly updated information strengthen customers' sense of control and trust. Customers feel

more "engaged" in the logistics process when they can monitor the status and location of their shipments in real time. This fosters a perception of high-quality digital service, particularly amid increasing complaints regarding delays and communication gaps in delivery processes.

Thus, real-time tracking (RTT) is not merely a technical component of the tracking system but also a customer service instrument with emotional impact, enhancing users' sense of security and engagement within the logistics chain.

The second hypothesis is also supported, as the obtained T-statistic value (3.251) exceeds the critical threshold of 1.96, and the p-value of 0.001 falls below 0.05. Therefore, the relationship between the variables is statistically significant. Delivery Accuracy (KP) is shown to be the variable exerting the strongest influence on Customer Satisfaction. This finding aligns with the Expectancy Disconfirmation Theory (EDT), which argues that satisfaction arises when the actual performance of a service meets or surpasses customers' initial expectations (Oliver, 1980). In this context, accuracy encompasses timely delivery, correct package content, and precise destination addressing.

Hermawan et al. (2024) reveal that discrepancies in delivery—even occurring only once or twice—can prompt customers to switch to alternative platforms. Deloitte (2023) further reports that two instances of delivery errors are sufficient to trigger lasting customer distrust.

The effectiveness of issue handling (problem resolution), such as in cases of misdelivery or delays, also represents an important dimension of delivery accuracy. Lande et al. (2024) emphasize that prompt and appropriate resolution of customer complaints can preserve loyalty even when service failures have occurred.

The implication is that logistics companies must strengthen their operational systems, including automated sorting, courier training, and quality control at the last-mile stage. Delivery reliability serves as a fundamental pillar of customer trust in the increasingly competitive e-commerce environment.

The third hypothesis examines the simultaneous influence of RTT and Delivery Accuracy on Customer Satisfaction, which is also found to be significant, with an R^2 value of 0.811. This indicates that the combination of these two independent variables explains 81.1% of the variance in E-Commerce Customer Satisfaction.

These results support the claim made by Purnomo et al. (2024), which states that the synergy between digital dimensions (such as RTT) and operational dimensions (such as Delivery Accuracy) is essential for success in modern logistics services. In the dynamic and competitive context of e-commerce logistics, customers expect not only transparent information but also precise execution of delivery processes.

An effective logistics service model is one that integrates both aspects: tracking technologies that enhance perceptions of control and transparency, and accurate delivery performance that ensures the physical reliability of the service.

Theoretically, these results can also be linked to the Service-Dominant Logic framework (Vargo & Lusch, 2004), which posits that customers are increasingly involved in value co-creation— in this context, through access to RTT and the reliability of delivery services. Customers perceive themselves as part of the logistics process rather than merely end recipients. As customer expectations continue to rise in the digital era, the integration of technology and operational reliability has become an inseparable element in designing superior courier services.

CONCLUSION

This study concludes that both independent variables—Delivery Accuracy and Real-Time Tracking—significantly influence E-Commerce Customer Satisfaction. Delivery accuracy exerts a stronger impact than real-time tracking; however, both variables play essential roles in enhancing customer satisfaction.

Practical Recommendations:

- Optimization of Tracking Systems: Couriers and e-commerce platforms should improve the accuracy, update frequency, and user interface of tracking systems, including support for multichannel tracking (applications, SMS, and email).
- Enhancement of Operational Accuracy: Efforts should focus on improving the accuracy of delivery timing and package content through automated sorting processes, courier training, and systematic field operational monitoring.
- Integrated Dashboard: The implementation of a technology-based control tower is recommended to monitor delivery performance and tracking activities simultaneously and in real time.
- System Collaboration Between Couriers and E-Commerce Platforms: API integration between courier systems and online marketplaces is essential to synchronize order statuses and delivery estimates, thereby preventing miscommunication and enhancing transparency.

Theoretical Recommendations:

- Inclusion of Mediating/Moderating Variables: Future studies may explore customer loyalty, trust, or customer engagement as variables that mediate or moderate the relationship between RTT and delivery accuracy and customer satisfaction.
- Longitudinal Approach: A longitudinal design is recommended to observe changes in customer perceptions over time or during major promotional periods.
- Expansion of Geographic Scope and Respondent Segmentation: Comparative studies between urban and rural areas can help evaluate the impact of infrastructure differences on logistics service expectations.
- Mixed-Methods Approach: Incorporating in-depth interviews or focus group discussions (FGDs) would enrich the interpretation of quantitative findings and provide deeper insights into customer motivations and preferences.

REFERENCES

Chandramouli, A. (2023). Optimizing last-mile delivery operations: Leveraging predictive analytics, technology integration, and sustainable practices. Journal of Mathematical & Computer Applications, 2(3), 1–7. https://doi.org/10.47363/jmca/2023(2)145

Deloitte. (2023). The future of last mile: Winning the e-commerce race. Deloitte Insights. Retrieved from https://www2.deloitte.com

GS, A., & Istanti, E. (2022). The role of timeliness in improving customer satisfaction, customer loyalty of PT. JNE. International Journal of Entrepreneurship and Business Development (IJEBd), 5(2), 339–345. https://doi.org/10.29138/ijebd.v5i2.1782

Google, Temasek, & Bain & Company. (2023). e-Conomy SEA 2023: Southeast Asia's digital economy at a crossroads. Retrieved from https://economysea.withgoogle.com

Hartono, M., Kusumo, A., & Asikin, D. (2021). Affective–Cognitive–Usability (ACU) model incorporating eye-tracking analysis for redesigning the e-commerce website. In M. Ahram, W. Karwowski, & R. Taiar (Eds.), Human Interaction and Emerging Technologies (pp. 39–44). Springer. https://doi.org/10.1007/978-3-030-74614-8_5

Hermawan, A., Putra, O., Junaedi, J., Kurnia, Y., & Riki, R. (2024). Enhancing consumer-to-consumer (C2C) e-commerce through blockchain: A model-driven approach. ComTech: Computer Mathematics and Engineering Applications, 15(1), 17–27. https://doi.org/10.21512/comtech.v15i1.10638

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.2023.3252566

Komara, E., & Fathurahman, F. (2024). Factors that affect the level of customer satisfaction and repurchase intention on Tokopedia. RBM: Riset Bisnis dan Manajemen, 2(1), 1–14. https://doi.org/10.58777/rbm.v2i1.168

Lande, O., Johnson, E., Adeleke, G., Amajuoyi, C., & Simpson, B. (2024). Enhancing business intelligence in e-commerce: Utilizing advanced data integration for real-time insights. International Journal of Management & Entrepreneurship Research, 6(6), 1936–1953. https://doi.org/10.51594/ijmer.v6i6.1207

Mantri, A. (2024). Real-time data streaming and AI enhancements: E-commerce live streaming shopping. International Journal of Computing and Engineering, 5(5), 22–32. https://doi.org/10.47941/ijce.2004

Purnomo, A., & Syafrianita. (2024). Towards sustainable polio vaccine distribution: Evaluating a green metrics framework in Indonesia's pharmaceutical industry. Decision Science Letters, 13(3), 741–750. https://doi.org/10.5267/j.dsl.2024.3.005

Syafrianita, Purnomo, A., & Nasrudin, M. F. (2024). Investigasi hubungan antara advanced technology, logistics service cost, dan logistics performance di Shopee Express Bandung Raya. Land Journal, 6(1), 253–265. https://doi.org/10.47491/landjournal.v6i1.4038

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

Yan, X. (2024). The impact of e-commerce live streaming on consumer decision-making: A case study of Taobao. Future Economy, 1(9). https://doi.org/10.61173/cbwvw824