



Data-Driven Analysis of Delivery Performance and Delay Factors at NGL Logistics

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ABSTRACT

Delivery performance is a crucial factor influencing customer satisfaction and operational efficiency in the logistics industry. This study analyses delivery performance and delay factors at NGL Logistics, an international courier service provider based in Vellore, with particular emphasis on domestic and international shipments. Using a sample of 200 shipment records, the research applies percentage analysis, cross-tabulation, and the chi-square test of independence to examine delay patterns and the relationship between shipment type and delivery outcomes.

The findings show that 72% of shipments were delivered on time while 28% experienced delays. International shipments, which constitute 77.3% of total volume, accounted for a disproportionate 82% of all delays, with customs clearance (39.3%) and documentation errors (25.0%) identified as the leading causes. Despite this, the chi-square test ($\chi^2 = 1.15$, $df = 1$, $p = 0.28$) indicates no statistically significant association between shipment type and delivery delay, suggesting that operational factors — rather than shipment category alone — drive delay outcomes.

The study recommends strengthening documentation and compliance procedures, improving coordination with third-party courier partners, and adopting data-driven tracking tools to enhance delivery reliability and customer satisfaction.

Keywords: *Logistics Performance; Delivery Delay; Data Analytics; Shipment Analysis; Supply Chain Efficiency; International Shipments; Operational Efficiency; Courier Services; Data-Driven Decision Making; Transportation Management.*

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1. Introduction

The logistics and international courier industry plays a crucial role in global trade by ensuring the smooth and timely movement of goods across countries. Delivery performance is a key factor that directly influences customer satisfaction, operational efficiency, and service reliability. In a highly competitive environment, logistics companies must continuously monitor and improve their performance to meet customer expectations. NGL Logistics, based in Vellore, operates as an international courier service provider and collaborates with major partners such as UPS and DHL for global shipments. The company handles shipment collection and forwards consignments to partner couriers for international delivery, a process that highlights the importance of coordination and efficient logistics management in maintaining customer trust and service quality.

A critical component of logistics operations is accurate shipment tracking, which provides transparency and real-time updates to customers. At NGL Logistics, shipment data is initially updated by partner courier companies and subsequently transferred to the company's internal tracking system. Maintaining accurate and timely updates is essential to avoid confusion and ensure customer satisfaction. However, logistics operations often face challenges such as delivery delays and inconsistencies in tracking updates, arising from customs clearance procedures, documentation errors, transportation issues, and external factors such as weather conditions. Such challenges can negatively impact



delivery timelines and overall operational efficiency, making proper monitoring and coordination essential to minimising these issues.

In this context, analysing delivery performance through a data-driven approach becomes essential. This study evaluates delivery performance and identifies delay factors at NGL Logistics using shipment tracking data, adopting descriptive and diagnostic methodologies to understand delivery patterns and root causes of delay. The study aims to provide insights into improving operational efficiency, coordination with courier partners, and shipment tracking processes. By identifying key delay factors, the research supports better decision-making, enhances service quality, and contributes to the development of a more efficient logistics management system.

2. Problem Statement

The logistics industry operates in a highly competitive and time-sensitive environment where timely delivery is a key factor influencing customer satisfaction and business success. At NGL Logistics, maintaining consistent delivery performance has become increasingly challenging with the rising volume of shipments and continued reliance on partner courier services for international carriage. Delays have been observed across both domestic and international operations, affecting overall service efficiency, and may arise from customs clearance issues, documentation errors, and coordination gaps with third-party logistics providers.

Despite the availability of shipment data, there is a lack of structured analysis to identify the key factors contributing to delivery delays. Without proper data-driven insights, the organisation finds it difficult to take corrective action and improve operational performance, creating a gap between operational processes and performance outcomes. This study addresses that gap by systematically analysing delivery data to understand delay patterns and evaluate the factors affecting delivery performance at NGL Logistics.

3. Research Objectives and Questions

1. To analyse the delivery performance of international courier shipments handled by NGL Logistics by comparing on-time and delayed deliveries.
2. To identify the main reasons for shipment delays.
3. To study the pattern of on-time and late deliveries across domestic and international shipments.
4. To examine how shipment tracking data is updated and monitored, and its influence on delivery reliability.

4. Review of Literature

Maesazshandy and Tohir (2025) found that delivery time plays a significant role in determining customer satisfaction in cargo and logistics services, with delays negatively affecting customer trust and service perception. Pan, Huang and Xiao (2021) similarly highlighted timely delivery as one of the most important customer expectations in modern logistics systems, noting that providers must focus on reducing delays to maintain competitiveness and loyalty.

Tian, Yan and Zhou (2025) reported that logistics delivery performance directly influences consumer purchasing behaviour, with delayed deliveries reducing purchase frequency and harming the performance of e-commerce platforms and logistics providers. Müller, Burggräf and Steinberg (2025) emphasised that predicting delivery delays is essential for supply chain efficiency, showing that data analytics and machine learning can help logistics firms forecast delays and take preventive action. Upriety (2026) added that logistics performance is shaped by operational and institutional factors such as infrastructure quality, governance efficiency, and supply chain coordination.



Classic supply chain literature offers complementary insight into delay causation. Lee, Padmanabhan and Whang (1997) described the 'bullwhip effect', whereby small variations in customer demand generate larger fluctuations upstream, producing inefficiencies and delivery delays. Chen, Drezner, Ryan and Simchi-Levi (2000) showed that inaccurate demand forecasting and information distortion increase lead-time variability, while Cannella and Ciancimino (2010) found that improved information sharing among supply chain partners reduces demand variability and helps avoid delays. Cui et al. (2015) demonstrated that network disruptions — such as supplier failures or transportation breakdowns — significantly affect delivery reliability, prompting firms to rely on backup suppliers or expedited shipments.

Operational and technological perspectives are also relevant. Li et al. (2021) showed that data-driven logistics systems and optimisation algorithms improve vehicle routing and delivery scheduling, reducing transportation costs and improving efficiency. Huang and Pan (2019) identified delivery time and reliability as core indicators of logistics service quality, noting that firms must balance speed with consistency. Pai, Hebbar and Rodrigues (2015) found that delivery delays significantly affect inventory levels and operational planning, particularly where coordination between suppliers and logistics partners is weak, a finding echoed by Ladva, Shukla and Vaghela (2024) in the context of transportation inefficiencies. More recent work by Faulkner, Zhao and Li (2026) explores deep-learning approaches to delay prediction, while Bo and Xiao (2024) apply causal analysis techniques to isolate the drivers of delivery risk in supply chains.

Collectively, this literature suggests that delivery delay is a multi-causal phenomenon shaped by demand-side variability, information distortion, coordination gaps, and external regulatory or environmental conditions. It also points to an emerging consensus that structured, data-driven analysis — rather than intuition-based process management — offers the most reliable path to improving delivery performance, which forms the methodological basis for the present study.

5. Research Methodology

This study adopts a descriptive and analytical research design to examine delivery performance and delay factors in logistics operations. Descriptive statistics are used to analyse shipment data and identify patterns in on-time and delayed deliveries, while diagnostic (chi-square) analysis is used to test the association between shipment type and delivery outcome. Data is drawn from both primary and secondary sources: primary data consists of shipment tracking records maintained by NGL Logistics, while secondary data is obtained from journal articles and company documentation. Key variables recorded for each shipment include delivery status, shipment type (domestic/international), delay duration, delay cause, and the handling courier partner.

The study uses purposive sampling, selecting shipment records based on data availability and completeness. A total sample of 200 shipments processed by NGL Logistics is considered sufficient for analysing delivery patterns and delay factors at a preliminary level. Statistical tools — percentage analysis, cross-tabulation, descriptive analysis, and the chi-square test of independence — are used to interpret the data, with Microsoft Excel used for data organisation, computation, and visualisation.

Hypotheses

H₀: There is no significant association between shipment type (domestic/international) and delivery delay.

H₁: There is a significant association between shipment type (domestic/international) and delivery delay.



6. Results and Discussion

The analysis of 200 shipment records from NGL Logistics provides important insights into delivery performance and the underlying causes of delay. Overall, 72% of shipments (144 of 200) were delivered on time, while 28% (56 of 200) experienced delays — indicating that the delivery system is generally efficient but retains meaningful scope for improvement.

Table 1: Cross-Tabulation of Shipment Type and Delivery Status (N = 200)

Shipment Type	On-Time	Delayed	Total	% Delayed
Domestic	35	10	45	22.2%
International	109	46	155	29.7%
Total	144	56	200	28.0%

Table 1 shows that international shipments make up 77.3% of total volume (155 of 200) but carry a higher delay rate (29.7%) than domestic shipments (22.2%). In absolute terms, international consignments account for 82% of all delayed shipments (46 of 56), confirming that cross-border operations are disproportionately exposed to delay risk. Domestic shipments, by contrast, show more predictable delivery timelines, reflecting the comparatively lower procedural complexity of within-country transport.

Table 2: Distribution of Delay Causes (n = 56 Delayed Shipments)

Delay Cause	Frequency	Percentage
Customs clearance	22	39.3%
Documentation issues	14	25.0%
Transportation delays	11	19.6%
Partner courier delays	6	10.7%
Weather-related delays	3	5.4%
Total	56	100.0%

Customs clearance emerges as the single largest contributor to delay (39.3%), followed by documentation issues (25.0%), together accounting for close to two-thirds of all delayed shipments. Transportation-related delays (19.6%) and partner courier delays (10.7%) reflect coordination and scheduling inefficiencies, while weather-related disruption has minimal impact (5.4%). This pattern indicates that most delays are operational and procedural in origin — and therefore largely addressable through internal process improvement — rather than driven by uncontrollable external conditions.

Table 3: Delay Severity and Courier Partner Distribution

Category	Segment	Frequency	Percentage
Delay Severity (n = 56)	Minor (1–2 days)	24	42.9%
	Moderate (3–4 days)	21	37.5%
	Major (5+ days)	11	19.6%
Courier Partner (N = 200)	UPS	105	52.5%
	DHL	67	33.5%
	Other partners	28	14.0%

Regarding severity, 42.9% of delayed shipments fall within a minor delay window of 1–2 days and 37.5% within a moderate window of 3–4 days; together these account for over 80% of delayed shipments, suggesting that most disruptions are recoverable within a short period. However, 19.6% of delayed shipments extend beyond five days, a



segment disproportionately likely to affect customer satisfaction and warrant targeted intervention. On the partner side, UPS handles 52.5% of shipment volume and DHL a further 33.5%, together accounting for 86% of shipments — a concentration that makes NGL Logistics' delivery performance materially dependent on the operational reliability of two external partners.

Table 4: Chi-Square Test of Association — Shipment Type and Delivery Delay

Hypothesis	Relationship Tested	χ^2 Value	df	p-Value	Decision
H ₁	Shipment Type → Delivery Delay	1.15	1	0.28	Not Supported (Fail to Reject H ₀)

The chi-square test of independence yields $\chi^2 = 1.15$ (df = 1, critical value at $\alpha = 0.05$ is 3.84), with $p \approx 0.28$. Since the calculated value falls well below the critical threshold and $p > 0.05$, the null hypothesis (H₀) is retained: there is no statistically significant association between shipment type and delivery delay. This is a noteworthy finding — although international shipments show a numerically higher delay rate in Table 1, the difference is not strong enough, at this sample size, to be attributed to shipment type itself. It implies that operational variables such as customs procedures, documentation accuracy, and courier coordination — rather than the domestic/international classification alone — are the more critical drivers of delay, reinforcing the pattern already visible in Table 2.

Taken together, the results indicate that NGL Logistics operates a reasonably reliable delivery system, but one in which a concentrated set of procedural factors — customs clearance and documentation — drives the large majority of delay incidents, compounded by heavy reliance on two courier partners. Improving documentation processes, streamlining customs coordination, and diversifying or more closely managing courier partnerships are therefore the most direct levers available to improve delivery performance.

7. Conclusion

This study, 'Data-Driven Analysis of Delivery Performance and Delay Factors at NGL Logistics', provides a structured evaluation of delivery performance and the operational challenges affecting the company's international courier operations. The findings show that a majority of shipments (72%) are delivered on time, reflecting a reasonably efficient delivery system, while the remaining 28% highlight operational gaps that merit attention. Customs clearance and documentation emerge as the leading causes of delay, underscoring that both regulatory compliance and internal process discipline materially affect delivery timelines. Given that international shipments constitute 77.3% of total volume, the complexity of cross-border procedures has an outsized effect on overall performance, while heavy dependence on two courier partners — UPS and DHL — further concentrates operational risk.

Although the chi-square test indicates that shipment type alone does not significantly predict delay, the descriptive evidence makes clear that international operations require closer procedural attention. The study recommends that NGL Logistics invest in improved documentation systems, automation, real-time tracking, and stronger coordination with logistics partners to enhance reliability. Adopting data-driven decision-making more broadly can help the organisation anticipate delay risk, reduce errors, and improve transparency for customers. Subject to the limitations noted above, the research offers a practical foundation for NGL Logistics to strengthen its operational processes, enhance delivery performance, and build greater competitiveness in the logistics industry.



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