

Smart Logistics • Supply Chain Analysis

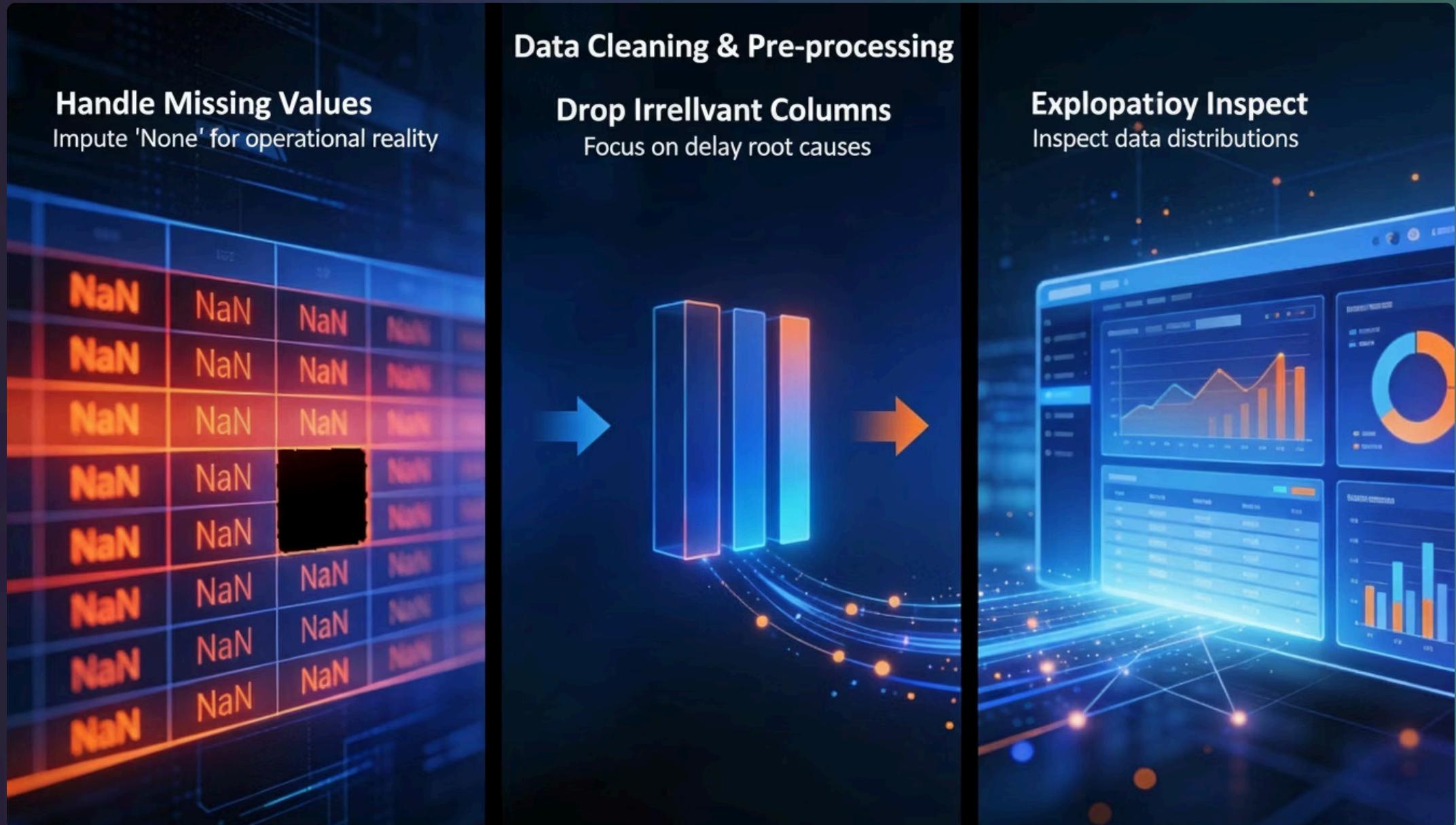
By Alexandre Andrade

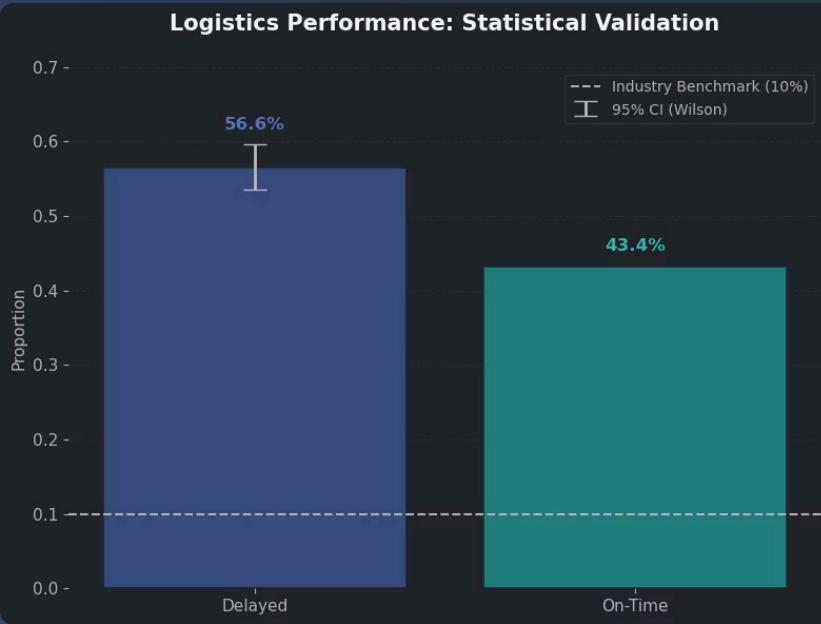
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Data Cleaning & Pre-processing

To ensure the accuracy and reliability of our analysis, we will prepare the dataset by addressing missing values, removing irrelevant features, and conducting an initial inspection of the data distributions. This structured approach allows us to refine our dataset, making it suitable for robust analytical modeling.





CRITICAL FINDING

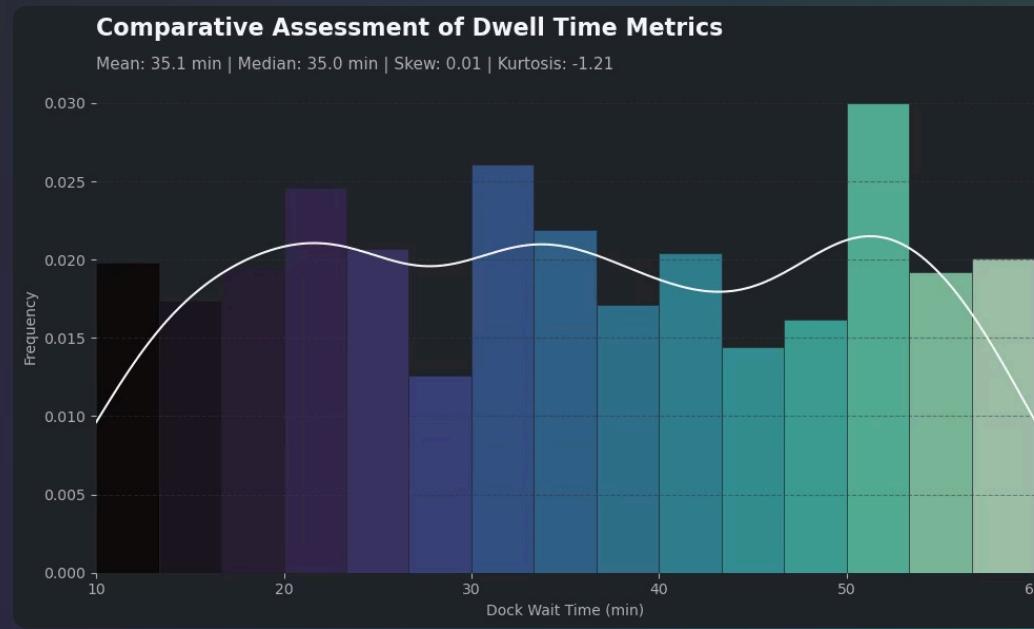
56.6% Delivery Failure Rate

Statistical Validation

Wilson 95% confidence interval confirms delay rate between 53.5-59.6%, more than 5x above the 10% industry benchmark.

Business Impact

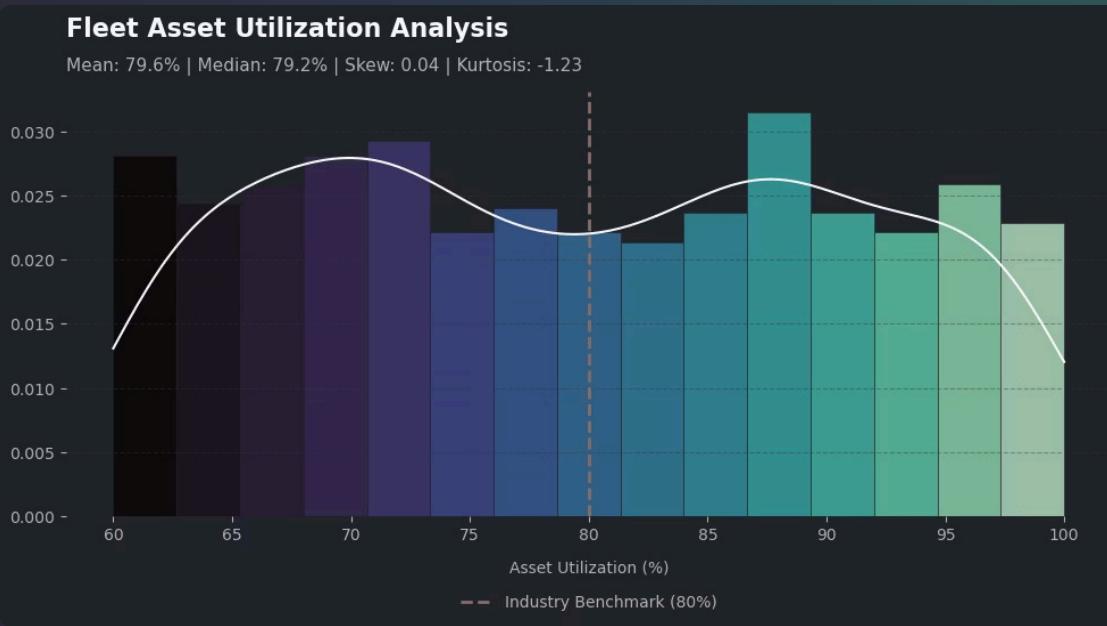
- 23% of customers won't buy again after delayed delivery
- 21% lose trust in the brand
- \$250-500 penalty per late delivery to major retailers
- 15% margin erosion from expedited shipping costs



Root Cause Analysis

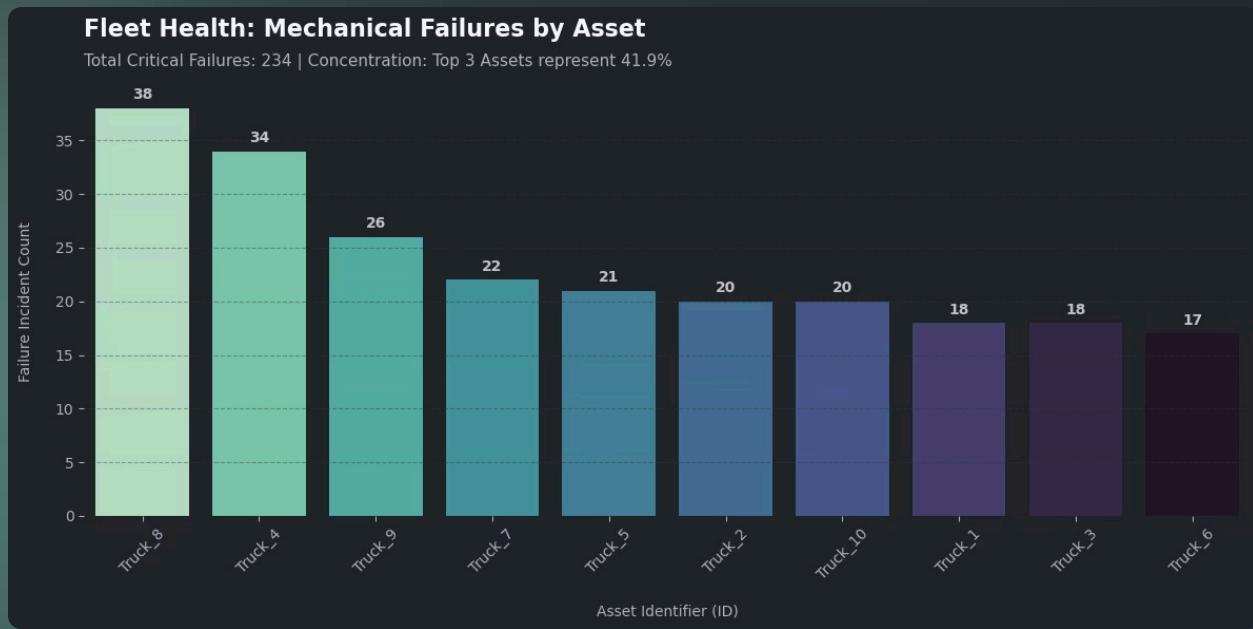
Dock Performance: Strong

Average wait time of 35 minutes—well below the 84-minute industry benchmark. Warehouse operations are not the bottleneck.



Utilization: Critical Threshold

Fleet operates at 79.6% average utilization, at or beyond the 70-80% optimal range. No buffer capacity remains.



Mechanical Reliability Crisis

234

Total Fleet Failures

Across the entire year—averaging 0.64 failures per day, or one breakdown every 37 hours.

17-38

Failures Per Truck

Even the best-performing asset fails more than once per month. Top 3 trucks account for 42% of all breakdowns.

21.9%

Industry Defect Rate

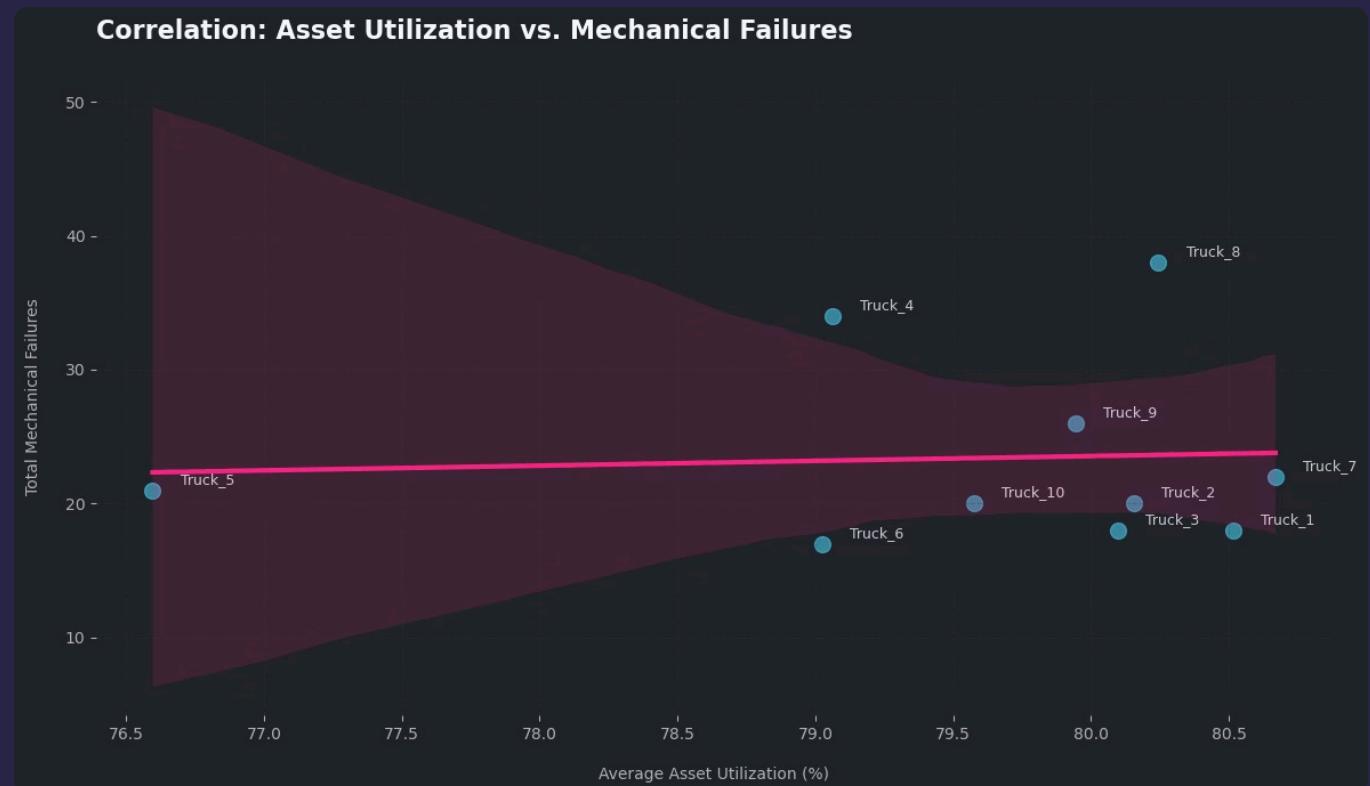
TÜV benchmark for heavy-duty trucks. Our fleet substantially exceeds this threshold across all assets.

Asset Utilization vs. Mechanical Failures

Key Finding

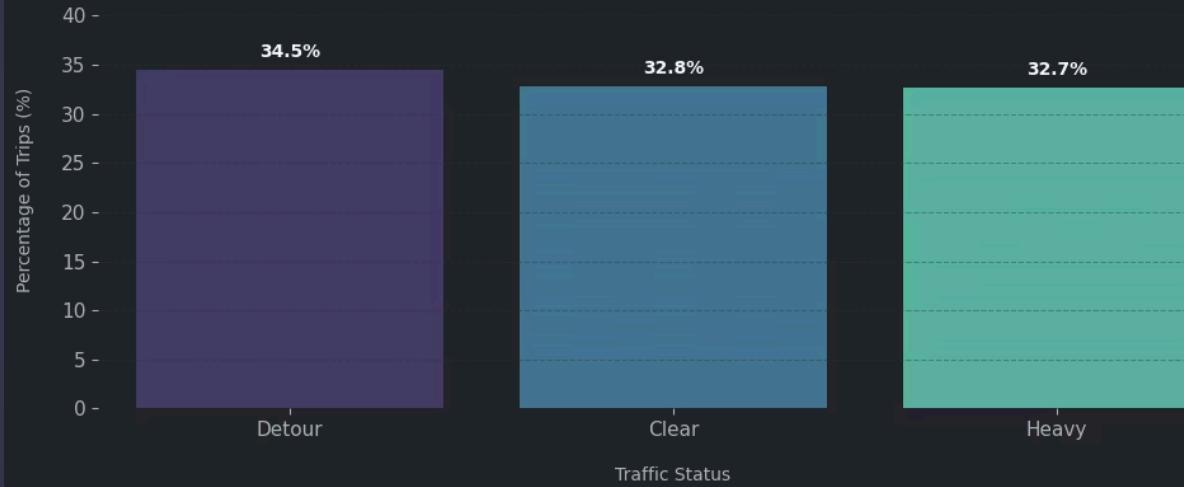
Trucks clustered between 79-81% utilization show radically different failure counts (17 to 38). Once the fleet enters high-utilization saturation, degradation becomes asset-specific rather than volume-driven.

Maintenance history and intrinsic mechanical condition become dominant failure predictors.



Impact of Traffic Conditions on Logistics Operations

Dominant Condition: Detour (34.5%) | Analysis of distribution across all logged trips

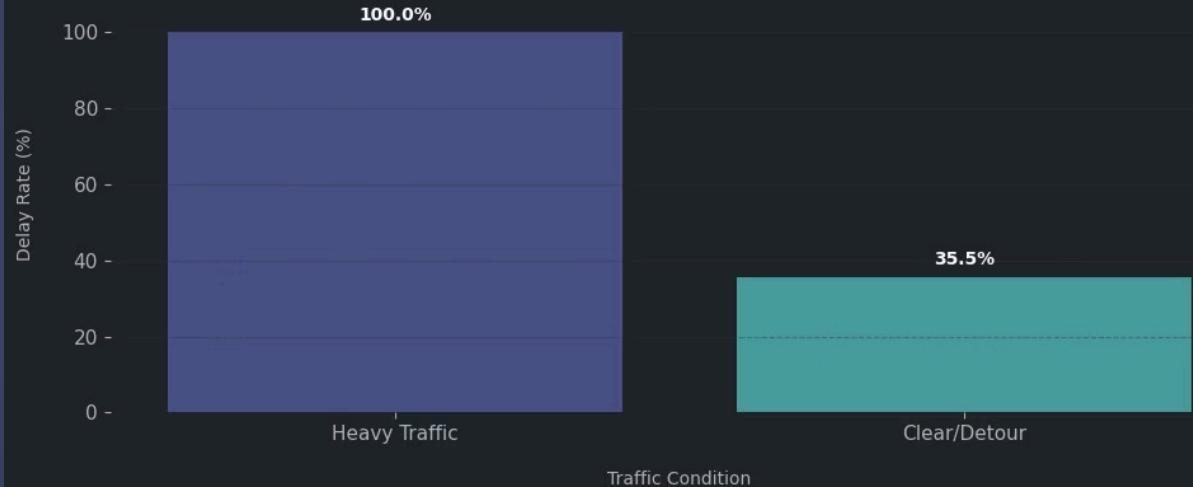


Traffic Conditions Show No Dominant Pattern

The distribution of traffic conditions across all monitored trips reveals a near-uniform split: Detour (34.5%), Clear (32.8%), and Heavy (32.7%). This indicates that no single traffic status dominates the operational landscape, and therefore, traffic alone cannot be immediately identified as the primary driver of delays.

Logistics Delay Probability: Statistical Impact of Traffic

Z-Statistic: 19.3020 | P-Value: 0.0000 | Significant Proof



Traffic Impact: A Deterministic Failure Mode Statistical Proof

Two-sample Z-test yields Z-statistic of 19.3020 with p-value of 0.0000, confirming heavy traffic is not just correlated with delays

IT guarantees them

Heavy-traffic corridors must be treated as "no-go zones" for time-sensitive deliveries.

Performance Benchmarking

1

Dock Wait Time

35.1 min vs. 84 min
benchmark

Superior
performance

2

Asset Utilization

79.6% vs. 70-80%
optimal

Critical threshold

3

Mechanical Failures

17-38/year vs. 21.9% defect rate

Systemic risk

Competitive Position

The fleet demonstrates strong dock management but operates at structural capacity limits with widespread mechanical fragility.

Waiting times are competitive, but the main bottlenecks are on the road and inside the vehicles—not at the warehouse door.

Strategic Priorities for Recovery

01

Redesign Network Routes

Map and avoid heavy-traffic corridors with 100% delay probability. Implement time-window optimization and service segmentation for critical loads.

02

Create Capacity Buffers

Lower structural utilization to 70-75% range by adding flexible capacity, rebalancing routes, and smoothing demand through delivery-slot configuration.

03

Tiered Maintenance Strategy

Immediate diagnostic of top-failure trucks, implement predictive maintenance program, and execute medium-term asset renewal plan for chronic outliers.

04

Data-Driven Governance

Track core KPIs with explicit thresholds that trigger route redesign, capacity adjustments, or maintenance actions in recurring operational reviews.

Thank You

Questions?

Alexandre Andrade | Ironhack Data Science Bootcamp | Janeiro 2026

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