Analysing Train Delays in UK National Rail

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Problem Statement

Many train rides during the period January to April 2024 experienced delays due to various reasons.

Objectives

1. To conduct analysis of train delay trends, causes and associated ticket refunds.
2. To explore and recommend optimised scheduling.
3. To recommend strategies to prevent common causes of train delays.

Data Findings

Delays were primarily caused by weather disruptions, signal faults, and staffing shortages.

They occurred most frequently on intercity routes connected to Manchester and Liverpool.

Disruptions peaked during morning and evening commuter hours, with severe delays and cancellations driving the highest number of refund requests, especially from Advance ticket holders.

Information Findings

Storm Henk (Jan) and Storm Kathleen (Apr) caused major flooding in the North West, disrupting rail lines around Manchester and Liverpool.

Rail strikes in January and February led to staff shortages and service cancellations, contributing to delays beyond the strike period.

These events explain the severe delays and high refund requests seen in affected regions, especially during commuter hours.

Knowledge Findings

AI scheduling and IoT-based maintenance help reduce peak-hour congestion and prevent technical delays (Thimmegowda, 2024; Gopalakrishnan, 2025).

Weather-integrated planning improves readiness for storms like Henk and Kathleen (Favela, 2024).

Automated refund systems speed up compensation and build trust (Network Rail, 2025), while sentiment analysis provides real-time feedback on service (Collins et al., 2013)

Performance Scorecard

This scorecard outlines the key performance indicators (KPIs) used to track delay patterns, refund behaviour, and operational hotspots. These metrics provide a data-driven foundation for monitoring service quality and guiding strategic improvements.

% of Trains Delayed Over 15 Minutes

5.82%

Average Delay Duration (Delayed Trains Only)

42.5 minutes

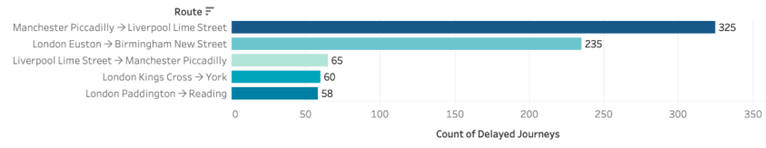
Refund Rate for Advance Tickets

27.13%

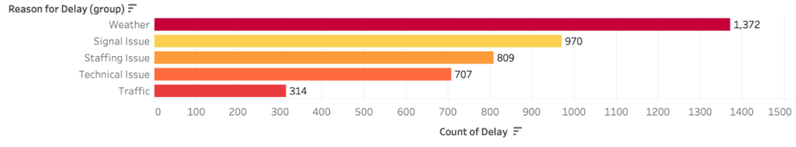
% of Short Journeys Delayed Over 15 Minutes

4.21%

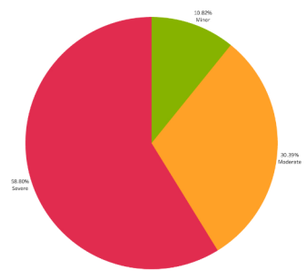
Top 5 Most Frequently Delayed Routes (>15 mins)



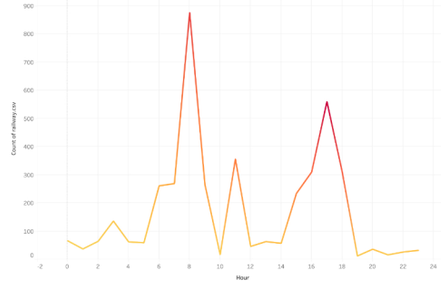
Most Frequent Delay Reason



Delay Severity Breakdown



Peak Delay Time Periods



STRATEGIC RECOMMENDATIONS

How Business Intelligence Improves Rail Services

Business Intelligence is transforming how rail operators respond to delays and service disruptions. Using data insights, operators can optimise scheduling, automate processes, and improve customer satisfaction. Below are the key strategies informed by this analysis.

INFRASTRUCTURE & MAINTENANCE

Upgrade Signal Infrastructure and Preventative Maintenance
Prioritise improvements and regular inspections on routes frequently impacted by signal faults.

Restructure Short Journey Timetables
Optimise short routes with frequent delays to reduce turnaround pressure and improve flow.

STAFFING & RESOURCE MANAGEMENT

Introduce Staffing Contingency Protocols
Deploy flexible staffing models to respond to shortages during strikes or peak hours, particularly at key stations.

AI & AUTOMATION

Deploy AI-Based Delay Prediction for Peak Hours
Use historical delay patterns and real-time data to forecast congestion and dynamically adjust scheduling.

Implement Predictive Weather-Responsive Scheduling
Integrate weather forecasting tools to proactively adjust operations during storm conditions.

Automate Advance Ticket Refund Processing
Trigger compensation automatically when delay thresholds are met, reducing administrative overhead.

CUSTOMER EXPERIENCE & COMPENSATION

Streamline Refund Policies and Processes
Improve transparency and fairness in compensation, particularly for Advance ticket holders impacted by severe delays.

BI MONITORING & OPERATIONAL INSIGHTS

Consolidate Delay Reason Monitoring in BI Dashboards
Integrate grouped delay reasons and severity levels into centralised dashboards for real-time operational awareness and executive decision-making.