

Delivery Visibility Dashboard – Project Report

1. Problem Statement & Business Impact

In modern supply chains, a major pain point is the lack of **real-time delivery visibility**. Companies often struggle to monitor order statuses, identify delivery delays, and understand product-level performance. This opacity leads to poor decision-making, customer dissatisfaction, and loss of revenue.

Our goal is to build an **interactive dashboard** that gives stakeholders clear visibility into the delivery pipeline. This enables faster anomaly detection, trend forecasting, and proactive supply chain management.

Business Impact:

- Improved **delivery performance tracking**.
 - Quick identification of **problematic orders or products**.
 - Data-driven decision-making for **inventory, procurement, and logistics teams**.
 - Enhanced **customer satisfaction** through timely order fulfillment.
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2. Data Structure & Design

Dataset Overview

We use a structured CSV dataset (`sample_orders_dataset.csv`) that contains the following key columns:

Column	Description
Date	Order/delivery date
Product	Name of the product
Status	Current delivery status (Delivered, Delayed, Pending)

Design Choices

- Dates are converted to `datetime` format and truncated into a new column `OnlyDate` to aid **trend visualization** and **aggregation**.
- Product and Status strings are normalized (title-case and stripped) to ensure **clean and consistent filtering**.
- All filters (Product, Status, Date Range) are dynamically controlled via **Streamlit sidebar inputs** for flexible querying.

This structure supports efficient **group-by operations**, **time-series modeling**, and **visual segmentation** by category.

3. Dashboard Features & Methodology

User Interface (UI)

Built with **Streamlit**, the UI is divided into four tabs:

1. **Overview**: Summary KPIs and three visualizations (bar, line, pie).
2. **Forecasting**: Predictive visualization using 3-day moving average for Delivered orders.

3. **Anomalies:** Outlier detection using z-score methodology on Delayed orders.
4. **Raw Data:** Clean, filterable data table of orders.

Features Breakdown

- **Sidebar Filters:** Enable users to slice data by date, product, and delivery status.
 - **KPI Metrics:** Highlight real-time counts of Total, Delivered, Delayed, and Pending orders.
 - **Bar Chart:** Order frequency by product.
 - **Line Chart:** Trend of delivery statuses over time.
 - **Pie Chart:** Proportional view of delivery status distribution.
 - **Forecasting Plot:** Shows actual vs. smoothed delivery counts (using a 3-day Moving Average).
 - **Anomaly Detection:** Highlights abnormal delivery delays using a z-score cutoff > 2 standard deviations.
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4. Machine Learning Techniques Used

Forecasting

We use a **3-Day Moving Average** to smooth fluctuations and forecast short-term delivery trends. Though simple, this technique is effective for highlighting **demand seasonality or dips**.

Anomaly Detection

Anomaly detection is done by calculating the **z-score** for daily delayed orders:

- Orders with z-score $> |2|$ are flagged as outliers.
 - This helps in **identifying spikes** in delays that could point to process or vendor issues.
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5. Key Insights

The dashboard enables the following **business insights**:

- **Volume Distribution:** Bar charts help identify high-volume products needing tighter delivery SLAs.
- **Delay Trends:** Spike in delays across specific dates may correspond to vendor disruptions or weather issues.
- **Forecasting Readiness:** Teams can prepare for future delivery loads by examining smoothed trends.
- **Outlier Spotting:** Anomalies flagged highlight operational breakdowns and help in **root cause analysis**.

By enabling such real-time insights, the dashboard ensures **transparency, accountability, and data-driven logistics planning**.

How the Delivery Visibility Dashboard Addresses SCM Inefficiencies

1. SCM Gaps & Inefficiencies

In many supply chain systems, the following issues are common:

- **Lack of Real-Time Delivery Visibility:** Stakeholders are unaware of where delays occur or why they happen.
- **No Proactive Anomaly Alerts:** Organizations often react to issues after customer complaints.
- **Siloed Product-Level Insights:** Teams can't easily identify which products or suppliers are consistently late.
- **Manual Reporting:** Weekly or monthly reporting requires effort and lacks interactivity.

2. How This Solution Addresses These Gaps

✓ Real-Time Delivery Monitoring

- The dashboard provides **live filtering by date, product, and delivery status**, allowing users to get real-time snapshots of delivery performance.

✓ Automated Anomaly Detection

- The use of **z-score-based outlier detection** flags unusual spikes in delays, helping teams respond **before customer impact**.

✓ Trend Forecasting

- The **3-day moving average forecast** allows planners to **anticipate delivery volume**, aiding in manpower and inventory planning.

✓ Actionable KPIs & Visuals

- **Product-wise order volume, delivery status pie chart**, and **trend lines** give instant visual insight.
- Enables users to drill down by status or time to find root causes.

✓ Clean & Customizable Interface

- Users can explore delays and deliveries via **intuitive UI components** like tabs, expanders, and filters—no technical background needed.

3. Methodology Summary

Step	Description
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Data Preprocessing	<ul style="list-style-type: none">- Normalized Product and Status columns- Parsed Date into datetime and extracted OnlyDate for trend analysis
Filtering	<ul style="list-style-type: none">- Enabled filtering on Product, Status, and Date Range via Streamlit sidebar
Forecasting	<ul style="list-style-type: none">- Applied 3-day moving average to smooth short-term delivery volume trends
Anomaly Detection	<ul style="list-style-type: none">- Calculated z-scores for delayed order counts to flag outlier days
Visualization	<ul style="list-style-type: none">- Used Plotly for line, bar, pie, and scatter charts to visualize key metrics interactively

4. Assumptions

- The data is assumed to be accurate and cleaned (minor string inconsistencies are handled via `.str.strip().str.title()`).
 - **Date** represents either **order creation** or **delivery attempt** (contextual to dataset).
 - Anomalies are defined as **z-score > 2**, which assumes **normal distribution of delays**.
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5. Results

- The dashboard helped **visually identify** the most delayed products and peak delay dates.
 - Forecasting allowed users to see **expected delivery volumes**, useful for **capacity planning**.
 - Anomalies pointed to **4–5 days** with outlier delays, prompting deeper root cause analysis.
 - **Managers and logistics teams** now have a single-pane view for monitoring and reacting to delivery trends.
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