AI-Agentic Supply Chain Analytics

Improving Reliability & Fulfillment Visibility at Atliq Mart

Contents

Executive Summary

This project presents the design, implementation, and validation of an AI-agentic supply chain analytics system for Atliq Mart, an organic food manufacturer operating across India and the United States.

Following geographic expansion into the U.S. market, Atliq Mart experienced declining fulfillment reliability, increased customer dissatisfaction, and limited analytical visibility into supply chain performance. Existing reporting processes—largely dependent on Excel files and manually processed CSVs received via email—proved inadequate for diagnosing operational issues at scale or supporting timely decision-making.

To address these challenges, an end-to-end analytics solution was designed using agentic automation (n8n), cloud-native data storage and modeling (PostgreSQL on Supabase), and AI-assisted analytics (Quadratic AI). The system automated data ingestion, standardized operational data across regions, and enabled rapid, prompt-driven business analysis—while explicitly retaining human-in-the-loop validation for business-critical metrics such as On-Time In-Full (OTIF).

1. Client Context

Atliq Mart is a Gujarat-based organic food manufacturer supplying packaged organic products to large supermarket chains. After establishing a strong domestic presence in India, the company expanded operations into the United States to capitalize on growing demand for organic food products.

While sales volumes increased post-expansion, the supply chain infrastructure did not mature at the same pace. Operational inefficiencies surfaced in order fulfillment, delivery reliability, and inventory planning. These issues were particularly visible in the U.S. market, where customers operate under strict Service Level Agreements (SLAs) and expect consistently high fulfillment standards.

The Chief Operating Officer identified unreliable order management, lack of fulfillment visibility, and delayed decision-making as strategic risks threatening customer retention and commercial negotiations.

2. Business Problem

The client faced four interrelated supply chain challenges that collectively constrained performance and scalability.

2.1 Customer Dissatisfaction

Supermarket customers reported:

- Late deliveries
- Partial order fulfilment
- Inconsistent service reliability

Even isolated fulfilment failures had a disproportionate impact due to SLA penalties and reputational risk, threatening long-term customer relationships.

2.2 Lack of Inventory & Fulfillment Visibility

The organization lacked reliable, standardized metrics to answer fundamental operational questions:

- Are orders being delivered on time?
- Are orders being delivered in full?
- Which customers, products, or regions are driving failures?

Key KPIs such as **On-Time Delivery**, **In-Full Delivery**, and **OTIF** were either unavailable or inconsistently calculated, preventing leadership from diagnosing whether failures stemmed from inventory shortages, planning gaps, or logistics execution issues.

2.3 Fragmented Data Landscape

Operational data arrived daily via email as CSV attachments and was fragmented across:

- Geography (India vs USA)
- Granularity (order-level vs order-line data)
- Format (inconsistent schemas and date representations)

Processing was manual, error-prone, and non-scalable, making analytical accuracy dependent on individual effort rather than system design.

2.4 Need for Modern, Scalable Analytics

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3. Project Objectives

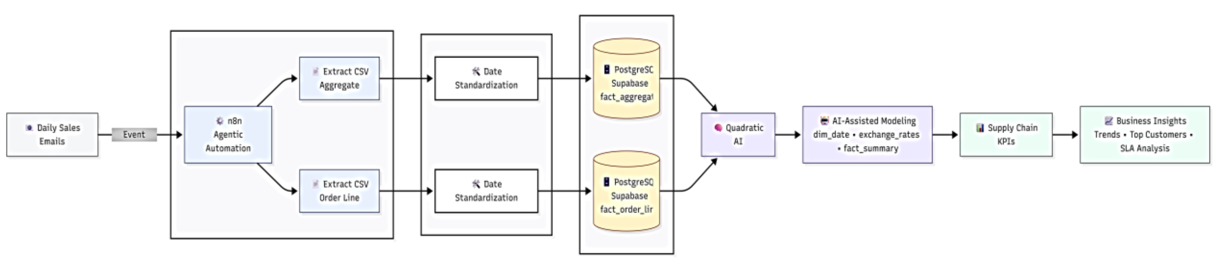
The project aimed to design and implement an **AI-agentic supply chain analytics system** that would:

- Automate ingestion of daily sales data received via email
- Centralize India and USA operations into a unified analytical environment
- Compute industry-correct supply chain KPIs
- Enable fast, prompt-driven business analysis using AI
- Improve fulfilment reliability before further geographic expansion

4. End-to-End Architecture Overview

A modern, layered analytics architecture was designed with explicit separation of responsibilities:

- **Agentic Automation Layer** – n8n (local deployment)
- **Data Storage & Modelling Layer** – PostgreSQL (Supabase)
- **Analytics & AI Layer** – Quadratic AI
- **Validation Layer** – Human-in-the-loop review



5. Data Ingestion & Agentic Automation (n8n)

An event-driven automation workflow was implemented using **n8n (local deployment)** to eliminate manual data handling.

Key Automation Steps

- Monitor Gmail inbox for emails with subject **“daily sales”**
- Automatically download CSV attachments
- Separate:
    - Aggregate order data
    - Order-line level data
- Standardize inconsistent date formats using **Luxon**
- Ingest cleaned data into PostgreSQL tables hosted on Supabase

This automation reduced ingestion latency, minimized human error, and created a repeatable operational pipeline.

6. Data Modeling & Storage (PostgreSQL on Supabase)

A centralized PostgreSQL database served as the **single source of truth** for analytics.

Key Design Principles

- Clear separation of **fact** and **dimension** tables
- Preservation of correct data grain:

- Order-level (fact_aggregate)
- Line-level (fact_order_line)

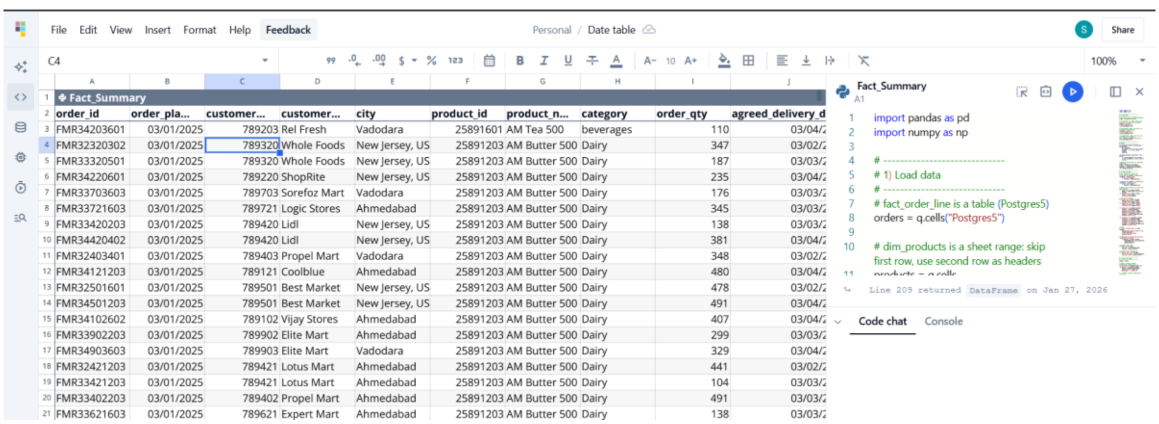
- Region-agnostic schema supporting both India and USA operations

This modelling approach ensured accurate KPI computation, prevented double counting, and enabled scalable multi-region analysis.

7. AI-Assisted Analytics (Quadratic AI)

Quadratic AI was used as the analytics and exploration layer, connected directly to PostgreSQL.Using **natural language prompts**, Quadratic AI was leveraged to:

- Generate a **date dimension table**
- Create a **historical exchange rate table** using the OpenExchangeRates API
- Build a denormalized **fact_summary** table for exploration
- Compute supply chain KPIs
- Generate charts and analytical tables on demand

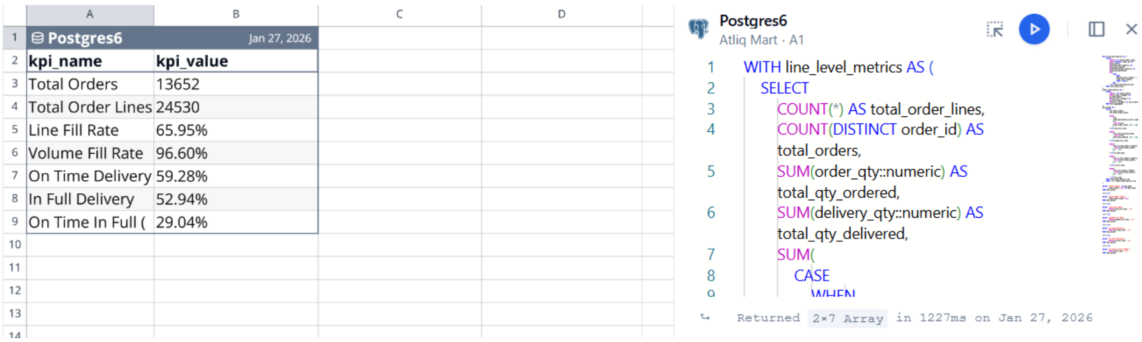


order_id	order_pla...	customer...	customer...	city	product_id	product_n...	category	order_qty	agreed_delivery_d
FMR34203601	03/01/2025	789203	Rel Fresh	Vadodara	25891601	AM Tea 500	beverages	110	03/04/2
FMR32320302	03/01/2025	789320	Whole Foods	New Jersey, US	25891203	AM Butter 500	Dairy	347	03/02/2
FMR33320501	03/01/2025	789320	Whole Foods	New Jersey, US	25891203	AM Butter 500	Dairy	187	03/03/2
FMR34220601	03/01/2025	789220	ShopRite	New Jersey, US	25891203	AM Butter 500	Dairy	235	03/04/2
FMR33703603	03/01/2025	789703	Sorefoz Mart	Vadodara	25891203	AM Butter 500	Dairy	176	03/03/2
FMR33721603	03/01/2025	789721	Logic Stores	Ahmedabad	25891203	AM Butter 500	Dairy	345	03/03/2
FMR33420203	03/01/2025	789420	Lidl	New Jersey, US	25891203	AM Butter 500	Dairy	138	03/03/2
FMR34420402	03/01/2025	789420	Lidl	New Jersey, US	25891203	AM Butter 500	Dairy	381	03/04/2
FMR32403401	03/01/2025	789403	Propel Mart	Vadodara	25891203	AM Butter 500	Dairy	348	03/02/2
FMR34121203	03/01/2025	789121	Coolblue	Ahmedabad	25891203	AM Butter 500	Dairy	480	03/04/2
FMR32501601	03/01/2025	789501	Best Market	New Jersey, US	25891203	AM Butter 500	Dairy	478	03/02/2
FMR34501203	03/01/2025	789501	Best Market	New Jersey, US	25891203	AM Butter 500	Dairy	491	03/04/2
FMR34102602	03/01/2025	789102	Vijay Stores	Ahmedabad	25891203	AM Butter 500	Dairy	407	03/04/2
FMR33902203	03/01/2025	789902	Elite Mart	Ahmedabad	25891203	AM Butter 500	Dairy	299	03/03/2
FMR34903603	03/01/2025	789903	Elite Mart	Vadodara	25891203	AM Butter 500	Dairy	329	03/04/2
FMR32421203	03/01/2025	789421	Lotus Mart	Ahmedabad	25891203	AM Butter 500	Dairy	441	03/02/2
FMR33421203	03/01/2025	789421	Lotus Mart	Ahmedabad	25891203	AM Butter 500	Dairy	104	03/03/2
FMR33402203	03/01/2025	789402	Propel Mart	Ahmedabad	25891203	AM Butter 500	Dairy	491	03/03/2
FMR33621603	03/01/2025	789621	Expert Mart	Ahmedabad	25891203	AM Butter 500	Dairy	138	03/03/2

Table: fact_summary

8. KPI Framework & Logic

A robust KPI framework was established using industry-standard supply chain definitions and strict grain control.



Postgres6 Jan 27, 2026

kpi_name	kpi_value
Total Orders	13652
Total Order Lines	24530
Line Fill Rate	65.95%
Volume Fill Rate	96.60%
On Time Delivery	59.28%
In Full Delivery	52.94%
On Time In Full (	29.04%

Postgres6
Atliq Mart · A1

```
WITH line_level_metrics AS (
  SELECT
    COUNT(*) AS total_order_lines,
    COUNT(DISTINCT order_id) AS
    total_orders,
    SUM(order_qty::numeric) AS
    total_qty_ordered,
    SUM(delivery_qty::numeric) AS
    total_qty_delivered,
    SUM(
      CASE
```

Returned 2×7 Array in 1227ms on Jan 27, 2026

8.1 Total Orders

Definition: Count of unique customer orders.
Formula: Count(DISTINCT Order_ID).
Grain: Order level.

8.2 Total Order Lines

Definition: Count of individual line items.
Formula: Count(rows in order-line table).
Grain: Line level.

8.3 Line Fill Rate (LFR)

Definition: Percentage of order lines delivered in full.
Formula: (Lines Delivered in Full ÷ Total Order Lines).
Grain: Line level.

8.4 Volume Fill Rate (VFR)

Definition: Percentage of total ordered quantity delivered.
Formula: (Total Delivered Quantity ÷ Total Ordered Quantity).
Grain: Quantity level.

8.5 On-Time Delivery (OT)

Definition: Orders delivered on the agreed delivery date.
Formula: (On-Time Orders ÷ Total Orders).
Grain: Order level.

8.6 In-Full Delivery (IF)

Definition: Orders delivered with 100% quantity across all lines.
Logic: Any shortfall in any line fails the order.
Formula: (In-Full Orders ÷ Total Orders).
Grain: Order level.

8.7 On-Time In-Full (OTIF)

Definition: Orders delivered both On-Time and In-Full.
Formula: (Orders OT AND IF ÷ Total Orders).
Grain: Order level.

9. Business Insights Generated

9.1 Monthly On-Time Performance by City

Monthly On-Time Delivery Performance by City (Line Chart)

Revealed regional performance variation, emerging reliability trends, and early warning signals for intervention.

9.2 Top Customers by Order Value & Reliability

Customer...	Customer...	City	Total Ord...	OTIF %	IF %	OT %
789320	Whole Foods	New Jersey, US	48,799,930	36.5	58.4	70.4
789301	Foodtown	New Jersey, US	48,682,351	30.8	56.6	68.6
789420	Lidl	New Jersey, US	48,450,607	22	68.3	28.7
789401	Wegmans	New Jersey, US	47,694,192	35.7	54.9	72
789101	Costco Wholes	New Jersey, US	47,370,701	35.5	56	71.2

Top 5 Customers – OTIF, IF %, OT % Table

Enabled customer prioritization, SLA discussions, and targeted corrective actions.

10. Human-in-the-Loop Validation

AI outputs were **not blindly trusted**.
All results were reviewed for:

- KPI definition correctness
- Proper data grain usage
- Business-safe interpretation

This prevented silent analytical errors and ensured long-term trust.

11. Impact

The solution:

- Eliminated manual CSV handling
- Improved visibility into fulfilment failures
- Accelerated decision-making
- Established a scalable analytics foundation

Leadership shifted from reactive explanations to **data-driven root-cause analysis**.

12. Key Learnings & Takeaway

AI is a force multiplier — not a replacement for analytical thinking.

When combined with domain expertise, disciplined modelling, and validation, AI-agentic systems significantly improve supply chain reliability.

Appendix

Appendix A: Date Standardization Logic

Luxon was used within n8n to normalize inconsistent date formats into ISO format prior to database insertion.

Appendix B: KPI Grain & Validation Strategy

Order-level and line-level KPIs were computed separately to avoid aggregation errors and ensure business correctness.

Appendix C: SQL Validation

Final KPIs were cross-validated using SQL Common Table Expressions to verify AI-generated outputs.

Appendix D: AI Prompt Governance

AI prompts were explicitly structured and all outputs manually reviewed.

Appendix E: Limitations & Future Enhancements

Limitations include partial US automation and retrospective analysis. Future enhancements include predictive OTIF modeling, SLA alerts, and inventory optimization.