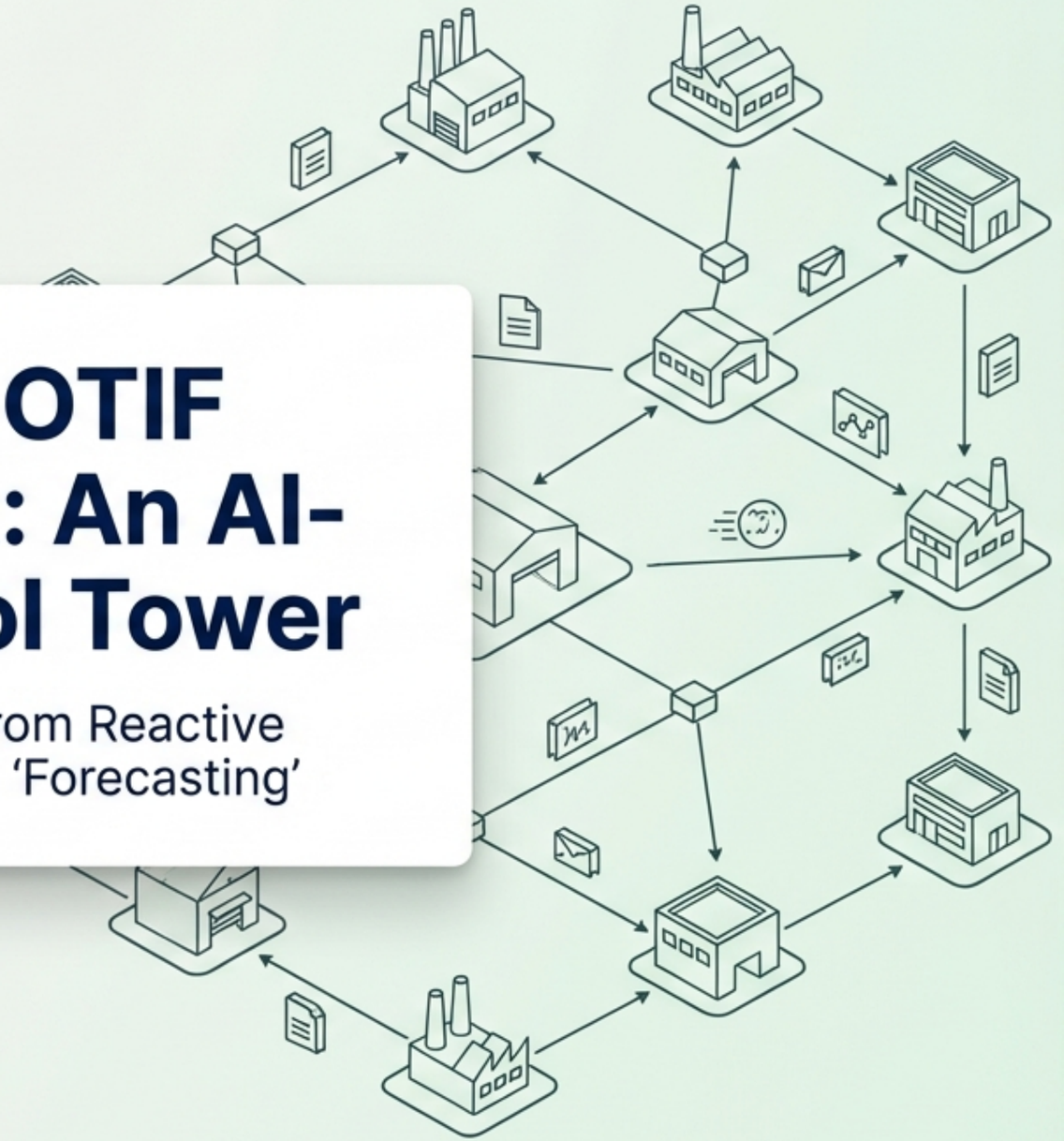
Predictive OTIF Management: An AI-Driven Control Tower

Moving Supply Chains from Reactive ‘Firefighting’ to Proactive ‘Forecasting’



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Executive Summary: The Strategic Value of Intelligence

The Shift

Moving from manual spreadsheet analysis to a unified Digital Twin.

The Method

A composite 3-model approach (Transformers, XGBoost, Linear Programming) to predict and prevent failures.

The Impact

98%

Target OTIF Score

-20%

Penalty Cost Reduction

The Challenge: Hidden Upstream Killers

Delivery failures are rarely a last-mile problem; they are symptoms of upstream invisibility.

Reactive Operations

Organizations operate in “firefighting mode,” discovering delivery failures only after the truck has arrived late.

Result: High Penalties.

Inventory Imbalance

Stock sits in the wrong warehouses due to static, historical-average planning. Misalignment causes downstream stockouts.

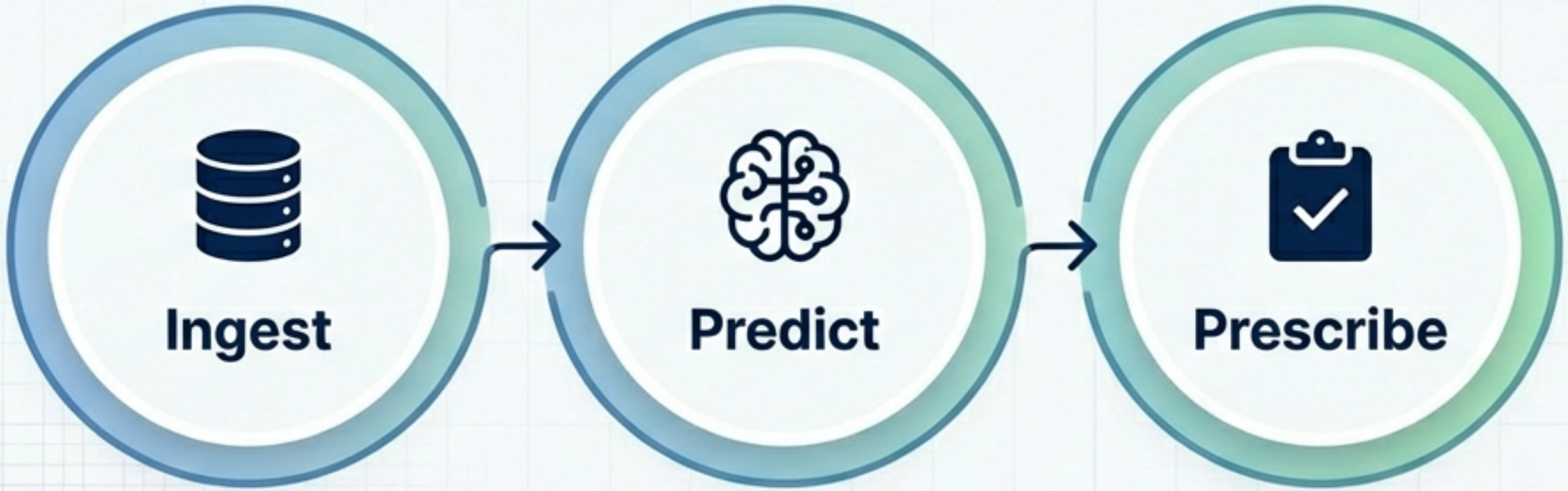
Result: Stockouts.

OTIF Failure

The Vision: Transforming the Operating Model

Dimension	Current State (Reactive)	Future State (Predictive)
Planning	Monthly Static Plans	Real-time Dynamic Planning
Visibility	Siloed (Logistics vs. Warehouse)	Unified “Digital Twin” Network
Trigger	Customer Complaint	AI Risk Alert (>80% Probability)
Resolution	Manual Firefighting	Automated Rebalancing

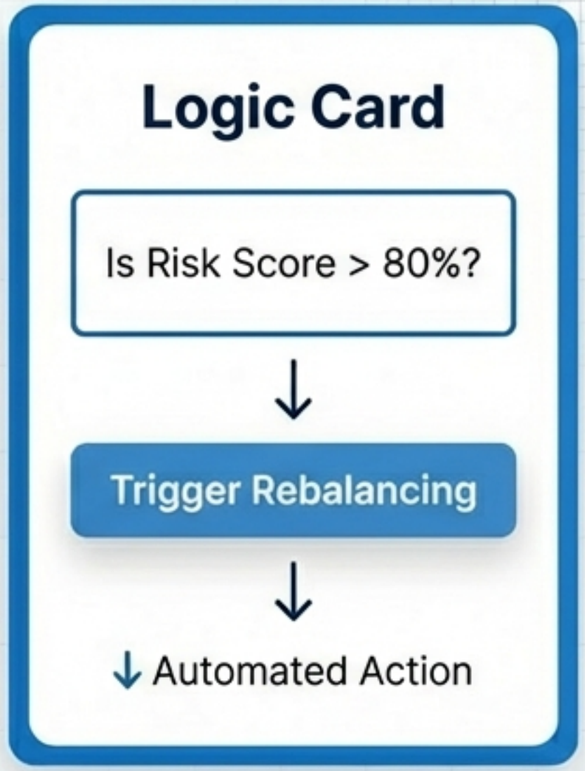
The Solution: AI-Driven Control Tower



Real-time data from ERP, WMS, and TMS.

Identify risks weeks in advance.

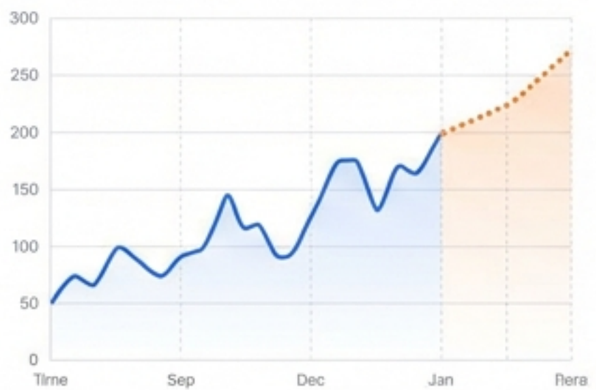
Recommend stock transfers.



The Engine: A Composite 3-Model Approach

Demand Forecasting

Transformers



Predicts granular SKU-level demand per location.

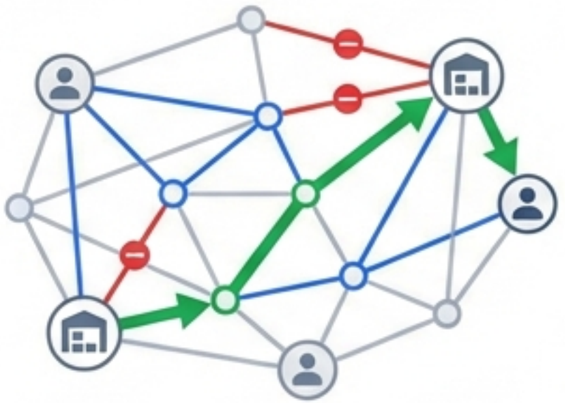
Risk Classifier

XGBoost / Random Forest

Assigns "Failure Probability Score" to every open order.

Network Solver

Linear Programming



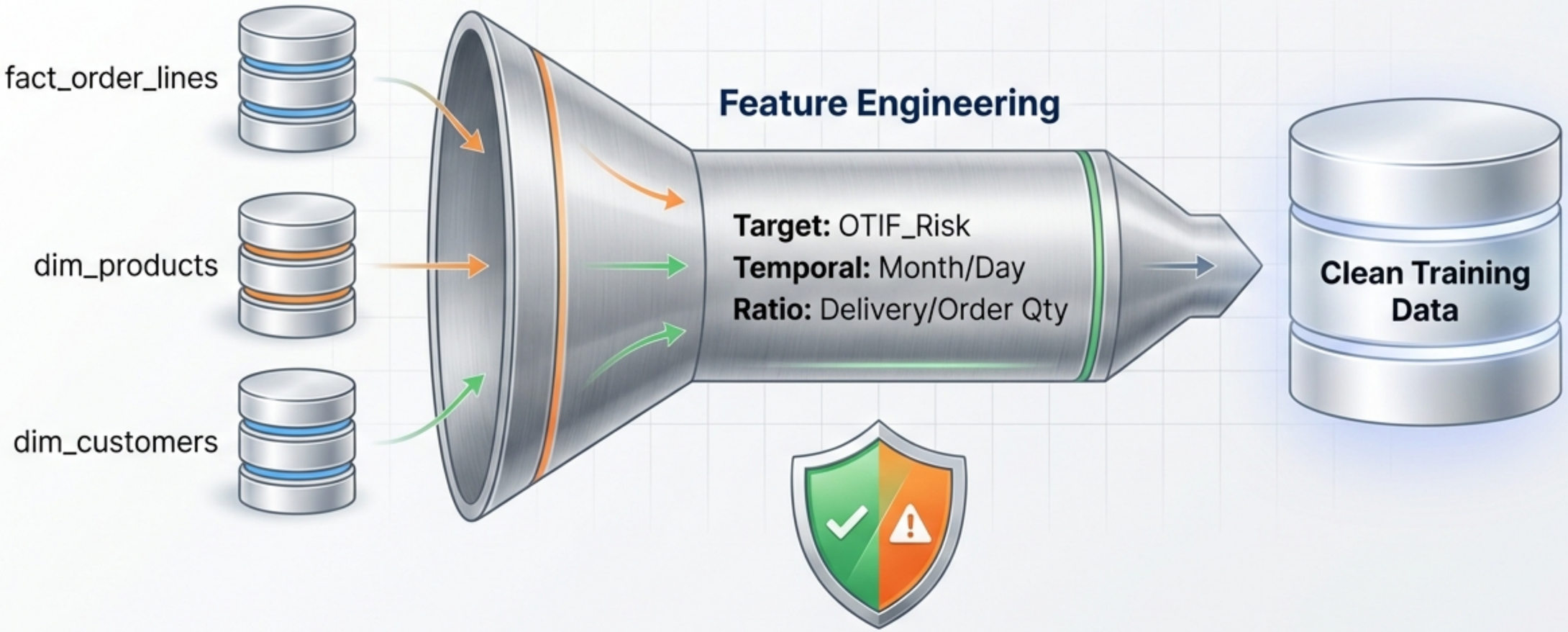
Calculates optimal corrective action balancing cost vs. speed.

Methodology: The CRISP-DM Framework

Key Stakeholders:
Ops Managers & Planners.

Success Metric:
>80% Accuracy.

Data Engineering & Governance Foundations



Automated Validation Rules: Range Checks & Format Checks
to prevent Garbage In, Garbage Out.

Model Selection Strategy: Classification vs. Regression

Regression Approach

Predicts exact delay (e.g., 48 hours).

Good for estimation, but lacks a clear trigger.

Classification Approach

Predicts Binary Risk (Alert / No Alert).

Selected because operations need a clear trigger for automated workflows.

Contenders Evaluated: Logistic Regression vs. Random Forest Classifier.

Model Evaluation: The Cost of a Missed Signal

Comparing Confusion Matrices on Test Data

Logistic Regression

TP 6104	FP 176
FN 2043 ⚠	TN 3097

High Precision, but missed 2,043 risks.

Random Forest (Selected)

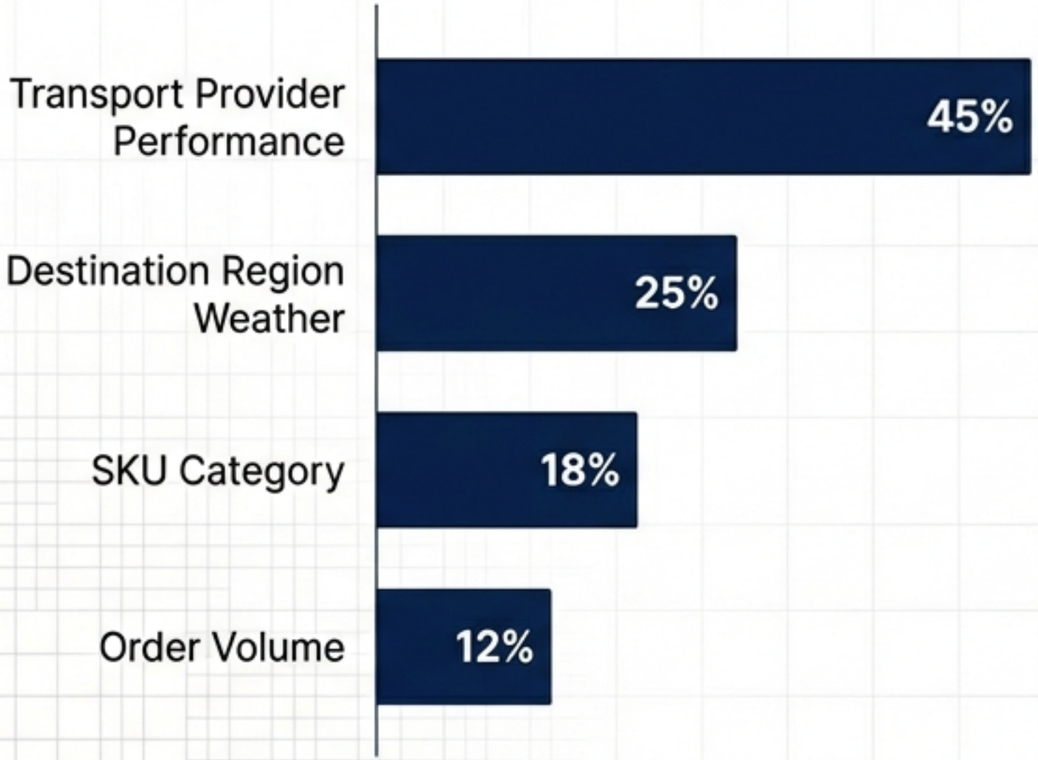
TP 6745	FP 954
FN 1402 ✓	TN 2319

Superior Recall. Reduced missed risks by ~30%.

We selected Random Forest because in supply chain, a missed risk (False Negative) costs significantly more than a false alarm.

Explainability & Feature Importance

Top Risk Drivers



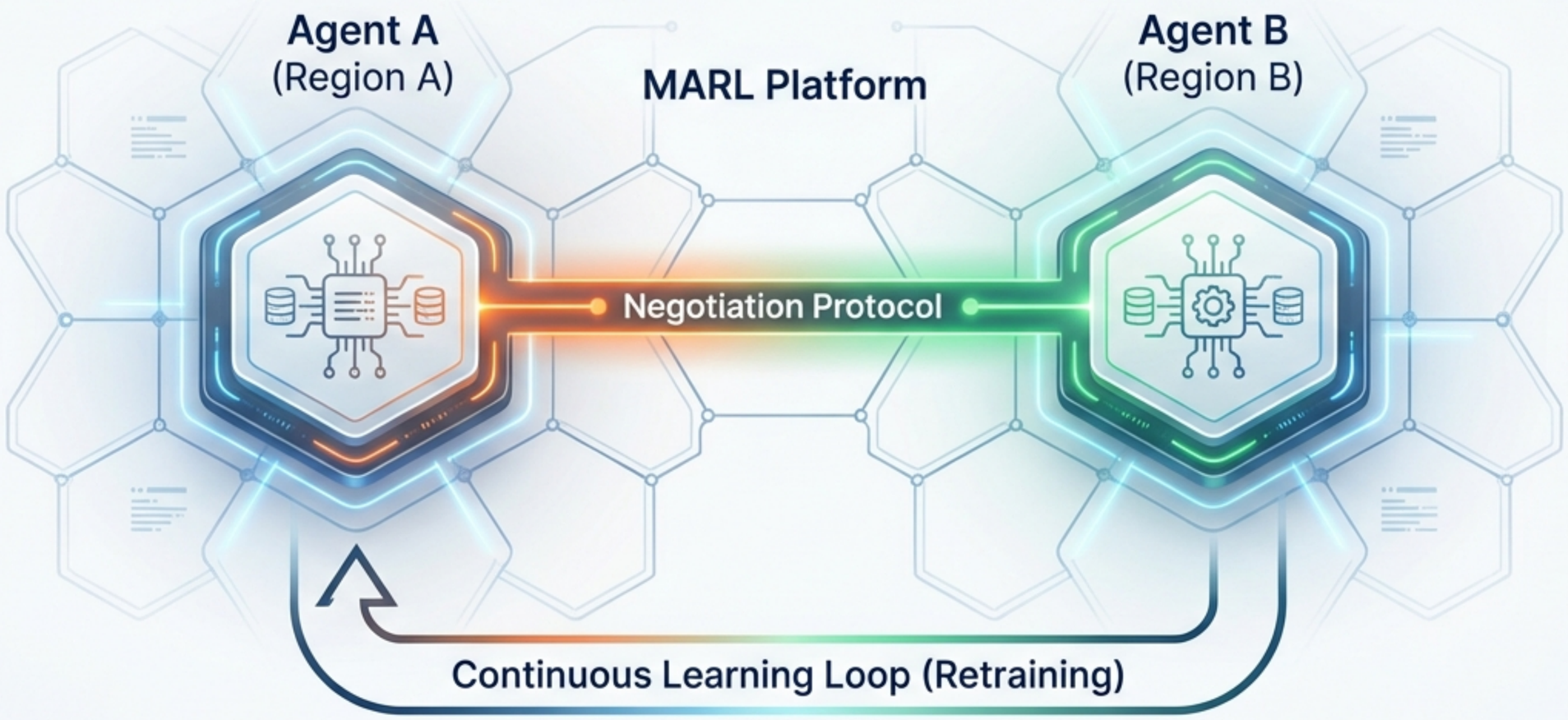
Order #1024 - High Risk (92%) ⚠

Why?

Primary Driver: Carrier Reliability in Southeast Region.

XAI (Explainable AI) ensures human trust in the loop.

Future State Architecture: Autonomous Orchestration



Moving from centralized prediction to decentralized multi-agent negotiation

Implementation Roadmap

Phase 1: Foundation
(Months 1-3)

Data Ingestion, Cleaning, and Graph DB Setup. Establishing visibility.

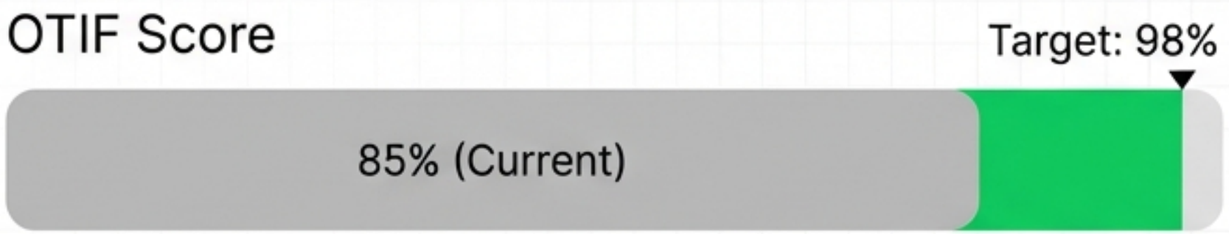
Phase 2: Intelligence
(Months 4-6)

Model training (Random Forest) and Pilot Program in one region.

Phase 3: Autonomy
(Months 7-9)

Network Solver deployment and ERP integration for automated execution.

Projected Business Impact & ROI



ROI Drivers

- **Revenue Protection:** Preventing lost sales due to stockouts.
- **Cost Avoidance**: Reducing vendor chargebacks.
- **Efficiency**: Automating manual coordination.

Path to Value: Next Steps

1. Finalize API access to ERP/WMS for historical data ingestion.
2. Assign Data Stewards for Phase 1 Governance.
3. Select ‘frozen food’ category for Phase 2 Pilot.

Thank You

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