AI – Powered Supply Chain Resilience Index (SCRI)

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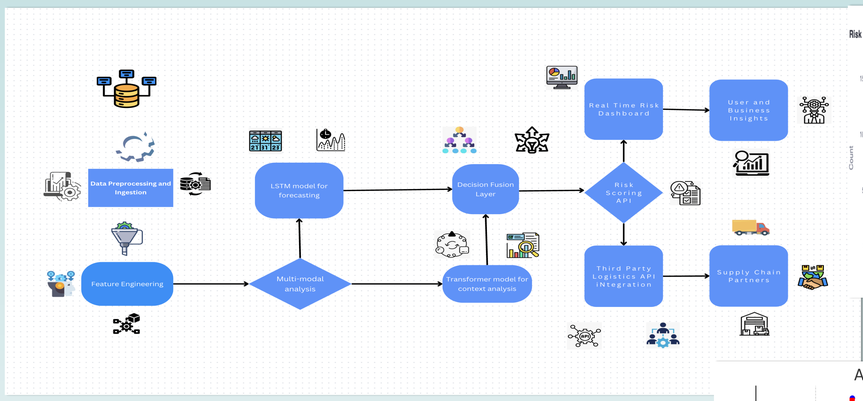
Introduction

Our project enhances risk prediction and decision-making by leveraging machine learning, deep learning, and real-time analysis to anticipate and mitigate supply chain disruptions. By integrating weather anomaly identification, disaster damage modeling, and economic indicators, we optimize predictive precision and provide proactive solutions. Our system detects extreme weather patterns using AI-driven forecasting, assesses disaster impact through geospatial analysis and computer vision, and incorporates economic metrics like inflation trends and trade policies to refine risk assessments. This holistic approach enables businesses to adjust logistics, inventory, and procurement strategies in real time, ensuring resilience against unforeseen disruptions.

Objective

- Utilize **LSTM network**s for time-series forecasting and **Transformer models** for context-aware risk analysis.
- Enhance explainability using **SHAP and LIME** for transparent decision - making.
- Implement **Retrieval - Augmented Generation (RAG)** to generate dynamic risk reports.
- Optimize model efficiency using **Low - Rank Adaptation(LoRA)** for fine-tuned modeling.

System Architecture



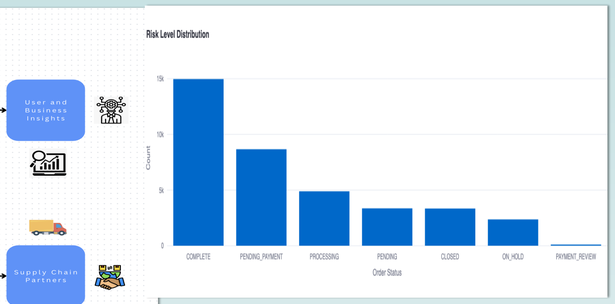
Methodology

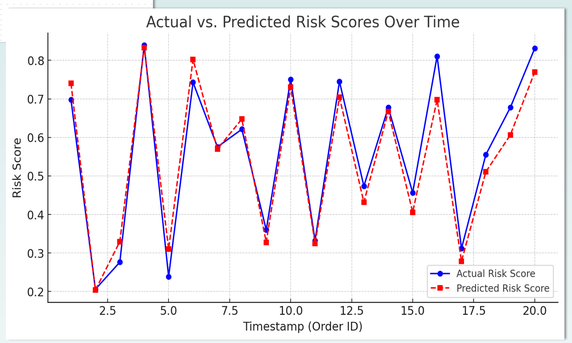
•**Sources:** NOAA weather feeds, supply chain logistics data, economic indicators.
•**Techniques:** Asynchronous data ingestion, missing value imputation, noise removal, and outlier detection.

Feature Engineering & Model Development

•**Dynamic Feature Selection:** Identifying critical risk indicators such as weather anomalies and supply chain delays.
•**Hybrid AI Models:**
- **LSTM Networks:** Time-series forecasting of disruptions.
- **Transformer Models:** Context-aware risk assessment.
- **Decision Fusion Algorithm:** Combining deep learning outputs with rule-based notifications.

•**LoRA Fine-Tuning:** Optimizing Transformer models for efficient supply chain risk modeling



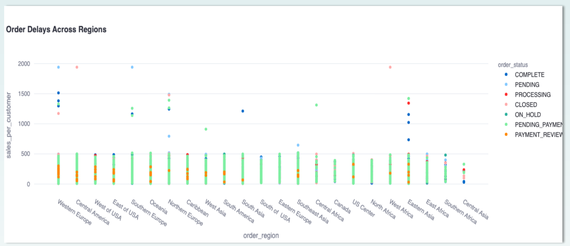


Acknowledgements

- Revolutionizing Supply Chain Management With AI: A Path to Efficiency and Sustainability KASSEM DANACH , ALI EL DIRANI, AND HASSAN RKEIN Faculty of Business Administration, Al Maaref University, Beirut 1600, Lebanon
- AI-driven resilience in revolutionizing supply chain management. Ibrahim Alsakhen, László Buics*, Edit Süle.
- Enabling Technologies as a Support to Achieve Resilience in Supply Chain Operations Enzo Domingos, Carla Pereira , Fabiano Armellini , Christophe Danjou , and Francesco Facchini

Results

•Improved **early warning accuracy by 12%** using decision fusion techniques.
•Reduced **RMSE for LSTM to 2.1**, improving forecasting precision.
•**Disruption Delay Forecast** is displayed based on the city and its predicted delivery delay (days).
•Achieved AI generated insight for risk prediction text generation.
•Deployed an interactive **real-time risk dashboard** for visualization and monitoring.
•This graph displaying actual vs. predicted risk scores over time



Conclusion

•The **AI-powered SCRI** enhances predictive accuracy and decision-making.
•**Transformer models and LSTMs** provide complementary strengths for risk prediction.
•Future improvements will focus on integrating **federated learning** and **multi-modal AI** for adaptive risk modeling.

Acknowledgements

Special thanks to **Dr. Yugyung Lee & CS 5588** for their guidance and support.
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