

AI-Based Anomaly Detection in Logistics Operations

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Abstract

This paper presents a practical approach to anomaly detection in logistics operations using AI-driven, context-aware methods. Traditional anomaly detection techniques based on fixed thresholds or simple statistical rules often fail to capture operational variability across different branches and process stages. In real-world delivery networks, what is considered normal in one unit may represent a significant deviation in another. To address this, we propose a process- and unit-aware anomaly detection framework that evaluates operational performance relative to local baselines and temporal patterns. The system leverages machine learning models to learn these baselines dynamically, enabling the detection of deviations in a data-driven manner. An AI-powered dashboard has been implemented to visualize anomalies in real time, segmented by process stages (first mile, middle mile, last mile) and operational units. This interface allows stakeholders to monitor trends, identify critical branches and transport units, and drill down to individual cases for detailed investigation. Observations indicate that the system effectively highlights operational bottlenecks, supports proactive interventions, and enhances visibility and responsiveness across logistics processes. The study demonstrates how AI-based, context-aware systems can improve operational efficiency and anomaly management in complex and competitive logistics networks.