E-Commerce Order Distribution Optimization Report

Introduction

Our e-commerce company, based in Lome, Togo, serves customers in Ghana through multiple delivery centres. However, we faced order distribution inefficiencies, leading to:

- Uneven truck utilization: Some trucks were overloaded while others traveled nearly empty.
- High pending orders: Large backlog.
- Slow logistic process: Due to inefficient truck assignments.

To solve these problems, we conducted data analysis, optimization, and visualization to improve our logistics operations.

Part 1: Data Analysis & Key Findings

Dataset Overview

We analyzed three datasets:

1. **Orders Table**: 526,945 records, tracking order status, assigned trucks, and volumes.
2. **Centres Table**: 5 delivery hubs across Ghana (Accra, Tema, Koforidua, Bolgatanga, Kintampo)
3. **Trucks Table**: 35 trucks with varying capacities.

Key Findings

1. Truck Utilization Problems

- 0 underutilized trucks (all were heavily loaded) when order loads are accumulated.
- Cumulated loads of all 35 trucks overloaded (100%+ capacity) meaning every truck in the system is overloaded
- Some trucks were handling up to 154,192% of their capacity cumulatively
- Even the least load utilization (273.7%).
- This means there can be even distributions of volume for trucks in multiple trips

2. Centre-Level Congestion

- Accra (235,077 orders) & Tema (162,403 orders) were overloaded.
- Pending Orders:
    - Accra → 111,379 pending orders.
    - Tema → 109,622 pending orders.
    - Smaller centres (Koforidua, Bolgatanga, Kintampo) had less workload.

3. Slow Order Processing

- Large number of orders stuck in PENDING status due to slow truck assignment.
- Some centres had low in-transit order movement, worsening delays.

Part 2: Optimized Order Distribution Strategy

Key Strategies Implemented

1. Dynamic Load Balancing & Partial Order Assignments

- Orders assigned based on available truck capacity instead of overloading a few trucks.
- Instead of waiting for full truck space, orders were split across multiple trucks.

2. Centre-Level Order Prioritization

- Moved 6,000 pending orders from Accra & Tema to Koforidua, Bolgatanga, and Kintampo.

3. Dynamic Reallocation for Future Orders

- Orders will be automatically redistributed as space frees up.

Reassigned Orders Data

- 6,000 orders successfully reassigned.

Part 3: Results Demonstration & Visualization

1. Pending Orders Per Centre (Before vs. After)

Visualization: Bar Chart

- Significant decrease in pending orders at Accra & Tema.
- Smaller centres received more orders, improving load balance.

2. Truck Utilization Before vs. After

Visualization: Heatmap & Pie Chart

- Before: Cumulated loads of all trucks overloaded (100%+ utilization).
- After: Balanced load distribution across fleet.
- Before: Higher number of pending orders
- After: pending orders was significantly reduced

3. Percentage of Orders Successfully Reassigned

KPI: 6,000 / 310,775 = ~1.9% Reassigned

- This is a strong first step toward efficiency.
- Future automation will increase reassignment dynamically.

Conclusion & Recommendations

- Reduced congestion at major centres (Accra & Tema).
- Balanced truck utilization by dynamically redistributing loads.
- Enabled future automation for real-time order reallocation since only 1.9% of orders were reassigned.
- Reassigned Orders Dataset available in CSV (reassigned_orders.csv)

Recommended Steps for Full Automated Optimization

- ❖ Automate truck rebalancing further (ensure no truck exceeds 70% utilization).
- ❖ Expand reassignment rules (move more orders to smaller centres).
- ❖ Ensure automatic order reallocation to centres
- ❖ Monitor real-time performance in dashboard.