Supply Chain Optimization – Tackling Delivery Delays and Profitability Challenges (2015-2017)

Prepared For: Supply Chain Management

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Executive Summary

This project focuses on optimizing the supply chain performance of a company by addressing key operational challenges such as delivery delays, profitability gaps, and inefficiencies in warehouse processes. The analysis is based on the DataCoSupplyChainDataset, with the data for 2018 excluded to maintain temporal consistency and avoid bias from incomplete records.

With a significant portion of orders experiencing delays, especially in First Class and Same Day shipping, and certain products and categories showing negative profitability, this analysis seeks to identify bottlenecks, propose strategic improvements, and provide actionable recommendations. The goal is to enhance customer satisfaction, improve cost-efficiency, and increase overall profitability by streamlining processes and aligning expectations with realistic delivery capabilities.

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I.   Introduction

Background:
The DataCoSupplyChainDataset, sourced from Kaggle, contains supply chain data spanning from 2015 to 2018. To ensure temporal consistency and avoid bias from incomplete data, records from 2018 were excluded, and the analysis focused on the period from 2015 to 2017. This report aims to evaluate the performance of the supply chain during these years, identify key issues such as delivery delays, profitability concerns, and operational inefficiencies, and provide actionable recommendations for optimizing performance and reducing costs.

Purpose:
The purpose of this project is to analyze and optimize the supply chain by addressing key challenges such as reducing late deliveries and improving on-time shipping rates, particularly for First Class and Same Day orders. Additionally, the project aims to identify products with negative profit margins and recommend pricing adjustments or discontinuation strategies. Finally, the project seeks to investigate warehouse processing delays and inventory management inefficiencies that contribute to late deliveries and high operational costs, ultimately providing actionable insights to improve overall supply chain efficiency, customer satisfaction, and cost-effectiveness.

II.   Methodology
1. Data extraction:

SQL queries were executed on the dataset to retrieve insights on sales, profits, orders, shipping delays, and customer behaviour. Specific queries focused on late deliveries, order values, regional performance, and product profitability.

2. Data analysis:
- Extracted SQL data was saved as CSV and analysed in Jupyter Notebook using Python.
- Pandas, Seaborn and Matplotlib were used for data manipulation, create charts for better insights.

III.   Findings and Analysis
A. Sales trend analysis Key insights
1. Order-related insights
- Total orders: 178,396
- Total sales: $36,453,084
- Total profit: $3,933,061

⇨ Order volume vs. profit: While we have a large number of orders, the total profit is relatively low. This indicates potential inefficiencies in profit generation per order.

- Total late delivery orders: 97,782
- Advanced shipping: 41,124
- Shipping on time: 31,822
- Shipping cancelled:7,668

⇨ Delivery Delays: There is a significant issue with on-time deliveries, with a 40.9% on-time delivery rate, 54.8% late deliveries, and 4.3% order cancelled. Late deliveries contribute to customer dissatisfaction and potential revenue loss.

	Delivery_Status	Total_Orders	Percentage
1	Late delivery	97782	54.811767079979
2	Advance shipping	41124	23.052086369649
3	Shipping on time	31822	17.837843897845
4	Shipping canceled	7668	4.298302652525

Figure 1: Delivery status vs. total orders and percentage result

- Sales and Profit by Region: Western Europe, Central America, South America, and Northern Europe are the highest in both sales and profit, whereas regions like Central Asia, Canada, and Southern Africa underperform in both categories.

2. Shipping & delivery performance

Shipping mode & late delivery percentage:
- Same day: 45.8%
- First class: 95.3%
- Second class: 76.6%
- Standard class: 38.1%

⇨ A major bottleneck is the high percentage of late deliveries, first Class, which has a high rate of late deliveries, should be re-examined for process inefficiencies.

⇨ Warehouse & Processing Delays: The significant delay across all shipping modes, particularly First Class and Same Day, suggests that warehouse processing could be a major bottleneck. It's essential to assess warehouse operations and fulfillment processes to identify inefficiencies.

	Shipping_Mode	Total_Orders	Avg_Shipping_Days	Late_Deliveries	Late_Delivery_Percentage
1	Same Day	9617	0.478631589892898	4404	45.793906623687
2	First Class	27486	2	26192	95.292148730262
3	Second Class	34771	3.99073940927785	26644	76.627074286042
4	Standard Class	106522	3.9955783781754	40542	38.059743527158

Figure 2: Shipping mode vs. total orders, and late delivery percentage

⇨ Late shipment trends vary by shipping mode but show no clear pattern from 2015 to 2017. Standard Class had the lowest late percentage (38%), while First Class was the highest (95%). Second Class averaged 75%, and Same Day fluctuated between 30% and 60%.
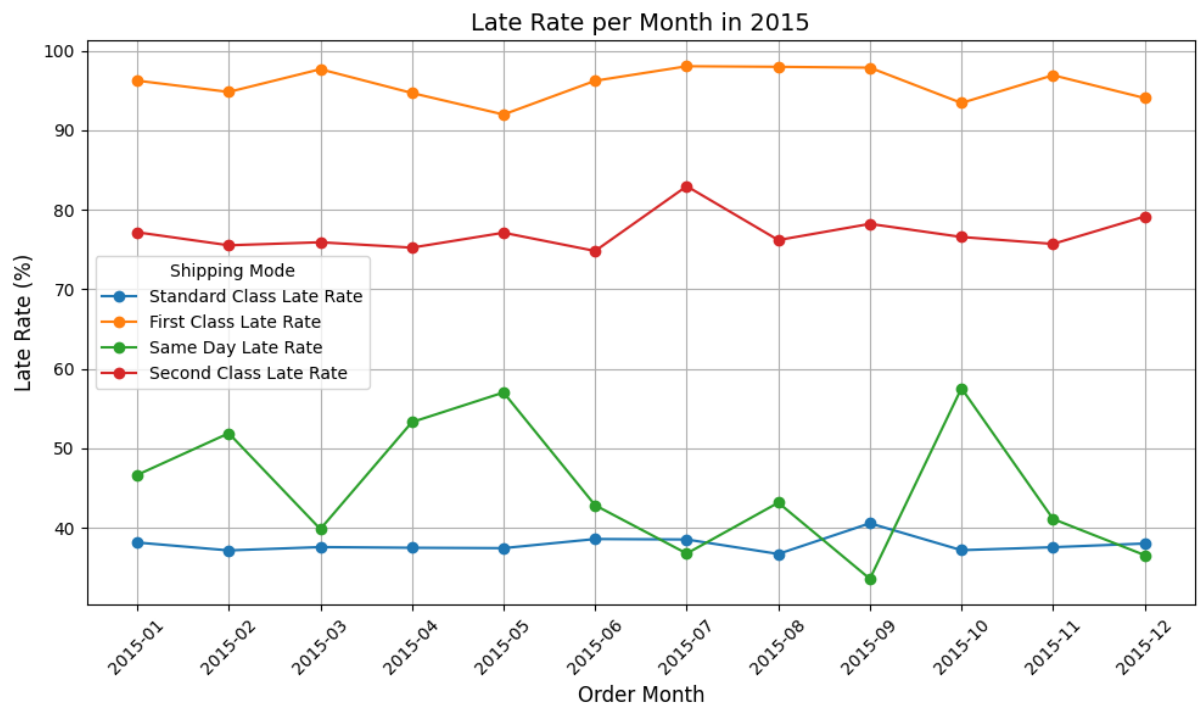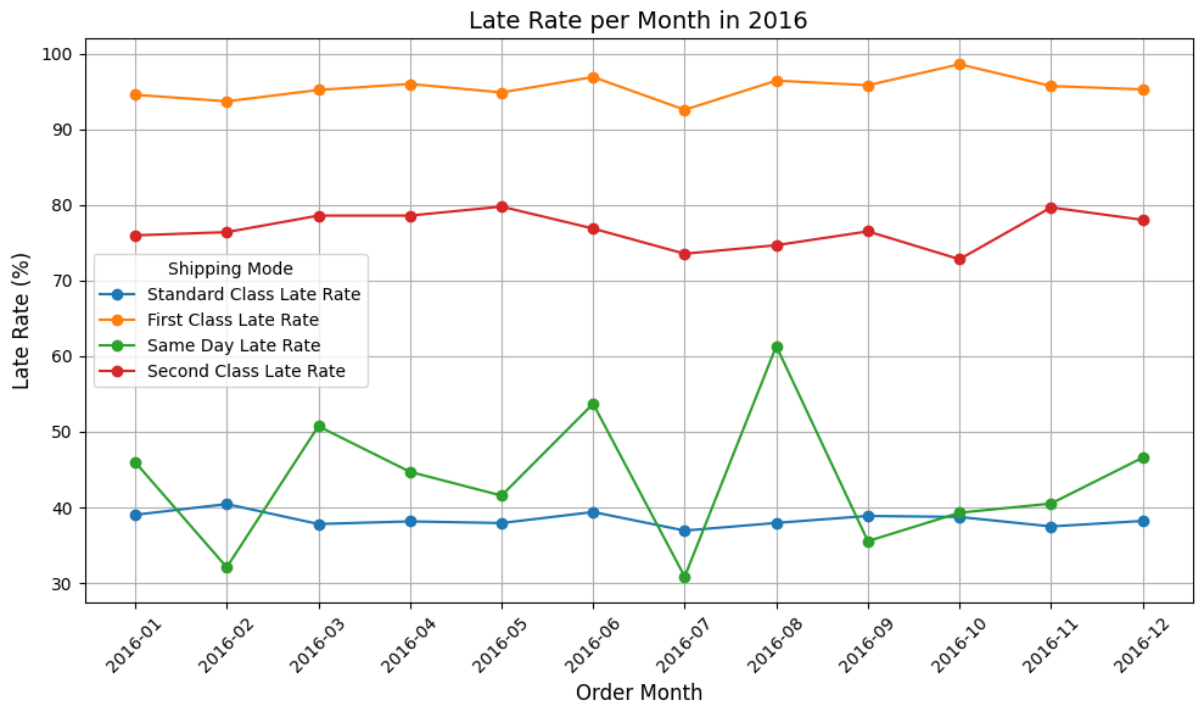

Figure 3: Late rate per month in 2015

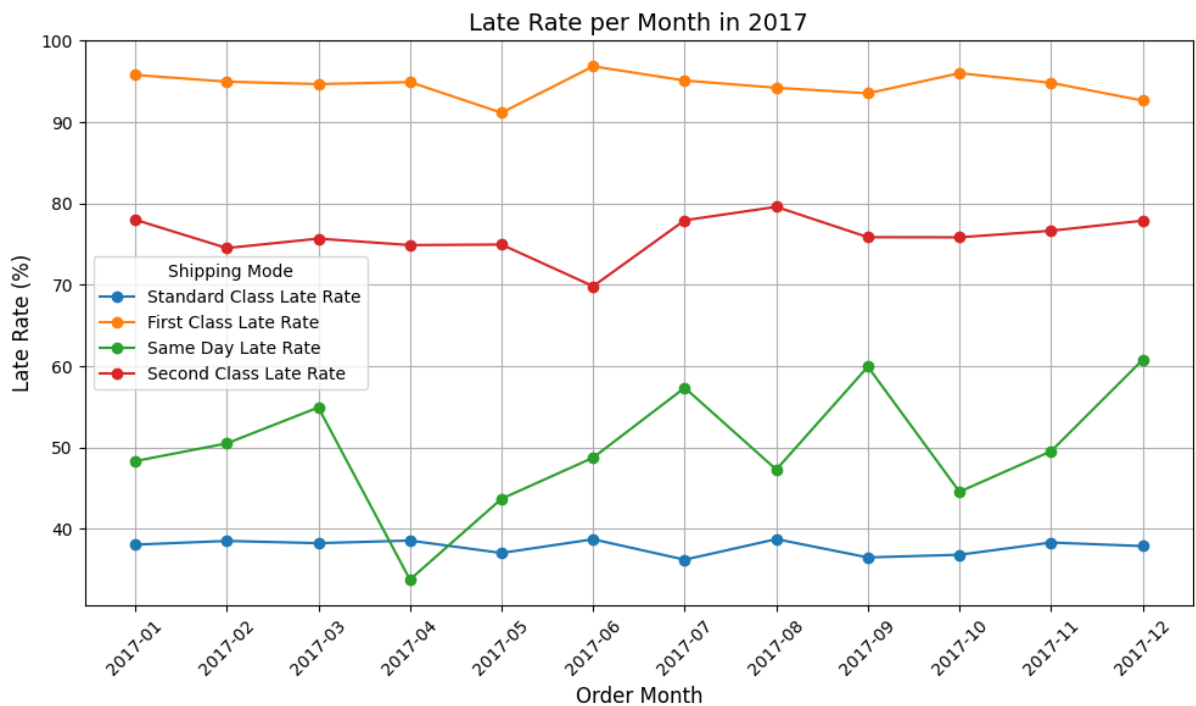Figure 4: Late rate per month in 2016

Figure 5: Late rate per month in 2017

3. Customer behaviour & segmentation

Customer segment vs. total sales:

- Consumer: $18,932,959
- Corporate: $11,063,676
- Home office: $6,456,448

Customer distribution by country:
- EE. UU.: 11,403
- Puerto Rico: 7,126

⇨ Consumer customers contribute the most in sales, followed by corporate and home office segments. There is room for targeting and optimizing the experience for each customer type to boost sales further.

⇨ Geographical Concentration: Customers are primarily from the U.S. and Puerto Rico, so strategies should be tailored to these regions to improve delivery times and customer satisfaction.

	Customer_Segment	Total_Sales
1	Consumer	18932959.9124432
2	Corporate	11063676.6513119
3	Home Office	6456448.33413315

Figure 3: Customer vs. total sales

4. Product & category insights
- Top Categories & Late Deliveries: Categories like Golf Bags & Carts, Basketball, and Fitness Accessories have high delivery late rates and also the highest order volumes, suggesting issues with inventory management or fulfillment processes in these categories.
- Product Profitability: Some products, like Sole E25 Elliptical and Bushnell Pro X7, have a negative profit, indicating issues either with pricing, demand, or high shipping costs. Analysing pricing strategy or discontinuing unprofitable products could improve margins.

	Category_Name	Late_Deliveries
1	Cleats	13496
2	Men's Footwear	12121
3	Women's Apparel	11476
4	Indoor/Outdoor Games	10565
5	Fishing	9516
6	Water Sports	8517
7	Camping & Hiking	7487
8	Cardio Equipment	6805
9	Shop By Sport	6058
10	Electronics	1770

Figure 4: Top 10 category vs. late delivery

Figure 5: Top 10 product vs. late delivery

5. **Inventory & supply chain efficiency**
   - High-Volume Categories: Cleats, Men's Footwear, and Women's Apparel have the highest order volumes but are also frequently late. It may indicate inefficiencies in inventory management or supply chain processes for these categories.
   - Low-Volume Products: Products with fewer orders tend to have the highest delivery late percentages, possibly due to low inventory or poor demand forecasting.

6. Regional performance

The data suggests that late deliveries are a consistent problem across all regions, so the issue likely lies in internal processes rather than regional-specific issues. This may indicate a universal need for operational improvements rather than regional adjustments.

B. **Key bottlenecks to address**
   - Shipping and Delivery Delays: The delay in deliveries, especially with First Class and Same Day services, is a significant issue. Optimizing fulfillment operations, setting more realistic shipping schedules, and reducing over-promising could help alleviate delays.
   - Warehouse Processing Efficiency: The high late delivery rate across all shipping modes points to potential warehouse or inventory management bottlenecks. Streamlining these operations and improving order processing could reduce delays.
   - Negative Profit Products: Identifying and addressing products with low or negative profit (e.g., Sole E25 Elliptical) could help improve margins. Consider revising pricing strategies or removing underperforming products.
   - Demand Forecasting and Inventory Management: Ensure that high-demand products are always adequately stocked to reduce fulfillment delays, especially for categories with high sales and late deliveries.

IV. **Conclusions**
   - Late Deliveries: Around 55% of orders face delivery delays, with First Class shipping particularly impacted (95.3%). Delays are consistent across regions, indicating internal process issues.
   - Profitability: Some products (e.g., Sole E25 Elliptical, Bushnell Pro X7) are unprofitable, suggesting a need for re-evaluating pricing and demand strategies.
   - Regional Insights: High sales and profits are concentrated in regions like Western Europe and Central America, while delays occur universally, indicating systemic inefficiencies.
   - Shipping Mode Issues: Standard Class has the highest sales but still faces delays (38.1%). First and Second Class suffer from severe delays, pointing to inefficiencies in shipping mode management.
   - Warehouse Bottlenecks: The delays across all shipping modes suggest that warehouse processing may be a key bottleneck.

V. **Recommendations**
   - Improve Shipping Scheduling: Align shipping policies with realistic delivery expectations and improve the scheduling for First Class and Second Class to reduce delays.
   - Optimize Warehouse Operations: Investigate and streamline warehouse workflows to minimize delays and improve inventory management.
   - Reevaluate Product Profitability: Review low-profit products and adjust pricing or marketing strategies for better profitability.
   - Enhance Demand Forecasting: Improve forecasting to ensure timely availability of high-demand products, especially in categories like Cleats and Men's Footwear.
   - Tailor Customer Strategies: Focus on customer segments like consumer, corporate, and home office to increase sales and retention, particularly in U.S. and Puerto Rico.

Addressing these recommendations will improve supply chain efficiency, reduce delays, and enhance profitability.