White Paper

Optimising Depot Location for Meachers Global Logistics

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Executive Summary

The efficient placement of logistical facilities, such as depots, is crucial for minimising operational costs and improving service delivery. This paper explores the use of a grid search algorithm to determine the optimal depot location for Meachers Global Logistics. The study incorporates real customer data from 2023 to enhance decision-making accuracy, achieving a depot location that minimises the total distance between the depot and customers. The findings indicate potential cost savings, operational improvements, and environmental benefits for the organisation.

Introduction

Facility location is a critical decision in logistics, directly impacting costs, service efficiency, and long-term operational effectiveness. Meachers Global Logistics, a leading provider of freight and transport logistics services, sought to optimise its depot placement using a computational approach. This study leverages real-world customer data to identify the best location for a new depot, addressing both current and future operational needs. By implementing a grid search algorithm, the research explores the algorithm's efficiency in delivering accurate and actionable insights while testing various customer scenarios.

Research Methodology

Objective

Minimise the total distance between the depot and customer locations to improve efficiency and reduce costs.

Data Source

Customer delivery and collection data provided by Meachers Global Logistics.
The data included:

- Unique customer locations.
- Spatial distribution of customer demand.
- Delivery and collection volumes.

Algorithm

A grid search method was used, systematically generating potential depot locations within a search region defined by customer latitude and longitude coordinates. Each potential location was evaluated for total travel distance.

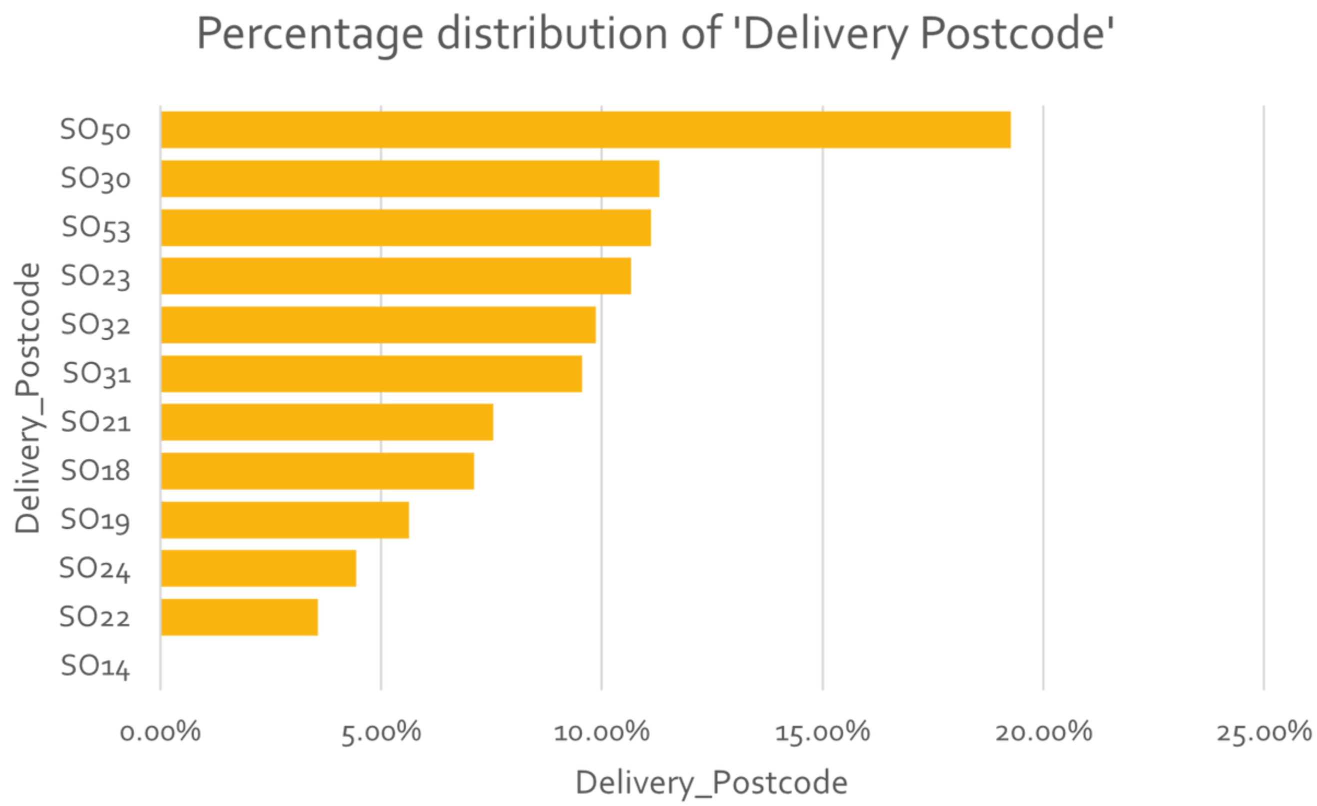
Scenarios Tested

- Grid Granularity: Multiple grid sizes were tested (10×10, 31×31, 40×40, and 70×70) to assess the trade-off between computation time and solution quality.
- Customer Demand Variations: Scenarios included adding 30% new customers and removing 30% of existing customers to test the algorithm’s robustness.

Environmental Impact

The study included an analysis of potential reductions in CO_2 emissions from optimised travel distances.

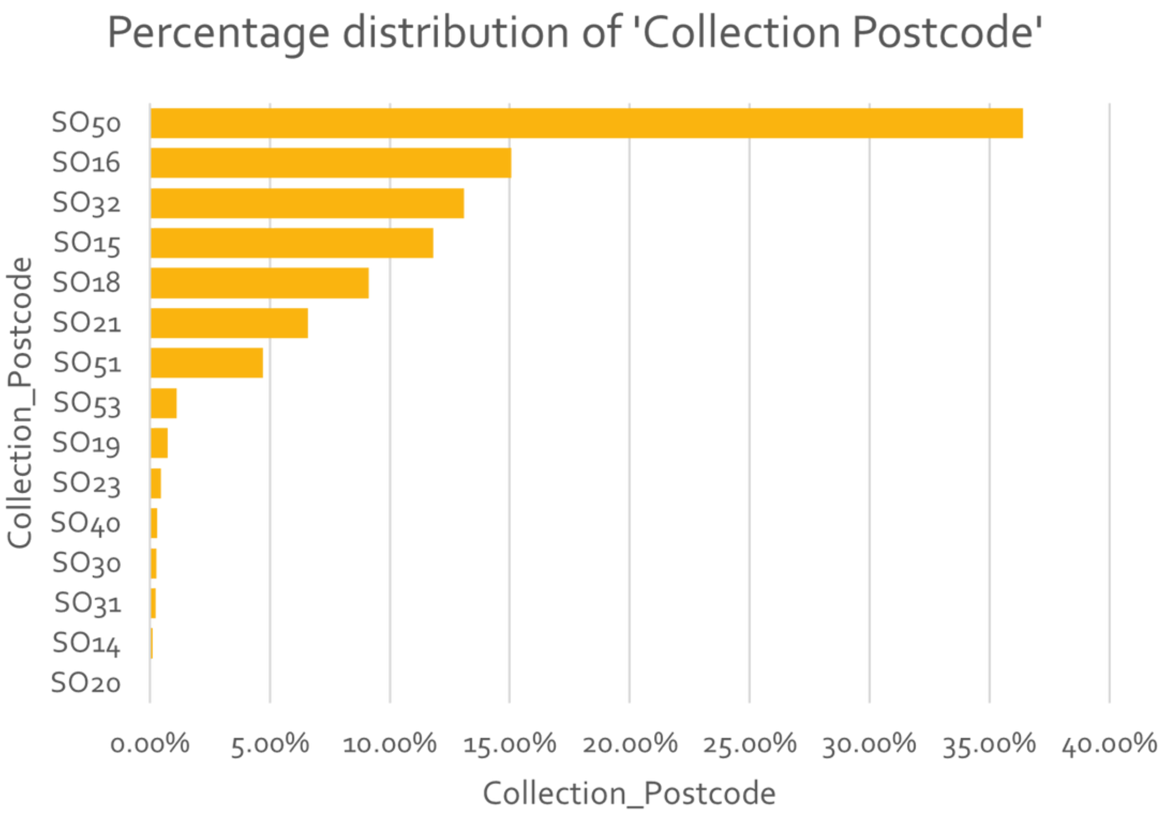
Our Analysis



21,202
total deliveries from depot in Southampton region

3,985
distinct delivery postcodes in Southampton region

Our Analysis



10,801
total collections made from depot in Southampton region

68
distinct collection postcodes in the Southampton region

Key Findings

Optimal Locations

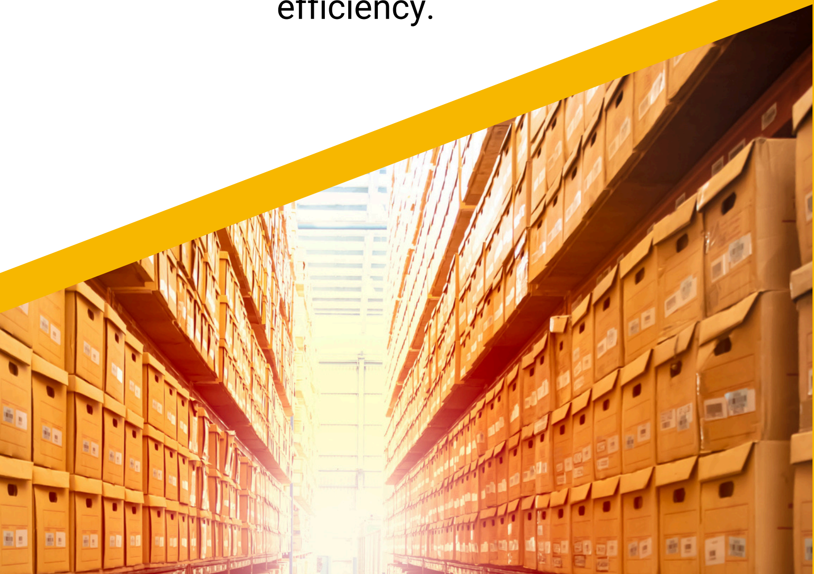
The algorithm consistently identified locations within the SO50 region, near the current depot, indicating that the existing depot placement is nearly optimal for the current customer base.

Impact of Grid Granularity:

- Increased granularity improved solution precision, with finer grids (e.g., 40×40) producing better approximations.
- Computational time increased exponentially with grid size, from under 1 minute for a 10×10 grid to nearly 2 hours for a 72×72 grid.
- Grid sizes between 31×31 and 40×40 offered the best balance between accuracy and efficiency.

Robustness to Demand Changes

- Adding new customers shifted the optimal location westward, demonstrating the algorithm's adaptability to changes in demand.
- Removing customers had minimal impact on the optimal location due to the high concentration of remaining customers in similar regions.



Descriptive Insights

- Over 35% of collections and nearly 20% of deliveries were concentrated in the SO50 region, underscoring its strategic importance.
- The average distance from the current depot to customers was 5.55 miles, with significant outliers driving up total travel distance.

Environmental Benefits

- Optimised depot placement reduced total annual mileage by 1,237 miles.
- This equates to a reduction of approximately 200,167 grams of CO2 emissions per ton-mile, contributing to the company's sustainability goals.

Benefits of the Approach

Cost Savings	Reduced travel distances lower fuel consumption and associated costs, improving profitability.
Operational Efficiency	The optimised depot location enhances delivery and collection times, supporting better customer satisfaction.
Scalability	The grid search algorithm is adaptable to different customer distributions and operational scales.
Sustainability	By minimising travel distances, the optimised location reduces the environmental impact of logistics operations.

Recommendations

Adopt the Identified Location	Relocating the depot to the suggested site near the SO50 region will enhance efficiency and reduce costs.
Integrate Real-World Constraints	◦ Incorporate road networks and zoning regulations into future analyses to ensure feasibility and accuracy. ◦ Assess land availability and accessibility at the suggested depot site.
Scenario Planning	◦ Regularly update customer data and rerun the algorithm to accommodate shifts in demand or geographic changes. ◦ Test additional scenarios, including seasonal demand fluctuations and multi-depot configurations.
Environmental Metrics	Expand the model to include detailed emissions data and optimise depot placement for both cost and environmental objectives.
Customer-Centric Solutions	Develop weighted models that account for customer demand frequency, ensuring high-demand areas influence depot placement more significantly.

Conclusion

This study demonstrates the effectiveness of grid search algorithms in optimising facility locations for logistics operations. Meachers Global Logistics can achieve significant cost and environmental benefits by relocating its depot to the proposed site near the SO50 region. While the algorithm performed well under varying scenarios, future iterations should incorporate real-world constraints and advanced metrics to enhance decision-making further.

By adopting these findings, Meachers Global Logistics positions itself to improve operational efficiency, reduce costs, and align with sustainability objectives, reinforcing its leadership in the logistics sector.

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