CHAPTER 1

INTRODUCTION

1.1 Overview

The quantum and quality of production, the manner of running the business and how the consumers interact with products and services has been the e-commerce sector and almost brought about a revolution to the current major sectors in the commercial areas. The last-mile delivery which is described as the final leg of the supply chain enables consumer delivery of goods, is described as the last point in the supply chain the products are transferred from distribution centres to the final end users of equal importance to consumers, is a cornerstone of this sector.

However, the management of logistics operations are constrained very much pressure because of the higher requirement for delivery which is more reliable and speedier. One of the most important tasks within the logistics management is delivery route planning which means off the best strategies with which to transport products to clients to reduce costs and time sensual constraints such as time definite windows, carrying capacity of vehicles and road network constraints. Due to excessive fuel consumption, inefficiency routes raise operating costs, slow down operations and entail higher on the subject of negative impact on the environment, a few subscribers replied.

E-commerce has completely changed the retail scene; it makes it so easy for customers to order online. But this rapid growth brings with it challenges, notably in the case of last mile delivery that is both costly and inefficient. Instead, studies have emphasized the importance of minimizing the cost and environmental impact on delivery routes while boosting customer satisfaction (Tang, 2023).

One powerful, and cost effective, tool for tackling such logistical problems is linear programming (LP). LP takes an optimal linear function that you specified to it and give it the best delivery routes and resource allocations. It is researched for its contribution in minimizing

the transportation costs and reduce the costs in operations. With emerging technologies including drones and multi modal delivery systems, last mile delivery also stands to benefit (Wang et al., 2021).

1.2 Problem Background

The volume of cargo that has to be delivered has been growing dramatically due to the swift growth of selling goods online. To maintain customer requirements of quick and convenient shopping, Thus, both for dependable deliveries organizations have to improve their logistics networks. Nonetheless, a number of difficulties still exist:

a. **High Delivery Costs**: If the routing applied is inefficient, then the organization incurs high labor costs, and the fuel costs are as well high.
b. **Timeliness:** It is difficult to address the delivery time constraints when one does not have laid down strategies in place.
c. **Environmental Concerns:** It is a demonstrated fact that higher carbon emissions are caused by ill planned routs.
d. **Complex Constraints:** Some of the factors that affect route planning are element such as vehicle facilitates, delivery points, and traffic conditions in the process of performing distinct capacities.

Traditional routing approaches sometimes use traditional or ad-hoc planning algorithms, which are neither economical nor scalable, and that is very important to be taken into account. The variety and the degree of integration of comprehended current electronic commerce are far too complicated for these strategies to handle on the level of logistics. By becoming a tool that allows companies to perform a methodical evaluate a large number of outcomes most favorable for business and choose the best one, the method of linear programming provides a solution.

1.3 Problem Statement

The most apparent hindrance to the flow of logistics in e-commerce is still a poor choice of delivery routes planning. Unclean or fair water, customer dissatisfaction, late supplies, and increased cost of operation are the consequences of the absence of organized and large-scale approaches. That is why it is so challenging to combine several constraints such as the vehicle capacity, time windows and minimizing distances distort the issue even more. With the help of the further developed linear programming model, it is possible to achieve the preservation study is designed to do this by generating delivery routes that are both optimal and cost effective timely.

Unfortunately, many e-commerce organizations have not moved from manual or heuristic methods for delivery planning which are in many cases less efficient and time consuming even with the development of logistics technology. These approaches may create inefficiencies because variable that include fluctuating demand, traffic and distribution of different clients. These lapses are compounded by a confusing approach driven by data, which pressures the delivery It increases operation costs and reduces the satisfaction of the customers (Alkhalifah et al., 2022).

1.4 Research Questions

The main research question for the project could be:
"Given real world constraints, how can linear programming be used to optimize delivery routes for e-commerce businesses under these constraints, minimizing costs and maximizing efficiency?"

1.5 Research Aim

This is to enhance the delivery routes for e-commerce logistics and therefore, reduce the operational costs and delivery times while providing feasible solutions in terms of physical

constraints such as maximum capacity of a truck and time windows in which deliveries can be made.

1.6 Research Objective

This paper analises E-commerce delivery challenges.
Understand the number of key logistical challenges that e commerce businesses face in delivery route planning.
A linear programming formulation is developed: A mathematical model which incorporates variables such as delivery locations, vehicle capacity and time constraints.
To Optimize Delivery Routes: Minimize total delivery time and costs while servicing orders on time can be solved using linear programming model.
Incorporate real world constraints: Include practical consideration, such as the traffic pattern, delivery time windows and vehicle limits, into the optimization model.
To Validate the Model: Apply the model to real data emerging from an e-commerce delivery network to validate its effectiveness and reality.
To Evaluate Sustainability Benefits: Determine and quantify the environmental benefits (e.g., reduction in fuel consumption and carbon emissions) associated with the optimized delivery routes.
An Approach for Providing a Scalable Framework: Make sure the model can be applicable to all e-commerce companies of different sizes and delivery scales.
To Enhance Decision-making: Come up with user friendly tools or guidelines for managers to actually apply the optimization model in real situations.

1.7 Research Scope (Current Work)

This study contributes to various stakeholders:

i. E-commerce Businesses: Enhanced efficiency, reduced costs, and improved customer satisfaction (Tang, 2023).
ii. Logistics Companies: Better resource management and operational sustainability (Xue et al., 2021).

iii. Academia: Expands knowledge on optimization techniques and their real-world applications (Thipparthy et al., 2024).
iv. Society: Promotes environmentally sustainable practices and reduces carbon footprints (Wang et al., 2021).

1.8 Expected Research Contribution

This project aims to make significant contributions in the following areas:

Improved Operational Efficiency: The project is expected to optimise delivery route using a robust linear programming model that is expected to increase the reduction of travelled distance and time in delivering goods. That will help e-commerce companies keep their operational costs low.

Cost Reduction: The model optimizes delivery tasks, thereby minimizing transport costs and decreasing fuel consumption as well as increasing vehicle utilization.

Enhanced Customer Satisfaction: With optimized routing, the project is able to reduce delivery time, which improves customer satisfaction and customer loyalty that are critical to e commerce success.

Sustainability: Delivery routes will be optimized in order to reduce the emission of greenhouse gases, an aim also of e-commerce companies' environmental goals.

Scalable Framework: It is shown how the linear programming model developed can be used as a scalable solution for companies of varying sizes in order to adjust methodology to the firm’s logistical and delivery difficulties.

Decision-Making Support: The resulting work offers an e-commerce manager a decision support tool based on real world constraints so as to aid in data driven decisions regarding logistics operations.

Advancing Knowledge: The project will also contribute to the body of work on optimization techniques in logistics by showing the use of linear programming to tackle complex delivery problems.

1.9 Thesis Organization

The remaining sections of the thesis are structured as follows:

Chapter 2: Literature review, covering earlier studies and theoretical underpinnings. 4 Data collection, model development, and implementation are covered in detail.

Chapter 3: Methodology. The performance of the model is assessed and results are presented.

Chapter 4: Results and Analysis. The work is summarized and areas for additional investigation are suggested in Chapter 5: Conclusion and Recommendations. This research attempts to close the gap between theoretical optimization techniques and real-world logistics issues in the e-commerce sector by concentrating on linear programming-based delivery route optimization.