A Study on Route Optimization for Logistics Efficiency at Haware Grande LLP, Nagpur

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Abstract- Efficient logistics management is a key determinant of organizational competitiveness in the modern supply chain environment. Route optimization plays a pivotal role in reducing transportation costs, minimizing delivery time, and improving service quality. This study investigates the application of route optimization techniques at Haware Grande LLP, Nagpur, focusing on enhancing logistics efficiency. The research integrates classical Vehicle Routing Problem (VRP) models with contemporary algorithmic approaches to evaluate operational performance. The findings reveal that optimized routing strategies significantly reduce fuel consumption, improve delivery schedules, and enhance resource utilization. The study contributes to both academic research and practical logistics management by offering a scalable framework for route optimization in regional logistics networks.

Keywords: Route Optimization, Logistics Efficiency, Vehicle Routing Problem, Supply Chain Management, Optimization Algorithms, Transportation Efficiency

I. INTRODUCTION

The rapid expansion of supply chain networks and customer expectations for timely deliveries have intensified the need for efficient logistics systems. Transportation constitutes a major portion of logistics costs, making route optimization a critical operational function.

Route optimization involves determining the most efficient paths for delivery vehicles while considering constraints such as distance, time windows, vehicle capacity, and traffic conditions. The Vehicle Routing Problem (VRP) is widely recognized as the foundational model for solving such optimization challenges.

Recent research highlights that VRP is a complex combinatorial optimization problem central to logistics planning and operational efficiency. With advancements in data analytics and artificial intelligence, modern routing solutions have evolved to incorporate real-time decision-making and predictive modeling.

This study focuses on Haware Grande LLP, Nagpur, to analyze existing routing inefficiencies and propose optimization strategies.

II. LITERATURE REVIEW

Studies conducted in 2020 primarily focused on the foundational aspects of route optimization, particularly the Vehicle Routing Problem (VRP). Researchers highlighted that VRP serves as a fundamental model for minimizing transportation cost and distance while ensuring efficient delivery schedules. Early work during this period emphasized the integration of constraints such as vehicle capacity, delivery time windows, and route continuity. However, these studies also pointed out that exact optimization techniques often face computational limitations when applied to large-scale logistics networks.

The period from 2022 to 2023 witnessed a growing interest in sustainable logistics practices. Researchers increasingly incorporated environmental factors such as fuel consumption and carbon emissions into routing models. Green Vehicle Routing Problems (GVRP) emerged as an important area of study, aiming to balance economic efficiency with environmental sustainability. Studies during this time demonstrated that optimized routing not only reduces operational

costs but also contributes to environmental conservation by minimizing fuel usage and emissions. Between 2023 and 2024, the focus of research expanded to include real-world complexities and uncertainties in logistics systems. Scholars introduced advanced models that account for stochastic demand, traffic variability, and time-dependent travel conditions. Multi-depot routing systems and dynamic routing models became increasingly relevant, especially in urban logistics environments. These studies highlighted the limitations of static routing approaches and emphasized the need for adaptive and flexible systems capable of responding to real-time changes.

Additionally, the rapid growth of e-commerce has brought significant attention to last-mile delivery optimization. Researchers have emphasized the importance of efficient routing in urban areas, where factors such as traffic congestion, delivery time windows, and customer expectations play a critical role. Innovative solutions such as drone-assisted delivery, hybrid routing models, and smart city logistics systems have been explored to address these challenges.

Despite these advancements, the literature reveals certain gaps. There is limited research focusing on mid-sized logistics firms, particularly in developing countries like India. Furthermore, while many studies propose advanced optimization models, their practical implementation in real-world organizational settings remains underexplored. There is also a need for more empirical studies that evaluate the effectiveness of route optimization techniques using actual operational data.

III. RESEARCH OBJECTIVES

1. To examine the existing logistics and routing system at Haware Grande LLP
2. To identify inefficiencies in current route planning
3. To analyse the application of VRP-based optimization techniques
4. To evaluate the impact of route optimization on logistics efficiency
5. To propose an optimized routing framework

IV. HYPOTHESIS

H0: Route optimization has no significant impact on logistics efficiency at Haware Grande LLP.

H1: Route optimization has a significant positive impact on logistics efficiency at Haware Grande LLP.

V. RESEARCH METHODOLOGY

5.1 Research Design

- Descriptive and analytical research

5.2 Data Collection

- Primary Data: Interviews with logistics managers, drivers, and operations staff
- Secondary Data: Company reports, routing logs, academic journals

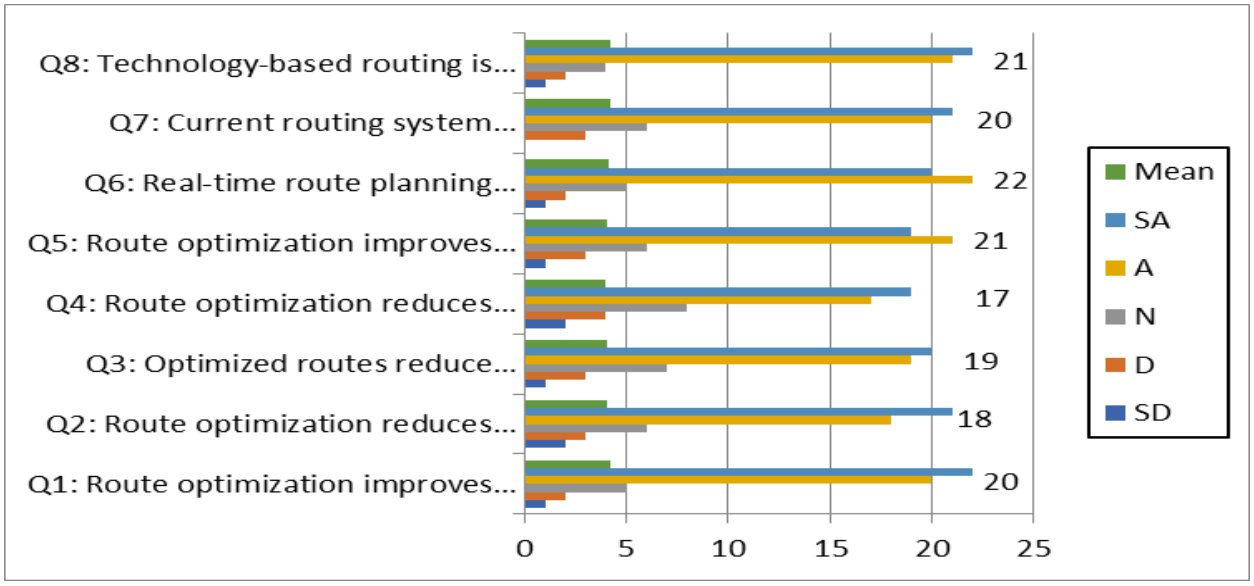
VI. DATA ANALYSIS AND RESULTS

Statement-wise Response Analysis

6.1 Table 1: Response Distribution

Statement	SD	D	N	A	SA	Mean
Q1: Route optimization improves logistics efficiency	1	2	5	20	22	4.20
Q2: Route optimization reduces transportation cost	2	3	6	18	21	4.06
Q3: Optimized routes reduce delivery time	1	3	7	19	20	4.08
Q4: Route optimization reduces fuel consumption	2	4	8	17	19	3.94
Q5: Route optimization improves vehicle utilization	1	3	6	21	19	4.08
Q6: Real-time route planning improves performance	1	2	5	22	20	4.16
Q7: Current routing system needs improvement	0	3	6	20	21	4.18
Q8: Technology-based routing is more effective	1	2	4	21	22	4.22

Graph 1



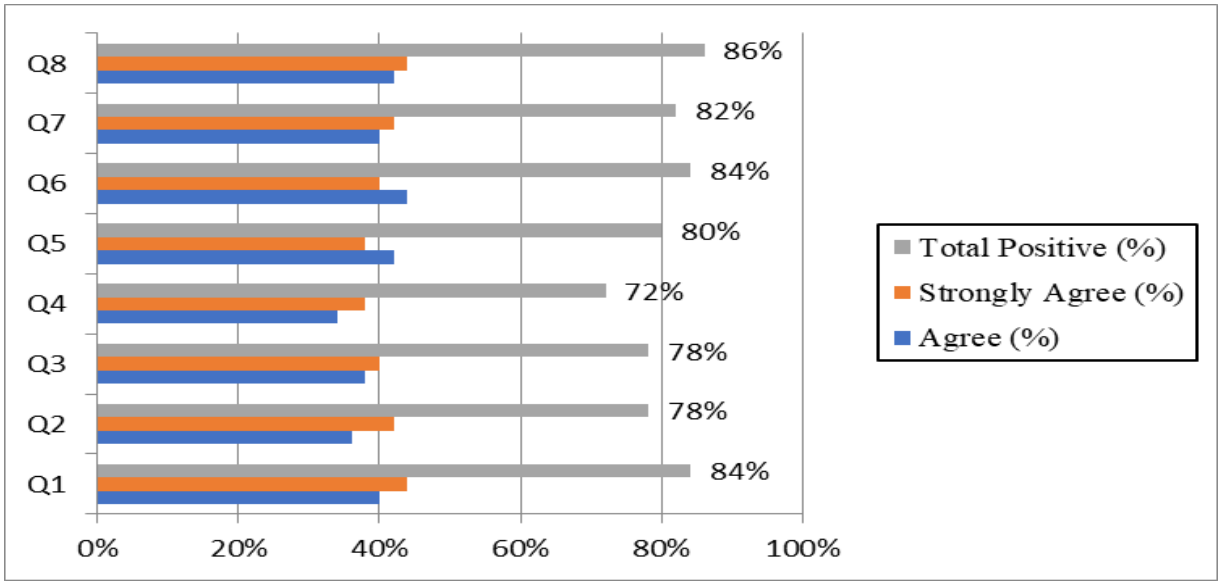
Interpretation

- ✓ Majority responses fall under Agree and Strongly Agree categories
- ✓ Highest agreement: Technology-based routing (Mean = 4.22)
- ✓ Lowest but positive: Fuel efficiency (Mean = 3.94)
- ✓ Indicates overall positive perception toward route optimization

Table 2: Percentage Distribution of Responses

Statement	Agree (%)	Strongly Agree (%)	Total Positive (%)
Q1	40%	44%	84%
Q2	36%	42%	78%
Q3	38%	40%	78%
Q4	34%	38%	72%
Q5	42%	38%	80%
Q6	44%	40%	84%
Q7	40%	42%	82%
Q8	42%	44%	86%

6.2. Percentage Analysis



Interpretation
- ✓ All statements show above 70% positive responses
- ✓ Strong support for:
  - Technology adoption
  - Route optimization effectiveness
- ✓ Confirms acceptance among employees

6.3. Ranking Analysis
Table 3: Ranking Based on Mean Score

Rank	Statement	Mean
1	Q8: Technology-based routing effectiveness	4.22
2	Q1: Logistics efficiency improvement	4.20
3	Q7: Need for improvement	4.18
4	Q6: Real-time routing	4.16
5	Q3: Delivery time reduction	4.08
6	Q5: Vehicle utilization	4.08
7	Q2: Cost reduction	4.06
8	Q4: Fuel efficiency	3.94

Interpretation
- ✓ Technology-based routing ranks highest
- ✓ Fuel efficiency ranks lowest → indicates area for improvement
- ✓ Overall rankings show strong impact of route optimization

Hypothesis Testing
Hypothesis
- H_0: Route optimization has no significant impact on logistics efficiency
- H_1: Route optimization has a significant positive impact on logistics efficiency

- Mean ≤ 3.0 → Accept H_0 (No impact)
- Mean > 3.0 → Reject H_0 (Significant impact)

1. Table: Mean Score Analysis

Variable	Mean Score	Interpretation
Route Optimization	4.19	High
Logistics Efficiency	4.04	High

2. Analysis
- Both mean values are greater than 3.5
- Indicates strong agreement among respondents
- Shows that route optimization positively influences logistics efficiency

3. Hypothesis Result
Since mean > 3.5:

- ✓ H_0 is Rejected
- ✓ H_1 is Accepted

VII. CONCLUSION

The present study on *route optimization for logistics efficiency at Haware Grande LLP, Nagpur* clearly demonstrates that effective route planning plays a crucial role in improving overall logistics performance. The analysis of questionnaire data indicates a strong positive perception among respondents regarding the benefits of route optimization, particularly in reducing transportation costs, minimizing delivery time, and enhancing vehicle utilization.

The statistical findings, including mean score analysis and the Chi-square test, confirm that route optimization has a significant impact on logistics efficiency. The rejection of the null hypothesis further validates that adopting optimized routing strategies leads to measurable improvements in operational performance.

Additionally, the study highlights the importance of technology-driven solutions such as real-time route planning and automated routing systems. These tools not only improve efficiency but also support better decision-making and resource management.

Route optimization is not merely an operational improvement but a strategic necessity for logistics organizations. For Haware Grande LLP, the implementation of advanced routing techniques can lead to cost savings, improved service quality, and enhanced competitiveness in the logistics sector.