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A Study on Warehouse Location Optimization for E-Commerce Fulfilment Centres

Mr. VM. SHREE SELVA ABHISHEK[1], Ms.P. Gopika[2]

[1]Student, School of Management studies, Karpagam College of Engineering, Coimbatore, Tamil Nadu

[2]Assistant Professor, School of Management Studies, Karpagam College of Engineering, Coimbatore, Tamil Nadu

ABSTRACT

In the rapidly evolving world of e-commerce, warehouse location optimization has emerged as a critical factor for business success, balancing the need for fast delivery with operational cost control. This study investigates the factors influencing location decisions for fulfilment centres, specifically focusing on Logon Logistics in Coimbatore. Using a descriptive and analytical research design, data was collected from 120 logistics professionals. Results indicate that transportation networks are viewed as the most critical factor (weighted average 3.9), while poor inventory management (45%) and delayed shipments (36.67%) represent the primary operational challenges. The study concludes that integrating data analytics, automation, and strategic proximity to customer hubs is essential for maintaining a competitive edge in the modern logistics landscape.

Keywords: Warehouse Optimization, E-commerce, Logistics, Supply Chain Management, Coimbatore, Fulfilment Centres.

INTRODUCTION

Logistics and supply chain management are the backbones of the modern economy, with the Indian market exceeding USD 100 Billion in size. As consumer demand shifts toward next-day or same-day delivery, companies are moving from centralized models to decentralized fulfilment centres to store products closer to customers. Logon Logistics, a leading Indian firm with over a decade of experience, provides comprehensive freight and contract logistics solutions. To stay competitive, such firms must optimize their warehouse networks to reduce transportation costs and enhance delivery speed.

REVIEW OF LITERATURE

* Daskin (2016) provided a framework for optimization using mixed-integer programming, emphasizing the need for robust models that adapt to demand variability.

* Chopra & Meindl (2017) highlighted that warehouse placement must align with overall business objectives, focusing on cost minimization and customer service.

* Yang & Lee (2018) explored e-commerce-specific challenges, noting that faster delivery times and variable order sizes require mathematical programming to select optimal sites.

* Zhang & Xie (2021) investigated the impact of automated technology, finding that AI and robotics reduce labour costs and improve fulfilment precision.

SCOPE OF THE STUDY

This research focuses specifically on e-commerce fulfilment centres within the Coimbatore region. It examines decision-making factors such as customer proximity, transportation infrastructure, labour availability, and real estate costs. The study also analyses optimization techniques including GIS-based mapping and mathematical modelling to suggest ideal sites for Logon Logistics.

STATEMENT OF PROBLEM

The rapid expansion of e-commerce has made warehouse location decisions increasingly complex. Businesses struggle to balance proximity to customers with the high costs of real estate and labour. Furthermore, traditional models are often insufficient to meet modern speed requirements, leading to systemic bottlenecks like poor inventory management and shipment delays.

OBJECTIVES OF STUDY

* To examine factors influencing location decisions for e-commerce fulfilment centres.
* To explore optimization models and techniques used in warehouse planning.
* To assess the impact of location on costs, delivery speed, and customer satisfaction.
* To identify best practices and provide strategic recommendations for Logon Logistics.

RESEARCH METHODOLOGY

This study employs a Descriptive and Analytical Research Design. Primary data was gathered from 120 respondents (logistics managers and subordinates) using a structured questionnaire. The study utilized Convenience and Judgment Sampling. Data analysis tools included Pareto Analysis to identify primary challenges, Weighted Average Analysis to rank influence factors, and Root Cause (Ishikawa) Analysis to evaluate operational inefficiencies.

This comprehensive methodological framework ensures that the resulting recommendations for Logon Logistics are grounded in empirical evidence and tailored to enhance delivery speed and overall supply chain profitability to ensure a rigorous and multifaceted analysis, the collected data is processed using Microsoft Excel and SPSS.

Linear Programming (LP): Applied to minimize total costs by analysing critical variables such as transportation, inventory, and facility expenses.

Weighted Average Analysis: Used to quantify Likert-scale responses and rank the importance of factors like transportation networks and labour availability.

Pareto Diagram: Implemented to distinguish the "vital few" operational challenges (such as poor inventory management) from the "useful many".

Root Cause Analysis (RCA): Conducted via Ishikawa (Fishbone) diagrams to categorize inefficiencies into Men, Machine, Methods, and Materials.

ANALYSIS AND INTERPRETATION

particulars	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree	Total	Average	Rank
Customer demand patterns	41(205)	44(176)	20(60)	9(18)	6(6)	120()	3.87	3
Transportation networks	42(210)	49(196)	13(39)	7(14)	9(9)	120(468)	3.9	1
Labour availability	36(180)	48(192)	18(54)	8(16)	10(10)	120(452)	3.77	4
Technology infrastructure	47(235)	31(124)	30(90)	5(10)	7(7)	120(466)	3.88	2

INFERENCE: The above table that, Transportation networks get weight 1st that is 3.9, Technology infrastructure gets weight 2nd that is 3.88, customer demand patterns weight 3rd that is 3.87, Labour availability gets weight 4th that is 3.88.

Pareto chart

Challenges	Frequency	in %	Cumulative %
Poor inventory management	54	45.00%	45.00%
Delayed shipments	44	36.67%	81.67%
Inventory shortages	9	7.50%	89.17%
Slow processing	7	5.83%	95.00%
High shipping costs	6	5.00%	100.00%
Total	**120**		

INFERENCE: Based on the given data, the Pareto study of warehouse operational difficulties shows unequivocally the most important problems influencing performance. With 54 events, or 45% of the overall problems discovered, the study shows that poor inventory control is the main barrier. Inaccurate stock records, item misplacing, or the lack of real-time tracking systems all contribute to over half of all warehouse-related issues resulting from inefficiencies in inventory control.

Delayed shipments then account for 36.67% of all the problems, second most common one. Together with poor inventory control, these two elements account for an amazing 81.67% of all reported issues. In Pareto analysis, this

finding best illustrates the conventional 80/20 rule when a small number of factors—more especially, two problems—account for the majority share of results. Delayed shipments and poor inventory control show a strong association, therefore boosting inventory accuracy and visibility can instantly help to improve delivery schedules and service reliability.

About 20% of the total problems remain inventory shortages (7.5%), slow processing (5.83%), and high shipping prices (5%). Though rare, if ignored these areas might affect general profitability and efficiency. While slow processing may indicate outdated systems or lack personnel, inventory shortages may result from poor demand projections or supplier delays.

FINDINGS

* Demographics: Majority of respondents (30.8%) are aged 26–30 years and hold graduate qualifications (28.3%).

* Technology: 35% of professionals "Always" use data analytics for site selection, and 30% view the implementation of new technologies as a "Very High" influence.

* Operational Impact: 38.3% of respondents believe warehouse location optimization has a "Very High" impact on reducing overall operational costs.

* Efficiency: 46.7% agree that implementing the right technology is the primary driver of warehouse operational efficiency.

SUGGESTIONS

* Data-Driven Decisions: Adopt predictive models to identify optimal locations based on real-time customer distribution patterns.

* Infrastructure Priority: Prioritize sites near major highways and airports to minimize "last-mile" delivery times.

* Decentralized Strategy: Utilize multiple smaller, strategically placed warehouses rather than a single large hub to enhance delivery speed.

* Automation Integration: Select locations that specifically support high-tech infrastructure for robotics and AI.

SUGGESTIONS

- Use data analytics and predictive models to forecast demand and identify optimal locations based on customer distribution patterns.
- Ensure warehouse locations are near major highways, airports, and ports to reduce transportation time and cost.
- Consider using multiple smaller, strategically placed warehouses rather than relying on a single large centre to reduce delivery time and costs.
- Choose locations that support the implementation of automation technologies like robotics and AI to enhance operational efficiency.
- Assess local labour markets and regulatory environments to ensure the availability of skilled workers and compliance with zoning laws.

CONCLUSION

Warehouse location optimization is the cornerstone of modern e-commerce success. By moving away from outdated manual processes and embracing data analytics and automation, companies like Logon Logistics can significantly reduce costs and improve customer satisfaction. As the industry in India continues to grow, the ability to strategically position fulfilment centres will remain the primary competitive advantage in the global supply chain.

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