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A Study on Outbound Logistics and Distribution Network Optimization at Minda Instruments Limited

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Abstract - This study explores the optimization of outbound logistics and distribution networks at *Minda Instruments Limited (MIL)*, a subsidiary of the Spark Minda Group and a leading manufacturer of automotive components. MIL operates dual manufacturing plants in Pune and Chennai, supported by regional distribution centers (RDCs) across India. Despite strong infrastructure, the company faces persistent challenges including long transportation routes, uneven inventory distribution, and high freight costs—especially for northern markets. The research adopts a descriptive and analytical approach, integrating data from ERP systems, field visits, and stakeholder interviews. Analytical tools such as FMEA, ABC analysis, and cost modeling were employed to identify key inefficiencies and assess alternative logistics models. The study proposes a *hub-and-spoke network design* with a central distribution hub at Nagpur or Indore and regional hubs in Delhi, Hosur, and Mumbai. Implementation of multimodal transport (rail + road), data-driven replenishment, and ERP-integrated analytics is expected to reduce logistics costs by 22%, lead times by 35%, and CO_2 emissions by 20%. The results demonstrate that a strategically optimized logistics framework enhances cost efficiency, service reliability, and sustainability, positioning MIL as a future-ready automotive supplier.

Key Words: Outbound Logistics, Distribution Network, Supply Chain Optimization, Multimodal Transport, Automotive Industry, ERP Integration

1.INTRODUCTION

The Indian automotive sector is among the world's fastest-growing industries, contributing approximately 7% to the national GDP and employing over 5 million people. Within this ecosystem, logistics plays a pivotal role in ensuring cost-effective, timely, and reliable product delivery to OEMs and aftermarket customers. Minda Instruments Limited (MIL), a subsidiary of the Spark Minda Group, manufactures advanced instrument clusters, sensors, and PCB assemblies. With facilities in Pune (Maharashtra) and Chennai (Tamil Nadu), the company's outbound logistics network spans Regional Distribution Centers (RDCs) in Delhi, Mumbai, Bengaluru, and Chennai.

Despite technological integration through SAP-ERP systems, MIL faces major outbound challenges, including excessive dependence on road transport, long transit routes, and uneven stock distribution. For instance, the Pune–Delhi route (1,450 km) incurs significant freight costs and lead times exceeding five days, compared to two days for western regions. These inefficiencies impact cost competitiveness, working capital, and customer satisfaction. Therefore, optimizing outbound logistics through a regionally balanced, multimodal, and data-driven network is imperative for sustainable growth.

2. LITERATURE REVIEW

Logistics optimization has emerged as a cornerstone of competitive advantage in modern manufacturing systems. Efficient logistics networks enable firms to minimize operational costs, ensure timely deliveries, and enhance responsiveness to market demands (Sharma & Gupta, 2020). Recent studies emphasize that sustainable and technology-driven logistics strategies, including digital integration and multimodal transport, significantly improve both cost and environmental performance (Raut & Kamble, 2021).

In the Indian automotive sector, overdependence on road transport and limited multimodal infrastructure continue to pose major challenges, particularly for long-haul freight movement (Singh & Dubey, 2021). Digital transformation, supported by ERP and analytics platforms, plays a crucial role in improving real-time visibility, transport scheduling, and order accuracy (Patil & Joshi, 2022). Moreover, the integration of ERP with IoT technologies enhances real-time decision-making, predictive maintenance, and dynamic routing in logistics operations (Das & Patel, 2024).

Despite these advancements, focused research on outbound logistics optimization within India's automotive component industry remains limited. The present study addresses this gap through an analytical examination of Minda Instruments Limited's outbound logistics network and proposes data-driven strategies for network redesign and operational improvement.

3. RESEARCH METHODOLOGY

The study adopts a descriptive and analytical research design integrating both primary and secondary data.

Primary Data: Collected through field visits to Pune and Chennai plants, interviews with logistics managers, dispatch teams, and finance personnel.

Secondary Data: Derived from MIL's ERP-SAP system, internal reports, and Spark Minda's annual sustainability publications.

Analytical Tools Used:

FMEA (Failure Mode & Effects Analysis) – to assess risk priorities in logistics operations.
ABC Analysis – to classify and prioritize inventory for efficient replenishment.
Cost Modeling and Power BI Visualization – to analyze freight patterns, lead times, and warehouse performance.

The study evaluates the cost structure, transportation efficiency, and inventory dynamics to propose a strategic redesign based on a hub-and-spoke distribution model integrating multimodal logistics.

4. DATA ANALYSIS AND FINDINGS

MIL currently operates through a hybrid model: **Plant → RDC → Dealer/OEM** and **Plant → Direct Dispatch**. While this ensures nationwide coverage, the existing setup results in several inefficiencies:

1. Transportation Costs: Constituting nearly 58% of total logistics expenditure, with long-haul Pune–Delhi routes consuming 38% of freight costs.
2. Lead Time Variance: Deliveries to northern regions take 5–6 days, compared to 2 days for western regions.
3. Inventory Imbalance: Overstocks at western RDCs and stockouts in Delhi, tying up approximately ₹12 crore in working capital.
4. ERP Limitations: Partial integration of dealer demand data delays replenishment decisions.

The proposed network introduces a Central Distribution Hub (CDH) at Nagpur or Indore, complemented by regional hubs in Delhi (North), Hosur (South), and Mumbai (West). Shifting 30–40% of long-haul shipments to rail transport would reduce costs by 25% and carbon emissions by 20%.

Comparative Performance:

Metric	Current	Proposed	Improvement
Lead Time	5–7 days	3–4 days	↓ 35%
Logistics Cost	8% of COGS	6.2%	↓ 22%
Inventory Holding	15 days	10 days	↓ 33%
On-Time Delivery	82%	95%	+13 points
CO_2 Emissions	Baseline	–20%	Sustainable gain

Financial evaluation confirms an annual saving of ₹15–19 crore, a two-year payback, and an ROI of 35–40%, indicating strong economic feasibility.

5. CONCLUSION

Optimizing MIL's outbound logistics network enhances operational agility, cost competitiveness, and environmental sustainability. The hub-and-spoke model ensures balanced inventory, reduced lead times, and efficient transport utilization. Adoption of multimodal logistics, ERP-integrated decision-making, and green technologies such as solar-powered RDCs and electric delivery vehicles strengthens MIL's commitment to sustainable manufacturing.

This study concludes that outbound logistics transformation is not merely an operational improvement but a strategic necessity for maintaining competitiveness in the automotive industry. Future research may explore AI-driven demand forecasting, IoT-enabled shipment tracking, and predictive logistics planning to further advance efficiency and resilience in automotive supply chains

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