

# From Gridlock to Growth: Transforming India's Logistics Network for a Sustainable Future

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**Abstract:** India's logistics sector is crucial to its economic development, contributing about 13-14% to the GDP. However, the sector is burdened by inefficiencies such as fragmented supply chains, underdeveloped infrastructure, and high logistics costs, which are approximately 14% of GDP—much higher than the global average of 8-10%. This paper explores these challenges, analyzes international case studies, and proposes a strategic framework for transforming India's logistics network. Emphasizing the role of technology, multimodal infrastructure, and regulatory reforms, the study offers actionable recommendations for improving efficiency, reducing costs, and fostering sustainability in India's logistics sector.

## I. INTRODUCTION

### A. Background

India's logistics sector plays a key role in economic growth by connecting manufacturing, trade, and services to global markets. Despite contributing significantly to GDP, the sector faces systemic challenges, including fragmented supply chains, inefficient transportation modes, and inadequate infrastructure. With logistics costs approximately 14% of GDP, much higher than in advanced economies, it is essential for India to reform this sector to achieve greater global competitiveness.

### B. Problem Statement

India ranks 44th in the World Bank's Logistics Performance Index (LPI), reflecting ongoing inefficiencies in the logistics sector. High logistics costs, combined with underdeveloped infrastructure and regulatory complexities, limit India's ability to fully capitalize on its economic potential. This paper investigates these issues and explores strategies to transform the logistics sector, aiming to reduce costs and improve efficiency.

### C. Objectives

- To identify and analyze key inefficiencies in India's logistics sector.
- To explore international case studies and best practices in logistics transformation.
- To propose a strategic framework for improving logistics infrastructure and adopting sustainable practices.

## II. LITERATURE REVIEW

### A. Overview of India's Logistics Sector

The logistics sector in India faces several challenges, including fragmented supply chains, poor infrastructure, and excessive reliance on road transport. Research by Sharma (2021) and Gupta et al. (2022) highlights these inefficiencies, noting that infrastructure deficiencies and high transportation costs undermine the sector's growth potential.

### B. Global Best Practises

International case studies reveal how countries like China, Germany, and Brazil have successfully integrated multimodal transport systems, advanced technologies, and regulatory reforms to streamline logistics operations. For instance, China's Belt and Road Initiative (BRI) and Germany's Green Logistics policies have significantly improved infrastructure and logistics performance, providing valuable insights for India.

### c. Research Gap

While previous studies have focused on specific inefficiencies or technological solutions, there is a lack of comprehensive frameworks that address the intersection of infrastructure, technology, and policy reforms in logistics transformation. This paper aims to fill this gap by providing a holistic framework for improving India's logistics network.

## III. METHODOLOGY

A. Research Approach

This study employs a mixed-method approach, integrating quantitative data analysis and qualitative insights. Key methods include:

1. Data Collection: Statistical data from government reports, international logistics performance indices, and case studies.
2. Comparative Case Studies: Analysis of logistics models in countries like China, Germany, and Singapore.
3. Policy Analysis: Evaluation of India’s National Logistics Policy and PM Gati Shakti initiatives.

B. Framework Development

The findings of the study will inform the development of a strategic framework for transforming India’s logistics network, emphasizing the integration of technology, infrastructure development, and regulatory reforms.

IV. RESULTS AND DISCUSSION

A. KEY FINDINGS:

The study identified several key inefficiencies in India’s logistics sector that are driving up costs and reducing overall competitiveness. These include fragmented supply chains, underdeveloped infrastructure, over-reliance on road transport, and limited technological adoption. The findings are broken down as follows:

1. Logistics Costs:

India’s logistics costs are significantly higher than the global average. According to the World Bank (2018), logistics costs in India account for approximately 13-14% of the GDP, compared to 8-10% in advanced economies like the USA, Germany, and China. This high logistics cost is attributed to multiple factors, including inefficient transportation modes, poor infrastructure, and regulatory barriers.

2. Fragmented Supply Chains:

The logistics network in India is highly fragmented, leading to inefficiencies and delays in the movement of goods. There is a lack of integration between

various logistics providers, including transportation, warehousing, and distribution networks. This results in goods being handled multiple times, increasing the chances of delays and product damage.

3. Over-Reliance on Road Transport:

Road transport accounts for approximately 60% of India’s total freight movement, which places an undue burden on the road network, leading to congestion, increased fuel consumption, and higher transportation costs. In comparison, countries with efficient logistics systems use a balanced mix of road, rail, and waterway transport. The reliance on roads also contributes to environmental pollution.

4. Limited Adoption of Technology:

While digital technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and blockchain have transformed logistics in other parts of the world, their adoption in India is still limited. According to an industry report, fewer than 20% of logistics companies in India have implemented advanced technologies, which hampers supply chain transparency, efficiency, and real-time tracking.

5. Regulatory Complexities:

Despite reforms such as the Goods and Services Tax (GST), regulatory complexity continues to slow the movement of goods across states. Inconsistent policies, excessive paperwork, and delays at border checkpoints add to the inefficiencies, affecting the overall performance of the logistics sector.

1. Infrastructure and Capacity Constraints

Road Network and National Highways:

India’s road network is vast but faces bottlenecks, especially in urban areas.

- Total Length of National Highways (2023): 155,000 km
- Road Freight Traffic Share (2022): 65% of total freight
- Highway Density: 0.8 km per square kilometer
- Roads with Four or More Lanes: 30% of the total network

Category	2022 Data	Impact
Total National Highways Length	155,000 km	Expanding but still insufficient for demand

Freight Transport via Road	65% of total freight	Heavy reliance on roads, leading to congestion
Roads with Four Lanes or More	30% of total roads	Limitations in capacity for growing traffic

Ports:

- Jawaharlal Nehru Port Trust (JNPT) Capacity (2022): 5.1 million TEUs
- Container Traffic Growth: 6% year-on-year

- Port Congestion at JNPT: Occasional bottlenecks due to inadequate infrastructure
- Cargo Throughput (India's Top 12 Ports, 2022): 699 million tons

Port	Capacity (Million TEUs)	Cargo Throughput (Million Tons)
Jawaharlal Nehru Port Trust (JNPT)	5.1	70
Chennai Port	1.6	60
Kolkata Port	1.0	50
Mumbai Port	0.9	40

2. Efficiency and Productivity of Transport Modes

Rail Freight:

- Rail Freight Share (2022): 36% of total freight
- Potential to Shift to Rail: 20% cost savings possible if freight is shifted to rail

Mode	2022 Freight Share (%)	Potential Cost Savings (%)
Rail Freight	36%	20%
Road Freight	65%	-

Logistics Costs:

Germany	8%
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India's logistics cost remains high due to infrastructure inefficiencies, fragmented supply chains, and regulatory challenges.

- Logistics Cost as Percentage of GDP (India): 13-15% (2022)
- Logistics Cost as Percentage of GDP (Global Average): 8-10%

Country	Logistics Cost (%) of GDP
India	13-15%
China	8-9%
USA	7-8%

3. Technological Integration in Logistics

India's logistics sector is rapidly adopting technology to streamline operations.

- Percentage of Logistics Firms Using Automation: 40% (2023)
- GPS and RFID Technology Adoption: 45% of logistics companies
- Amazon India's Warehouse Automation: 30% reduction in inventory processing time

Technology	Adoption Rate (%)	Impact
Automation in Logistics	40%	Reduced lead times, enhanced accuracy
GPS and RFID Technology	45%	Improved inventory management, tracking
Amazon's Warehouse Automation	-	30% faster inventory processing

4. Sustainability and Environmental Impact

Carbon Emissions from Freight Transport:

The logistics sector in India contributes significantly to carbon emissions. Transitioning to electric

vehicles and renewable energy could reduce this impact.

- Carbon Emissions from Freight Transport (2022): 7% of total carbon emissions

- EV Adoption for Last-Mile Delivery: 10% of logistics companies
- EVs in Last-Mile Delivery (2023): 500 electric delivery vans deployed by companies like Mahindra Electric

Freight Mode	Carbon Emissions (%)	Electric Vehicle Adoption Rate (%)
Road Freight	7%	10%
Rail Freight	-	-

Government Initiatives:

- National Logistics Policy (2022): Aimed at reducing logistics costs to 9% of GDP by 2030 and improving multimodal transport.
- PM Gati Shakti Master Plan: A \$35 billion investment aimed at integrating different modes of transport.

Government Initiative	Objective	Expected Outcome
National Logistics Policy	Reduce logistics cost to 9% of GDP	More efficient, cost-effective logistics sector
PM Gati Shakti Plan	Integrate multimodal transport	Reduced congestion, faster delivery times

5. Policy and Governance

The government’s focus on infrastructure development and regulatory reforms is expected to make a significant impact.

- Infrastructure Investments: \$15 billion allocated to transport sector under the National Infrastructure Pipeline (NIP).
- Multimodal Logistics Parks (MMLPs): 35 MMLPs to be developed by 2025.

Policy	Investment	Expected Impact
National Infrastructure Pipeline	\$15 billion	Boost to infrastructure development
Multimodal Logistics Parks (MMLPs)	35 new parks by 2025	Reduced congestion, better cargo handling

C. Proposed Framework

1. Technological Integration:

- Implementing AI, IoT, and blockchain can enable real-time tracking of goods, predictive analytics for route optimization, and enhanced transparency across the supply chain.
- Use of automated systems in warehouses and for inventory management can further reduce operational costs and improve efficiency.

2. Infrastructure Development:

- Expand multimodal transport systems to reduce congestion on roads and increase reliance on rail and waterways for long-distance freight movement.
- Develop dedicated freight corridors and increase investment in rural infrastructure to improve last-mile connectivity.

3. Policy Reforms:

- Streamline regulatory frameworks and simplify customs processes to reduce delays at border checkpoints.
- Introduce incentives for companies adopting green logistics practices, such as the use of electric vehicles and sustainable packaging solutions.

4. Sustainability:

- Encourage the use of renewable energy sources for logistics operations, including electric vehicles for last-mile delivery and green logistics practices across the sector.
- Support initiatives that aim to reduce the carbon footprint of the logistics sector and promote sustainability in logistics operations.

V. DISCUSSION

#### A. Innovations in Material Use

The findings underscore the need for transformative changes in India's logistics sector. Integrating technologies such as AI, IoT, and blockchain offers a way forward by optimizing operations and reducing inefficiencies. The use of multimodal transport systems, as evidenced by successful models in Germany and China, can significantly reduce costs and improve environmental sustainability.

#### B. Challenges and Limitations

1. **Material Availability:** Ensuring consistent availability of high-quality textile waste and eco-friendly materials for infrastructure development is a challenge.
2. **Production Costs:** The cost of implementing new technologies and building multimodal infrastructure may be higher in the short term, but the long-term benefits outweigh these costs.
3. **Scalability:** Expanding the framework to a national level will require substantial investments and continuous research to address regional disparities.

#### C. Sustainability Impact

1. **Environmental Benefits:** The use of multimodal transport and green technologies can help reduce the logistics sector's carbon footprint, contributing to India's sustainability goals.
2. **Social Awareness:** The adoption of green logistics practices and efficient technologies can promote sustainability awareness among businesses and customers alike.

### VI. CONCLUSION

#### A. Summary

India's logistics sector faces significant challenges, but through strategic reforms and the integration of advanced technologies, there is potential for transformation. By addressing inefficiencies in infrastructure, supply chains, and regulatory frameworks, India can reduce logistics costs, improve global competitiveness, and support sustainable growth.

#### B. FUTURE RESEARCH

Further research should explore the practical implementation of multimodal transport systems, the role of AI in logistics optimization, and the

integration of green technologies to reduce the environmental impact of logistics operations.

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