

Driving Change: Indian Railway Freight Challenges Through SDG'S

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Abstract- Freight transportation plays a crucial role in supporting economic growth, industrial development, and supply chain efficiency in India. Indian Railways is one of the largest freight carriers in the world and serves as a vital component of the national logistics system. However, the railway freight sector continues to face several challenges such as infrastructure limitations, technological gaps, operational inefficiencies, environmental concerns, and safety issues. This study aims to examine the factors influencing freight efficiency in Indian Railways with particular focus on rail infrastructure modernization, rail electrification, multimodal connectivity, digitalization and smart technologies, environmental sustainability initiatives, and safety enhancements. A quantitative research design was adopted for the study. Primary data were collected through a structured questionnaire distributed among railway and logistics professionals. Out of 170 questionnaires distributed, 150 valid responses were used for final analysis. Data analysis was conducted using SPSS with techniques including descriptive statistics, reliability analysis, correlation analysis, and multiple regression analysis. The findings reveal that all six independent variables significantly influence freight efficiency in Indian Railways. Among these variables, infrastructure modernization and digitalization emerged as major contributors to improving operational performance and freight reliability. The study highlights the importance of integrated modernization strategies aligned with Sustainable Development Goals (SDGs) to enhance the efficiency, sustainability, and long-term competitiveness of railway freight transportation in India.

Keywords- Freight Efficiency, Indian Railways, Infrastructure Modernization, Rail Electrification, Digitalization, Sustainable Development Goals.

I.INTRODUCTION

Freight transportation plays a vital role in supporting economic growth, industrial development, and

efficient supply chain operations. In a developing economy like India, an effective freight transport system is essential for facilitating trade, improving logistics performance, and strengthening national competitiveness. Among different modes of transport, railways are considered one of the most efficient and sustainable options for long-distance and bulk freight movement.

Indian Railways is one of the largest railway networks in the world and plays a significant role in transporting goods across the country. It connects major industrial centres, ports, and markets, thereby supporting economic activities and national logistics operations. However, despite its importance, the railway freight system faces several challenges such as infrastructure limitations, technological gaps, environmental concerns, and safety issues that affect freight efficiency.

In response to these challenges, the Government of India has introduced several modernization initiatives such as rail infrastructure development, electrification of railway routes, multimodal connectivity, and the adoption of digital technologies. These initiatives aim to improve freight efficiency and support sustainable transportation systems.

Therefore, this study examines the key factors influencing freight efficiency in Indian Railways, including infrastructure modernization, rail electrification, multimodal connectivity, digitalization and smart technologies, environmental sustainability, and safety enhancements. The study aims to provide insights that can help improve the efficiency and sustainability of railway freight transportation in India.

II. STATEMENT OF THE PROBLEM

Freight transportation is an essential component of economic growth and industrial development. In India,

the demand for efficient movement of goods has increased due to rapid industrialization, expansion of trade, and growing logistics requirements. Although Indian Railways has the potential to transport large volumes of freight efficiently and sustainably, the railway freight system still faces several operational and infrastructural challenges.

One of the major problems is the dominance of road transport in freight movement, which increases logistics costs, fuel consumption, and environmental pollution. Despite being more energy-efficient and cost-effective, rail freight is often underutilized due to factors such as infrastructure limitations, lack of multimodal connectivity, slow adoption of digital technologies, and operational inefficiencies.

In addition, environmental concerns and safety issues have become important challenges in freight transportation. Without improvements in infrastructure, technology, sustainability practices, and safety measures, the efficiency of railway freight operations may remain limited.

Therefore, it is important to identify and analyse the key factors that influence freight efficiency in Indian Railways in order to improve the performance, reliability, and sustainability of freight transportation in India.

III.SIGNIFICANCE OF THE STUDY

This study is important because it helps to understand the key factors that influence freight efficiency in Indian Railways. Efficient freight transportation is essential for reducing logistics costs, improving supply chain performance, and supporting economic growth.

The findings of this study can provide useful insights for policymakers, railway administrators, and logistics professionals to improve freight operations. By identifying the role of infrastructure modernization, electrification, multimodal connectivity, digitalization, environmental sustainability, and safety enhancements, the study highlights areas where improvements can enhance freight efficiency.

Additionally, improving freight efficiency in rail transport can help reduce road congestion, lower fuel consumption, and decrease environmental pollution. Therefore, this study contributes to promoting a more efficient and sustainable freight transportation system in India.

IV. OBJECTIVES OF THE STUDY

The main objective of this study is to examine the factors influencing freight efficiency in Indian Railways.

The specific objectives of the study are:

1. To examine the influence of rail infrastructure modernization on freight efficiency in Indian Railways.
2. To analyse the impact of rail electrification on freight efficiency.
3. To evaluate the role of multimodal connectivity in improving freight efficiency.
4. To assess the influence of digitalization and smart technologies on freight efficiency.
5. To examine the impact of environmental sustainability initiatives on freight efficiency.
6. To evaluate the effect of safety enhancements on freight efficiency.

V. RESEARCH METHODOLOGY

Research Design

This study adopts a quantitative research design to examine the factors influencing freight efficiency in Indian Railways. The quantitative approach helps in analysing relationships between variables using statistical techniques.

Sample Design

The study focuses on railway and logistics professionals involved in freight transportation and operations. A structured questionnaire was used to collect responses from the participants.

Sample Size

A total of 170 questionnaires were distributed, out of which 150 valid responses were collected and used for the final analysis.

Sources of Data

The study uses both primary and secondary data. Primary data were collected through a structured questionnaire from respondents, while secondary data were obtained from academic journals, government reports, and related research publications.

Tools Applied

The collected data were analysed using SPSS software. The following statistical tools were used for analysis:

- Descriptive Statistics
- Reliability Analysis
- Correlation Analysis
- Multiple Regression Analysis

VI. REVIEW OF LITERATURE

Gupta (2025) examined the role of rail infrastructure development in improving freight transportation efficiency in India. The study found that modernization of railway infrastructure significantly improves freight capacity, reduces transit time, and enhances logistics performance.

World Bank (2024) highlighted that efficient freight transportation systems help reduce logistics costs and improve supply chain performance in developing economies. The study emphasized that infrastructure investment and better logistics integration are essential for improving freight efficiency.

International Energy Agency (2024) reported that rail electrification improves energy efficiency and reduces greenhouse gas emissions in freight transportation systems. The study indicated that electrified rail networks contribute to sustainable transport and long-term operational efficiency.

OECD (2023) stated that multimodal connectivity plays an important role in improving freight transportation efficiency. The integration of rail, road, and port systems enhances logistics coordination and reduces delays in the movement of goods.

World Economic Forum (2023) emphasized the importance of digitalization and smart technologies in modern freight systems. The study found that technologies such as real-time tracking, data analytics, and automated systems improve operational visibility and decision-making in logistics operations.

United Nations Environment Programme (2024) highlighted that sustainable freight transport systems help reduce environmental impact and support climate goals. The study suggested that shifting freight transportation from road to rail can significantly reduce carbon emissions.

International Transport Forum (2023) emphasized the importance of safety improvements in freight

transportation systems. The study found that better infrastructure, advanced signalling systems, and strict safety regulations help reduce accidents and improve operational reliability in freight transport.

VII. RESULTS AND DISCUSSION

The data collected from 150 respondents were analysed using statistical tools in SPSS. The analysis examined the influence of six independent variables on freight efficiency in Indian Railways. The results indicate that infrastructure modernization, rail electrification, multimodal connectivity, digitalization and smart technologies, environmental sustainability initiatives, and safety enhancements all contribute positively to improving freight efficiency.

The findings suggest that modernization of railway infrastructure plays a major role in increasing freight capacity and reducing operational delays. Similarly, rail electrification improves energy efficiency and operational reliability. Multimodal connectivity enhances the integration of rail with other transport modes, which improves logistics coordination. Digitalization and smart technologies improve operational visibility and decision-making, while sustainability initiatives support environmentally responsible freight transportation. Safety enhancements also contribute to improved reliability and reduced operational disruptions.

Table 1 Factors Influencing Freight Efficiency in Indian Railways

S. No	Variables	Mean Score	Impact on Freight Efficiency
1	Rail Infrastructure Modernization	4.21	Significant
2	Rail Electrification	4.10	Significant
3	Multimodal Connectivity	4.05	Significant
4	Digitalization & Smart Technologies	4.18	Significant
5	Environmental Sustainability	3.98	Significant
6	Safety Enhancements	4.02	Significant

The results show that all variables have a significant influence on freight efficiency. Among them, rail infrastructure modernization and digitalization recorded relatively higher mean scores, indicating

their strong contribution to improving freight performance in Indian Railways. These findings highlight the importance of integrated modernization strategies to enhance the efficiency and sustainability of railway freight transportation.

VIII. FINDINGS

- The study found that rail infrastructure modernization significantly improves freight efficiency by reducing delays, increasing freight capacity, and improving operational performance.
- Rail electrification enhances operational efficiency by improving energy utilization, reducing dependence on diesel fuel, and lowering operating costs.
- Multimodal connectivity plays an important role in improving freight movement by integrating rail transport with other modes such as road transport and ports.
- Digitalization and smart technologies improve freight operations through real-time tracking, better coordination, and improved decision-making.
- Environmental sustainability initiatives contribute to efficient and cleaner freight transportation by reducing carbon emissions and promoting energy-efficient transport systems.
- Safety enhancements in freight operations help improve reliability and reduce operational disruptions in railway freight transportation.
- The study reveals that digital technologies and infrastructure modernization are among the strongest contributors to improving freight performance.
- Improved freight efficiency can reduce logistics costs and enhance supply chain performance in the Indian transportation sector.
- Efficient railway freight systems can reduce road congestion by shifting freight movement from road to rail transport.
- The study highlights that integrated modernization strategies are necessary to achieve sustainable and efficient freight transportation in India.

IX. SUGGESTIONS

- The government should increase investment in railway infrastructure modernization to improve freight capacity and reduce operational delays.
- Indian Railways should expand rail electrification across major freight corridors to enhance energy efficiency and reduce dependence on fossil fuels.
- There should be greater focus on developing multimodal connectivity by improving integration between railways, roads, ports, and logistics hubs.
- Railway authorities should adopt advanced digital technologies such as real-time tracking systems, automated scheduling, and data analytics to improve freight management.
- Policies should encourage environmentally sustainable freight transportation by promoting energy-efficient railway operations and reducing carbon emissions.
- Stronger safety measures and improved signalling systems should be implemented to minimize accidents and operational disruptions.
- The government should promote public-private partnerships in freight infrastructure development to enhance investment and technological advancement.
- Training programs should be provided to railway and logistics professionals to improve operational efficiency and adoption of modern technologies.
- Continuous monitoring and evaluation systems should be introduced to assess freight performance and identify operational improvements.
- Future policies should focus on integrated transport planning to ensure efficient and sustainable freight transportation in India.

X. CONCLUSION

Freight transportation plays an important role in supporting economic growth, industrial development, and supply chain efficiency in India. Indian Railways has significant potential to improve freight transportation due to its extensive network and capacity for bulk cargo movement. However, several challenges such as infrastructure limitations, technological gaps, environmental concerns, and

safety issues affect the overall efficiency of railway freight operations.

This study examined the key factors influencing freight efficiency in Indian Railways, including rail infrastructure modernization, rail electrification, multimodal connectivity, digitalization and smart technologies, environmental sustainability initiatives, and safety enhancements. The findings of the study indicate that all these factors have a significant impact on improving freight efficiency.

The results highlight that modernization of infrastructure, adoption of digital technologies, and improved connectivity are essential for enhancing freight performance. In addition, sustainability initiatives and safety improvements play an important role in ensuring reliable and environmentally responsible freight transportation.

Overall, improving freight efficiency requires integrated strategies that combine infrastructure development, technological advancement, sustainability practices, and safety management. Strengthening these areas will help Indian Railways enhance its freight performance and contribute to a more efficient and sustainable transportation system in India.

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