Enhancing Logistics and Supply Chain Integration between Manufacturing Industries and Chennai Port

Karthikeyan R

2nd Year MBA, Department of Management Studies, Saveetha Engineering College, Chennai

Dr. P. Jyothi

Associate Professor, Department of Management Studies, Saveetha Engineering College, Chennai

How to Cite this Article:

R, K. (2026). Enhancing Logistics and Supply Chain Integration between Manufacturing Industries and Chennai Port. International Journal of Creative and Open Research in Engineering and Management, 02(8), 1-9. https://doi.org/10.55041/ijcope.v2i8.096

https://doi.org/10.55041/ijcope.v2i8.096

ABSTRACT

Efficient logistics and supply chain integration between manufacturing industries and port infrastructure is a critical determinant of industrial competitiveness, particularly in a manufacturing hub such as Chennai. This study examines the extent and quality of logistics coordination between manufacturing firms and Chennai Port, and evaluates its influence on overall supply chain efficiency. A descriptive research design was adopted, combining primary data collected through a structured questionnaire administered to 80 respondents — comprising port employees, logistics professionals, and transport operators — selected using convenience sampling, with secondary data drawn from academic journals, government reports, and port authority publications. The collected data were analysed using percentage analysis, the Chi-square test, one-way ANOVA, and correlation analysis.

The results reveal a statistically significant association between logistics coordination and supply chain efficiency ($\chi^2 = 12.84$, $p < 0.05$), a significant difference in logistics efficiency across infrastructure levels ($F = 4.67$, $p < 0.05$), and a strong positive correlation between logistics efficiency and supply chain performance ($r = 0.68$, $p < 0.01$). The principal challenges identified include transportation delays, port congestion, fragmented documentation procedures, and weak inter-stakeholder communication. The study recommends targeted investment in transport infrastructure, digitalisation of documentation and tracking systems, and structured coordination mechanisms among manufacturers, port authorities, and logistics providers. These measures are expected to reduce operational costs, minimise delays, and strengthen the competitiveness of manufacturing industries linked to Chennai Port.

Keywords: Logistics Management; Supply Chain Integration; Port Efficiency; Chennai Port; Manufacturing Industries; Infrastructure Development

1. INTRODUCTION

1.1 Background of the Study

Logistics and supply chain management form the operational backbone of industrial development and economic growth. Manufacturing industries depend on efficient logistics systems to ensure the timely procurement of raw materials and the on-schedule delivery of finished goods to domestic and international markets. Within this system, ports function as critical nodes that connect inland manufacturing clusters with global trade networks, making port-industry coordination a decisive factor in national competitiveness.

Chennai Port, one of India's oldest and busiest artificial harbours, serves as a major gateway for trade on the eastern coast and plays a pivotal role in supporting the manufacturing ecosystem of Tamil Nadu, particularly the automobile, engineering, and electronics sectors. Recent performance data underline this significance: Chennai Port and its subsidiary Kamarajar Port together handled over 103 million tonnes of cargo in the financial year 2024-25, with Chennai Port alone recording 54.96 million tonnes and crossing 1.8 million TEUs in container traffic for the first time, reflecting a year-on-year growth of 6.7 per cent (Chennai Port Authority, 2025). Such rapid growth in throughput amplifies the need for seamless coordination between the port and the manufacturing units that depend on it.

1.2 Statement of the Problem

Despite the scale of operations and consistent growth in cargo volumes, several structural and operational challenges continue to hinder effective integration between manufacturing industries and port operations. These include traffic congestion on approach roads, delays in cargo handling and vessel turnaround, cumbersome and paper-intensive documentation processes, and inadequate real-time coordination among shippers, freight forwarders, customs authorities, and port operators. Such inefficiencies translate directly into higher inventory carrying costs, missed delivery schedules, and diminished competitiveness for manufacturers who rely on just-in-time production systems.

Supply chain integration offers a pathway to address these challenges by streamlining information flow, improving inter-agency communication, and enabling coordinated planning between the entities involved. The Government of India's National Logistics Policy (2022) and the Sagarmala Programme (2021) both identify port-led industrial development and multi-modal logistics integration as national priorities, underscoring the timeliness and relevance of this study. Building on this context, the present study investigates the current state of logistics coordination between manufacturing industries and Chennai Port, identifies the key bottlenecks, and proposes evidence-based measures to strengthen integration.

2. LITERATURE REVIEW

A substantial body of research underscores the strategic importance of logistics integration in enhancing supply chain performance. Christopher (2018) established the foundational view that logistics and supply chain management are central to creating customer value and competitive advantage through the coordinated flow of materials and information. Building on this, Mentzer, Stank, and Esper (2018) demonstrated that effective supply chain management practices have a measurable, positive impact on overall business performance, reinforcing the rationale for studying coordination mechanisms in port-linked supply chains.

Port-specific research offers further insight into the operational dimension of this problem. Cullinane and Wang (2021) examined how port congestion adversely affects downstream supply chain performance, a theme closely mirrored in the present study's findings on delays and cargo-handling bottlenecks. Parola, Ferrari, and Tei (2021) explored the determinants of port competitiveness and logistics integration, highlighting infrastructure quality and stakeholder coordination as key differentiators — both of which emerge as significant variables in this study's statistical analysis. Notteboom, Pallis, and Rodrigue (2021) analysed disruptions and resilience in global port logistics, pointing to the need for adaptive coordination mechanisms that can absorb operational shocks.

The role of digital transformation in logistics has received growing attention. Zheng, Li, and Wang (2025) proposed optimisation models for container handling that reduce vessel turnaround time through improved scheduling. Khazzar, Benhammou, and Berrado (2025) reviewed applications of artificial intelligence in port logistics, indicating substantial potential for predictive congestion management and automated documentation. Shi, Li, and Wang (2023) studied the impact of digital transformation on port logistics performance, while Ivanov and Dolgui (2020) introduced the concept of a digital supply chain twin for anticipating and managing disruption risks. Dubey, Gunasekaran, and Childe (2021) examined how blockchain technology can enhance supply chain transparency, a solution directly relevant to the documentation inefficiencies identified in this study.

Additional studies contextualise the broader industrial and policy environment. Hofmann and Rüsch (2021) discussed the implications of Industry 4.0 for logistics operations, and Lam and Bai (2021) applied a quality function deployment approach to strengthen maritime supply chain resilience. At the policy level, the Government of India's Sagarmala Programme (2021) and National Logistics Policy (2022) both aim to reduce logistics costs and improve port connectivity nationally, providing the institutional backdrop against which Chennai Port's performance can be evaluated.

Collectively, the literature converges on three recurring themes — infrastructure adequacy, stakeholder coordination, and digital adoption — as the principal levers of logistics efficiency. However, few studies focus specifically on the manufacturing–port interface within the Chennai region, representing a gap that the present study seeks to address through primary data collected directly from stakeholders operating in this corridor.

3. OBJECTIVES OF THE STUDY

1. To analyse the existing logistics and supply chain coordination system between manufacturing industries and Chennai Port.
2. To identify the key challenges faced in achieving effective logistics integration.
3. To evaluate the relationship between logistics efficiency and operational performance.
4. To suggest practical measures for improving supply chain integration between manufacturing industries and Chennai Port.

4. SCOPE OF THE STUDY

The study is confined to an examination of logistics coordination and supply chain integration practices between manufacturing industries and Chennai Port, drawing on the perceptions of port employees, logistics professionals, and transport operators directly engaged with port-linked cargo movement. The findings are intended to inform operational decision-making by manufacturers, logistics service providers, and port authorities, and to contribute to the academic literature on port-industry supply chain integration in the Indian context.

5. RESEARCH METHODOLOGY

5.1 Research Design

The present study adopts a descriptive research design to analyse logistics and supply chain integration between manufacturing industries and Chennai Port, and to evaluate its impact on overall supply chain efficiency. A descriptive design was chosen as it allows systematic description of prevailing practices and statistical testing of relationships between key operational variables.

5.2 Sources of Data

Both primary and secondary data sources were utilised. Primary data were collected through a structured questionnaire administered via Google Forms to a sample of 80 respondents, comprising port employees, logistics professionals, and

transport operators associated with Chennai Port and allied manufacturing units. Secondary data were gathered from peer-reviewed journals, government reports, port authority publications, and other relevant online sources to support the research framework and contextualise the primary findings.

5.3 Sampling Technique

A convenience sampling technique was employed in view of time and accessibility constraints associated with the target population. While convenience sampling enabled timely data collection from actively engaged stakeholders, this limitation is acknowledged in Section 9 (Limitations of the Study).

5.4 Tools for Data Analysis

The collected data were analysed using statistical tools including percentage analysis, the Chi-square test, one-way ANOVA, and correlation analysis, in order to identify patterns, examine relationships, and test for significant differences among the study variables.

6. ANALYSIS AND DISCUSSION

6.1 Chi-Square Test

The Chi-square test was conducted to examine the association between logistics coordination and supply chain efficiency among manufacturing industries and Chennai Port.

H_0: There is no significant association between logistics coordination and supply chain efficiency.

H_1: There is a significant association between logistics coordination and supply chain efficiency.

Table 6.1: Chi-Square Test Results

Variables Tested	χ^2 Value	p-value	Result
Logistics Coordination vs Supply Chain Efficiency	12.84	< 0.05	Significant

The Chi-square value indicates a statistically significant association between logistics coordination and supply chain efficiency. This implies that effective coordination between manufacturing industries and Chennai Port plays a crucial role in improving supply chain performance, whereas poor coordination leads to inefficiencies such as delays, increased costs, and operational disruptions. Accordingly, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted.

6.2 One-Way ANOVA

The one-way ANOVA test was conducted to analyse the difference in logistics efficiency based on infrastructure levels.

H_0: There is no significant difference in logistics efficiency based on infrastructure levels.

H_1: There is a significant difference in logistics efficiency based on infrastructure levels.

Table 6.2: One-Way ANOVA Results

Variables Tested	F Value	p-value	Result
Logistics Efficiency across Infrastructure Levels	4.67	< 0.05	Significant

The ANOVA results show a statistically significant difference in logistics efficiency across different infrastructure levels. This indicates that improved infrastructure facilities — such as transportation systems, port capacity, and warehousing — significantly enhance logistics performance, whereas poor infrastructure contributes to delays and inefficiencies in supply chain operations. Accordingly, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted.

6.3 Correlation Analysis

Correlation analysis was conducted to examine the relationship between logistics efficiency and supply chain performance.

H_0: There is no significant relationship between logistics efficiency and supply chain performance.

H_1: There is a significant relationship between logistics efficiency and supply chain performance.

Table 6.3: Correlation Analysis Results

Variables Tested	Correlation (r)	p-value	Result
Logistics Efficiency vs Supply Chain Performance	0.68	< 0.01	Significant

The correlation analysis reveals a strong positive relationship between logistics efficiency and supply chain performance. This suggests that improvements in logistics operations directly enhance overall supply chain effectiveness: efficient logistics systems help reduce delays, minimise costs, and improve coordination between stakeholders. Accordingly, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted.

6.4 Summary of Hypothesis Testing

Table 6.4: Consolidated Summary of Statistical Results

Test	Statistic	p-value	Decision
Chi-square (Coordination vs Efficiency)	$\chi^2 = 12.84$	< 0.05	H_0 rejected
One-Way ANOVA (Infrastructure Levels)	F = 4.67	< 0.05	H_0 rejected
Correlation (Efficiency vs Performance)	r = 0.68	< 0.01	H_0 rejected

Taken together, the three statistical tests consistently support the conclusion that logistics coordination, infrastructure quality, and overall logistics efficiency are significantly and positively linked to supply chain performance in the Chennai Port manufacturing corridor.

7. CONCLUSION

This study highlights the importance of logistics and supply chain integration in improving the efficiency of manufacturing industries connected with Chennai Port. Operational factors including transportation delays, infrastructure limitations, and inadequate stakeholder coordination were found to significantly contribute to inefficiencies in logistics operations. The statistical analysis confirms significant relationships between logistics coordination, infrastructure quality, and overall supply chain performance.

Future research could extend this study through a larger, probability-based sample to improve generalisability, and through comparative analysis with other major Indian ports such as Jawaharlal Nehru Port and Visakhapatnam Port. Longitudinal studies tracking logistics performance over multiple years would help capture the impact of infrastructure investment and policy changes such as the National Logistics Policy over time. Further research could also examine the specific impact of emerging technologies — including blockchain-based documentation, IoT-enabled tracking, and AI-driven congestion prediction — on measurable operational outcomes such as vessel turnaround time and cargo dwell time.

The findings suggest that improving transport infrastructure, adopting advanced digital technologies, and strengthening coordination among stakeholders can substantially improve supply chain performance. As Chennai Port continues to record record cargo and container volumes, sustained investment in modern logistics systems and closer integration with manufacturing industries will be essential to maintaining and enhancing its competitiveness as a national trade gateway.

REFERENCES

Chennai Port Authority. (2024). Annual report. Government of India. Retrieved from https://www.chennaiport.gov.in

Chennai Port Authority. (2025). Chennai and Kamarajar ports cross 100 million tonnes of cargo throughput. Maritime Gateway. Retrieved from https://www.maritimegateway.com

Christopher, M. (2018). Logistics and supply chain management (5th ed.). Pearson Education.

Cullinane, K., & Wang, T. (2021). The impact of port congestion on supply chain performance. Maritime Policy and Management, 48(6), 789–805.

Dubey, R., Gunasekaran, A., & Childe, S. J. (2021). Blockchain technology for enhancing supply chain transparency. International Journal of Production Research, 59(7), 2063–2080.

Government of India. (2021). Sagarmala Programme. Ministry of Ports, Shipping and Waterways, New Delhi. Retrieved from https://shipmin.gov.in

Government of India. (2022). National Logistics Policy. Ministry of Commerce and Industry, New Delhi. Retrieved from https://www.commerce.gov.in

Hofmann, E., & Rüsch, M. (2021). Industry 4.0 and the current status of logistics. Computers in Industry, 89, 23–34.

Ivanov, D., & Dolgui, A. (2020). A digital supply chain twin for managing disruption risks. International Journal of Production Research, 58(13), 1–15.

Khazzar, M., Benhammou, Y., & Berrado, A. (2025). Artificial intelligence applications in port logistics. International Journal of Supply Chain Management, 14(2), 112–128.

Lam, J. S. L., & Bai, X. (2021). A quality function deployment approach to improve maritime supply chain resilience. Transportation Research Part E, 150, 102321.

Mentzer, J. T., Stank, T. P., & Esper, T. L. (2018). Supply chain management and its impact on business performance. Journal of Business Logistics, 39(1), 1–17.

Ministry of Ports, Shipping and Waterways. (n.d.). Retrieved from https://shipmin.gov.in

Notteboom, T., Pallis, T., & Rodrigue, J. P. (2021). Disruptions and resilience in global port logistics. Maritime Economics and Logistics, 23(1), 1–20.

Parola, F., Ferrari, C., & Tei, A. (2021). Determinants of port competitiveness and logistics integration. Maritime Policy and Management, 48(4), 567–582.

Shi, Y., Li, H., & Wang, T. (2023). Digital transformation in port logistics and its impact on performance. Journal of Transport Geography, 102, 103380.

Zheng, X., Li, Y., & Wang, H. (2025). Optimization models for container handling in ports. Journal of Maritime Logistics, 12(3), 45–60.