MARITIME SUPPLY CHAIN COMPETITIVENESS IN INDIA THROUGH MEGA PORT DEVELOPMENT, TRANSSHIPMENT HUBS AND OPERATIONAL OPTIMIZATION UNDER MAKV 2047

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Abstract

This research examines the strategic transformation of India's maritime infrastructure to enhance supply chain competitiveness, aligned with the Maritime Amrit Kaal Vision 2047. Despite India's significant economic growth, port performance has not kept pace with rising trade volumes, revealing critical structural inefficiencies. Using a mixed-methods approach (QUAN → qual), this study investigates three primary pillars: mega port development, the expansion of domestic transshipment hubs and operational optimization. Quantitative analysis reveals a projected cargo handling requirement of 7,000 MMTPA by 2047, necessitating a shift toward "next-generation" ports capable of handling 24,000 TEU mega-vessels. Furthermore, the study identifies a significant transshipment leak, where 68% of Indian containers are currently handled at foreign hubs (such as Colombo and Singapore), resulting in an annual revenue loss of USD 200–220 million. Findings also highlight that India's average vessel turnaround time of 2.9 days significantly lags behind global benchmarks of under 24 hours. Through comparative case studies of global leaders like Singapore and Rotterdam, the research proposes actionable strategies for infrastructure scaling and digital optimization. The study concludes that developing strategic hubs at Vizhinjam and Galathea Bay, coupled with widespread automation, is essential for reducing logistics costs by 25% and positioning India as a central node in global maritime trade routes.

Keywords

Maritime Supply Chain; Maritime Logistics; Mega Ports; Transshipment Hubs; MAKV 2047

1. Introduction

Maritime Logistics plays an important role, where about 80% of international trade is done through the ocean (Ismail Ali, 2025; Prabir De, 2024)[1] [22]. Within the maritime supply chain (MSC), seaports function as "nodes" that act as gateways for the import and export of goods, thereby linking countries and facilitating international trade (Narasimha et al., 2021)[2]. India's maritime industry plays a significant role in supporting the nation's economy (Dasgupta, 2025)[3], with ports facilitating approximately 90% of the country's EXIM (export-import) trade by volume (Jović, 2024)[4]. For a fast-growing economy like India, which possesses a coastline extending beyond 7,500 kilometers and is increasingly integrated into global supply chain networks, the maritime sector contributes substantially to its overall economic development (Sapovadia, 2025)[5]. This research is to emphasize the development of next-generation ports to attain world-class standards, as outlined in the 9th thematic focus of Maritime Amrit Kaal Vision 2047 (MoPSW, 2021)[6] to maintain India's competitiveness on the world stage.

The primary objectives of this study are:

i) To assess the development of mega ports in enhancing India's maritime logistics efficiency.
ii) To examine the role of transshipment hubs in improving India's cargo handling efficiency.
iii) To analyze operational optimization measures for improving port performance.

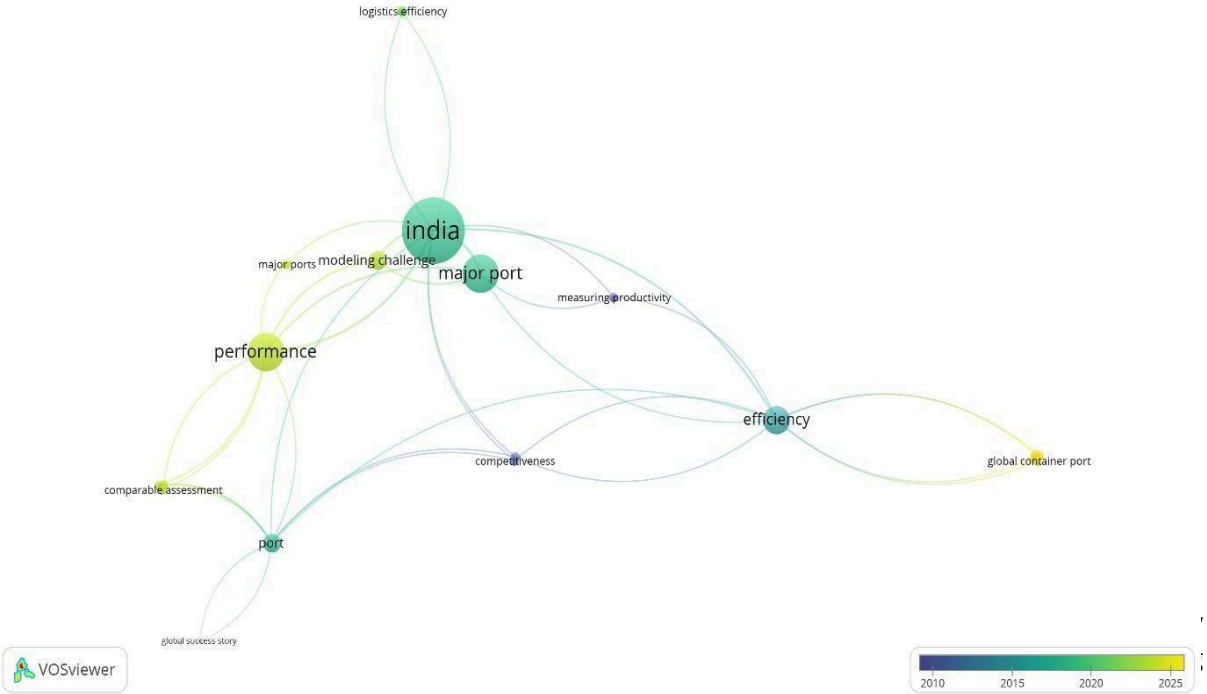
Figure 1: Three key focus areas to enable Best-in-class port infrastructure

Source: (MoPSW, 2021)[6]

The present study focuses on assessing the development of mega ports to enhance maritime logistics efficiency in India, examining the contribution of transshipment hubs to improving cargo handling efficiency and analyzing operational optimization strategies for advancing port performance.

2. Literature Review:

Over the past decade and a half, the Indian economy has undergone substantial growth, with ports emerging as key enablers of this expansion. India's economic size increased from US$ 1.5 trillion in 2010 to US$ 3 trillion in 2022, while port cargo traffic rose from 885 million tons in 2010-11 to 1,410 million tons in 2022-23. However, despite this parallel growth, the performance of Indian ports has not been proportionated, indicating underlying inefficiencies within the sector. The literature consistently identifies structural constraints, particularly low productivity and operational inefficiencies, as major factors limiting port performance (Prabir De, 2006, 2009; Monteiro, 2010; Gaur et al., 2011; Mandal et al., 2016; Sinha and Bagodi, 2019; Mitra et al., 2021; Nanyam and Jha, 2023)[7 - 14]. These challenges have contributed to relatively modest cargo growth during 2010-2022. Existing studies emphasize that improving port efficiency and productivity is essential for enhancing competitiveness and reducing international trade costs.



maritime logistics efficiency. It also examines transshipment hubs and operational optimization measures to improve cargo handling efficiency and overall port performance.

3. Research Methodology

i) Main Research Problem: The research addresses a challenge in India's maritime logistics infrastructure: the need to develop world-class next-generation ports to maintain and enhance India's competitiveness in global maritime trade. Despite India's substantial economic growth from USD 1.5 trillion in 2010 to USD 3 trillion in 2022 and parallel increases in port cargo traffic (885 million tons in 2010-11 to 1,410 million tons in 2022-23), the performance of Indian ports has not been proportionating to this growth, indicating underlying structural inefficiencies.

ii) Methodology: This study adopts a mixed methods research design, specifically an explanatory sequential approach (QUAN → qual). This methodology is chosen to provide a comprehensive understanding of India's maritime logistics efficiency by combining the breadth of quantitative performance metrics with the depth of qualitative stakeholder insights.

iii) Research Design: The research is conducted in two distinct yet integrated phases:

Phase 1 (Quantitative): Focuses on quantifying port performance, capacity gaps and economic impacts using large-scale data and statistical modelling.
Phase 2 (Qualitative): Explores the contextual factors, implementation challenges and strategic perspectives through case studies to explain and enrich the quantitative findings.

4. Key Findings and Implications

The research highlights several key findings, which have significant implications for the future development of India’s maritime logistics infrastructure:

i) **The Need for Mega Port Development**:

India accounts for approximately 95% of its trade volume and 70% of its trade value through maritime transport, thereby necessitating substantial strategic investments in port infrastructure (Kaur & Thakur, 2026)[15]. In this context, the Maritime Development Fund (2025), with an allocation of USD 3 billion, aims to enhance the country’s shipping performance. Furthermore, under the Amrit Kaal Vision 2047 (MoPSW, 2021)[6], India aspires to reduce logistics costs by 25% through the development of mega ports and the establishment of transshipment hubs (Kaur & Thakur, 2026)[15]. India’s current port infrastructure is insufficient to meet the demands of increasing global trade. The existing cargo handling capacity of approximately 2,500 MMTPA is projected to rise to over 7,000 MMTPA by 2047 (MoPSW, 2021)[6]. This increase necessitates the development of mega

ports capable of handling mega vessels with capacities of up to 24,000 TEUs. Indian ports such as Jawaharlal Nehru Port (JNPT) and Mundra have shown the potential to lead this expansion but face draft limitations and capacity constraints (MoPSW, 2021)[6]. Global ports such as the Port of Singapore, Rotterdam and Shanghai have successfully increased their container throughput by investing in port infrastructure, improving draft depths and expanding terminal capacities (Chen & Tsai, 2026)[16]. India can draw lessons from these ports to create facilities capable of accommodating larger ships, thereby enhancing its position in global maritime trade (World Bank, 2023)[17].

Table 1: Comparison with Best-in-class Mega Ports

Parameter	Port of Yangshan, Shanghai	Port of Singapore	Port of Busan, South Korea	Port of Rotterdam, Netherlands	Port of Colombo, Sri Lanka	Jawaharlal Nehru Port Authority, India
Volume 2020 (Million TEUs)	43.5	36.8	21.8	14.4	6.85	4.5
Draft Availability (m)	~20	~18	~20	~24	~18	~15
Vessel Size (TEUs)	19,000	18,000	19,000	24,000	18,000	12,500

Source: (MoPSW, 2021)[6]

Currently, no Indian ports rank among the top 10 globally in container volume, but cargo traffic is expected to grow significantly due to economic expansion, higher modal share on waterways and industrial cluster development. By 2047, bulk cargo is projected at ~3,500 MMTPA and container traffic at ~240 million TEUs, totalling ~7,000 MMTPA under the high-case scenario. To accommodate this, assuming 65% utilization, Indian ports would require a cargo handling capacity exceeding ~10,000 MMTPA. The development of mega ports is expected to significantly enhance maritime logistics efficiency by reducing vessel turnaround time, lowering transportation costs, increasing cargo handling capacity and minimizing India's dependence on foreign transshipment hubs.

ii) **Expanding Domestic Transshipment Hubs**:

Transshipment refers to the transfer of cargo or containers at an intermediate location before reaching the final destination and ports handling 65% or more transshipment cargo are classified as transshipment ports (Munim et al., 2022)[18]. Indian Ports handled 17.23 million TEUs of containers in 2019-20 (MoPSW, 2021)[6], out of which 4.30 million TEUs (25%) of the Indian origin and destined containers were transhipped. Out of 4.3 million TEUs India's transhipped containers, 2.93 million TEUs (~ 68%) are handled outside India, at

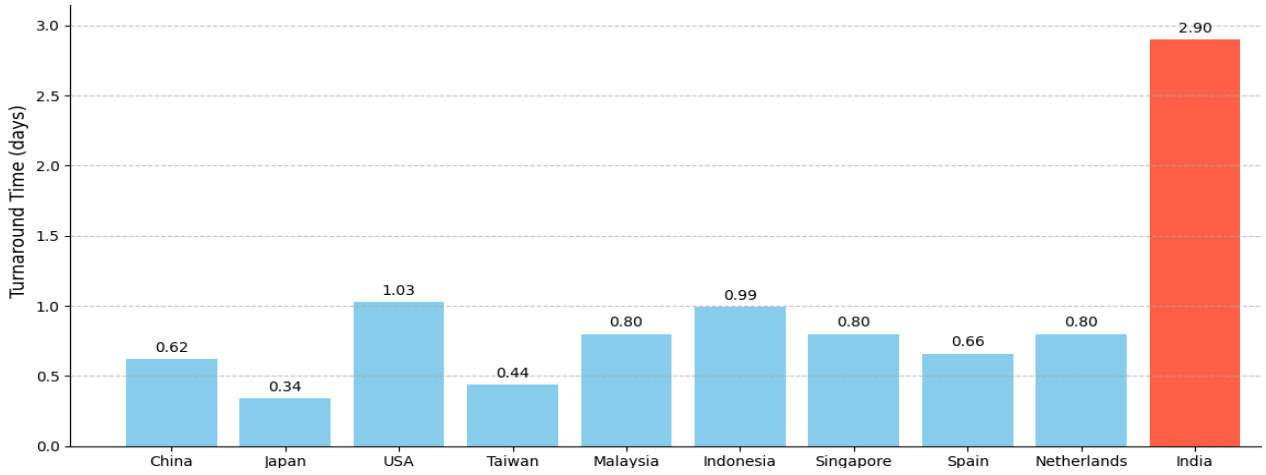
hubs such as Colombo, Singapore and Port Kelang. Out of 68% of India's transhipped containers handled outside India, 49% of the share are handled by 4 major transshipment hubs namely, Colombo, Klang, Singapore and Jebel Ali ports and remaining 19% of the share by other ports. The feeder volumes from/to Indian major ports transhipped at foreign hubs reveals the lost opportunity (MoPSW, 2021)[6].

India's dependence on foreign transshipment ports results in an annual revenue loss of approximately USD 200-220 million and increases logistics costs for shippers due to additional freight and handling charges (Geetha Rani & Akhil, 2024)[19]. India currently loses a significant portion of transshipment business to international hubs like Singapore, Colombo and Port Kelang. In 2019, approximately 68% of India's transhipped containers were handled outside India. This transshipment loss results in an estimated annual revenue loss of $200-220 million (MoPSW, 2021)[6]. Establishing efficient domestic transshipment hubs would not only reduce these costs but also position India as a key node in major global trade routes connecting the US, Europe, Africa and the Far East (Geetha Rani & Akhil, 2024)[19]. By developing domestic transshipment hubs at strategic locations such as Vizhinjam and Galathea Bay, India can retain revenue, reduce logistical costs and increase operational efficiency.

iii) **Operational Optimization for Improved Port Performance**:

India's current average vessel turnaround time of 2.9 days is significantly higher than the global average, where leading ports maintain turnaround times of under 24 hours (UNCTAD, 2020)[20].

Figure 1 : Median vessel turnaround time (days), 2020



Source: (MoPSW, 2021; UNCTAD, 2020)[6] [20]

Extended waiting times result in vessel idling, which increases operational costs (Franzkeit et al., 2020)[21] for shippers due to higher ship-day charges, additional bunker consumption and other ancillary expenses that are ultimately passed on to customers. Moreover, elevated vessel turnaround times at a port generate opportunity costs for vessel operators, as they may forgo potential cargo pickups from other ports. The study emphasizes that reducing turnaround time is essential to improving India's competitiveness in global trade. Measures to optimize operational efficiency include improving customs and clearance procedures, investing in smart technologies and enhancing terminal operations. Ports like JNPT and Mundra have implemented measures to reduce pre-berthing waiting time and increase container handling efficiency. However, more widespread adoption of automation and digital solutions is needed to achieve best-in-class operational standards (MoPSW, 2021)[6].

iv) **Case Studies of Port Development and Optimization**

Case Study	Application	Functionality	Source
Developing Tanjung Pelepas (PTP)	Establishing a competitive transshipment hub	Government incentives attracted APM Terminals and Maersk; leveraged gateway cargo, competitive tariffs, strong feeder network and superior infrastructure vs competitors; achieved faster turnaround time	(Sulaiman et al., 2011)[23]
Port of Colombo - South Asia Hub	Regional transshipment leadership	Strategic location on East-West route, deep drafts for mega vessels, advanced terminals, EDI systems, bonded warehousing, cost competitiveness	Gunawardena et al., 2023)[24]
Smart Quay Walls - Rotterdam	Real-time port efficiency & safety	IoT sensors monitor weather, tides and berth conditions; cloud analytics optimize berthing decisions and reduce delays	(Taneja et al., 2021)[25]
Smart Map - Port of Houston	Yard visualization & routing	Real-time mapping of containers and equipment; improves traffic flow, reduces congestion, enhances security	(Kidd, 2010)[26]
Smart Lifts - Total Terminals International	Container handling efficiency	RFID-based job identification and automated equipment coordination; reduces truck turnaround time and increases accuracy	(Tahmasseby, 2022)[27]

5. Conclusion

The research concludes that achieving the objectives of India's Maritime Amrit Kaal Vision 2047 requires a paradigm shift from incremental improvements to transformative, world-class infrastructure and operational excellence. The study underscores three critical pillars for enhancing India's maritime supply chain competitiveness:

- Mega Port Development: To accommodate the projected cargo traffic growth to over 7,000 MMTPA by 2047, India must prioritize the development of mega ports capable of handling 24,000 TEU vessels. This transition is essential to reducing vessel turnaround times and lowering logistics costs from current levels to the targeted 25% reduction.
- Strategic Transshipment Hubs: The current reliance on foreign transshipment ports (Colombo, Singapore and Port Kelang) results in an annual revenue loss of approximately USD 200-220 million. By strategically developing domestic hubs at Vizhinjam and Galathea Bay, India can recapture this lost revenue, reduce the "transshipment loss" (currently at 68% of Indian containers) and establish itself as a central node in global trade routes.
- Operational Optimization: India's average vessel turnaround time of 2.9 days remains a significant competitive disadvantage compared to global leaders with turnaround times under 24 hours. The study emphasizes that widespread adoption of smart technologies, automation and digital solutions (as seen in the Port of Rotterdam and PTP) is non-negotiable for achieving best-in-class operational standards.

In summary, the transition to next-generation ports is not merely an infrastructural requirement but a strategic necessity for India's global economic integration. By aligning port capacity with projected economic expansion and optimizing operational workflows, India can secure a top-tier position in global maritime trade, ensuring the maritime sector remains a robust engine for the nation's US$ 30 trillion economy by 2047.

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