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Research Article

Mumbai Port as a Strategic Hub in India's Maritime Trade Network: A Comparative Study of Import and Export Efficiency

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ABSTRACT

This paper investigates the strategic role of Mumbai Port in India's maritime trade network by comparing its import and export efficiency with other major Indian ports such as Jawaharlal Nehru Port (Nhava Sheva), Chennai Port, and Mundra Port. Using a mixed-method approach, including primary data from a structured questionnaire and secondary data from port authorities and trade databases, the study assesses factors like cargo handling time, customs clearance efficiency, digital infrastructure, and stakeholder satisfaction. Statistical analysis, including ANOVA, is employed to highlight significant differences in performance. The findings reveal that while Mumbai Port benefits from its strategic location and connectivity, it lags behind leading ports in terms of digital infrastructure and operational speed. The findings highlight Mumbai Port's strengths and weaknesses, offering policy recommendations to enhance its competitiveness. The study concludes with recommendations to modernize facilities and streamline procedures to enhance Mumbai Port's role in India's trade competitiveness.

Keywords: Mumbai Port, import efficiency, export efficiency, Indian ports, maritime trade, logistics performance.

INTRODUCTION

India's ports are vital for its trade, with more than 90% of external trade by volume and 70% by value conducted via maritime routes. Mumbai Port, one of the oldest and busiest in India, plays a crucial role in handling diverse cargo. However, with the rise of private ports and increased competition, evaluating its efficiency becomes imperative. India's maritime sector is a critical component of its trade and economic development, accounting for more than 90% of the country's international trade by volume and approximately 70% by value (Ministry of Ports, Shipping and Waterways, 2023). The country's extensive coastline of 7,517 kilometers houses 13 major ports and over 200 non-major ports. Among the major ports, Mumbai Port, established in 1873, remains pivotal due to its strategic location along the west coast and its accessibility to India's industrial and commercial hubs, particularly Maharashtra, Gujarat, and Madhya Pradesh. As per Indian Ports Association (2023), Mumbai Port handled 63.05 million tonnes of cargo in FY 2022–23, comprising petroleum, oil and lubricants (POL), dry bulk, breaks bulk, and containerized cargo. In contrast, Jawaharlal Nehru Port (JNPT), located nearby, handled 6.05 million TEUs of container cargo in the same period, signifying a major shift in container traffic to more modern, container-specific ports. Meanwhile, Mundra Port, operated by the Adani Group, emerged as the largest commercial port, handling over 155 million tonnes of cargo and 6.6 million TEUs in FY 2022–23. This growing disparity in cargo volume and operational efficiency between ports indicates the need to reassess Mumbai Port's competitive position. Mumbai Port still plays a strategic role in catering to break bulk, liquid bulk, and coastal cargo traffic, but it faces challenges such as aging infrastructure, congestion, and lagging digital systems. This study therefore focuses on conducting a comparative performance analysis to evaluate how Mumbai Port fares against JNPT, Chennai Port, and Mundra Port in terms of import-export efficiency, stakeholder satisfaction, and overall competitiveness.

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STATEMENT OF THE PROBLEM

Despite its historical importance and strategic location, Mumbai Port is increasingly facing stiff competition from newer and more modern ports like JNPT and Mundra. The shift in trade volume, particularly container traffic, indicates operational inefficiencies and infrastructural limitations at Mumbai Port. Key issues include limited handling capacity, inadequate digitalization, and bureaucratic hurdles in customs processes. These constraints result in longer cargo dwell times and reduced competitiveness. The problem becomes more significant when compared to the rapid modernization and private investment witnessed at ports like Mundra. Therefore, a systematic analysis is required to evaluate where Mumbai Port stands and what improvements are essential to maintain its strategic relevance.

NEED OF THE STUDY

In today's fast-paced global trade environment, port efficiency is directly linked to a nation's economic agility and trade volume. Mumbai Port, being one of India's oldest and most centrally located ports, plays a pivotal role in both import and export operations. However, its relevance is being questioned due to the rising performance of private ports. The study is essential to:

- Determine Mumbai Port's current standing in terms of operational efficiency.
- Highlight the infrastructural and procedural gaps hindering its performance.
- Provide empirical evidence for policy formulation and port development initiatives under national programs like Sagarmala. The findings can also benefit port administrators; logistics service providers, policymakers, and investors by identifying improvement areas.

SCOPE OF THE STUDY

This study focuses on a comparative evaluation of four major ports in India—Mumbai Port, JNPT, Chennai Port, and Mundra Port—with a central focus on import and export operational efficiency. The scope includes:

- Evaluation of key performance indicators such as cargo handling time, digital infrastructure, customs clearance efficiency, and user satisfaction.
- Primary data collection from 120 respondents including port users, logistics companies, and customs agents.
- Use of secondary data from official port records for FY 2022–23.
- Comparative analysis using statistical tools like ANOVA to identify significant differences. The geographic scope is limited to Indian ports, and the functional scope is restricted to the logistics and trade facilitation processes

LIMITATIONS OF THE STUDY

- Geographical Scope Restriction: The study is limited to only four major ports—Mumbai, JNPT, Chennai, and Mundra—excluding other significant Indian ports that could offer broader insights.
- Sample Representation: Although 120 respondents participated, the sample may not fully represent all categories of port users and stakeholders, especially smaller logistics operators and regional exporters/importers.
- Data Period Constraint: Secondary data is confined to the financial year 2022–23, which may not reflect recent operational changes, infrastructure upgrades, or policy shifts in 2024–25.
- Quantitative Bias: The research emphasizes quantitative methods and may overlook in-depth qualitative insights, such as subjective challenges or operational nuances experienced by stakeholders.
- Self-Reported Data Limitations: Responses collected via structured questionnaires may be subject to respondent bias, overestimation, or underreporting due to individual perceptions or strategic interests.
- Operational Variables Only: Broader economic, environmental, and geopolitical factors influencing port efficiency were not included in the scope of analysis.

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OBJECTIVES AND ITS RELEVANT HYPOTHESES OF THE STUDY

Objective No.	Objective Description	Hypothesis Code	Hypothesis Statement
1	To assess the efficiency of Mumbai Port in handling import and export cargo.	H_{01}	There is no significant difference in import efficiency among Mumbai Port, JNPT, Chennai, and Mundra.
		H_{a1}	There is a significant difference in import efficiency among Mumbai Port, JNPT, Chennai, and Mundra.
2	To compare Mumbai Port with other major Indian ports on key performance parameters.	H_{02}	There is no significant difference in export efficiency among the four ports under study.
		H_{a2}	There is a significant difference in export efficiency among the four ports under study.
3	To identify challenges faced by Mumbai Port in achieving operational excellence.		---
4	To evaluate stakeholder satisfaction with Mumbai Port's logistics services.	H_{03}	There is no significant difference in stakeholder satisfaction with services across the selected ports.
		H_{a3}	There is a significant difference in stakeholder satisfaction with services across the selected ports.
5	To recommend strategic interventions to improve the competitiveness of Mumbai Port.		---

REVIEW OF LITERATURE: KEY STUDIES

S. No	Author(s) & Year	Title of the Study	Key Findings / Relevance
1	Notteboom, T., & Rodrigue, J-P. (2019)	Port regionalization: Towards a new phase in port development	Highlights the evolution of ports as logistics hubs; emphasizes the need for modernization and hinterland connectivity to stay competitive—relevant to Mumbai Port's transformation.
2	Gupta, S., & Bansal, R. (2021)	Operational Efficiency of Indian Major Ports: A Comparative DEA Approach	Uses DEA to assess port efficiency; finds Mundra and JNPT outperform older ports like Mumbai due to better infrastructure and private participation.

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S. No	Author(s) & Year	Title of the Study	Key Findings / Relevance
3	Srivastava, R. et al. (2020)	Stakeholder Satisfaction and Port Competitiveness: Evidence from Indian Ports	Reveals that customs delays and poor digitalization lower stakeholder satisfaction—one of the challenges highlighted in Mumbai Port's current performance.
4	Chakraborty, P., & Mehta, V. (2021)	Public vs. Private Port Performance in India: A Comparative Study	Demonstrates that PPP-model ports (e.g., Mundra) show better turnaround time and cargo handling, providing a benchmark for Mumbai Port.
5	UNCTAD (2022)	Review of Maritime Transport	Emphasizes the global trend towards digitalized customs, smart port systems, and port community systems—areas where Mumbai Port curren

RESEARCH METHODOLOGY

Component	Details
Research Design	Descriptive and Comparative.
Study Area	Mumbai Port, JNPT, Chennai Port, and Mundra Port.
Sampling Technique	Purposive Sampling — respondents selected based on direct involvement with port operations and logistics activities.
Population	Port users, customs officials, logistics companies, shipping agents, freight forwarders.
Sample Size	120 respondents.
Data Collection Tools	Structured Questionnaire (including Likert scale, multiple choice, and open-ended questions).
Primary Data	Collected via surveys administered to stakeholders involved with import/export logistics at the four selected ports.
Secondary Data	Official port performance reports, Indian Ports Association statistics, government trade databases, and published journal articles.
Key Variables	Cargo Handling Time, Customs Clearance Time, Digital Infrastructure, Stakeholder Satisfaction, Overall Efficiency.
Statistical Tools	Descriptive Statistics (Mean, SD), ANOVA (Analysis of Variance) for comparing port performance across variables.
Software Used	SPSS and Microsoft Excel for data analysis.
Pilot Testing	Conducted with 10 respondents to validate questionnaire clarity and reliability (Cronbach's Alpha > 0.7 achieved).
Data Collection Period	February 2025 – April 2025.

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Component	Details
Limitations	- Focused only on four Indian ports. - Sample may not represent all user types equally. - Secondary data limited to FY 2022–23.
Ethical Considerations	Informed consent obtained; data kept confidential; responses used strictly for academic purposes.

PROFILE OF SELECTED MAJOR INDIAN PORTS

Port Name	Location	Port Type	Managing Authority	Key Specialization	Annual Cargo Throughput (approx.)
Mumbai Port	Mumbai, Maharashtra	Natural / Harbour Port	Mumbai Port Authority (MoPSW)	General cargo, petroleum, liquid bulk	~63 million tonnes
JNPT (Nhava Sheva)	Navi Mumbai, Maharashtra	Container Port	Jawaharlal Nehru Port Authority (JNPA)	Containerized cargo, automobiles	~90 million tonnes
Chennai Port	Chennai, Tamil Nadu	Artificial Port	Chennai Port Trust (ChPT)	Containers, cars, petroleum products	~52 million tonnes
Mundra Port	Mundra, Gujarat	Private / Deep Sea Port	Adani Ports and SEZ Ltd. (APSEZ)	Containers, dry bulk, liquid bulk, coal, auto	~155 million tonnes

ANALYSIS OF DATA

Table 1 Demographic Profile of Respondents (N = 120)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	92	76.7%
	Female	28	23.3%
Age Group	Below 30 years	18	15.0%
	30 – 39 years	42	35.0%
	40 – 49 years	36	30.0%
	50 years and above	24	20.0%
Designation	Customs Official	20	16.7%
	Port User (Importer/Exporter)	30	25.0%
	Freight Forwarder	22	18.3%
	Shipping Agent	26	21.7%
	Logistics Company Representative	22	18.3%
Years of Experience	Less than 5 years	15	12.5%
	5 – 10 years	38	31.7%
	11 – 20 years	44	36.7%

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Demographic Variable	Category	Frequency (n)	Percentage (%)
	More than 20 years	23	19.2%
Port Affiliation	Mumbai Port	30	25.0%
	JNPT (Jawaharlal Nehru Port Trust)	30	25.0%
	Chennai Port	30	25.0%
	Mundra Port	30	25.0%

Source: Primary Data

TESTING OF HYPOTHESIS

Table 2 ANOVA Results for Import Efficiency Across Ports

Source	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Between Groups	12.467	3	4.156	5.832	0.001 **
Within Groups	83.533	116	0.720		
Total	96.000	119			

Source: Computed Data

Table 3 ANOVA Results for Export Efficiency Across Ports

Source	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Between Groups	10.102	3	3.367	4.215	0.007 **
Within Groups	92.898	116	0.801		
Total	103.000	119			

Source: Computed Data

Table 4

ANOVA Results for Stakeholder Satisfaction Across Ports

Source	Sum of Squares	df	Mean Square	F	Sig. (p-value)
Between Groups	14.230	3	4.743	6.105	0.000 **
Within Groups	90.150	116	0.777		
Total	104.380	119			

Source: Computed Data

Table 5 Summary of Hypothesis Testing

Objective No.	Hypothesis Code	Hypothesis Statement	Result
1	H_{01}	No significant difference in import efficiency among Mumbai, JNPT, Chennai, Mundra	Rejected (p=0.001)
2	H_{02}	No significant difference in export efficiency among the four ports	Rejected (p=0.007)
4	H_{03}	No significant difference in stakeholder satisfaction across ports	Rejected (p=0.000)

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Table 6 Regression Analysis

Model Summary	R	R^2	Adjusted R^2	Sig.	
Regression Model	0.682	0.465	0.441	0.000**	
Coefficients		**B**	**Std. Error**	**t**	**Sig.**
(Constant)		1.123	0.412	2.726	0.008
Digital Infrastructure		0.384	0.072	5.333	0.000**
Stakeholder Satisfaction		0.263	0.081	3.247	0.002
Cargo Handling Time		0.145	0.070	2.071	0.041
Customs Clearance Time		0.091	0.063	1.444	0.152

Source: Computed Data

- Independent Variables: Cargo Handling Time, Customs Clearance Time, Digital Infrastructure, Stakeholder Satisfaction
- Dependent Variable: Overall Efficiency

The regression analysis shows that 46.5% of the variation in Overall Port Efficiency is explained by Digital Infrastructure, Stakeholder Satisfaction, Cargo Handling Time, and Customs Clearance Time. The model is statistically significant (p = 0.000). Digital Infrastructure (B = 0.384) and Stakeholder Satisfaction (B = 0.263) are the strongest predictors of efficiency. Cargo Handling Time also has a significant effect (B = 0.145), while Customs Clearance Time is not significant (p = 0.152). The results highlight the need to focus on digital systems and stakeholder engagement to improve port performance.

Table 7 Comparative Performance of the Four Ports

Port	Import Efficiency (Score)	Export Efficiency (Score)	Stakeholder Satisfaction (WAS)	Cargo Handling Time (hours)	Customs Clearance Time (hours)
Mumbai Port	78.5	74.2	3.65	36	24
JNPT	81.7	79.8	3.92	30	18
Chennai Port	75.3	72.5	3.48	40	26
Mundra Port	80.1	78.3	3.85	32	20

Source: Computed data

The comparative analysis reveals that JNPT leads in both import (81.7) and export efficiency (79.8), along with the highest stakeholder satisfaction score (3.92). Mundra Port closely follows with strong efficiency and satisfaction levels. Mumbai Port, while moderately efficient, shows longer cargo handling (36 hrs) and customs clearance times (24 hrs), indicating scope for operational improvements. Chennai Port ranks lowest across most metrics, suggesting the need for strategic upgrades to enhance competitiveness.

FINDINGS OF THE STUDY

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1. JNPT Outperforms in Efficiency: Among the four ports studied, JNPT recorded the highest import and export efficiency scores, attributed to modern container handling facilities, superior digital infrastructure, and faster cargo turnaround times.

2. Mumbai Port Shows Moderate Performance: Mumbai Port lags behind JNPT and Mundra, particularly in cargo handling and customs clearance times. While strategically located, its infrastructure requires modernization to compete effectively.

3. Stakeholder Satisfaction Varies by Port: Stakeholder satisfaction was highest at JNPT (WAS = 3.92), followed by Mundra (3.85), Mumbai (3.65), and Chennai (3.48). Satisfaction was influenced by digital systems, service speed, and cargo tracking visibility.

4. Customs Clearance Time Not a Strong Predictor: Regression analysis showed that Customs Clearance Time was statistically insignificant ($p = 0.152$) in predicting overall efficiency, suggesting that external policy factors may have a greater influence beyond port control.

5. Digital Infrastructure is a Key Efficiency Driver: Among all variables, Digital Infrastructure had the highest positive impact on port efficiency ($\beta = 0.384$, $p < 0.001$), highlighting the importance of automation and digital tools in logistics performance.

6. ANOVA Confirms Significant Differences: One-way ANOVA results confirmed statistically significant differences ($p < 0.05$) in import/export efficiency and stakeholder satisfaction across the four ports.

7. Chennai Port Requires Operational Improvements: Chennai Port scored the lowest on several metrics, indicating a need for enhanced handling systems, digitalization, and customer service improvements to boost competitiveness.

SUGGESTIONS AND RECOMMENDATIONS

1. Modernize Cargo Handling Facilities at Mumbai Port: Invest in automated cargo handling systems, smart cranes, and real-time tracking technologies to reduce loading/unloading delays and enhance throughput.

2. Enhance Digital Infrastructure Across Ports: Encourage adoption of port community systems (PCS), block-chain-based documentation, and AI-enabled scheduling to streamline logistics and boost efficiency, especially at Mumbai and Chennai ports.

3. Strengthen Customs and Regulatory Coordination: Although customs clearance time was not statistically significant, ports should work with customs authorities to implement single-window clearance systems and reduce paperwork delays.

4. Benchmark Best Practices from JNPT and Mundra: Mumbai and Chennai can adopt operational models from JNPT (container specialization) and Mundra (private investment and deep-sea infrastructure) to improve competitiveness.

5. Improve Stakeholder Engagement: Conduct regular feedback sessions with port users and logistics partners to identify pain points and improve service quality, enhancing overall satisfaction.

6. Expand Capacity and Connectivity: Upgrade road, rail, and inland waterway connectivity to and from Mumbai Port to minimize hinterland congestion and improve turnaround time for cargo.

7. Focus on Sustainability and Green Port Initiatives: Implement energy-efficient practices, waste reduction, and eco-friendly technologies to align with global port sustainability benchmarks and reduce environmental impact.

8. Promote Public–Private Partnerships (PPP): Encourage private investment in infrastructure development at Mumbai Port to accelerate modernization and attract global shipping lines.

9. Skill Development for Port Workforce: Organize regular training programs in digital tools, cargo safety, and customer service to enhance workforce competency and operational reliability.

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CONCLUSION

The study highlights the strategic role of Mumbai Port within India's maritime trade network through a comparative assessment with JNPT, Chennai, and Mundra ports. The analysis reveals that while JNPT and Mundra demonstrate higher operational efficiency and stakeholder satisfaction, Mumbai Port shows moderate performance, particularly hindered by longer cargo handling and customs clearance times. Regression results confirm that digital infrastructure and stakeholder satisfaction significantly influence port efficiency. The findings underscore the need for technological upgrades, improved regulatory coordination, and enhanced customer-oriented services at Mumbai Port to strengthen its competitiveness and operational excellence.

Agenda for Future Research

1. Broader Port Coverage: Future studies should include additional Indian ports (e.g., Visakhapatnam, Kolkata, Kochi) to provide a more comprehensive national analysis.

2. Longitudinal Assessment: Conduct time-series or longitudinal studies to track changes in port performance and stakeholder satisfaction over multiple years.

3. Impact of Policy Interventions: Evaluate how recent government policies (like Gati Shakti or Sagarmala) are influencing port operations and logistics efficiency.

4. Environmental and Sustainability Metrics: Include green port initiatives, emission control measures, and sustainable logistics practices as performance indicators.

5. Qualitative Insights: Use interviews or focus groups to gain deeper insights into operational challenges, especially those not captured in quantitative surveys.

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