IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125164

ANALYZING THE PORT DELAYS AND THEIR IMPACT ON LAST MILE DELIVERY

Phagya V R[1], Dr. Madhumita. G[2]

II MBA, Department of Management Studies, School of Management Studies, Vels Institute of Science Technology and Advanced Studies (VISTAS) Pallavaram, Chennai[1]

Professor, Department of Management Studies, School of Management Studies, Vels Institute of Science Technology and Advanced Studies (VISTAS) Pallavaram, Chennai.[2]

Abstract: The causes of port delays are investigated in this project, and also the ways in which they impact last-mile delivery (LMD) operations. Disruptions can seriously affect downstream logistics, resulting in missed delivery deadlines, higher storage costs, and operational inefficiencies, given the vital role ports play in the global supply chain. The study identifies the main causes of port delays, including heavy cargo loads, problems with customs clearance, and bad weather, and investigates how these causes affect stakeholders involved in last-mile delivery. The study assesses the degree of association between particular delay causes and LMD impacts using statistical analysis, specifically Chi-square tests and Multiple Response Analysis. The results point out how important it is to address port inefficiencies by implementing digital and automated systems, enhancing port infrastructure, coordinating with freight forwarders more effectively, and expediting customs clearance. Strategies like forming alliances with alternate transportation providers, reserving warehouse space in advance, employing airlift and expedited shipping for urgent shipments, improving real-time tracking, and taking into account alternate ports are all advised in order to reduce last-mile disruptions. The insights are intended to help freight operators, port authorities, and logistics providers create proactive plans that improve customer satisfaction and supply chain resilience.

Keywords: Port delays – Last – mile disruptions (LMD) – Supply chain disruptions – Customs Clearance – Port Infrastructure – Expedited Delivery – Real time tracking – Logistics Management

I. INTRODUCTION

Ports are essential entry points for international trade because they make it easier for goods to move between markets. Port delays, on the other hand, have become a major bottleneck in the logistics chain, interfering with the efficient movement of cargo and making last-mile delivery (LMD) operations difficult. Numerous factors, including heavy cargo volumes, ineffective customs clearance, unfavourable weather, and infrastructure constraints, can cause these delays. Missed delivery dates, higher transportation and warehousing expenses, and decreased customer satisfaction are all consequences of shipments being delayed at ports.

It is becoming more crucial than ever to comprehend how port delays affect last-mile delivery given the growing complexity and interconnectedness of supply chains. The main causes of port delays are examined in this project, along with their effects on the dependability and efficiency of LMD operations. The study determines the tactics logistics providers use to lessen these disruptions using statistical tools like multiple response analysis and chi-square analysis. It also looks at operational changes, communication difficulties, and suggestions for lowering the risks associated with delays.

The results are intended to provide useful information for port officials, freight forwarders, logistics firms, and other interested parties. In an increasingly dynamic global economy, this study helps to improve supply chain resilience, operational efficiency, and customer satisfaction by highlighting important pain points.

THE STATEMENT OF THE PROBLEM:

The efficiency and dependability of last-mile delivery (LMD) operations are directly impacted by port delays, which have emerged as a major issue in global supply chains. Frequent disruptions at ports are caused by a number of factors, including traffic, slow customs clearance, bad weather, and infrastructure limitations. In addition to delaying the flow of goods, these delays expand logistics expenses, cause deliveries to be delayed, and aggravate customers. The reliance on efficient port operations is still a significant vulnerability, even with improvements in supply chain technology.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125164

Communication breakdowns, operational inefficiencies, and financial losses are the results of many logistics providers' inabilities to quickly adjust to unanticipated delays. Analyzing the underlying reasons for port delays and comprehending how they affect last-mile delivery performance is imperative.

PRIMARY OBJECTIVE:

To examine the impact of port delays on last-mile distribution by analyzing how disruptions at ports affect delivery timelines, transportation efficiency, and overall supply chain reliability.

SECONDARY OBJECTIVE:

- To Identifying factors causing port delays.
- To Examining their impact on delivery schedules and efficiency.
- To Exploring mitigating strategies.

RESEARCH QUESTIONS:

1. Which are the main causes of port delays in international supply chains?
2. How do port delays impact the efficiency and reliability of last- mile delivery (LMD) operations?
3. What strategies are logistics providers adopting to mitigate the effects of port – related disruptions on LMD?
4. How do communication challenges during port delays affect customer satisfaction and supply chain coordination?
5. What measures can be implemented to reduce the occurrence of port delays and improve last – mile delivery performance?

SIGNIFICANCE OF THE STUDY:

This study provides useful information for supply chain managers, port authorities, and logistics providers by highlighting the crucial connection between port delays and last-mile delivery (LMD) performance. The study offers effective ways to reduce interruptions and improve operational resilience by determining the primary reasons for port delays and analyzing how they affect LMD. The results are intended to encourage better coordination among supply chain participants, enhance customer satisfaction, and facilitate more effective logistics planning. In the end, the study helps make global supply chains more reliable and responsive in a market that is becoming more and more competitive.

II. LITERATURE REVIEW

Zhu et al. (2023) examined the evolution of last-mile delivery systems and the challenges of ensuring efficient, cost-effective distribution. The study discovered problems like urban congestion, growing consumer expectations, and technology use through surveys and interviews with logistics companies, e-commerce companies, and urban planners. To boost performance, the authors suggested making investments in sustainable delivery practices, effective route planning, and clever logistics.

Mthembu, S. M., and Naude, M. J. (2023) conducted a study titled "The impact of disruptions on the operations and performance of the Durban Port. The study discovered that disruptions resulted in longer vessel turnaround times and monetary losses through interviews with port officials and logistics operators. Enhancing contingency planning, investing in digital tracking, and upgrading infrastructure were among the recommendations.

Sahu, P.K., Pani, A., and Santos, G. (2022) completed a study on "Freight Traffic Impacts and Logistics Inefficiencies in India: Policy Interventions and Solution Concepts for Sustainable City Logistics". The study found problems like inadequate infrastructure, obstacles from regulations, traffic in cities, and environmental issues. Results indicated a rise in carbon emissions, delivery delays, and transportation expenses. To increase urban freight efficiency, the study suggested policy interventions like funding multimodal infrastructure, smart logistics, and green logistics techniques.

7Bai, X., Jia, H., and Xu, M. (2022) conducted a study titled "Identifying Port Congestion and Evaluating Its Impact on Maritime Logistics." They discovered elements such as increasing cargo volumes, ineffective terminal operations, a lack of workers, and regulatory obstacles by using port reports, interviews, and surveys. Congestion increased shipping costs and caused cargo delays, according to the study. To increase efficiency, it suggested port automation, better vessel scheduling, and better coordination.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125164

Notteboom T., Rodrigue J.P. (2020) conducted research on "port congestion and its impact on global supply chains", demonstrating how delays are caused by growing trade volumes and inadequate management. According to their research, traffic strains inland transportation and raises operating costs. To lessen traffic and avoid supply chain interruptions, they suggested investments in infrastructure, automation, digitization, and improved demand forecasting.

III. RESEARCH METHODOLOGY

RESEARCH DESIGN:
To examine how port delays, affect last-mile delivery, a quantitative, descriptive research design was employed.

SAMPLING METHOD:
Port authorities, freight forwarders, and logistics providers were chosen using convenience sampling and snow ball sampling method.

SAMPLE SIZE:
One hundred respondents in all took part in the research.

DATA COLLECTION METHOD:
Surveys and structured questionnaires were used to gather primary data.

DATA ANALYSIS TOOLS:
SPSS software was utilized to interpret the data using chi-square analysis and multiple response analysis.

VARIABLES:
Dependent variables: Effect on last-mile delivery operations;
Independent variables: Reasons for port delays.

ETHICAL CONSIDERATIONS:
Ethical considerations included obtaining informed consent, protecting participant confidentiality, and using data only for research.

LIMITATIONS:

- There were only 100 participants in the sample, which limited how broadly the results could be applied.
- Not all parties involved in port operations and last-mile delivery may be adequately represented by convenience sampling.
- Deeper research into the long-term effects of port delays was not possible due to time constraints.

RESULTS:

- 45% of those surveyed had zero to two years of experience.
- 65% of those surveyed handled containerized cargo (FCL/LCL).
- Of those surveyed, 56% reported occasional port delays (10–30% of shipments).
- 55% of those surveyed reported that port delays typically lasted one to three days.
- According to 38% of those surveyed, last-mile delivery delays occur for 10–30% of their shipments.
- According to 47% of respondents, customers rarely cancel shipments because of excessive port delays
- Half of those surveyed thought that a centralized digital system could help cut down on delays.

WEIGHTED AVERAGE:
FACTORS CONTRIBUTING TO PORT DELAYS AND THEIR FREQUENCY:

Factors	Average	Rank
Port Congestion	21.8	I
Documentation Errors	20.3	II
Bad Weather Conditions	18.5	III
Customs clearance Issues	17.8	IV
Infrastructure Limitations	15.6	V
Government regulations and inspections	14.8	VI
Strikes or Labour shortages	14.7	VII

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125164

The study highlights port congestion as the top causes of delays, with documentation errors and weather conditions following closely. Customs clearance, infrastructure challenges, regulations and labour strikes are also identified though they had a comparatively smaller impact.

IMPACT OF PORT DELAYS ON LAST-MILE DELIVERY:

Factors	Average	Rank
Missed Delivery Deadlines	25.4	I
Customer Dissatisfaction & Penalties	24.5	II
Limited Carrier Availability	19.3	III
Increased transportation cost	19.3	III
Operational disruptions & rerouting	18.9	V
Higher fuel consumption	18	VI
Storage and warehousing issues	17.4	VII

Missed delivery deadlines and customer dissatisfaction emerged as the top impacts of port delays on last-mile delivery, followed by limited carrier availability, increased transportation cost, operational disruptions, storage & warehousing issues and higher fuel consumptions.

CORRELATION ANALYSIS:

The study conducted spearman's rho correlation test to examine the strength and direction of relationships between various delays factors and their impacts on last-mile delivery (LMD).

Factor	Impact	r - value	P - value	Result
Port congestion	Delivery deadlines	0.381	<.001	Weak but significant
Infrastructure limitations	Operational disruptions	0.213	0.033	Weak but significant
Bad weather	Customer dissatisfaction & penalties	0.041	0.688	Very weak, not significant
Customs clearance issues	Storage & warehousing issues	0.192	0.055	Very weak, not significant

These findings suggest that **port congestion** and **infrastructure limitations** have weak but statistically significant correlations with missed delivery deadlines and operational disruptions, respectively. In contrast, **bad weather** and **customs clearance issues** do not show significant correlations with their associated impacts indicating a weaker or inconsistent influencer on last – mile delivery inefficiencies.

MULTIPLE RESPONSE ANALYSIS:

The key findings from Multiple Response Analysis (MRA) are summarized below. This table highlights the major response patterns from participants.

Area Analyzed	Major Findings	Least Findings
Regions frequently experiencing port delays	Africa (21%), South Asia (20%)	East Asia (12%), North America (9%)
Months with most port delays	No Seasonal trend (39.6%), Oct–Dec (20.8%)	Jan–Mar (9.4%), Jul–Sept (13.2%)
Communication challenges during delays	Confusion over charges (23.9%), Uncertainty in tracking shipments (23.4%)	Difficulty in updating customers (19.6%), No major challenges (10.9%)
Measures to reduce port delays	Coordination between port authorities & freight forwarders (24.1%), Digitization & automation (24.1%)	Faster customs clearance (17.3%), Port infrastructure (16.8%)

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 12, Issue 5, May 2025

DOI: 10.17148/IARJSET.2025.125164

Managing last mile disruptions	Real-time tracking (29.2%), Improved coordination with port authorities (26.9%)	Expedited trucking (12.9%), rerouting trucking (11.7%)
Infrastructure improvements	Use of technology like AI & IoT (27%), Dedicated lanes for time-sensitive cargo (24.3%)	Rail connectivity (15.9%), Road infrastructure (15.3%)
Improving communication across supply chain actors	Automating status updates (23.7%), Establishing direct coordination channels (23.2%)	Regular training (14.4%), real time shipment visibility (16%)
Contingency plans	Airlifting urgent shipments (27.1%), Expedited delivery services (22.3%)	Stockpiling goods (12.8%), prebooked storage space (17.6%)

These results suggest that considering real-time tracking, infrastructure upgrades, and improved coordination are making significant progress in reducing port delays, there are still issues, especially with communication and contingency plans. Depending on their operations and geographic location, businesses are continuing to respond to these challenges to differing degrees. Opportunities for additional improvement, like utilizing automation, improving rail connectivity, and boosting staff training for improved coordination during disruptions, are highlighted by the least frequent findings.

DISCUSSIONS:

This study's main goal was accomplished when it successfully investigated how port delays affect last-mile distribution. Results showed that port delays significantly impacted delivery schedules and supply chain dependability by frequently resulting in missed delivery deadlines, unhappy customers, and higher transportation expenses.

With respect to the first secondary goal, weighted average analysis was used to determine the main causes of port delays. The top three factors were port congestion, documentation errors, and inclement weather. Infrastructure constraints and problems with customs clearance also played a significant role. By examining how last-mile disruptions like restricted carrier availability, operational rerouting, and increased fuel consumption affected delivery efficiency, the second secondary goal was achieved.

Finally, the study investigated mitigation strategies in order to address the third secondary objective. To lessen the negative effects of port delays, respondents highlighted expedited customs clearance, digitization of port operations, enhanced stakeholder communication, and backup plans like strategic warehousing and expedited deliveries.All things considered, the results successfully complemented and matched the stated study goals.

IV. CONCLUSIONS

The study emphasizes that proactive attention to port efficiency and last-mile coordination is necessary to increase supply chain resilience. Reducing disruptions requires embracing technology-driven solutions, fortifying infrastructure, and encouraging improved stakeholder collaboration. Distribution reliability will be further improved by addressing workforce issues and regulatory bottlenecks. The results emphasize that last-mile success is directly impacted by responsiveness and flexibility at ports. Strategic investments and contingency strategies should be given top priority in future initiatives to guarantee more seamless operations even in the face of unforeseen disruptions.

REFERENCES

[1]. Notteboom, T., & Rodrigue, J.P. (2020). Port congestion and its impact on global supply chains. *Maritime Economics & Logistics, 22(1), 15-35.*

[2]. Bai, X., Jia, H., & Xu, M. (2022). Identifying port congestion and evaluating its impact on maritime logistics. *Journal of Maritime Studies, 10(3), 145-160.*

[3]. Sahu, P.k., Pani, A., & Sanots, G. (2022). Freight traffic impacts and logistics inefficiencies in India: Policy interventions and solutions concepts for sustainable city logistics. *Sustainable Transportation Journal, 6(4), 230-250.*

[4]. Mthembu, S.M., & Naude, M.J., (2023). The impact of disruptions on the operations and performance of the Durban port. *African Journal of Transport Management, 9(1), 70-85.*

[5]. Zhu, X., Cai, L., Lai, P.-L., Wang, X., & Ma, F. (2023). Evolution, challenges, and opportunities of transportation methods in the last-mile delivery process. *International Journal of Logistics Innovation, 11(2), 180-195*

[6]. http://www.wikipedia.com/

[7]. https://www.shippingandfreightresource.com/

[8]. https://www.researchgate.net

