

International Journal Research Publication Analysis

Page: 01-22

PORT CONGESTION AND CARGO DELIVERY TIME AT APAPA SEAPORT, LAGOS

Oyakhamoh, I.,^{*1} Prof C. H. Wizer² & Dr. K. A. Ibiama³

^{1,2}Centre for Logistics and Transport Studies, University of Port Harcourt, Rivers state, Nigeria.

³Department of Transport and Logistics, Federal Polytechnic of Oil and Gas, Bonny, Rivers State, Nigeria.

Article Received: 28 August 2026

Article Revised: 16 September 2026

Published on: 06 October 2026

*Corresponding Author: Oyakhamoh, I.

Centre for Logistics and Transport Studies, University of Port Harcourt, Rivers state, Nigeria.

DOI: <https://doi-doi.org/101555/ijrpa.2365>

ABSTRACT

This article examined the effect of port congestion on cargo delivery time at Apapa Seaport, Lagos, drawing specifically from the first objective of Oyakhamoh Ibrahim's dissertation on the determinants of port congestion and supply chain efficiency in Apapa Seaport. The article focused on congestion as an operational condition arising from the interaction of vessel waiting time, truck queues, cargo evacuation constraints, terminal capacity, cargo dwell time and related coordination challenges. The source study adopted a descriptive and correlational survey design and collected questionnaire responses from port and logistics personnel. Chapter Four reported 306 valid responses and applied descriptive statistics and Pearson Product Moment Correlation (PPMC). The univariate results showed agreement that congestion increases the time required to deliver cargo, creates long truck queues, reduces cargo-delivery efficiency, produces unpredictable delivery schedules and that congestion reduction would improve delivery speed and reliability. The PPMC result reported a statistically significant relationship between the two measures used for the first hypothesis, with $r = -0.159$ and $p = 0.005$. Accordingly, the first null hypothesis was rejected. The article interprets the result within the conceptual and theoretical arguments presented in the dissertation, particularly Queuing Theory, Systems Theory and Supply Chain Management Theory. The evidence indicates that cargo delivery performance at Apapa cannot be separated from the capacity, coordination and reliability of the wider port and inland logistics system. The article concludes that congestion management should combine improved berth and truck

scheduling, cargo evacuation coordination, digital information exchange and multimodal transport capacity rather than rely on a single intervention.

KEYWORDS: Apapa Seaport; port congestion; cargo delivery time; truck queues; vessel waiting time; supply chain efficiency; maritime logistics; Lagos.

1. INTRODUCTION

1.1 Background to the Study

Seaports are critical interfaces between maritime transport and inland distribution systems. The dissertation identifies the strategic importance of ports through the observation that more than 80% of the volume of international merchandise trade is transported by sea, making port performance consequential for the speed, reliability and cost of international trade (UNCTAD, 2023). When port operations function efficiently, cargo can move through vessel arrival, berthing, discharge, documentation, clearance, storage and inland evacuation with relatively limited interruption. When congestion develops, however, delays at one stage can be transmitted to other stages of the logistics chain.

Apapa Seaport occupies a particularly important position in Nigeria's maritime and logistics system because of its relationship with Lagos, a major commercial and industrial centre. The dissertation describes Apapa as a principal gateway for containerized cargo, industrial inputs, petroleum-related cargoes, food products, machinery and manufactured goods. Its importance creates high demand for berth capacity, cargo-handling equipment, storage space, access roads, truck services, customs processing and inland distribution. Consequently, the performance of Apapa is not limited to activities inside terminal boundaries; it is linked to road, rail, barge, customs, freight-forwarding and distribution systems connected to the port.

Port congestion may be understood as a condition in which the demand placed on port services and associated transport infrastructure exceeds the available capacity for timely service. In operational terms, the condition is visible through vessel waiting, queues of trucks, prolonged cargo dwell, slow cargo handling, delays in documentation and difficulties in evacuating cargo. The dissertation emphasizes that congestion at Apapa is multidimensional and should not be reduced to road traffic alone. It is produced through interactions among vessel operations, terminal capacity, cargo clearance, truck management, infrastructure and administrative processes.

The relationship between congestion and cargo delivery time is particularly important because cargo delivery time represents the period required for goods to move from the port

interface to their intended inland destination. A delay at the port can extend the total logistics lead time even when inland transport itself is relatively efficient. Similarly, a truck that spends extended time waiting to enter a terminal completes fewer productive trips, while cargo that remains in the terminal occupies scarce space and may generate additional storage or demurrage exposure. These effects make cargo delivery time a practical indicator of port and supply-chain performance.

Recent developments discussed in the dissertation show that the congestion problem has been addressed through several interventions, including the Electronic Truck Call-Up System (ETO), road rehabilitation, rail freight initiatives, port automation and other measures intended to improve cargo evacuation. The source dissertation notes, however, that the persistence of congestion despite such interventions indicates that multiple determinants operate simultaneously. The empirical question is therefore not simply whether congestion exists, but whether congestion is significantly associated with the time required to deliver cargo.

Within this context, the first objective of the study examined the effect of port congestion on cargo delivery time at Apapa Seaport, Lagos. The objective was operationalized through questionnaire statements addressing delivery delay, truck queues, vessel and truck waiting time, unpredictability of delivery schedules, and the expected effect of reducing congestion on delivery speed and reliability. The resulting evidence provides a focused basis for discussing how congestion conditions translate into supply-chain delivery outcomes.

1.2 Statement of the Problem

The central problem addressed by the first objective is the continuing difficulty of achieving timely and reliable cargo delivery through Apapa Seaport despite repeated efforts to improve port operations. The dissertation reports that Nigerian port cargo throughput increased substantially between 2023 and 2024, while container throughput also increased. Such growth places additional pressure on terminals, cargo-handling facilities, access roads, truck-management systems and inland evacuation infrastructure. Where service capacity does not expand at the same pace as demand, queues and waiting conditions can emerge.

At Apapa, truck traffic represents one visible manifestation of congestion. The dissertation discusses historical evidence of large numbers of trucks around the Apapa corridor and notes that road capacity, exit-point constraints and truck movements have contributed to persistent congestion. The introduction of ETO was intended to regulate truck access, yet the source also records continuing concerns associated with terminal processing capacity, infrastructure constraints, access roads, road works and illegal checkpoints. These observations suggest that

scheduling technology may improve coordination but cannot, by itself, eliminate capacity constraints.

A second dimension is cargo dwell and clearance. When cargo remains in a terminal because documentation, inspection, customs release or inland evacuation is delayed, terminal space is occupied for longer. This can make subsequent cargo processing more difficult and create a reinforcing congestion cycle. For importers, exporters and logistics firms, the consequence is uncertainty about when cargo will be available for onward delivery.

The practical problem is therefore a supply-chain problem as much as a port problem. Delayed cargo delivery can affect production planning, customer service, inventory decisions, transportation utilization and business costs. The first objective of the dissertation addresses this problem by empirically testing whether the measures of port congestion used in the questionnaire are significantly related to the cargo-delivery performance measure used in the study.

1.3 Objective of the Article

The article pursued the first objective of the dissertation: to examine the effect of port congestion on cargo delivery time at Apapa Seaport, Lagos. In line with the source study, the analysis considered the relationship between port congestion and cargo delivery performance rather than treating congestion as an isolated physical phenomenon.

1.4 Research Question

To what extent does port congestion affect cargo delivery time at Apapa Seaport, Lagos?

1.5 Research Hypothesis

H₀₁: There is no significant relationship between port congestion and cargo delivery time at Apapa Seaport, Lagos.

2. Literature Review

2.1 Concept of Port Congestion

The dissertation conceptualizes port congestion as a situation in which the volume of ships, cargoes, trucks and associated logistics activities exceeds the handling and operational capacity of the port. The resulting manifestations include delays in vessel berthing, cargo clearance, freight movement and other port operations. Rodrigue (2020) and the broader literature in the dissertation indicate that congestion becomes more likely when throughput demand grows faster than infrastructure and logistics-support capacity.

Congestion has both a maritime and landside dimension. On the maritime side, vessels may wait for berths, cargo-handling services or clearance processes. On the landside, trucks may

queue for terminal access or cargo release. Between these two dimensions are storage, customs, documentation, inspection and cargo-handling processes. A delay in any one component may affect the timing of subsequent activities. This systems perspective is consistent with the dissertation's conceptual framework, which links infrastructure and facilities, operational factors, regulatory and administrative factors, and market factors to port congestion.

At Apapa, road dependence intensifies the relationship between congestion and cargo delivery. The dissertation reports that road transport has historically carried the dominant share of cargo leaving the port, while rail and inland-waterway alternatives have had more limited capacity. A high dependence on trucks means that access-road conditions and truck scheduling directly affect the time between cargo release and inland delivery.

Congestion is also connected with cargo dwell time. Ezenwa and Chukwu (2024) are cited in the dissertation in relation to cargo dwell and operational efficiency at Apapa. The source literature explains that prolonged dwell occupies terminal space, raises storage-related exposure and reduces the capacity available for newly arriving cargo. Thus, congestion can be both a cause and a consequence of extended cargo residence within the port.

Digitalization is another dimension. The dissertation discusses electronic documentation, cargo tracking, customs automation and the ETO system as mechanisms intended to improve coordination and reduce avoidable waiting. The effectiveness of digital systems nevertheless depends on their integration with physical capacity, institutional coordination and reliable information flows. Digital scheduling cannot completely compensate for insufficient terminal, road, rail or cargo-handling capacity.

2.2 Concept of Cargo Delivery Time

Cargo delivery time refers, in the context of the first objective, to the time required for cargo to move through the port-related logistics process to its final or intended destination. The dissertation links delivery performance to vessel and truck waiting, cargo handling, customs procedures, truck access, evacuation and inland transportation. This makes delivery time a composite outcome influenced by several interconnected activities rather than a measure determined solely by the terminal.

An efficient cargo-delivery process should be predictable as well as fast. Importers and consignees need reasonable certainty about when cargo will become available because production, inventory replenishment, customer fulfillment and distribution schedules depend on that information. Consequently, the dissertation included an item addressing unpredictable cargo delivery schedules, not only absolute delay.

Delivery reliability is also important for transport operators. A truck that spends excessive time waiting at a port has lower asset utilization and may incur additional fuel, labour and opportunity costs. The effect can propagate to other shipments because vehicle availability is reduced. Therefore, congestion may affect the supply chain even where the direct physical movement of a particular container is eventually completed.

From a supply-chain perspective, cargo delivery time is closely related to lead time and responsiveness. Christopher (2016) and Bowersox, Closs and Cooper (2019), cited in the dissertation's reference base, emphasize coordination, responsiveness and the integration of logistics activities. Applied to Apapa, the implication is that delivery performance depends on the synchronization of maritime operations, terminal processes, regulatory clearance and inland transport.

2.3 Relationship Between Port Congestion and Cargo Delivery Time

The theoretical relationship is straightforward: when congestion increases waiting and processing time, total cargo delivery time is expected to increase. Queuing Theory provides a formal explanation. When arrival demand exceeds service capacity, waiting lines grow and service delays become longer. At a seaport, ships, trucks and cargoes can be regarded as users of limited service facilities such as berths, gates, cranes, storage areas and inspection points (Erlang, 1909; Gross and Harris, as discussed in the dissertation).

Systems Theory adds a broader explanation because the port operates as an interconnected system. A delay at the gate can affect terminal access; a delay in customs can prolong cargo dwell; prolonged dwell can reduce available storage space; reduced storage space can affect handling operations; and those disruptions can subsequently affect truck scheduling. Bertalanffy's systems perspective therefore supports the dissertation's treatment of congestion as an interaction among components rather than as a single isolated variable.

Supply Chain Management Theory further explains why a port delay can influence firms outside the port. Christopher (2016) emphasizes the integration of logistics activities across interconnected networks. In the Apapa setting, a cargo-delivery delay can affect manufacturing inputs, inventory replenishment, distribution schedules and customer service. The port is therefore one node in a larger network, and congestion at that node can create downstream consequences.

The empirical literature summarized in the dissertation generally supports the existence of this relationship. Studies cited in the source review associate truck congestion, cargo dwell, customs delays, infrastructure limitations and operational inefficiencies with longer cargo processing and delivery times. The dissertation's own empirical test is important because it

converts those general observations into a statistical test using respondents operating in the Apapa port environment.

2.4 Empirical Evidence Reported in the Dissertation

Adeyemi Johnson and Chukwuemeka Okafor (2026), as reported in the dissertation's empirical review, examined port congestion and supply-chain efficiency at Apapa and found that excessive truck traffic, prolonged cargo dwell and inadequate transport infrastructure were associated with increased logistics costs and reduced cargo-delivery efficiency. The study supports the proposition that congestion has consequences beyond the terminal gate.

Grace Ekanem (2025) examined port congestion and logistics costs using data from importers, exporters and shipping companies operating through Apapa. The dissertation reports that vessel waiting, customs delays and truck congestion were associated with higher demurrage, fuel and warehousing costs. Although the outcome differs from cargo delivery time, the study provides supporting evidence that congestion imposes measurable logistics consequences.

Michael Adewale and Binta Lawal (2024) examined truck congestion and freight distribution within Lagos State. The dissertation reports that excessive truck traffic contributed to transportation delays, fuel wastage and increased operating costs, while freight distribution time increased during periods of severe congestion. This is closely aligned with the first objective because it connects the physical manifestation of congestion—truck queues—with time-based freight performance.

Ahmed Musa (2024) examined port congestion and international trade performance and reported that persistent congestion at Apapa affected import and export activities by increasing transaction costs and reducing trade efficiency. The study supports the wider argument that delays in port operations can influence the performance of trade-related logistics systems.

Chioma Obi (2024) examined logistics inefficiencies and manufacturing productivity and found that cargo delays and transportation disruptions affected production schedules, inventory management and customer delivery performance. The finding demonstrates the downstream significance of cargo-delivery delays, particularly for firms that depend on imported inputs.

Olusegun Adebayo (2025) assessed the ETO system and reported improvements in truck scheduling but continuing challenges associated with system manipulation, enforcement and infrastructure. The evidence is relevant because it indicates that congestion-management

technology can improve coordination without necessarily removing all structural causes of delay.

David Olatunji and Moses Uche (2025) examined rail development and cargo evacuation at Apapa and reported some improvement in cargo evacuation following rail freight reactivation, while noting that rail capacity remained limited relative to cargo demand. This evidence reinforces the importance of multimodal evacuation when addressing congestion-related delivery delays.

Ngozi Eze (2025) examined customs procedures and cargo clearance efficiency and reported that bureaucratic bottlenecks, multiple inspections, weak digital integration and policy inconsistencies contributed to prolonged cargo dwell and supply-chain delays. This evidence indicates that congestion-related delivery performance can be influenced by administrative processes as well as physical infrastructure.

2.5 Theoretical Framework

2.5.1 Queuing Theory

Queuing Theory is central to the first objective because congestion is fundamentally a waiting-line phenomenon. The dissertation traces the theory to Erlang (1909), who studied waiting and service capacity in telephone systems. The theory later became relevant to transport terminals and maritime operations because ships, trucks and cargoes arrive for service at facilities with finite capacity.

In the Apapa environment, berth capacity, terminal gates, cranes, inspection points, storage facilities and truck-access systems can all function as service points. When arrivals exceed service capacity, queues form. The theory therefore provides a direct explanation for why long truck queues and vessel waiting periods can increase cargo delivery time.

The theory also emphasizes service discipline and scheduling. ETO, berth scheduling and cargo coordination can be interpreted as attempts to manage arrivals and improve service utilization. However, the dissertation also recognizes that mathematical queuing assumptions may not fully capture institutional, human and governance factors. This limitation is important because congestion at Apapa can be affected by administrative processes and coordination failures as well as arrival and service rates.

Despite these limitations, Queuing Theory provides the most direct theoretical explanation for the first objective: increased waiting caused by constrained capacity or inefficient service processes can lengthen the time required to complete cargo movement.

2.5.2 Systems Theory

Systems Theory, associated in the dissertation with Bertalanffy (1968), views an organization or operational environment as a set of interdependent components. The theory is relevant because cargo delivery is not produced by one department or facility. Vessel operations, terminal handling, customs clearance, truck scheduling, roads, rail, barges and information systems interact.

A systems perspective also explains why a localized improvement may produce limited overall gains if other bottlenecks remain. For example, faster cargo handling inside a terminal may not substantially improve total delivery time if trucks cannot access the terminal or if cargo release procedures remain slow. The theory therefore supports coordinated interventions across the port and its hinterland.

2.5.3 Supply Chain Management Theory

Supply Chain Management Theory emphasizes the coordination and optimization of goods, information and services from origin to final consumer. Christopher (2016) and Mentzer et al. (2001), cited in the dissertation, emphasize integration, responsiveness and information flow. The theory explains why port congestion can create downstream effects for inventory, production and distribution.

For the first objective, the theory establishes that cargo delivery time is a supply-chain outcome. A container that arrives at the port but cannot be evacuated efficiently has not achieved effective delivery. Consequently, improving cargo delivery requires coordination between maritime operations, terminal activities, regulatory procedures and inland transportation.

3. METHODOLOGY

The source dissertation adopted a descriptive and correlational survey design. The descriptive component was intended to describe respondent perceptions and operational conditions, while the correlational component was used to examine relationships among the study variables. For this article, the first objective was isolated from the wider study and the analysis reported for port congestion and cargo delivery time was retained.

The study area was Apapa Seaport and the surrounding logistics corridor in Lagos State. The dissertation describes Apapa as a major Nigerian maritime gateway connected to shipping lines, freight forwarders, customs operations, transport operators, logistics providers and port users. The geographical focus was therefore appropriate for a study of congestion and cargo delivery.

The population was stated as 1,300 persons across six groups: shipping companies, freight forwarding companies, customs personnel, transport operators, logistics personnel and port users. The dissertation states that the Taro Yamane formula produced a sample size of 306 at a 0.05 level of precision. A later methodological statement mentions a final sample of 100 for manageability, but Chapter Four reports 306 questionnaires administered, retrieved, validated and analyzed. Because the first-objective results and the PPMC table both report $N = 306$, this article follows the analyzed sample of 306 responses.

Primary data were collected through a structured questionnaire. The questionnaire used agreement categories and included five items for the first objective. The source instrument addressed whether congestion increases delivery time, whether truck queues delay evacuation, whether vessel and truck waiting time reduces delivery efficiency, whether congestion makes delivery schedules unpredictable, and whether reducing congestion would improve speed and reliability.

Validity was addressed through expert review, while reliability was assessed through a pilot study and Cronbach's alpha, with 0.70 or above stated as the acceptable benchmark. The data-analysis plan included frequencies, percentages, mean scores, standard deviation, Pearson Product Moment Correlation and regression analysis using SPSS. For the first objective, the reported inferential test was PPMC.

Interpretation of the univariate results followed the source dissertation's decision rule: a mean of 2.50 or above indicated agreement, while a mean below 2.50 indicated disagreement. The hypothesis was tested at the 5% significance level. A p-value below 0.05 led to rejection of the null hypothesis.

4. RESULTS AND ANALYSIS

4.1 Profile of the Analyzed Responses

Chapter Four of the dissertation reported 306 valid questionnaires, representing 100% of the questionnaires administered and retrieved. The respondent profile showed substantial experience in port and logistics activities: 93.8% of the respondents had at least six years of work experience. This is relevant to the interpretation of the congestion responses because the majority had extended exposure to operational conditions within their respective roles.

Table 1: Summary of Response and Experience Profile Relevant to Objective One.

Indicator	Result
Questionnaires administered	306
Questionnaires retrieved	306 (100.0%)
Valid questionnaires analyzed	306 (100.0%)
Respondents with 6–10 years' experience	93 (30.4%)
Respondents with 11–15 years' experience	148 (48.4%)
Respondents with 16+ years' experience	46 (15.0%)
Respondents with 6+ years' experience	287 (93.8%)

Source: Research Survey (2026), as reported in the source dissertation.

4.2 Univariate Analysis of Port Congestion and Cargo Delivery Time

The first objective was assessed through five questionnaire items. The results reported in Table 4.7 of the dissertation showed that every item recorded a mean above the 2.50 decision benchmark. Thus, respondents generally agreed that congestion affects cargo delivery performance at Apapa Seaport.

Table 2: Univariate Analysis of Port Congestion and Cargo Delivery Time at Apapa Seaport.

No.	Questionnaire item (condensed)	SA %	A %	D %	SD %	Mean	Decision
1	Congestion increases time to final destination	42.5	37.5	12.5	7.5	3.15	Agreed
2	Truck queues delay timely cargo evacuation	38.8	41.3	12.5	7.5	3.11	Agreed
3	Vessel/truck waiting reduces delivery efficiency	36.3	42.5	13.8	7.5	3.08	Agreed
4	Congestion creates unpredictable delivery schedules	33.8	43.8	13.8	8.8	3.03	Agreed
5	Reducing congestion improves delivery speed/reliability	45.0	40.0	10.0	5.0	3.25	Agreed

Source: Research Survey (2026); adapted from Table 4.7 of the source dissertation.

Item 1 recorded a mean of 3.15, with 80.0% of respondents either strongly agreeing or agreeing that congestion increases the time required to deliver cargo to its final destination. This is the most direct descriptive evidence for the first objective. The result indicates that the dominant response pattern associated congestion with longer delivery time.

Item 2 recorded a mean of 3.11. A combined 80.1% of respondents strongly agreed or agreed that long truck queues cause delays in timely cargo evacuation. The result connects the general concept of congestion to a specific operational mechanism: truck queues. This is

important because road-based evacuation is a major component of the Apapa logistics system.

Item 3 produced a mean of 3.08, with 78.8% selecting either strongly agree or agree. Respondents therefore generally perceived vessel and truck waiting time as reducing cargo-delivery efficiency. The result indicates that congestion is not confined to a single transport mode; waiting can occur at both the maritime and landside interfaces.

Item 4 recorded a mean of 3.03. A combined 77.6% agreed or strongly agreed that congestion creates unpredictable cargo-delivery schedules for importers and consignees. This finding extends the interpretation from speed to reliability. Uncertainty in delivery timing can complicate inventory replenishment, production planning and customer commitments.

Item 5 recorded the highest mean, 3.25, with 85.0% of respondents selecting strongly agree or agree that reducing congestion would improve cargo-delivery speed and reliability. The result provides a strong descriptive indication that respondents perceived congestion reduction as relevant to delivery performance.

4.3 PPMC Analysis and Hypothesis Test

Table 3: Pearson Product Moment Correlation for Objective One.

Variables	N	Pearson r	p-value	Decision	Interpretation
Port congestion ↔ cargo-delivery performance measure	306	-0.159	0.005	Reject H_{01}	Statistically significant relationship

Source: Research Survey (2026); adapted from Table 4.11 of the source dissertation.

Table 4.11 of the dissertation reported a Pearson correlation coefficient of $r = -0.159$ with $p = 0.005$ and $N = 306$. The reported p-value is below the 0.05 significance level, and therefore the null hypothesis was rejected. The result indicates a statistically significant relationship between the two questionnaire measures used to represent congestion and cargo-delivery performance.

The negative sign of the coefficient should be interpreted in relation to the wording of the two questionnaire items rather than as evidence that congestion reduces delivery time. The first item was worded as congestion increasing the time required to deliver cargo, whereas the

second item was worded as reducing congestion improving the speed and reliability of delivery. Because the items are framed in opposite directions, the negative correlation is directionally consistent with the expected relationship between congestion and delivery performance. The substantive conclusion in the dissertation is that the measures are significantly related.

The coefficient magnitude, $|r| = 0.159$, represents a weak linear association between the two specific questionnaire measures. Statistical significance therefore should not be interpreted as a large effect. Rather, the result indicates that the relationship was unlikely to have arisen by random sampling variation under the null hypothesis at the 5% level. Other operational variables not captured by this bivariate test may also contribute to cargo delivery time.

5. DISCUSSION OF FINDINGS

The first objective found that respondents generally associated port congestion with longer cargo delivery time at Apapa Seaport. The descriptive findings were consistent across all five questionnaire items. Congestion was associated with increased delivery time, truck queues, waiting time, unpredictable delivery schedules and an expected improvement in delivery performance if congestion were reduced.

The result is consistent with Queuing Theory because congestion is expected when demand for limited service facilities exceeds service capacity. At Apapa, truck access, berth availability, cargo-handling capacity and clearance processes can generate waiting lines. The questionnaire results specifically identified truck queues and vessel/truck waiting as practical mechanisms through which congestion is experienced.

The finding also agrees with Systems Theory. Cargo delivery depends on the interaction of multiple subsystems. A delay at the gate, terminal, customs point or evacuation route can affect the performance of other components. The significance of this perspective is that an intervention directed at only one component may not eliminate total delivery delay if another component remains constrained.

Supply Chain Management Theory provides the downstream explanation. Cargo delivery time is not merely a port performance statistic; it affects the timing of material availability and distribution. When delivery is delayed or unpredictable, firms may need to revise inventory plans, production schedules and customer commitments. The dissertation's wider findings on inventory and distribution provide context for these potential downstream effects, even though the fourth hypothesis was not statistically significant.

The result is also broadly consistent with empirical studies cited in the dissertation. Adeyemi Johnson and Chukwuemeka Okafor (2026) associated truck traffic and cargo dwell with reduced delivery efficiency. Michael Adewale and Binta Lawal (2024) linked truck congestion to transportation delays and longer freight distribution time. Grace Ekanem (2025) associated vessel waiting, customs delays and truck congestion with higher logistics costs. These studies use different designs and outcomes, so they should not be treated as identical evidence, but together they provide contextual support for the present finding.

The ETO discussion in the dissertation provides an important qualification. Electronic truck scheduling can improve coordination and reduce indiscriminate truck parking, but persistent congestion can remain when physical capacity, enforcement and road conditions are constrained. Therefore, the significant relationship observed in this study should not be interpreted as evidence that one particular intervention will solve the problem. Instead, it supports a coordinated congestion-management approach.

The result also has implications for cargo-delivery reliability. The highest descriptive mean was recorded for the statement that reducing congestion would improve speed and reliability. This suggests that respondents did not perceive the problem solely as a matter of longer average delivery time; they also viewed predictability as an operational outcome. Reliability is particularly important for firms whose procurement, production and distribution schedules depend on imported cargo.

At the same time, the weak magnitude of the PPMC coefficient indicates that congestion is not the only determinant of delivery time. Customs processes, cargo-handling capacity, road conditions, rail and barge availability, terminal operating practices, documentation, weather and other operational factors may contribute. The source dissertation itself adopts a multidimensional view of congestion, and the first-objective result should be interpreted within that wider framework.

6. Implications for Port and Supply Chain Management

First, congestion management should be approached as a cargo-flow management problem. Improving berth scheduling, truck appointment systems, terminal gate coordination and cargo release processes can reduce unnecessary waiting. The objective should be to improve the continuity of cargo movement from vessel discharge through inland delivery.

Second, the result supports the need for integrated information flows. Cargo owners, terminal operators, shipping lines, customs, freight forwarders and transport operators require timely

information about cargo status, release conditions and access schedules. Digital systems can improve visibility, but their benefits depend on interoperability and accurate data.

Third, multimodal cargo evacuation can reduce the concentration of delivery risk on roads. The dissertation discusses rail and barge options as ways of reducing pressure on the road network. These modes should be treated as components of a coordinated evacuation system rather than as isolated projects.

Fourth, congestion management requires performance monitoring. Indicators such as truck turnaround time, vessel waiting time, cargo dwell time, gate processing time and final delivery time can help identify where delays accumulate. Regular monitoring can distinguish terminal bottlenecks from landside bottlenecks and guide targeted interventions.

Finally, the statistical result suggests the need for caution in attributing all delivery delays to congestion. Because the observed relationship was statistically significant but weak in magnitude, managers and researchers should investigate the combined effects of congestion with customs processing, infrastructure, cargo handling, digitalization and modal connectivity.

11. Consolidated Analysis Table

Table 4: Consolidated Analysis for Objective One.

Objective	Measure	Descriptive result	Inferential result	Decision	Meaning
Objective 1: Port congestion → cargo delivery time	Five congestion/delivery questionnaire items	All means 3.03–3.25; all agreed	$r = -0.159$; $p = 0.005$; $N=306$	Reject H_{01}	Significant relationship between the measures

Source: Research Survey (2026), as reported in Chapter Four of the source dissertation.

Table 5: Empirical Citations in the Dissertation Text Without Complete Reference Entries.

Source-text citation	Details captured from dissertation
Adeyemi Johnson & Chukwuemeka Okafor (2026)	Port congestion and supply-chain efficiency in Nigerian seaports/Apapa; survey and multiple regression; congestion-related factors associated with delivery efficiency.
Fatima Bello (2026)	Road infrastructure deficits and freight movement efficiency at Apapa; deteriorated roads associated with congestion, breakdowns and delayed evacuation.
Samuel Nwosu (2026)	Infrastructure deficits and operational efficiency in Nigerian ports; inadequate handling equipment, berth capacity and automation associated with lower throughput.

Amina Yusuf & Ibrahim Sani (2025)	Port operational inefficiencies and inventory management among manufacturing firms; delays and customs bottlenecks associated with production and inventory effects.
Olusegun Adebayo (2025)	Electronic Truck Call-Up System (ETO); improved scheduling but continuing implementation and enforcement challenges.
Grace Ekanem (2025)	Port congestion and logistics costs; vessel waiting, customs delays and truck congestion associated with higher costs.
David Olatunji & Moses Uche (2025)	Rail transport development and cargo evacuation; rail reactivation improved evacuation but capacity remained limited.
Ngozi Eze (2025)	Customs procedures and cargo clearance; bureaucratic and digital-integration issues associated with prolonged dwell and delays.
John Mensah (2024)	Comparative port efficiency in Apapa, Tema and Abidjan; Apapa described as experiencing higher congestion and longer clearance.
Patricia Nnamani (2024)	Digital transformation and port operational efficiency; digital systems associated with improved coordination, subject to ICT limitations.
Michael Adewale & Binta Lawal (2024)	Truck congestion and freight distribution in Lagos; congestion associated with longer distribution time and higher operating costs.
Ahmed Musa (2024)	Port congestion and international trade performance; congestion associated with higher transaction costs and lower trade efficiency.
Chioma Obi (2024)	Logistics inefficiencies and manufacturing productivity; cargo delays associated with production, inventory and customer-delivery effects.

Source: Uploaded dissertation, Chapter Two, Empirical Review.

7. CONCLUSION

The first objective of the dissertation examined the effect of port congestion on cargo delivery time at Apapa Seaport, Lagos. The descriptive evidence showed consistent agreement among respondents that congestion increases delivery time, generates truck queues, increases vessel and truck waiting, makes delivery schedules less predictable and that reducing congestion would improve delivery speed and reliability. The inferential test reported $r = -0.159$ and $p = 0.005$ for $N = 306$, leading to rejection of the first null hypothesis. The finding supports the interpretation that congestion is significantly associated with cargo-delivery performance at Apapa, while the weak correlation magnitude indicates that congestion is one of several factors influencing delivery outcomes. The result is theoretically consistent with Queuing Theory, Systems Theory and Supply Chain Management Theory and is broadly aligned with the empirical evidence reviewed in the source dissertation.

The principal conclusion is therefore that improvements in cargo-delivery performance at Apapa require coordinated congestion management. Measures should address waiting, truck

scheduling, cargo evacuation, information exchange and multimodal connectivity. Because congestion is embedded in a wider logistics system, isolated interventions may have limited effect unless complementary bottlenecks are also addressed.

8. Recommendations

The Nigerian Ports Authority and terminal operators should strengthen berth, gate and truck scheduling systems so that cargo and vehicle arrivals are coordinated with actual service capacity.

Cargo evacuation should be managed as an integrated road, rail and inland-waterway system. Greater operational use of appropriate alternatives to road-only evacuation can reduce concentration of traffic on the Apapa corridor.

Digital cargo and truck-management systems should be integrated across relevant operational interfaces. The focus should be on accurate information exchange, cargo visibility, appointment management and timely notification of release status.

Performance monitoring should include delivery-time indicators in addition to port-centric indicators. Measures such as truck waiting, cargo dwell, gate processing and final delivery time can identify bottlenecks that may otherwise remain hidden.

Congestion interventions should be evaluated continuously. The ETO experience discussed in the dissertation demonstrates that digital scheduling can improve some aspects of truck management while structural constraints remain. Future interventions should therefore combine technology with infrastructure, enforcement and operational coordination.

9. Contribution to Knowledge

The article isolates and synthesizes the first objective of the dissertation and demonstrates how a port-congestion construct can be empirically connected to cargo-delivery performance at Apapa. Its principal contribution is the integration of descriptive evidence and PPMC analysis: the descriptive results show how respondents experienced congestion, while the inferential result tests whether the two selected measures were statistically related. The article also emphasizes the distinction between statistical significance and effect magnitude, thereby providing a more careful interpretation of the reported $r = -0.159$ result.

The article further contributes by connecting the empirical finding to Queuing Theory, Systems Theory and Supply Chain Management Theory. This theoretical integration shows why congestion should be treated as an interconnected operational problem involving

capacity, coordination and information flow rather than simply as road traffic outside the port.

10. Limitations and Interpretation Note

The article is based on the first objective and the empirical material contained in the uploaded dissertation. It therefore inherits the design and measurement limitations of that source. The PPMC result is based on two questionnaire measures and does not by itself establish a causal effect. In addition, the dissertation contains a methodological inconsistency: the Taro Yamane calculation produces 306, a later sentence mentions a final sample of 100, while Chapter Four reports 306 questionnaires administered, retrieved and analyzed. For this article, the reported empirical analysis uses the 306 valid responses because that is the sample size explicitly attached to the reported tables and correlation test.

A second limitation is that several empirical studies are described in the dissertation's literature review by author and year but do not appear as complete bibliographic entries in the dissertation's final reference list. Those citations are preserved below in a source-citation audit note rather than being completed with invented journal details.

12. REFERENCES

1. The following references are reproduced from the uploaded dissertation's reference section so that the article retains the source publication record. They are not independently verified in this article.
2. Adebayo, T. O., & Ogunleye, A. A. (2023). Customs administration and freight forwarding efficiency at Apapa Port Complex, Lagos. *Journal of Maritime Administration and Logistics*, 8(2), 44–61.
3. Adebayo, T. O., & Ogunleye, A. A. (2024). Institutional reforms and operational efficiency at Nigerian seaports. *International Journal of Transportation and Supply Chain Management*, 10(1), 66–84.
4. Adekunle, M. A., & Emenike, P. O. (2022). Freight forwarding documentation processes and cargo clearance efficiency at Apapa Port Complex. *Journal of Shipping and Trade Logistics*, 7(3), 51–69.
5. Adeyemi, S. O., & Eke, C. N. (2025). Digital freight forwarding systems and operational efficiency at Apapa Port, Lagos. *African Journal of Maritime Studies*, 12(1), 21–45.
6. Adeyemi, S. O., & Eke, C. N. (2025). Port congestion and logistics performance in Nigerian seaports. *Journal of African Transport and Infrastructure*, 9(4), 75–93.

7. Afolabi, K. T., & Yusuf, M. A. (2023). Containerization and port performance in Nigerian seaports. *International Journal of Logistics and Maritime Research*, 6(2), 102–120.
8. Afolayan, J. A., & Nwosu, P. C. (2021). Intermodal transportation systems and logistics efficiency in Nigerian ports. *Journal of Transportation and Supply Chain Management*, 5(2), 88–105.
9. Akinola, R. O., & Hassan, M. S. (2022). Intermodal transportation systems and cargo evacuation efficiency at Apapa Port. *Nigerian Journal of Logistics and Transport Management*, 4(1), 71–90.
10. Ballou, R. H. (2007). *Business logistics/supply chain management* (5th ed.). Pearson Education.
11. Bello, A. S., & Umeh, C. C. (2022). Institutional coordination and maritime logistics performance in Nigeria. *Journal of Maritime Policy and Administration*, 8(3), 59–78.
12. Bowersox, D. J., Closs, D. J., & Cooper, M. B. (2019). *Supply chain logistics management* (5th ed.). McGraw-Hill Education.
13. Celik, B., & Umar, A. (2020). The impact of public-private partnerships on the performance of Nigerian seaports: A case study of Apapa Port Complex, Lagos. *Journal of Global Economics and Business*, 1(1), 18–43.
14. Celik, B., & Umar, A. (2024). Port concession reforms and cargo handling efficiency in Nigerian seaports. *African Journal of Maritime Economics*, 11(2), 33–54.
15. Christopher, M. (2016). *Logistics and supply chain management* (5th ed.). Pearson Education Limited.
16. Chukwu, K. E., & Eze, M. C. (2021). Vessel turnaround time and port productivity in Nigerian seaports. *International Journal of Maritime Transport and Logistics*, 6(1), 34–52.
17. Council for the Regulation of Freight Forwarding in Nigeria. (2023). *Annual report on freight forwarding operations in Nigeria*. CRFFN Publications.
18. Council of Supply Chain Management Professionals. (2023). *Supply chain management definitions and glossary*. CSCMP Publications.
19. DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48(2), 147–160. <https://doi.org/10.2307/2095101>
20. Erlang, A. K. (1909). The theory of probabilities and telephone conversations. *Nyt Tidsskrift for Matematik*, 20, 33–39.

21. Eze, U. M., & Chukwuma, B. C. (2022). Customs procedures and trade facilitation in Nigerian seaports. *Journal of International Trade and Port Management*, 9(2), 44–63.
22. Ezenwa, C. I., & Chukwu, P. O. (2021). Cargo dwell time and port productivity in Nigerian seaports. *Nigerian Journal of Maritime Affairs*, 7(2), 91–108.
23. Ezenwa, C. I., & Chukwu, P. O. (2024). Cargo dwell time and operational efficiency at Apapa Port, Lagos. *Journal of Port and Shipping Management*, 10(3), 67–89.
24. Federal Republic of Nigeria. (2006). Port concession programme and reform policy. Federal Government Press.
25. FIATA. (2022). Freight forwarding and logistics services report. International Federation of Freight Forwarders Associations.
26. Goldratt, E. M. (1984). *The goal: A process of ongoing improvement*. North River Press.
27. Ibrahim, A. S., & Yusuf, M. A. (2019). Maritime transport infrastructure and trade facilitation in Nigeria. *Journal of Maritime Economics and Logistics*, 5(1), 25–44.
28. Ibrahim, A. S., & Yusuf, M. A. (2023). Transportation infrastructure and cargo evacuation efficiency at Apapa Port. *African Journal of Logistics and Infrastructure*, 8(2), 59–80.
29. Meyer, J. W., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology*, 83(2), 340–363.
<https://doi.org/10.1086/226550>
30. Mustapha, A. M., Galadima, S. P., & Shitu, S. (2022). Assessing the freight transport and modal logistics infrastructure connectivity in Apapa Seaport. *Journal of Transportation and Logistics Management*, 5(2), 44–58.
31. Mustapha, A. M., Galadima, S. P., & Shitu, S. (2024). Transportation infrastructure and freight forwarding operations at Apapa Port. *International Journal of Maritime Infrastructure Studies*, 9(1), 82–104.
- Nnamani, C. O., & Okeke, E. U. (2021). Customs modernization and cargo clearance efficiency at Nigerian seaports. *Journal of Trade Facilitation and Maritime Administration*, 4(3), 48–66.
32. Nnadi, E. C., & Okeke, J. O. (2023). Freight forwarding practices and supply chain efficiency at Apapa Port Complex. *International Journal of Supply Chain and Logistics Research*, 7(1), 39–58.
33. Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). McGraw-Hill.
34. Nwachukwu, E. O., Stephens, T. A., Okoli, K. C., & Akpudo, L. I. (2025). Port performance indicators and cargo handling efficiency in Nigeria. *Journal of Maritime Operations and Trade*, 11(1), 51–74.

35. Nwachukwu, E. O., Stephens, T. A., Okoli, K. C., & Akpudo, L. I. (2025). Vessel turnaround time and operational productivity at Apapa Port Complex. *International Journal of Port and Shipping Administration*, 10(2), 61–83.
36. Nwankwo, P. U., & Ibrahim, H. S. (2022). Port congestion and operational productivity at Apapa Port Complex. *Nigerian Journal of Port Management*, 6(4), 73–95.
37. Nwosu, B. C., & Eke, M. A. (2023). Maritime security and freight forwarding operations at Apapa Port. *Journal of Maritime Security and Logistics*, 5(1), 57–79.
38. Obi, T. N., & Hassan, R. A. (2021). Traffic congestion and freight transportation efficiency within the Apapa Port corridor. *Journal of Urban Transportation Studies*, 8(2), 66–88.
39. Ojo, A. K., & Balogun, M. T. (2022). Cargo handling equipment and port operational efficiency in Nigeria. *Journal of Port Technology and Logistics*, 5(2), 49–68.
40. Okafor, U. C., & Ibrahim, M. D. (2022). Freight forwarding challenges and maritime logistics management in Nigeria. *African Journal of Transport and Logistics*, 6(3), 84–103.
41. Okafor, U. C., & Ibrahim, M. D. (2024). Freight forwarding challenges and maritime logistics performance at Apapa Port Complex, Lagos. *Journal of Maritime and Supply Chain Studies*, 9(3), 91–113.
42. Olatunji, S. A., & Yusuf, R. O. (2021). Port concession reforms and operational efficiency at Apapa Port. *Journal of Maritime Policy and Development*, 4(2), 40–62.
43. Olayemi, D. O., & Hassan, M. U. (2020). Containerization and port operational efficiency in Nigeria. *Journal of Maritime Trade and Logistics*, 3(1), 33–52.
44. Olayemi, D. O., & Hassan, M. U. (2023). Digital customs systems and cargo clearance efficiency in Nigeria. *International Journal of Customs and Trade Administration*, 7(2), 72–94.
45. Osadume, R., Okene, A. J., Uzoma, B., & Enaruna, D. (2024). Operational delays and cargo clearance efficiency in Nigerian seaports. *Journal of Transportation and Port Administration*, 8(2), 191–204.
46. Osadume, R., Okene, A. J., Uzoma, B., & Enaruna, D. (2026). Freight forwarding efficiency and port performance at Apapa Port Complex, Lagos. *Journal of African Maritime Research*, 13(1), 27–51.
47. Rodrigue, J. P. (2020). *The geography of transport systems* (5th ed.). Routledge.
48. Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.). Pearson Education Limited.

49. Scott, W. R. (2014). *Institutions and organizations: Ideas, interests, and identities* (4th ed.). Sage Publications.
50. Transparency International. (2023). *Corruption perceptions and trade facilitation report*. Transparency International Publications.
51. Uche, E. C., & Balogun, T. O. (2022). Maritime logistics management and port operational performance in Nigeria. *Journal of Shipping and Logistics Management*, 7(1), 58–79.
52. United Nations Conference on Trade and Development. (2023). *Review of maritime transport 2023*. United Nations Publications.
53. World Bank. (2023). *Container port performance index 2023*. World Bank Publications.
54. Yusuf, M. A., & Adewale, S. O. (2023). Road transportation and logistics performance at Apapa Port. *Nigerian Journal of Transportation and Infrastructure*, 6(2), 81–102.

13. Source-Citation Audit: Empirical Studies Mentioned in the Dissertation Text

The dissertation's empirical-review text contains several named studies for which complete bibliographic entries are not present in the final reference list. To avoid inventing publication details, the following citations are retained as source-text citations only.