

Backlog of Container Ships at Los Angeles Ports

Tyler Deis, Zoe Atkins, Karshin Gupta, Duc-Huy Dam and Mohamed Awwad

Industrial and Manufacturing Engineering Department

California Polytechnic State University

San Luis Obispo, CA 93407, USA

tdeis@calpoly.edu, zatkins@calpoly.edu, kgupta06@calpoly.edu, dddam@calpoly.edu,
mawwad@calpoly.edu

Abstract

The onset of COVID-19 led to numerous changes in the global supply chain, affecting all members, including suppliers, distributors, retailers, and consumers. Consumer demand for e-commerce skyrocketed, and all other supply chain members struggled to meet this new demand, with the supply chain disruption becoming most prevalent in 2021. One such public disruption was the backlog of container ships at the twin ports of Los Angeles and Long Beach, which continues well into 2022. These backlogs are caused by various issues, including worker shortages, equipment failures, and the eCommerce boom. As a result, ships that were once able to arrive and unload their cargo promptly must now spend two to three weeks waiting for a spot to clear up in the port. In this paper, we will examine the root causes of the backlog of container ships occurring at the ports in Los Angeles and Long Beach and provide our findings and analysis of possible avenues to decrease or end this disruption.

Keywords

Supply Chain, Ports, COVID-19, and Marine Chassis.

1. Introduction

1.1. Background of the Ports of Los Angeles and Long Beach

The Ports of Los Angeles and Long Beach, within the San Pedro Bay Port Complex, have ranked the highest in container volume and cargo value in the United States every year since 2000. The port is the leading gateway for trade between the United States and countries in Asia (Port of Los Angeles, 2022). Trade activities at the port of Long Beach generate 1.4 million jobs in the United States and serve as one of the primary drivers of the economy of not only Long Beach but Southern California as a whole, with more than \$140 billion worth of cargo moving through these ports every year (Port of Long Beach, 2022). The Ports of Los Angeles and Long Beach combined handled 31% of all US imports and exports via containers via sea freight, meaning the Ports of Los Angeles and Long Beach maintain the largest share of the market of sea freight shipment in the United States (Facts and Figures | Port of Los Angeles, 2022). With the Ports of Los Angeles and Long Beach having such a large market share compared to the other ports along the West Coast, the effects of the failures at the ports were felt across the United States.

1.1.1. Disruptions of the Supply Chain

The ports located in Los Angeles and Long Beach have been experiencing a sharp increase in delays since 2019, with the numerous disruptions to the supply chain heavily contributing to the ports being unable to meet the number of shipping containers that need to be offloaded. The major supply chain disruption came in the form of the COVID-19 pandemic causing complications to arise regarding the necessary labor to keep the ports running smoothly. The number of ships waiting for berths offshore has numbered in the dozens since the start of the pandemic, with 2021 marking the year when the number of vessels waiting for berths reached its all-time high.

1.2. Motivation

The number of container ships waiting for berths at the ports of Los Angeles and Long Beach has seen little improvement with the continued evolution of the COVID-19 pandemic. The change in consumer buying trends has contributed to this situation as well; the pandemic has led to a sharp increase in the demand for eCommerce. This eCommerce boom created a higher demand than ever for foreign-made products necessitating an increase in sea freight, meaning more container ships needed to be processed to meet this new level of demand, and the current failure

to offload the container ships at the ports of Los Angeles and Long Beach in a timely and efficient manner needed to be improved.

1.3. Organization

The main sections used in this paper include the Literature Review, where some of our key sources will be synthesized for discussion with each other; the Data Collection, with the collected relevant data used for analysis in this paper; the Results and Discussion, where the key findings of the research will be presented and analyzed; and lastly the Conclusions, where the overall takeaways from the research and analysis will be discussed and verified that all objectives of this paper were satisfied by providing proposed improvements to the management of the system at the ports to be able to ease this supply chain disruption.

1.4. Objectives

During the pandemic, the ports in Los Angeles and Long Beach experienced backlogs resulting from major supply chain disruptions, resulting in increased wait times and lead times for products. The research objectives are to research and analyze the port systems in Los Angeles and Long Beach, as well as the reasons for the increase in delays. In addition to this, we will recommend potential solutions and the possible outcomes of these solutions on this continued problem at the ports.

2. Literature Review

2.1. Port Systems

The docks located at the ports of Los Angeles and Long Beach have had to manage changes in the number of empty containers there, causing issues with clearing cargo and allowing the container ships to exit the ports.

2.1.1. Problems Caused by Empty Containers

Space for containers at the docks has become increasingly hard to find, with most of the container storage areas at the docks being filled with empty containers resulting in no place to put the newly imported containers from the offloaded ships. Of the containers that leave the ports in Los Angeles and Long Beach every day, roughly four out of every five of them are empty compared to the pre-pandemic rate of three out of every five containers exiting the ports being empty. Prior to the COVID-19 outbreak, the docks had more flexibility with allowing empty containers to remain so they wouldn't be empty when they were sent back to Asia. This policy proved to be too flexible with the buildup of empty containers leading to serious logistics problems with the storage of imports (Saraiva and Murray, 2021). Changes to the availability of space to store new containers led to this change of a long-standing operational policy at the port and examination of other operations.

2.1.2. Efforts to Reduce Empty Containers at Docks

Due to the excess amount of empty containers on the docks, the management at the ports in LA/Long Beach threatened to impose fines on carriers that failed to clear containers off the docks in a reasonable amount of time. As of November 2021, the ports reported a 30% reduction in the number of container carriers that had failed to clear off the docks (Saraiva and Murray, 2021). The outbound volume of empty containers leaving the ports needs to increase to reduce the amount of time spent finding space to store full containers being offloaded from incoming ships. As of November of 2021, the number of empty outbound containers leaving the docks has decreased from 358,581 containers in September to 337,106 in October. Solutions for the removal of empty containers are needed to address this failure to increase the number of empty containers leaving. One such potential solution that was tested was the "sweeper" ships that were being deployed to solely remove empty containers, somewhat easing the strain of available space on the docks for new imports (Miller, 2021).

2.2. Marine Chassis

The containers offloaded from container ships require marine chassis, a form of trailer specifically for shipping containers to be moved to the next destination, such as warehouses or distribution centers. Chassis are available as 20-foot slider chassis, 40-foot gooseneck chassis, and 40-45 foot extendable chassis. These specific trailers are necessary for unloading cargo from the cargo ships and moving goods to their destination.

2.2.1. Problems Caused by the Lack of Available Chassis

The next logistics issue affecting the movement of containers from the ports comes from the shortage of chassis for marine containers and the supply chain challenges that have negatively affected the manufacture of new chassis. The marine chassis are the trailers that containers sit on when being moved by truck. The short supply of chassis is attributed to the increase in imports seen since 2020, leading to the capacity of the chassis pool being overwhelmed and many chassis being stuck under empty containers. According to the American Trucking Association, the United States lacks about 80,000 truck drivers. The lack of chassis to hold containers and the lack of truck drivers to move containers have contributed to the failure of not clearing cargo from the docks timely enough to make room for cargo from newly berthed ships (Saraiva and Murray, 2021).

2.2.2. Problems in Acquisition of New Marine Chassis

The scarcity of chassis has led to efforts to acquire new ones through overseas trade and increased manufacturing in the United States. The acquisition of new chassis from overseas manufacturers has been complicated by tariffs imposed on these products (Saraiva and Murray, 2021). The manufacturing of new chassis in the United States has been unable to scale to meet demand due to the industry's own supply chain issues. As of March 2022, the number of chassis needed to meet demand was somewhere between 45,000 and 50,000 chassis. The chassis manufacturing industry projects that they will be able to build somewhere between 20,000 to 25,000 marine chassis in 2022. Manufacturers had hoped to inject enough supply into the market by the third quarter of 2022 to meet the import surge, but supply chain issues have pushed this back to 2023. Long lead times for components such as steel beams and air tanks have led to manufacturers not being able to ramp up production with their underutilization capacity (Ashe, 2022).

2.3. Warehouses

After the overseas shipping containers are loaded onto the marine chassis and moved via truck, the product within the containers needs to be shipped to its next destination, which for most cargo shipped through the Ports of Los Angeles and Long Beach, are the warehouses and distribution centers within proximity to the ports.

2.3.1. Problems with Available Warehouse Space

The logistics problems attributed to the congestion at the ports extend to the storage of containers after leaving the docks in warehouses. Southern California has among the least vacant space available in warehouses in the country, with less than 1% of the 2 billion square feet of warehouse space being vacant. Around 20 million square feet of new warehouse space is being constructed in the Inland Empire development east of Los Angeles. However, to meet the demand for space, around 50 million square feet of space need to be made available (Saraiva and Murray, 2021).

2.3.2. Supply Chain Struggles and Delayed Development

The deficit in available warehouse space is attributed to supply chain struggles as well as delays in approvals for new warehouses. In regard to supply chain issues, building materials such as doors and conveyors have become increasingly scarce, causing delays in construction and underutilized equipment and labor. Concerns over emissions from the trucking industry have led to fewer warehouse development projects being approved with the time a developer makes an offer on a piece of land to the time it becomes available for occupancy, taking over two years, when two decades ago, this process would have typically taken less than nine months (Hamanaka, 2022).

3. Methods

The data and statistics used for analysis in this report were found using online sources. All sources used for analysis are cited in the References section at the end of this report.

4. Data Collection

Los Angeles and Long Beach ports account for about 40% of the country's imported goods. The time it takes for goods originating in Shanghai to reach their destinations through the San Pedro Bay ports has increased to 62 days since January 2020. As of November 23, 2021, the number of container ships was 93 waiting in the new queuing system. The new system had the vessels waiting farther offshore to reduce the number of vessels visible from the shore. The port reported that 337,106 TEUs of empties were exported last month, down from 358,581 TEUs in September and 364,212 TEUs in August. The ports reported a 30% reduction in the number of containers carriers failed to clear off the docks in November of 2021.

It now costs \$10,000 - \$15,000 in the spot market to ship each 40-foot container from China to the West Coast, 5x the pre-pandemic rate. There are over 70 vessels waiting for an average of more than 18 days in the port of LA. Southern California has some 2 billion square feet of nearly full warehouse space. This year, 20,000 - 25,000 marine chassis will be built, but the industry needs about 45,000 - 50,000 to address the current demand. There is also a shortage of truck drivers as well, with a lack of 80,000 drivers.

The ports are generally operating from 8:00 a.m. - 5:00 p.m. on weekends and 6:00 p.m. - 3:00 a.m. on weekdays. This adds up to 90 hours each week.

5. Results and Discussion

5.1. Numerical Results

The port is usually in operation about 90 hours a week. If switched to open 24 hours a day, 7 days a week, it will be operational 168 hours a week. This is an 86% increase in working time, potentially leading to an 86% increase in work done in a week. This would result in an increase in labor costs as well.

5.2. Graphical Results



Figure 1. Average Number of Days waiting from arrival to berth at Los Angeles ports from 9/1/21-11/17/21

Based on Figure 1, it is evident there is a clear upward linear trend in the waiting times for ships from anchorage to berth. As of November 23, 2021, 93 ships are waiting in the queue system and counting. To minimize safety concerns, waiting ships are being asked to anchor and wait further and further away from shore. While this does not solve the inherent problem, it does prevent further complications from ships being clogged together in close proximity.

5.3. Proposed Improvements

There are several key improvements that could be implemented in order to ease the burden currently held by the ports of Los Angeles and Long Beach. The main problem lies with the need to maximize the amount of cargo being unloaded from the ports, as the current situation is resulting in a bottleneck traffic jam. To do this, several features can be used.

5.3.1. Increased Vertical Cargo Storage

First, cargo can be stored vertically, thus decreasing the space utilization percentage and allowing for more cargo to be moved off the ships. Doing so will require legal intervention. Current port laws allow for only stacks of crates two high, resulting in lots of cargo being left on the marine chassis scattered throughout. Changing laws regarding storage safety will take time, so this is not the most timely option.

5.3.2. Government Assistance in Chassis Procurement

Another method to maximize cargo unloaded is to call in emergency chassis supplies from the National Guard and military. This will take time and resources from government involvement, which will cost time as well. Temporary

assistance in this area could give more time for domestic chassis manufacturers to increase their production capacity to meet the demand.

5.3.3. Land Acquisition for Increased Storage Space

Additionally, another method to unload more cargo is to find land nearby for additional storage space. Dedicating land to assist the ports is a project in itself, where local governments will have to justify where and how to assign this land. Due to the logistics of maintaining container storage, there are concerns about pollution from the emissions from trucks and other equipment used and the storage of potentially hazardous materials. Adding new storage areas will take a long time to get in place, but it could help alleviate the current strain on the ports and possibly prevent future incidents of this level from occurring at the ports.

5.3.4. Regulatory Changes

A final method to assist with cargo unloading is to suspend and redo several rules and regulations surrounding the operations in the ports. In a letter sent to Governor Newsom, a coalition of several business groups, including the California Retailers Association, Los Angeles Area Chamber of Commerce, and the Agricultural Council of California, asked for modifications to current laws surrounding port operations. The most relevant questions are for the suspension of environmental and pollution laws, suspending the state's landmark worker status law reclassifying independent contractors as employees, and suspending a law requiring warehouses to disclose quotas and work speed to workers.

5.3.5. Alleviate Shortage of Truckers

In addition to these, possible changes regarding regulations and rules would be to hire more truck drivers to make up for the shortage of 80,000 drivers. There may need to be extra incentives needed to attract and hire more drivers, so a possible solution for this would be to increase truck driver pay. While this would cost additional money, there would be great benefits from increasing the labor force. Similarly, it would be beneficial to expand the operating time of the port, which would require additional workers and money to pay the workers and run the port. The port of Los Angeles recently expanded the operating hours of the port to 24 hours a day, 7 days a week, to relieve the supply chain issues.

5.4. Validation

Recently, the port officials expanded the operating hours of both the Los Angeles and Long Beach ports to 24 hours a day, 7 days a week. This has resulted in helping the ports recover from the supply chain issues as the pandemic is starting to end by clearing cargo at a high enough rate to decrease the number of container ships waiting for berths at the ports.

6. Conclusion

The docks at the LA and Long Beach ports, as well as the systems connected with it have been hit with supply chain issues stemming from the pandemic, which has greatly increased wait times and lead times for parts. This has resulted in greater costs for products, as well as increased transportation costs. Some of the main problems are the lack of available chassis, which negatively affects the possible movement of containers, as well as too many empty containers and a lack of truck drivers, which decreases the number of possible products that can be transported on land. In addition to this, there are a plethora of other issues, including but not limited to a lack of warehouse space. Possible solutions caused by the lack of chassis could be to vertically stack more than the allowed two pallets on each chassis. This would possibly decrease safety, but if done well and safely would increase the possible amount of work done by each chassis. This would also require legal intervention. Additionally, we could vertically stack cargo more often to decrease space utilization as well as use empty land to store cargo. Many of these solutions would require modifications to current laws. Other solutions involve hiring more workers, such as truck drivers, to increase the amount of possible work done, as well as expanding the operating hours of the port. In conclusion, many of our solutions involve working through certain regulations to allow us to move and store cargo more efficiently by increasing the workforce and time spent operating.

References

- Ashe, A., TPM22: Marine chassis shortage to last into 2023. [Www.joc.com. https://www.joc.com/trucking-logistics/trucking-equipment/tpm22-marine-chassis-shortage-last-2023_20220304.html](https://www.joc.com/trucking-logistics/trucking-equipment/tpm22-marine-chassis-shortage-last-2023_20220304.html)
- Facts and Figures | Statistics | Port of Los Angeles. ,2022. [Www.portoflosangeles.org. https://www.portoflosangeles.org/business/statistics/facts-and-figures](https://www.portoflosangeles.org/business/statistics/facts-and-figures)

- Hamanaka, K, Looking for the High-Rent District? Think Warehouses. Sourcing Journal. <https://sourcingjournal.com/topics/logistics/warehouse-rents-ecommerce-supply-chain-inland-empire-326145/>, 2022.
- History | About | Port of Los Angeles. , Www.portoflosangeles.org. <https://www.portoflosangeles.org/about/history>, 2022.
- Littlejohn, D, It's taking more time again for unloaded cargo to be hauled away, Long Beach port chief says. Press Telegram. 2022. <https://www.presstelegram.com/2022/04/12/rail-cargo-dwell-times-causing-congestion-concerns-again-long-beach-port-chief-says/>
- Miller, G. , California ship pileup still piling up — but out of sight, over horizon. FreightWaves. 2021.<https://www.freightwaves.com/news/california-pileup-still-piling-up-but-out-of-sight-over-horizon>
- Miller, G, Congestion, falling arrivals hit Southern California import volume. FreightWaves. 2021.<https://www.freightwaves.com/news/peak-season-over-container-ship-arrivals-to-southern-california-sink>
- Saraiva, A., & Murray, B, Every Step of the Global Supply Chain Is Going Wrong — All at Once. 2021.Bloomberg.<https://www.bloomberg.com/graphics/2021-congestion-at-americas-busiest-port-strains-global-supply-chain/>

Biographies

Tyler Deis is an undergraduate student at California Polytechnic State University, San Luis Obispo. He is currently a fourth-year student pursuing a Bachelor of Science degree in Industrial Engineering, graduating in June of 2022.

Zoe Atkins is an undergraduate student at California Polytechnic State University, San Luis Obispo. She is currently a fourth-year student majoring in Industrial Engineering, graduating in June of 2022.

Karshin Gupta is an undergraduate student at California Polytechnic State University, San Luis Obispo. He is majoring in Industrial Engineering and pursuing a minor in computer science, graduating in June 2023.

Duc-Huy Dam is an undergraduate student at California Polytechnic State University, San Luis Obispo. He is currently a third-year student majoring in Industrial Engineering, graduating in June of 2023.

Mohamed Awwad is an Assistant Professor in the Department of Industrial and Manufacturing Engineering at California Polytechnic State University (Cal Poly), San Luis Obispo, CA. He received his Ph.D. and MS degrees in Industrial Engineering from the University of Central Florida, Orlando, FL, USA. Additionally, he holds MS and BS degrees in Mechanical Engineering from Cairo University, Egypt. Before joining Cal Poly, San Luis Obispo, Dr. Awwad held several teaching and research positions at the State University of New York at Buffalo (SUNY Buffalo), the University of Missouri, Florida Polytechnic University, and the University of Central Florida. His research and teaching interests include applied operations research, logistics & supply chain, blockchain technology, distribution center design, unconventional logistics systems design, and OR applications in healthcare and the military.