Analysis of offshore waiting of container ships causing a supply chain crisis

(Study period: FY2019-2021)

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Key Words: container ship, delay, terminal congestion, AIS

1. Global Supply Chain Crisis

The supply chain crisis has become a crucial issue all over the world, causing shortages of imported goods and delays in the delivery of Christmas gifts. It has also had an impact on civil life in Japan, with increases in the price of consumer goods due to the surge in transport costs, and limitations on sales of products such as french fries. Numerous container ships have been waiting weeks for berthing offshore of major ports in North America, China, and Europe.

In this study, the author (1) identified and analyzed congested ports causing long delays and (2) developed a method for grasping the situation of ships waiting offshore and analyzing the relationship between offshore waiting and terminal operation.

2. Occurring Delays at Congested Ports

The author grasped and analyzed the delays of all east-west container services that connect to Japan that were operated by three major alliances between April and December 2018 using data from the AIS (Automatic Identification System, which automatically transmits the name, dimension, location, speed, and other information of the ship on which it is installed) to compare the actual arrival dates and times against the schedule. **Fig. 1** indicates the share of the occurred delay, namely the increment of delays at a port, by area and by route. It was discovered that, in all routes, approximately 80% of delays occurred at ports in Europe, China, and North America. There was also a significant difference among the average delays of terminals at these congested ports.

One of the major factors of this congestion is the concentration of container services calling on highly efficient ports and terminals. Since the mid-1990s, shipping companies have continued to make ships larger to reduce unit costs, which has led to corporate M&As and reorganizations of alliances as larger ships need larger volumes of cargo at a time. As a result, container services have integrated and now concentrate to call at specific ports and terminals.

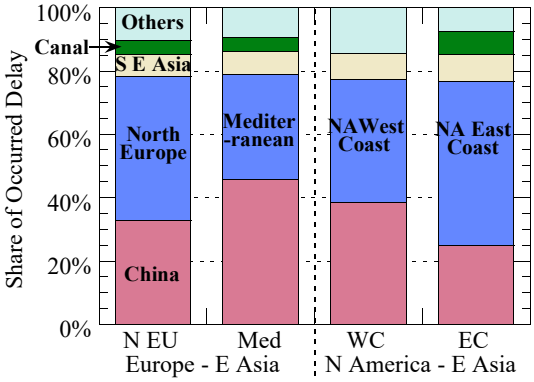

Fig. 1 Occurred Delay at Ports by Routes

3. Grasping and Analyzing of Offshore Waiting

Container ships are forced to wait offshore when there is no space for berthing at their destination terminal. The author developed a method for identifying offshore waiting ships by utilizing AIS data at congested terminals. **Fig. 2** shows a concept image of this method, setting the areas for judging of port entry and berthing, and identifying ships waiting offshore based on the times from port entry were longer than the threshold. This threshold is the maximum time needed for normal navigation and it is set by utilizing the anchoring signal and navigation speed of each ship.

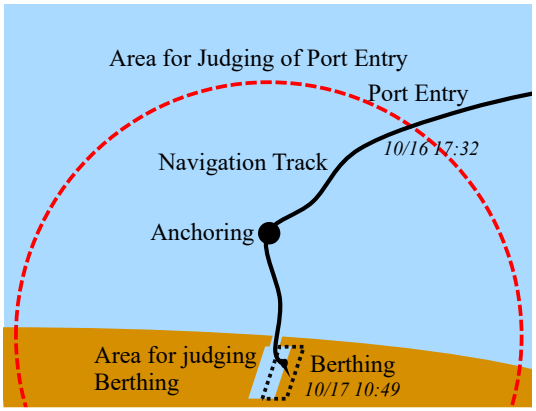

Fig.2 Concept Image for Identifying Waiting Ships

The estimation of offshore waiting covered major terminals in ports in Los Angeles/Long Beach (U.S.), Rotterdam (Netherlands), and Shanghai and Ningbo (China) in October 2019, and terminals in ports in Tokyo, Yokohama, Osaka, and Kobe (Japan) in October 2019 and January 2021. The author calculated the offshore waiting time-volume for each terminal, indicating how many containers wait and for how long, by assuming a 60% slot utilization rate.

Since it is assumed that the waiting time-volume is linked to terminal congestion, the relationship between the berth occupancy ratio, the share of occupied space and time by berthing ships against the total time and length, and the waiting time-volume per berth length was calculated as shown in **Fig. 3**. Increases in the berth occupancy ratio led to considerable rises in the waiting time-volume if the ratio exceeded about 30%. It was also found that the terminals with many ships berthed for short berthing times tended to cause a larger offshore waiting time-volume than those with few ships berthed for long berthing times. At Japanese ports located between the U.S. and the Netherlands, small ships made up a large proportion of waiting ships at that time.

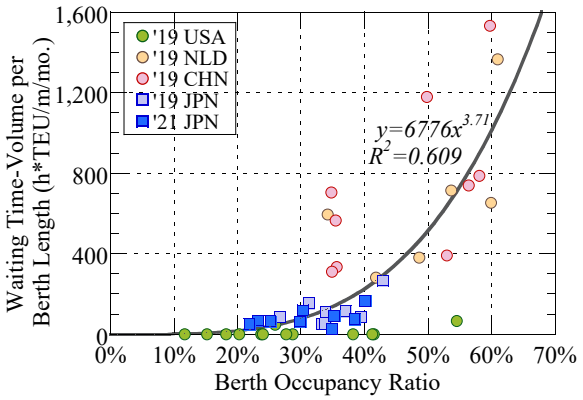

Fig.3 Berth Occupancy Ratio vs. Waiting Time-Volume

4. Surge of Waiting Ships in the Pandemic

The number of waiting ships has skyrocketed since winter 2020, especially at ports in North America, China, and Europe due to impacts from the COVID-19 pandemic such as surges in demand for stay-at-home consumption, capacity constraints at terminals, and shortages of drivers, port workers, containers, warehouses, and so on. For example, on November 19, 2021, there were 71 container ships waiting offshore of the Los Angeles/Long Beach port, and the longest wait time was 55 days. **Fig. 4** indicates changes in the volume of import laden containers and the average offshore waiting days at the Los Angeles port. The container volume increase after summer 2020 led to a surge in waiting days in winter 2020, and there was another such surge in summer 2021. It was presumed that terminals restricted the berthing of ships due to capacity constraints on the land side.

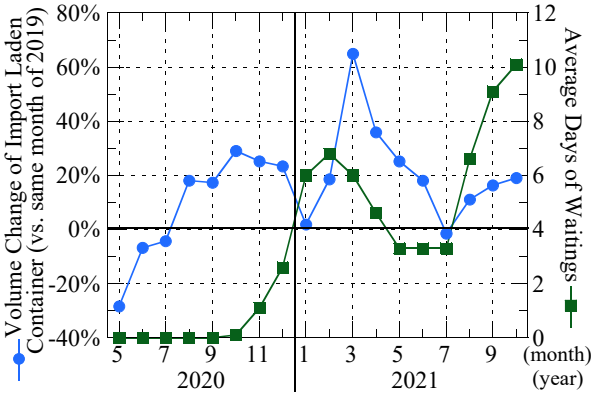

Fig.4 Container Volume and Waiting Days (LA port)

5. Research in Progress

The author is working to develop a system that calculates the offshore waiting time-volume in real time. It has been confirmed that the system can automatically calculate the waiting time-volume and the berth occupancy ratio of terminals at Yokohama Port using real-time AIS data up through the day before. The author is also estimating the CO_2 emissions of ships waiting offshore, as many container ships emit greenhouse gases during long periods of offshore waiting, and the Japanese government is aiming to achieve a carbon-neutral society by 2050 and decarbonization of international shipping is being discussed at IMO. These research results will be published in future papers.

☞Reference

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