論文の要旨

題 目　Studies on the Ship Basic Planning Support System using Maritime Logistics Big Data
（海洋物流ビッグデータを利用した船舶基本計画支援システムに関する研究）

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Recently, the era of shipping records big data has been started along with mandatory of digitalized ship movement with AIS (Automatic Identification System). Substantial data amount is generated by AIS, such as the ship's unique identification of international maritime organization number (IMO number), position, course, speed, and destination. Moreover, maritime logistics big data, such as ship and port specification data, route data, international trade data, and data provided by AIS, are currently available and can be used. Based on that, some studies have been conducted on big data utilization to improve ship construction, ship operations, and ship maintenance. However, studies regarding the utilization of such maritime logistics big data for ship basic planning or ship design are limited. Therefore, in this study, we developed marine logistics database (MLDB) in order to realize the ship allocation by conducted a ship allocation model aimed for the basic planning support system in the future. The characteristics of the proposed method are as follows: the ship allocation model consists of three specified models, shipper model, shipowner model, and operator model. In order to realize the actual ship allocation, the proposed model was conducted by extracting the data from MLDB.

The MLDB consists of the latest marine logistics data, i.e., operation information from AIS, ship, port, route and international trading information. The data are managed, integrated, and structured to derive valuable insights from information buried in marine logistics data. In this study, to ensure and the reliability and quality of the data used to construct the MLDB, error cleaning are performed by considering the following points:

- Keeping the first data recorded in AIS based on the arrival date and time, and deleting duplicate data points.
- Deleting unrealistic voyage data by checking the average voyage speed, which is calculated by considering the navigation days and distance between two ports. If the average voyage speed exceeds the service speed, it is defined as an error and the data are deleted.
- Deleting inappropriate zero values, such as 0-m drafts, null data, and unavailable data.

In the MLDB, all of the data sets i.e. AIS, ship, port, route and international trading information are integrated and can be extracted to develop ship allocation model in order to realize and reproduce the actual ship allocation model.

Allocation is the process of assigning product items from the inventory to shipping orders and then fulfilling the shipping orders from appropriate fulfillment sites. In this study, the basic concept of the ship allocation model is highlights the two important steps for realizing the objectives: first, developing a ship allocation model, and second, carrying out simulations using the ship allocation model. A ship allocation model can reproduce actual ship allocation. To realize actual ship allocation conditions, the three distinct models—the shipper, shipowner, and operator models are required. The configuration of the proposed model shown as follows:

- The shipper model issues a request for cargo transportation between two or more ports. The shipper model is defined using cluster analysis.
- The shipowner model estimates the shipment days, amount of cargo, and operating cost in response the cargo transportation requests. The shipowner model is defined using deep learning analysis.
- The operator model requests all shipowner models to estimate shipment costs, cargo volume, and transport time based on shipper requests; then, based on the answer from the shipowner model, the operator model decides on a ship for cargo transport.

The next important stage of this study is simulation. In order to develop the new ship allocation and examine which specification of ship is effective, by considering the present condition based on the data extracted from MLDB and the future scenario such as fuel price, fuel oil consumption the following simulation should be consider, such as:

- Examination of the supply–demand balance of various ships
  In our system, supply is defined as a ship allocation only using existing ships, and demand is defined as a ship allocation in which all the ships can be used freely for cargo transportation. Therefore, by changing the number of ships that can be used in the simulation, we can estimate the supply–demand balance.
- Examination of effective ship specifications
  In this study, we can change the specifications freely. Then, by changing ship specifications and simulating ship allocation, we can understand the demand for various kind of ships. Therefore, by executing this simulation, we can examine effective ship specifications and the kinds of ships that are attractive for operation on the intended routes.
- Influence of economic situations on demand.
  In our system, port constraints can be changed. Moreover, fuel price and trade volume between the ports can be freely changed. By forecasting such a future situation using a ship allocation model, we can understand logistics and demand results. Moreover, we can understand the kinds of ships that will operate effectively on intended routes in the future.

This study presents a ship basic planning support system using maritime big data. All of big data are integrated into MLDB, and the data from MLDB used to construct a ship allocation model as a proposed model. The proposed model was composed of distinct shipper, shipowner, and operator models was developed. This model was effective in estimating ship supply and demand, the influence of ship size and fuel efficiency on ship allocation, and the principal particulars of ships for which demand is expected to increase. By using the proposed model, the reproducibility of the ship allocation model was confirmed. The supply–demand balance, effective ship specifications, and influence of ship efficiency on demand could be realized. So that, it is useful for the ship basic planning support system in the future.