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Time Estimation for Container Handling and Yard Arrangement

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Abstract

Nowadays as economies rapidly have developed, the scale of trade and quantities of shipping goods have caused ship size to expand to size never previously seen. By August 2017, there were 60 mega-containerships with capacities over 18,000 TEUs. There were 165 those ships including ships with capacities over 14,000 TEUs. From the above, since the volume of maritime freight transport has increased so significantly, the liner shipping companies have also benefited from this containerization and mega-vessels era. In order to being fully effective on employing mega-containerships, at a terminal where mega-containerships are calling, most cargoes to be handled are transshipments from origin to destination ports via that terminal. Thus, associated handling operations are undertaken between mega-containerships and feeder ships. In order to decrease the turnaround time of ships calling at this terminal, smooth handling of operations is of major importance. For such as the above terminal, there are the scheduling problems for ship-to-berth assignment in Imai et al.(2007) and so on. In that study, it is given in advance that the handling time required from the ship berthing position to the container storage location in the yard. Normally, the handling time spent for a ship is determined by the number of containers handled and the QC assigned to that ship. However, we consider the above scheduling problems at the terminal with long quay consisted of multiple-berth ranged in a line. Thus we consider the model to estimate the handling time spent for the ship. Additionally, this paper also considers the storage arrangement for transshipment containers which are unloaded from ships (as inbound) and are loaded to other ships (as outbound). Due to the above issues, some situations can be considered as follows. Since a large number of ships call at relevant terminals, a high workload will be needed at quay side operations unload and load to the relevant ships. This situation offers a great challenge to yard management. Congestion in the yard area prolongs the time containers are handled and ships' departure from the terminal may be delayed. This causes a backup of following ships that have to wait until the relevant ships' departure. A domino effect occurs and will delay the ships calling to the next port. This is one of the bottleneck issues in the hub-and-spoke system. Therefore, the efficiency of quay side operations at a container terminal depends on smooth and efficient handling operations at the yard side. Using the estimated time of ship handling, our proposed approach that optimizes the yard arrangement along with the ship-to-berth assignment was applied in the genetic algorithm. The iterative approach, which first optimizes the ship-to-berth assignment and then optimizes the yard arrangement, is iterated. Total service times obtained by the proposed approach were shorter than those done by the iterative one, in most cases under three average intervals of ship arrival. Additionally, the CPU times spent by the proposed approach were less than those done by the iterative approach in all cases. Therefore this paper's contribution is, the proposed approach outperformed the existing iterative one in both the computational results and CPU times.

Keywords

Container terminal, Handling time, Multiple regression analysis, Yard arrangement, Optimization

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Biography / Biographies

Etsuko Nishimura is working as an Associate Professor, in the Department of Global Transportation Sciences in the Graduate School of Maritime Sciences at the Kobe University, Kobe, JAPAN. She gained the Bachelor of Engineering in Transportation and Information Systems Engineering from Kobe University of Mercantile Marine, Master of Engineering in Transportation and Information Systems Engineering from Kobe University of Mercantile Marine, and Doctor of Engineering, PhD in Civil Engineering from Kyoto University, Japan. She has published the journal and conference papers, such as Transportation Research Part-E, Transportation Research Part-B, European Journal of Operational Research, and so on. Her research interests include container transportation, marine terminal, terminal operation, simulation, optimization, and scheduling. Her research field is scheduling problems occurred at marine container terminals. It is utilized that a mathematical programming and numerical analysis etc. in order to solve the problems as followings: Optimize quay space use for the mega-containership calling terminal, Optimize yard area use for transshipment containers, Design the stack arrangement of container block at the yard area with irregular shape