Guest editorial

Maritime and port logistics: operations modeling and sustainable development

The theme of this special issue of *Maritime Business Review* is "Maritime and Port Logistics: Operations Modeling and Sustainable Development." It is an assortment of selected papers from the maritime and port logistics session of the MHCL 2019 (the 23rd International Conference on Material Handling, Constructions and Logistics) – Bar Conference held on 1-2 July 2019 at Bar, Montenegro, and individual submissions were included to this special issue. Overall, we received thirteen submissions, six of which were accepted to this focused issue.

In ensuing very short overview, we attempt to outline the basic attributes of the world seaborne trade and the world merchant fleet to brief those who are not experts on maritime and port logistics. According to the latest UNCTAD (2019), *Review of Maritime Transport*, world seaborne trade grew from 2,605 to 11,005 billion tons between 1970 and 2018, an increase of more than four times over the period. In 2018, total tanker trade reached 3,194 billion tons (29 per cent of the total seaborne trade in 2018 with 17.1 per cent for crude oil, 2.9 per cent of liquefied natural gas (LNG), 0.9 per cent of liquefied petroleum gas and 8.1 per cent of others) and dry bulk trade was at 5,230 billion tons (47.5 per cent of the total seaborne trade in 2018 including major bulks with 29.2 per cent and minor bulks with 18.3 per cent), while containerized cargo increased with a rate of 17.1 per cent (UNCTAD 2019).

In the first part of 2019, the total world fleet reached 95,402 ships with 1.97 billion deadweight tons (dwt) of capacity or 20,649 dwt per ship. The largest part of this belongs to bulk carriers with 42.6 per cent followed by oil tankers with 28.7 per cent, container ships with 13.5 per cent, general cargo ships with 3.7 per cent and other types of ships with 11.5 per cent (UNCTAD 2019).

However, it is impossible to speak of world seaborne trade and shipping without referring to ports, especially to container ports as they handled 793.26 million twenty-foot equivalent units (TEUs) in 2018, reflecting an increase of 4.5 per cent over 2017, whereas the world's top 20 container ports account for 43.8 per cent of the global container port throughput (UNCTAD 2019). With regard to megaships, which have reached and surpassed 23,000 TEUs, it is very important to note the implications for container port cargo handling and the advances in ship technology, both of which have strong effects on the maritime and port logistics.

Today, almost all companies operate in a very globalized environment with many complex constraints imposed by the operational, technological and compliance necessities. The nodes and links of the transport network that the world cargo flows pass through are the maritime ports and maritime corridors. Thus, a need arises for firms to explore problem areas and to seek analytical solutions that integrate, optimize and overall improve the transport flows and operational procedures within the network. These tools enhance the decision-making process and provide management with useful insights.

Over the years, as it has been mentioned by Song and Panayides (2012) in *Maritime Logistics: A Complete Guide to Effective Shipping and Port Management*, we have witnessed the convergence of shipping and port, followed by the convergence of logistics and supply chain management, and as such this special issue contains three papers for port logistics, followed by papers dealing with multi-modal transport between two regions, Panama Canal vs alternative routes and LNG supply chain planning.

Brief outlines of the six papers are as follows.

Maritime Business Review
Vol. 5 No. 1, 2020
pp. 2-4
Emerald Publishing Limited
2397-3757
DOI 10.1108/MABR-03-2020-052

To achieve a high container handling efficiency at transshipment hub ports, there are a variety of scheduling problem challenges such as ship-to-berth assignment (BAP) and container-to-yard arrangement (YAP). In most previously published studies, either the BAP is provided in advance when considered the YAP or vice versa. In *Yard and berth planning efficiency with estimated handling time*, by Nishimura, a way is proposed to optimize the YAP along with the BAP, simultaneously, to minimize the total service time of ships, including the waiting time until beginning of ship services, by using the estimated time of container handling. The objective function is to minimize the total service time, and a mixed-integer programming formulation combining the YAP with BAP (referred to as YAPB) is used. To find a feasible solution that seeks to minimize the total service time which includes YAP and BAP simultaneously, a genetic algorithm based on heuristics is developed. A regression model to estimate the container handling time based on simulation data is used in an optimization model to minimize the ship's turnaround time in this paper.

Marine container terminals (MCTs), as the facilities for connecting seaborne and inland transportation, are expected to handle the increasing amount of containers delivered by ships. Berth scheduling plays an important role for the total throughput of MCTs and the overall effectiveness of the MCT operations. In *Berth Scheduling at Marine Container Terminals: A Universal Island-based Metaheuristic Approach*, by Kavoosi, Dulebenets, Abioye, Pasha, Theophilus, Wang, Kampmann and Mikijeljevic, a mixed-integer linear mathematical model for the berth-scheduling problem, which minimizes the total cost of serving the arriving vessels at the MCTs, is developed. In the paper, a universal island-based metaheuristic algorithm (UIMA) is proposed to solve the berth-scheduling problem and minimize the total cost of serving the arriving ships at the MCT. The developed UIMA algorithm can be used by the MCT operators as an efficient decision support tool (DST) and can assist with a cost-effective design of berth schedules within an acceptable computational time. This UIMA, as a novel island-based metaheuristic algorithm, is designed to solve the spatially constrained berth-scheduling problems. The UIMA adopts several types of metaheuristic algorithms to cover different areas of the search space. The considered metaheuristic algorithms rely on different operators. Such feature is expected to facilitate the search process for superior solutions.

The analytical approximate solution of closed queueing networks devoted to modeling logistic processes in maritime container terminals has proven to be worthy of renewed research efforts. In *Queueing analysis for operations modeling in port logistics*, by Legato and Mazza, two specific queueing network models are presented to cope with modeling needs and quantitative evaluation of the two major logistic processes in a real container terminal of pure transshipment. The main issue focused on, in this paper, is the effectiveness of using two alternative approaches. The first is a constant-rate two-moment decomposition approach within a fixed-point iteration procedure aimed at returning an "equivalent" but open network. The second is a one-moment state-dependent rate approach within a fixed-point iteration procedure aimed at returning an "equivalent" but closed network. Both approaches share the common idea of managing non-product form features detected in the original queueing network by capturing these features in an "isolated" artificial station, which is then amenable to be solved by the underlying Markov chain. To support authors' discussion, a sample of encouraging numerical results has been obtained with respect to the two general closed queueing network models that may cover the two main logistic processes in a pure transshipment maritime terminal.

There are a lot studies which try to find out the optimal network and analyze the trade transportation and its demand on intermodal transportation between two or more regions over the world by combining various modeling approaches and real data from the existing transport networks. In *Analyzing the trade transportation and its demand on multi-modal*

transportation system between China and Koreas, by Wu, Sun and Yang, the trade transportation situation between China and Koreas is presented to explore the possibility of establishing the surface transportation corridor between China and Koreas. The modal split of trade transportation between China and Koreas is estimated by establishing a mode choice model based on a questionnaire survey. According to that, the mode choice behaviors of the shippers are analyzed supposing that they are faced with the multi-modal transportation system (MTS) to verify the necessity of opening the surface transportation corridor. The findings of this paper offer some important implications with regard to one of the most important premises in promoting the MTS which would create a stable and peaceful political environment, then the infrastructural development which will be the basis for promoting the MTS, especially the surface transportation system, between China and Koreas and finally, many efforts should also be made to enhance the service level of the MTS in particular to the surface transportation system from the management perspective

The Panama Canal is very essential for trade across the Pacific and Atlantic Ocean. Because of its expansion in 2016, the Canal has been able to attract larger vessels as they are able to be accommodated by the new Neopanamax locks. In *Panama Canal vs alternative routes: Estimating a Logit Model for grains*, by Ho and Bernal, grain transits both through the Panama Canal and alternative routes are examined, and a logit model is developed to explain the route decision from a carrier/ship operator's point of view. This study attempts to fit a logit model for dry bulkers transporting grains through the Panama Canal vs alternative routes to explain the route decision from a carrier's point of view. Alternative routes observations are obtained from the automatic identification system (AIS) data from Market Intelligence Network (MINT) software. The comprehensive data developed for the study and the information extracted from it provided the first useful insights for the analysis and ensuing a decision related to the grain trade through the Panama Canal.

Planning a LNG supply chain is one of main problems faced by a shipowner and is based on the optimal deployment of LNG fleet, assigning ships to most favorable contracts that service cargoes for trade routes between liquefaction and regasification terminals. In *An innovative decision support tool for LNG Supply Chain planning*, by Papaleonidas, Lyridis, Papakostas and Konstantinidis, a mathematical model is presented which improves tactical planning of the stakeholders of the midstream LNG supply chain, using an optimization approach. The main aim of this paper is to optimize the midstream LNG supply chain by adopting DST. A case study is used to illustrate its potential in generating quantitative data about the cost of the midstream LNG supply chain, the fleet usage and annual delivery schedule. The mathematical model uses a mixed-integer linear programming (MILP) formulation for the assignment of the fleet to the trade routes with the inclusion of a binary decision variable, while maintaining other real-life operational variables. The MILP model is oriented to provide optimal options to a shipping company that operates LNG carriers under long-term contracts for minimizing operational expenses and optimally assigning specified contracts to each vessel in the fleet.

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