Cover letter

Dear Editor,

We would like to submit the enclosed manuscript entitled **Round-trip multimodal transportation routes planning for COSCO foldable vehicle racks**, with the hope for review in the ***Maritime policy and management***.

Motivation:

Over the past five years, the incremental expansion of China's electric vehicle exports and pulp imports has presented challenges to the international shipping sector. The COSCO Shipping Specialized Carriers Corporation proposes an innovative logistics service, known as the Foldable Vehicle Rack (FVR) multimodal transportation business, which offers flexibility and circular logistics benefits. Specifically, during the forward outbound logistics process, commercial vehicles are loaded into FVRs to help containerize and multimodalize auto transportation, thereby reducing handling and transshipment costs; and during the reverse return logistics section, empty FVRs are folded and loaded onto the deck of the Multipurpose Pulp Carrier (MPPC) to decrease the empty container repositioning costs while maximizing the pulp capacity of the cargo hold.

Owing to the variations in transportation forms, conveyances, modes, terminals and handling ways, FVR multimodal transportation has certain **special features** (combining the characteristics of general cargo transportation, ro-ro automobile shipping and container liner service), and **novelty** (saving logistics costs while making up for the lack of capacity and high freight rates of ro-ro ships and container vessels, as well as facilitating the repositioning of empty FVRs). The pivotal necessity from the angle of the multimodal transport operator (MTO) is to delineate a suite of optimal shipping routes and transportation modes that not only optimize gains but also consider the duration for cargo delivery.

Main work:

In light of this, we first comprehensively introduce the basic forms of the four business types: vehicle container transportation, auto ro-ro shipment, FVR carriage, and pulp shipping. We then explain the characteristics of COSCO's FVR and pulp transportation business. And based on this, the advantages of the full logistics business of employing MPPCs and 48ft FVRs transporting automobiles on the outbound trip and carrying pulp and empty FVRs on the return trip are systematically analyzed for the first time. After proposing the benefit-duration route planning model, the bi-objective optimization problem is transformed into a single-objective optimal issue by entropy weight method. The paper discusses the computational results of the model, proves the effectiveness of the hybrid algorithm, and also analyzes the scheme variations in different parameter scenarios.

Results:

It is found that the optimal solution calculated in this paper reduces the transit time consumed by 24.77% while improving the logistics benefit by 4.11% over the firm's current shipping schedule. In addition, we explore the alternative optimal logistics routes for the MTO in different parameter variation scenarios and benefit-time preferences. Eventually, six managerial insights are proposed for the sustainable development of COSCO's FVR and pulp business based on the experimental results and the survey interviews.

The academic highlights and industrial contributions:

(1) To the best of our knowledge, this is the first systematic study of the multimodal transport route planning optimization problem for both the 48ft FVR and the pulp, providing a methodology for this area.

(2) For the first time, we consider the case of double O-D pairs for full round-trip transportation (with different origins and destinations for the outbound and return trips), and the empty FVRs repositioning problem for the return trip is also taken into account.

(3) Based on the experimental results and the survey interviews, six pragmatic management insights for the sustainable development of COSCO's FVR and pulp shipping business in the future are proposed.

(4) Overall, this work is of managerial implications and provides new horizons for a comprehensive picture of international automotive and pulp logistics, as well as designing a set of operational multimodal route planning approaches balancing transportation benefit and duration from the perspective of the MTO/carrier.

It is worth noting that this work is one of the three outstanding papers at the 5th Y-RIB (The Yangtze River Research and Innovation Belt Association) conference and has been recommended for publication on MPM by the committee, Prof. Paul Tae-Woo Lee, Prof. Zhongzhen Yang, Prof. Jingbo Yin and Prof. Meifeng Luo. We do hope this article is suitable to be considered for review by MPM.

Regards,

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