Empty Container Repositioning: Current Strategies and Challenges

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ABSTRACT

Containerization is considered as one of the most remarkable improvements in the shipping. Containerization has gained popularity due to its inherent advantages of supporting inter-modal transport, additional safety of goods, cost effectiveness and faster speed of transportation. Container fleets have been increasing dramatically to ensure availability and in response to the imbalance of trade. The impact of container inventory mounts a substantial pressure on global supply chain. More precisely, the researchers are interested in the problems related to the management of full containers as well as the repositioning of empty containers. Therefore areas such as cost control, inventory level optimization, forecasting future demand requirements and optimizing container repositioning expenses need concentration. Thus the problems faced in the container allocation and management have been discussed and these problems form the vital part of the containers logistics and supply chain. This paper aims at presenting an overview of empty container repositioning problem. It attempts to review the relevant literatures and to identify the factors causing the need for repositioning.

KEYWORDS: empty containers, repositioning, factors, overview

I. INTRODUCTION

Ports are intermodal transit facilities for containers. After the vessel arrives at the terminal, the loaded containers are unloaded from the vessel and are transported to their destination by road or rail. At the final destination the containers are then unloaded and empty containers are returned to the shipping company. The shipping company will reuse empty containers to meet other demands or will store them at a container yard for future requirements. Then, the imported, stored and returned empty containers will be available on demand. On the other hand, requests for empty containers are made by shippers who need to export goods. To meet these requests, the shipping company should provide enough empty containers to shippers, then the shippers can pick up those empty containers and move them to their own premises to load them. After that, the loaded containers are returned to the terminal at the same port. As a consequence, a shipping company can determine the total number of empty containers that are being requested.

II. CONTAINER MANAGEMENT

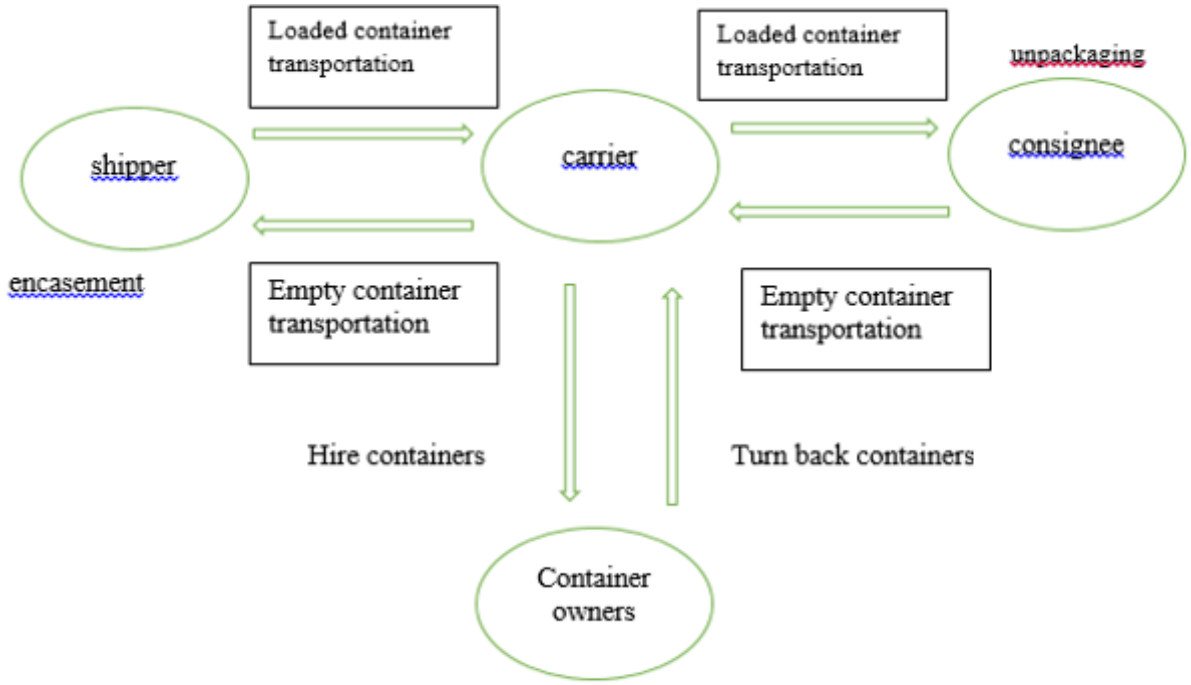
Container management means knowing that X containers are required at time Y in quality Z at one or a number of specified locations, and that they are in place in the proper quantity and at the right time to meet the requirement. The quantity of empty container allocation gets large, and the container using efficiency gets low, those makes the cost of empty container allocation increase, and the harbor empty container stock level rise, meanwhile indirectly influence the route container equipment quantity, container rent quantity, causes the total cost of container transportation to increase. The cost control and reduction in empty container allocation have become the key aspect to influence the shipping companies' state of operation.

Container circulation process

The container circulation in the entire transportation process is as follows:

1) The cargo owners are in need of empty containers. These empties are obtained from the nearby container freight stations
2) Then the empties are stuffed with the cargo. Then they are transported through the intermodal facilities to the container yard
3) The loaded containers are then load to ships in ports and are transported to the destination port.
4) There they are picked up and transported through the interior transportation modes and are delivered to the consignees' premises.
5) Then the containers are destuffed and becomes empty again and are either stored or transported to the place of demand.

Figure:



The container's circulation procedure in entire transportation process

III. PROBLEM DESCRIPTION

Due to the imbalance in international trade activities arising from different economic needs in different countries, the supply and demand patterns of empty containers at different ports are also quite different. According to an investigation carried out by the "International Asset System", more than 50% of container total life span a container spends empty or "waiting" for the availability of cargo for transport, or being repositioned to the point of demand. Repositioning may reduce container waiting times and increase their utilization, but it incurs additional transportation and handling costs and occupies precious vessel spaces, especially when they were repositioned to a port where demands fall or too many empties have already arrived. Containers are intended to be used constantly but this is not always possible.

IV. LITERATURE REVIEW

Different literatures attempted to study the problem of repositioning empty containers. Many focussed on formulating mathematical models and attempted to implement on the real-time network. Most of the literatures focus on minimising the overall costs of repositioning of empty containers. Some literatures review the strategies that are followed by the international ports for better management of the problem. Container sharing, vehicle routing were some among those strategies that were suggested for the implementation, by ignoring their limitations. The key issues discussed in those papers include imbalances of empty containers, container allocation problems, trade imbalances, uncertain demand on ports, the movement and flow of empty containers, container scheduling problems, distribution planning problems, and fleet management. Many papers deal with operational planning level which includes scheduling of services, routing and dispatching of resources, etc. The key issues are identified through the literature study. In most literatures, an independent and identical distribution is assumed for probabilistic demand and more complicate stochastic process could be studied in future research. In the modelling oriented analysis, two distinct method approaches have been adopted. They have been categorized either as mathematical modeling or heuristic products.

V. FACTORS EFFECTING THE TRANSPORTATION OF EMPTY CONTAINERS

Through the study of literatures, the factors contributing the need for repositioning and transportation of empty containers are as follows:

- The objective factors include, imbalance in in/out container numbers, which indirectly emphasizes on demand and supply, the imbalance in container types, rate of turnover of the containers, which is a slow process due to which the container cycles are delayed and it remains inactive for long periods, the sudden variation of cargo volume, the difference in the economic development between different regions, etc.
- The subjective factors include, backlog of empty containers, mistakes made by different parties in managing the containers, extended use or misuse of containers by parties, the cost of container repairs and standards differ from place to place.
- Some of the other factors are: the company stores empty containers to meet customer demand and attempts to minimize safety stock of empty containers at each port. Safety stock of empty container affects the amount of repositioned-into empty containers and repositioned-out empty containers.
- The cost factor play a major role. Handling cost at port is a major and indispensable expenditure. The cost of transportation mode is divided into three kinds of cost: cost of owned slot; cost of charted slot; and cost of inland drayage by truck.

The other reasons for container allocation are:

- Container equipping quantity: The number of container equipping quantity in a route is the direct factor affecting empty containers' allocation and transportation.
- The number of hired container and the hire rate: There are two choices for Liner Corporation to make when lots of empty containers are needed: hire or allocate. When the hire rate is very high, Liner Corporation will allocate
- Containers' Sale price: Liner Corporation can chase containers directly if the containers' sale price is reasonable and the demand for empty container is urgent.
- The management level of container: The low container management level is the main cause of empty container allocation. It's necessary to improve the container management level.

VI. ANALYSIS METHODS AND TECHNIQUES

The past historic data has to be obtained and can be used for analysis purpose. Data pertaining to the costs of repositioning, which includes transportation costs, leasing costs, holding costs, hauling costs, etc, can be obtained. Other relevant data such as number of empties demanded or in excess are to be obtained. If in need, the past data could possibly be projected for future needs. Data and opinions on location and capacity, cargo volume, the number of truck trips generated, separate laden containers and empty containers movement, typical business arrangements, and current and innovative business practices to improve the management and utilization of empty containers as well as overall container inventory control can be obtained through surveys.

From the data obtained, analysis can either be done through the use of software or through modeling approach. Softwares such as LINGO, OptQuest were used in some studies. Otherwise the problem can possibly be expressed as mathematical functions and analysis can be done through suitable model such as inventory or mathematical model or operational research model. Numerous literatures study the problem with deterministic approach and some with stochastic approach. The factors affecting the complexity of models are the supply, demand, planning horizon, capacity of vessels, container types etc. Most realistic model would be a stochastic, dynamic, multi commodity model including container substitution, container leasing and street turns.

VII. CONCLUSION

Empty container movements lay a burden on a shipping company's profits, because they are costly and non-revenue generating. These movements also contribute considerably to emissions and other external effects of transport.

Main issues identified at operational planning level are the scheduling of services and the routing and dispatching of resources such as containers, vehicles and crews. Critical factors are trade imbalance, dynamic operations, uncertainties, lack of collaboration within transport chain, transport companies operational and strategic practices. Factors affecting the complexity of models are the supply, demand, planning horizon, capacity of vessels, container types etc. Several practical strategies can be suggested for managing the empty containers at regional level. Especially, strategies for reducing the number and length of empty movements may be proposed. Some examples may be the use of inland container depots, street turns, container substitution, container leasing, foldable containers, internet based systems, etc.

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