

# Virtual Container Yard: A review of Literature



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## Introduction

In 2006, Journal of Commerce published the ideology about "virtual container yard" (VCY) citing exchange of empty containers in "street turns" instead of hauling them back to the ports. The concept is rather basic. Trucking companies post a description of their empty containers on a portal called eModal Web site, the shipping lines that own or lease the containers and the location of the boxes. Truckers who register for the program have access to the site will do street run more economically than those who follow traditional container return and collection from container yards (Mongelluzzo, 2006). In 2015, the author of this article argued that the exchange could be done even at international scale between container carriers and proposed a vertical integration to the original VCY model. In other words, exchange of containers could be done in many locations simultaneously. Also, the exchange was not merely for domestic transport but included sea carriage between countries. However, the operationalization of extended VCY model is complicated. Therefore, popular game theoretic approach was used to describe this phenomenon. Accordingly, two exchange types were introduced in 2015 namely, intra-port and inter-port collaboration (Edirisinghe, et al., 2015). This extended model of VCY has been evaluated by many authors and its pros and cons have been identified. This article provides a

basic understanding about the second-generation model of the VCY and its potential in Sri Lankan context.

Containerization system is significant to the international trade as it holds good characteristics of sea transportation (Mhonyai, et al., 2013) and was invented and first commercially implemented in the US in the mid-1950s (Bernhofen, et al., 2013). Majority of ocean bound liner cargo (Lai, et al., 2010) is transported in containers due to numerous advantages it offers to shippers, ship owners and port authorities (Aserkar, 2007). By adopting containerization, the industry opened the flood gates for global commerce (Stopford, 2009). Cargo travelling in sealed containers was far less susceptible to the perennial risk of pilferage; less likely to be damaged at sea (Cudahy, 2006). Containerization has made a significant change globally in the system of freight transport responsible for the acceleration of the globalization of the world economy since the 1960s (Bernhofen, et al., 2013). The system, led to greatly reduced transport costs, and supported a vast increase in international trade. The management of container fleets, regardless of type and size, is a rather costly operation (Lagoudis, et al., 2010). From 1981 to 2009, global transport of containerized cargo increased approximately 3.3 times faster than the world's GDP (UNCTAD, 2011). The total existing cellular fleet as at 13th March 2020 (all sizes / all positions) stands at 6,143 active ships (including 5,351 fully cellular) for 23,670,615 TEU (Alphaliner, 2020).

### **Marketing Context**

Physical goods can be stored and use when the demand is established. In the event of excess production, the producer or the wholesaler retains the goods (if not perishable) and market when the demand is re-established. On the contrary, shipping, in marketing terms referred as a service. Therefore, its “perishability” character influences carriers to share their excess capacity with competitors to minimize the direct loss as it cannot be hold until the demand is re-established. For example, a ship's unused slots (port pair) cannot be stored and will be perished once it is sailed from a port. This reality paved the way for liner shipping companies to exchange shots despite its possible marketing disadvantages. There are several tools for market cooperation in contemporary liner shipping: slot charter agreement, slot exchange agreement and vessel sharing agreement. However, the co-operative structures among liner companies began from conferences and consortia to the recent strategic alliances (Chen, et al., 2010).

Under alliance co-operation, carrier's decision-making in how to execute slot exchange with its partners is an important part of its slot allocation plan, which links to company's profitability. In a slot exchange co-operation, participating carriers seek to benefit in which their surplus of controlled capacities can be shared to exchange slots belong to partners for their shortages. To each participant, whether the exchanged conditions can bring more benefits is based on its slot allocation planning (Chen, et al., 2010). Therefore, collaboration between container carriers has a long history. Kadar (1996) disclosed that the purposes of alliance members are to effectively reduce costs, to increase the freight revenues without investing any more capital, and to enjoy economies of scale by sharing resources with other partners.

### **Economics Context**

Shipping, in economics respective, is a “derived” demand of international trade. Accordingly, imbalances in empty container supply and demand are a consequence of trade imbalances along

the main trade lanes. This is termed as a structural and endemic problem of the global trade by many authors. Demand for container shipping services is derived from demand for container trade (Lai, et al., 2010). In other words, demand for containers is derived from the demand for movements of cargo by exporters and importers. As explained previously, supplying of empty containers to exporters is an essential part of the chain in container shipping because a slot has no commercial value without a container. The import and export volume is not equal with each other in the foreign trade of the world countries, so empty container repositioning problem is caused by trade imbalanced exactly because of the different economic needs in different regions (YUR & Esmer, 2011). As cited in Lai, et al., (2010) Demand for sea transport is derived from demand for goods to be transported (Jansson and Schneerson, 1987). Container handling within the chain may be completed in numerous ways including the use of shipping agents (González-Torre, et al., 2013).

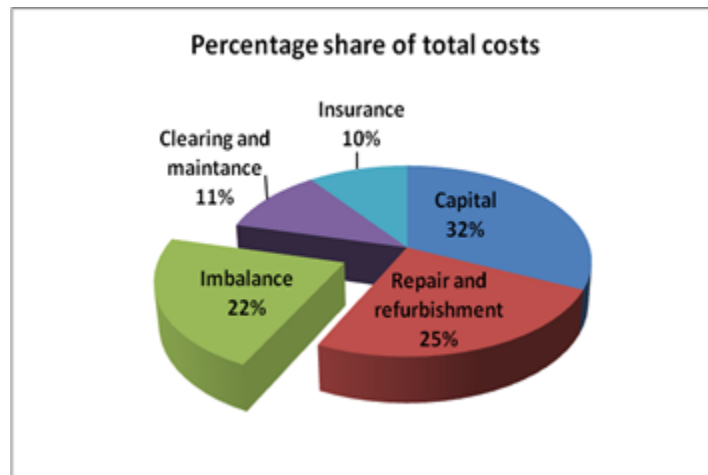
The “Wealth of Nations” written by Adam Smith in 1776 stated that “by means of water-carriage more extensive market is opened to every sort of industry than what land-carriage alone can afford it”. The impact of shipping to the society was seen in this manner by this great philosopher long time ago which is still valid. Containers have been more important for globalization than free trade (The Economist, 2013). One of the most striking developments in the global economy since World War II has been the tremendous growth in international trade (Bernhofen, et al., 2013). Once countries get embedded in the global supply chains, they feel part of something much bigger than their own business (Friedman, 2005). About 90% of world trade is carried by the international shipping industry (I.C.S., 2013). Water transportation systems provides low speed and relatively low accessibility, but extremely high capacities (Banks, 2004). Containerisation which changed everything was the brainchild of Malcom McLean, an American trucking magnate (The Economist, 2013). McLean understood that reducing the cost of shipping goods required not just a metal box but an entire new way of handling freight (Marc, 2006). Containerization which is believed to have developed after World War II has made a significant change globally in the system of freight transport. The first deep-sea container service was introduced in 1966 and in the next 20 years containers came to dominate the transport of general cargo, with shipments of over 50 million units per year (Stopford, 2009).

### **Container Inventory Imbalance**

The indispensable allocation of empty containers plays the squanderer in container logistics, which has become an urgent problem yet to be solved in practice and an interesting topic being studied in academic circles (Qing-kai, et al., 2014). Owing to an imbalance of trade, the shipping line accumulates many empty containers at some ports, while other ports are often faced with a shortage of empty containers (Leung, et al., 2004). Within the whole world container traffic, the largest share of containers is in the status of repositioning (Karmalic, et al., 2012). The movement of empty containers generates no profits for shipping companies, but it represents an essential operation to satisfy future transportation opportunities. Alphaliner’s survey of the 10 largest container ports in the US showed that the total laden imports grew by 6.2% in 2018 to reach 20.66 million TEU while total laden exports grew by only 2.1% to 11.06 million TEU. The total number of empty containers handled at the 10 ports surveyed increased to a record of 10.89 million TEU, growing by 5.6% in 2018 with the incidence of empty container handling reaching an all-time high of 25.6% (World Maritime News, 2019).

Empty container repositioning is an integral part of an overall efficient global transportation system. The empty container allocation problem in a port is related to one of the major logistics issues faced by distribution and transportation companies: the management of importing empty containers in anticipation of future shortage of empty containers or exporting empty containers in response to reduce the redundancy of empty containers in this port (Leung, et al., 2004). Ocean carriers currently spend close to \$100 billion per year operating their container assets and approximately \$15 billion of this directly related to cost of repositioning the empty equipment to its next exporting port (Akca, 2013).

Figure 1: Container costs



Source: (Alderton, 2004)

### Extended VCY Model (EVCY)

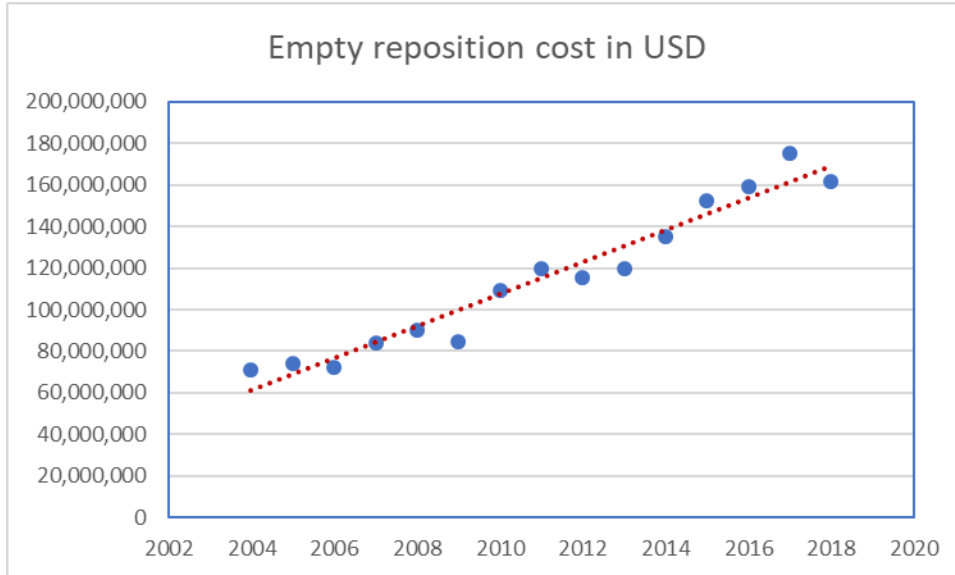
The primary argument of the EVCY concept is that “Collaboration” could be the most appropriate solution to the container imbalance problem in container liner shipping industry. This proposed solution has rooted in following fundamentals. 1) Container shipping lines carry cargo stuffed in containers between ports. 2) Ship space (slots) and containers are complimentary to each other without which the “Container shipping service” cannot be rendered to its customers unless both components are available simultaneously at a given location. 3) Container shipping lines have collaborated to share slots to gain the advantage of scale of economies. 4) Major Container shipping lines have existing alliance agreements that have provisions to exchange equipment (containers). 5) Container shipping lines do not share their containers with other container carriers at present, but they are willing to collaborate and exchange containers if the overall benefits supersede perceived disadvantages. For example, majority of container shipping line agents in Sri Lanka are willing to collaborate and exchange containers as evidenced in previous study conducted by the researcher. Song & Carter (2009) in their study proposed external container sharing as a strategic option. It refers to pooling container fleets among different ocean carriers.

The concept of EVCY is based on the container exchange between carriers on a global platform. Each carrier has the full control of their containers with respect to release or hold for their own use. Shao et al. (2015), formulate this problem as maximum matching in a large general graph, and propose a distributed matching algorithm to solve this problem. Lines may exchange containers provided it enhances value of the supply chain to all participants. The basic requirements that demands this action is that one carrier should be experiencing a deficit of containers (either the particular size or the type in demand) while another carrier has surplus on the identical size and the type of containers at the same time horizon and in the same location. The exchange provides a quick solution to the imbalance problem. The offeree will be able to fulfil the customers' empty container requirements promptly. As far as the offeror is concerned the cost of repositioning empty containers or the cost of inventory holding could be minimized. If the carriers are solely depending on their owned containers it obviously attracts two types of costs namely, the cost of empty repositioning from a nearby port or the opportunity cost of losing new business.

### **The Sri Lankan Context**

The first ever container was unloaded in the port of Colombo- Sri Lanka in 1973 (Ratnayake & Wijeratne, 2012). Shipping is the most favoured mode of international transportation in Sri Lanka and more than 85% of ships arriving to Sri Lanka are container ships. The Government of Sri Lanka has embarked on a development agenda with the objective of converting the country to a naval, aviation, commercial, energy and knowledge hub in Asia (Edirisinghe & Muller, 2014) and every successive government focuses on naval activities in the country. It is also learnt that the container imbalance is a global issue. Brito and Konings (2013) in their paper states worldwide about 20% of total container flows at sea are empty and the costs of repositioning are about USD 400 per container. When the volume of domestic imports (in containers) of a country is greater than its exports such location would ultimately end up with a surplus MTY stocks. This problem has been identified as a structural and chronic problem (Karmelić, Dundović, & Kolanović, 2012). This reality is applicable in the context of Sri Lanka as well. Therefore, finding a solution to container imbalance problem would be crucial at this moment and would provide many benefits to the country. With respect to Sri Lanka, 10,640,582 TEUs of empty containers have been handled in port of Colombo during past 15 years namely, 2004 -2013. Figure 2 illustrates the cost associated with empty container movements in Sri Lanka during said period.

Figure 2: Cost associated with empty container reposition in Sri Lanka.



It was evident only handful of scientific researches are done in Sri Lanka regarding container inventory imbalance. It may be useful the Ceylon Association of Shipping Agents (CASA) –the official forum of shipping line agents in Sri Lanka take the leadership and conduct proper study on this sensitive issue thus help mitigate the negative impact to the industry.

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