World Academy of Science, Engineering and Technology
International Journal of Transport and Vehicle Engineering
Vol:15, No:5, 2021

Virtual Container Yard: A Paradigm Shift in Container Inventory Management

Lalith Edirisinghe, Zhihong Jin, A.W. Wijeratne, Hansa Edirisinghe, Lakshmi Ranwala Rashika Mudunkotuwa

***Abstract*—**A paradigm shift in container inventory management (CIM) is a long-awaited industry need. Virtual container yard (VCY) is a concept developed in 2013 and its primary objective is to minimize shipping transport cost through implementing container exchange between carriers. Shipping lines always try to maintain lower container idle time and provide higher customer satisfaction. However, it is disappointing to note that carriers turn a blind eye to the escalating cost resulted from the present inefficient CIM mechanism. The cost of empty container management is simply transferred to the importers and exporters as freight adjustments. It also creates an environmental hazard. Therefore, it has now become a problem for the society. Therefore, a paradigm shift may be required as the present CIM system is not working for common interests of human beings as it should be.

***Keywords*—**Virtual container yard, imbalance, management, inventory, container inventory management.

I. Introduction

THE concepts of the VCY are based on the container exchange between carriers on a global platform. Each carrier (container liner shipping line) owns the full control of their containers with respect to release for export shipment or store in a designated yard for future use. Efficient and effective management of empty containers [1] and empty container repositioning is an important issue [2] in the liner shipping industry. In the global context of container traffic, the largest share of containers is in the status of repositioning [3]. According to [3], estimated empty container repositioning costs alone accounted for USD 20 billion per year on a global level in 2002, which is the latest evidence found in the literature. That means, this cost would have substantially increased after the past two decades. Usually, CIM is carried out in each port by the shipping agency office under the strict guidance of the carrier company. This inventory management includes inward movements, storage, repairs, maintenance and outward movements of all containers belonging (including leased units) to the shipping line. It is believed that the container inventory imbalance could be reduced by 14% through exchange between carriers [4].

Generally, container shipping companies reposition empty containers from surplus ports to deficit ports. As a result, obviously there is a cost involved in balancing the container fleet by respective shipping lines. In fact, it is considered as the third biggest cost component in containers.

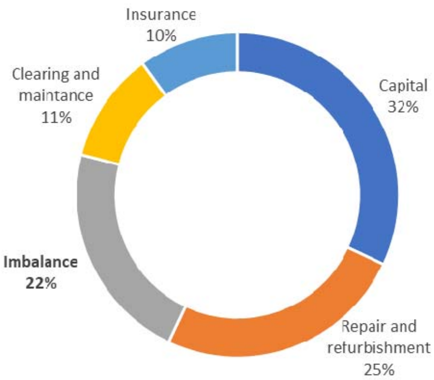

Fig. 1 Percentage share of container costs [5]

The container inventory imbalance was in existence from the day containerization started more than six decades ago. The consequential impact of the container inventory imbalance (CII) has grown unproportionate to that of containers. There are 6,145 active ships including 5,352 fully cellular that carry 23,325,747 twenty equivalent units (TEU) containers as at 29 Apr 2020 [6]. In order to strike a balance between inward flow and outward flow of container fleet at a specific location, Container Shipping Lines (CSL) are compelled to transport the empty containers at their cost. Due to the nature of the liner shipping industry, supply and demand is very difficult to match.

While container inventories are handled through the online platforms of individual carriers, there are many bottlenecks that need human intervention in decision making. According to [7], 33% of repositioning costs arise from company inefficiencies, which highlights the need for more refined mechanism to handle this problem [7]. Unlike in the break bulk, tanker, or bulk ships, the space available in container ships are unusable without containers to stuff the intended cargo to be transported. In other words, ships and containers are complimentary items, without which, one cannot supply a transport solution. Therefore, it is logical to investigate how CSL approach the imbalance of ship space (slot) because both slots and containers are equally exposed to similar market demand and supply condition at a given port. Accordingly, it was noted that CSL share slots among the carriers calling at

Lalith Edirisinghe is with the CINEC Maritime Campus Sri Lanka affiliated to Dalian Maritime University-China (corresponding author, phone: 094 777 562 505 lalith.edirisinghe@cinec.edu).

Zhihong Jin is with the College of Transportation Management, Dalian Maritime University, Dalian, China

A. W. Wijeratne is with the Sabaragamuwa University of Sri Lanka, Po Box 02, Belihuloya 70140 Sri Lanka.awwijeratne@yahoo.com).

Lakshmi Ranwala is with the CINEC Campus Sri Lanka

Hansa Edirisinghe is a doctoral candidate with the Board of Investment of Sri Lanka

R.Mudunkotuwa is a doctoral candidate with the CINEC Campus, Sri Lanka.

the same ports at the same time [8]. Although there were many deliberations and marketing concerns at the initial stages, later CSL found space sharing for vessels to be economical and they formed strategic alliances to enhance performance and sustain the highly competitive liner shipping market. There are now alliances in the liner shipping industry in which different CSL share ship space. In the process, these CSL are compelled to share very confidential marketing information which is a critical disadvantage especially when working with a limited number of highly dependent customers. Carriers have proven that the sharing of ship space is very effective in gaining the advantage of economies of scale which supersede other disadvantages, and thus the system works very fine [9]. In addition, some liner shipping alliance agreements have provided necessary provisions for its partners to interchange equipment (containers) too. However, investigation into this scenario reveals a serious paradox sustained in the shipping industry.

CSL have so far failed to implement an exchange mechanism to resolve the CII issue. On the other hand, adding insult to injury, even the partners of the alliances who should have taken the leadership and interchange containers have not made use of the provisions in their agreements. It is quite clear from these documentary evidences that there is no disagreement to exchange containers at the strategic management level although the same has not drawn the attention at the operational level. This inconsistency and its impact to the industry is a serious matter. According to [10], 13 mega carriers that represent 42% of world container trade have had alliance agreements that facilitated equipment interchange in the past but not a single carrier has made use of that flexibility under the agreement. In terms of the application of the concept of exchange containers, it is now just a matter of extending the same strategy with respect to containers. It is surprising to note the absence of collaboration although the 'equipment interchange' is included in major liner shipping alliances (existed at the time of report by FMC) agreements such as Grand Alliance II (NYK, OOCL, HL); APL/HLAG; CMA CGM/MSC; HMM/MOL; CMA CGM/CSCL and CWA.

Although the cost of empty container reposition is primarily borne by the respective shipping lines, it is subsequently recovered from the exporters as a part of freight. Ultimately, this higher freight is inadvertently paid by the consumer of the cargo [11]. Therefore, minimizing the escalating empty container reposition cost helps reduce the price of consumer goods that are being imported to a country. Since the freight is usually paid in dollars, the savings on export freight will have a huge impact on that country's economy. On the other hand, repositioning (instead of reusing them in the same port though interchange) of containers adds a huge environmental impact to the world. For the sake of argument, one exchange reduces the reposition of two empty containers. Also, a container reposition is not only polluting the marine environment, but other environments also through many intermodal transportation activities associated with single container repositioning. Considering this background, it is quite evident that a paradigm shift in CIM should be initiated to minimize the impact on shipping costs and thereby, lessen the burden on society and negative impact on global environment.

II. The Prerequisites to VCY

The fundamental prerequisite in a container exchange is that there should be a CSL that is in shortage and another carrier in excess. However, given the fundamental differences that are characterized in shipping containers, this process is very complicated. The 6 R container interchange model identifies six components namely, Quantity, Size, Type, Time, Location, and Quality that play a significant role when CSL take a container exchange decision [12]. However, the location and quality were found to be less significant in terms of statistical analysis. The overall outcome of these six components could be illustrated as shown in Fig. 2, and every time a container exchange in a VCY takes place, the two parties need to ensure these requirements are duly met. For example, if Line A has a deficit of five 20-foot, general purpose containers for a Tea exporter in Colombo on the 25th of May, it should find a Line B that caters to all the conditions. This example can be described as follows: Line A has a five (right quantity) 20-foot (right size), general purpose containers (right type), for a Tea exporter (right quality) in Colombo (right location) on May 25 (right time).

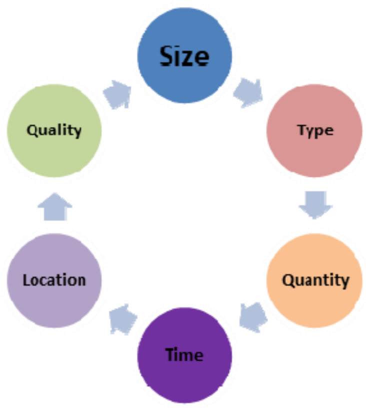

Fig. 2 General matching process of 6 R container exchange model

The disparity in container demand and supply is the fundamental cause that creates the global CII. The demand and supply can be classified under six sub criteria as in Fig. 2 namely, 6 R model. Striking the right balance between the exporters' demand and the carriers' ability to supply containers is the main challenge that the CSL face. Exporters create the demand for containers subject to the six conditions identified in Fig. 2. If the functions of VCY perform successfully, carriers may supply containers according to six qualifying criteria namely, right size, right type, right quantity, right time, right location and the right quality. In other words, the effectiveness and the efficiency of CIM depend on the strategic mix of these components.

Fig. 3 illustrates a simple matching of container demand and supply between three carriers operating in a VCY. Any

CSL may alternatively play one or more roles from three identities explained as Line A, Line B and Line C. For example, Line A has excess 20' and 40' containers and Line B is deficit 20' and 40' while Line C has a deficit of 40' and excess of 20' containers, simultaneously. Fig. 3 illustrates that Line A exchange 20' and/or 40' containers with Line B. Line C, while offering excess 20' containers to Line B, accepts 40' containers from Line A. For simplicity, only one qualifying criteria out of six namely, right size of containers was considered.

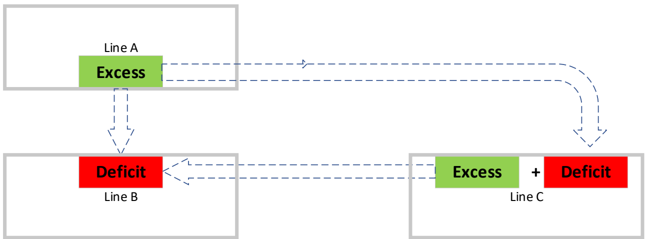

Fig. 3 Basic model of VCY with three participating carriers

The common agony of the carriers who hold excess inventory is the substantial cost associated in empty container repositioning out from that port. If they are not immediately repositioned, the idle inventory leads to ground rent, cost of monitoring, unrealized return on investment, and consequently, extra cost of maintenance (against rust and other natural/environmental phenomena) at CFS cannot be avoided. On the other hand, the CSL with deficit inventory tends to experience regular cargo booking cancellation, and thus is always at risk of losing customers in the long run. Cargo booking cancellation is a serious issue, as it not only affects the revenue to the CSL but negatively impacts on the long-term forecast and budgets. Liners usually consider exports from one port to another port in the respective port rotation as the prime source of empty containers to the later. Therefore, cancellation of a booking will have a continuous negative impact throughout the supply chain for all ports connected the CSL service. In order to avoid this chain of effect, CSL tend to import empty containers or on-hire boxes. Both these options add financial costs to the CSL. The sharing may reduce the need for empty reposition.

III. The Process of VCY

One of the key problems to be solved in CSL, is to find a mechanism that reduces the CII; thus, a better utilization of resources. There is a need to address the following: what is the current situation, what are the factors that determine the degree of willingness with respect to container sharing (interchange), how to organize those factors in a hierarchical system in order to understand the extent of their influence on the container fleet imbalance, how to improve those critical factors, and what benefits are expected through collaboration.

Having considered all key issues pertaining to the container exchange concept, it is now possible to summarize the sequence of activities in a basic Chevron process model. The Chevron Process Flow Diagram is an arrow timeline infographic template.

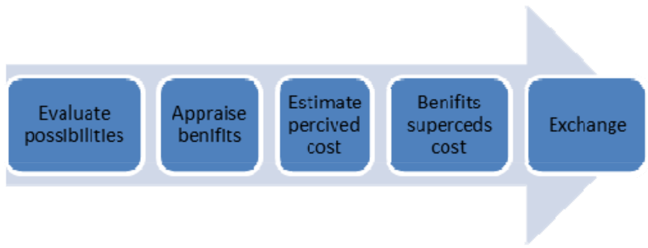

Fig. 4 The process of a container exchange model

The possibility to exchange containers between CSL may highly depend on the four conditions stated below.

1. The market condition should be conducive to exchange. Shipping is a highly volatile business and the demand for shipping is derived from demand of global trading patterns.
2. Benefits of exchange should supersede its perceived disadvantages. CSL is considered as an oligopoly industry, and thus there are obvious disadvantages to inter-competitor collaboration. Therefore, the overall benefits of VCY activities should exceed those possible disadvantages.
3. There should be a mechanism to visualize/assess the consequential results. VCY is a highly complicated operation that involves multiple carriers dealing with many exporters in hundreds of ports around the world. This creates multiple probability options and all such options should be carefully appraised by the decision makers. Therefore, these analyses should be visible to all participating lines.
4. Carriers should be able compute the outcome of container exchange in advance. Unlike an exchange that ends in one location, the output of the VCY may be realized in multiple locations and the origin of exchange and its ultimate destination has a direct relevance to the outcome of the exchange. For example, Line A offer (exchange) a container to Line B at port x and Line B transport the container to destination y and return the container to Line A after 20 days. Reciprocally, Line B offers two containers to Line A at port u and Line A transports them to destination v and later returns two containers to Line B after 10 days. The ultimate outcome delivered by both activities is equal in terms of simple mathematics. Likewise, any carrier attached to the VCY should be able to compute the outcome before they commit to any exchange activity.

In order to address these requirements, which are fundamental in implementing the VCY, a paradigm shift in the shipping industry may be required regarding CIM. VCY is the ultimate outcome of a sustainable container exchange mechanism. Fig. 5 visualizes the key variables that influence the efficient and effective operation of VCY. It illustrates that,

1. FRT- Freight rate is a key consideration if VCY is to be successful (FRT); the ability of CSL to do accurate forecasting may provide confidence to exchange

containers (FCT); Flexibility in CIM decision making is the key to VCY (FBL). These three components represent the 3F CIM model [13]

2. LGT- Ensure application of correct logistics concepts (LGT) in handling container inventory is one of the key determinants of an exchange decision. This is explained under 6 R Container supply model [12].
3. MCI- The competence in CIM leads to successful exchange decision (MCI). This is originated from the multidimensional carrier index and country index [14].
4. CED- Expectation of higher customer satisfaction (CED) is the driver of creating combined efforts of the whole decision-making process [9].
5. CIT- Expectation of lower container idle time (CIT) is the driver of creating combined efforts of the whole decision-making process [9].
6. EXC- Container exchange (EXC) is influenced by lower container idle time and higher customer satisfaction.

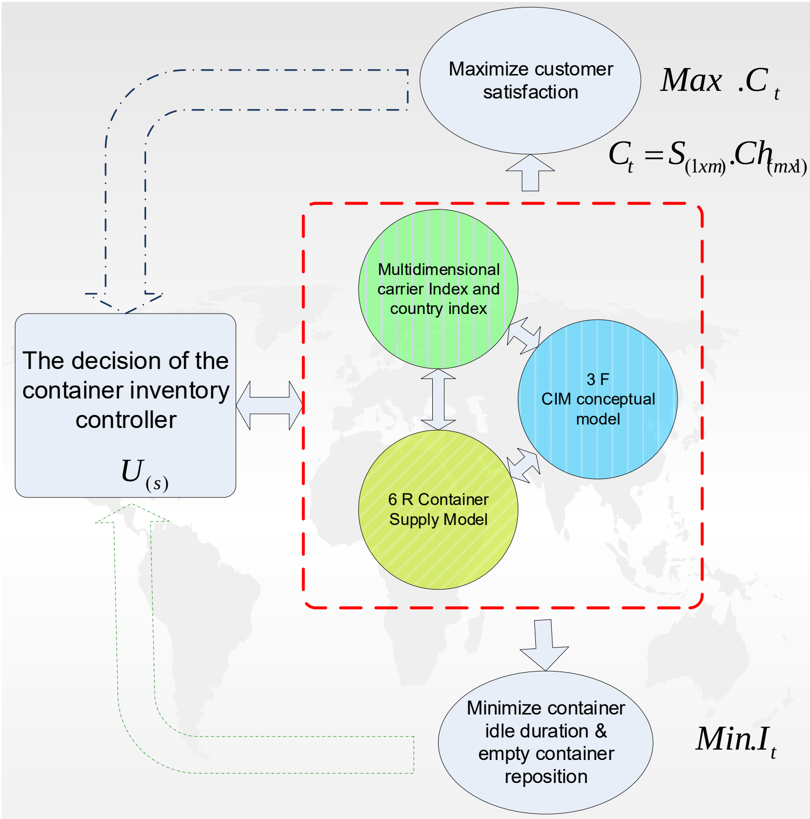

Fig. 5 Conceptualizing the VCY

Effective and efficient CIM means striking the right balance between customer satisfaction and cost of container imbalance (i.e. $Max.C_t$ and $Min.I_t$ at the time *t*). For the purpose of this research, the cost of container imbalance is defined as container idle duration and empty container reposition. The decision of the container inventory controller $U_{(s)}$ is to make both ends satisfied. The customer satisfaction is given by:

$$C_t = S_{(1\times m)}.Ch_{(m\times 1)},$$

where, *S* is a raw vector consisting of the perceived utility scores of *m* service factors, *Ch* is a column vector consisting (0 ,1), where the corresponding element 1, represents the desired level of the given service factor and, 0 represents the absence of the desired level. In order to achieve the optimum level of satisfaction, all the elements of the column vector should be in unity.

Each objective of the main research is covered by different material and methods of each sub researches. However, the research location, respondents, literature, and container data are common. From this background, it is clear that the decision of the container inventory controllers of CSL is a strategic balance between the container idle cost including storage, empty container reposition cost and maximization of customer satisfaction. Therefore, a paradigm shift in shipping should take place at this stage.

Paradigms are generally defined as a framework that has unwritten rules and that directs actions. A paradigm shift occurs when one paradigm loses its influence, and another takes over. A paradigm shift can be described a fundamental change in approach or underlying assumptions. It is a time when the usual and accepted way of doing or thinking about something changes completely [15]. The present paradigm in shipping is clearly demanding this timely change.

The paradigm in maritime transport is, as such, facing the need for a thorough readjustment in accordance with the vigor of Asian economies [16]. Shinohara [16] identifies the 1st Paradigm as Freedom of Shipping; Ocean transportation has been growing based on the principle of free seas. Redrafting maritime structure is not in favor to the freedom of shipping based on the free seas, it is however a detached but inevitable shift of the maritime paradigm for the sake of global sustainability. The 2nd Paradigm noted by Shinohara is the Economies of Scale. In transportation economics, the scale of economies is considered a paradigm and it applies in shipping too. Bulk, tanker, and container ships, and car carriers have increased their size, which has enabled a reduction of transportation cost per unit. Through this, energetic measures for a fundamental reform of the decision-making system, maritime transport may progress to a new dimension of orderliness. This shift of paradigm may come back in the center of institutional environment to contribute to a better governance of maritime transport. Therefore, the proposed paradigm shift in CIM is timely and highly appropriate.

IV. Literature Review

As cited in [17], Kuhn (1962) defined scientific paradigms as "accepted examples of actual scientific practice that include laws, theory, application and instrumentation that provide models from which particular coherent traditions of scientific research springs". Baker (1992) as cited in [17] defined a paradigm as "a set of rules and regulations that establishes or defines boundaries and tells you how to behave inside those boundaries".

The growing imbalance of containers globally creates substantial additional expenses as well as environmental issues. Leading carriers have already implemented a Container Imbalance Surcharge adding a direct cost to the consumer. Maersk Line (2013) advised their customers that the Equipment Imbalance Surcharge was implemented due to an increasingly severe equipment imbalance at Toronto container yards, leading to significantly higher empty repositioning costs. Therefore, finding a solution to mitigate such impacts would benefit primary shippers, consignees and shipping lines and then countries, regions and the entire world at the macro level. Also, carriers have a social responsibility towards reducing the empty container reposition through an effective CIM system [18]. A CSL service is a fleet of ships, with a common ownership or management, which provide a fixed service, at regular intervals, between named ports, and offer transport to any goods in the catchment area served by those ports and ready for transit by their sailing dates [19].

Container fleets of CSLs usually experience imbalances in many locations primarily, shipping being a derived demand. Trade imbalances have always existed. It is noted from global information that the greatest imbalances exist in China for both the US and Europe trade lanes. Obviously, this also has dramatic repercussions for container transport, since trade imbalances imply container transport imbalances and consequently a need to reposition empty containers [20]. The fundamental reason for empty repositioning is the trade imbalance [1].

The prospective outcome of container sharing may be realized in two ways. In quantitative terms, it reduces the cost of transporting empty containers. In qualitative terms, it will improve the service quality through catering to exporters' demands promptly and reliably. Bose et al. [21] identifies container availability as one of the criteria that determine the service quality of CSL. For example, some US exporters from time-to-time may experience capacity and equipment shortages [10] and this has a direct impact on service reliability. In addition to passing the part of additional cost incurred owing to having transport empty containers to the customer (i.e. shipper or consignee) as a surcharge, CSL try to mitigate the impact through controls internally. For example, some CSL (principals) penalize regional offices and agents for any idle containers that remain in their respective territories. As a result, the agents may be compelled to keep 'lean stocks' which are then vulnerable to the occurrence of frequent shortages. Therefore, such controls are not effective, as the company may lose potential bookings due to shortages at a given location. However, 'inter-competitor' cooperation is different from other types of inter-firm cooperation according to [22] because by definition, competitors are companies with 'similar' products and customers. CSL is considered to be of oligopolistic nature. Especially after the formation of vessel sharing agreements, most CSLs (who compete with each other in same trade lane) now share shipping space (slots) in same ship. Therefore, the 'product' offered by most CSL can be termed as 'similar' products. The vessel arrival time (ETA) and vessel departure time (ETD) are the same, and thus, every participating CSL may essentially cater to the same customers. Since the status (types and sizes) of container inventory of CSL is different from one to another (i.e. deficit or excess), there is the possibility to interchange containers between carriers. In addition to vessel sharing, these alliances gradually extend the collaboration to other areas such as, service rationalization, operating expense sharing, equipment interchange, and joint service contracts. Inter-firm cooperation is a source of competitive advantage [23], [24]. However, it was noted that no active 'containers interchange' is taking place in the industry despite all other collaborative measures being very popular among CSL. However, according to industry sources, CSL do not pool their containers and interchange, even if the contract agreements provide provisions for the same. The ultimate result is that CSL never opt to strike a balance between container inventories even within active consortiums (alliances). Therefore, it is quite obvious that the behavioral patterns of CSL with respect to these two phenomena (i.e. sharing ship space and pooling containers) are not the same. CSL in principle agree to pool the ship's space already; therefore, arguably, nothing prevents CSL from sharing containers too, particularly when 'space' and 'containers' are complementary to each other in offering service to customers. As such, it makes sense to identify the factors that influence the behavior of CSL with respect to container sharing (interchange) particularly by contrasting the response to the space issue by CSL as one of the key objectives of the research.

Management of empty containers not only has an economic effect, but also an environmental impact [1], since ever-increasing empty container movements also increase fuel consumption, congestion and emissions, and thus the pressure being placed on the shipping industry over carbon emissions [25].

Shipping Lines will exchange containers if it adds value to the supply chain. The basic requirements that demand this action are that one CSL should be experiencing a deficit of containers (either the particular size or the type in demand) while another has A surplus on the identical size and the type of containers at the same time horizon and in the same location. The offeror however primarily needs to make sure that they have ongoing services (and agents to undertake handling) at the intended destination. Secondly, there should be a demand for empty containers by the offeror at the time that the respective containers are scheduled to reach their destination. This demand should be either be greater or equal to the number of containers the CSL offers to the other carrier (offeree).

The exchange provides a quick solution to the imbalance problem. The offeree will be able to fulfill 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 global overcapacity of container shipping will result in carriers deepening their push to cut costs, whether by expanding alliances so as to maximize utilization of the largest and most cost-effective ships, by taking measures to make ships more fuel efficient or by reducing ships' time in port so as to maximize opportunities for slow steaming. The overcapacity of ship space would naturally mean a surplus of containers globally. It was estimated earlier that container volume is usually more than double of ship space given the weaker strategies of container inventory utilization. Therefore, developing strategies that help increasing the utilization of existing inventories would be vital for the sustainability of the container shipping industry.

The core issue that prevails in the industry is to find a mechanism to decrease the costs incurred on CII, and thus, better utilization of resources. It is understood from the exploratory study that there is no collaboration among shipping lines with respect to container interchange. To change this situation, a new paradigm should be created. True paradigm shifts represent drastic, sometimes uncomfortable change. It is not surprising, therefore, that these events can be met with resistance as organizational leaders step outside their comfort zones according to Pink (2005) as cited in [17].

V. Methodology

Research was conducted in Sri Lanka with the intention of generalizing its outcome in the global context. Sri Lanka attracts a majority of mega carriers due to its strategic geographic location. 17 out of the top 20 container carriers in the world operate regular services in the busiest commercial port in the country, Colombo. Approximately 75% of the global container capacity is operated [26] by those top carriers. Accordingly, the sample is expected to be relatively reflective of the general views of the global shipping industry. Therefore, it is presumed that the results can be generalized for the benefit of the global shipping community. There are two formal organizations that represent CSL in Sri Lanka namely, the Ceylon Association of Shipping Agents which is composed of 135 licensed ships' agents, and Sri Lanka. The other association, the Sri Lanka Association of Vessel Operators, comprises 14 members. The views of exporters are also obtained wherever applicable and there are approximately a thousand exporting companies (including non-regular) in Sri Lanka according to unpublished data. Interviews with senior professionals in shipping companies and exporting companies have been conducted to ascertain key aspects in container demand and supply and other aspects pertaining to CIM decisions.

The methodology of the research is constructed on the two fundamental objectives of VCY namely, maximization of customer satisfaction and minimization of container idle duration and empty container reposition. The paradigm shift in CIM should be derived from the VCY underpinning collaboration between CSL.

An opinion survey was conducted using 112 shipping agents. According to industry experts, the major decisions with respect to containers are usually taken in consultation with chief executives, operation managers, and container controllers (three strata). Every agent has one employee from each stratum reflecting 336 employees in total. It was learnt that each stratum influences the decision with respect to empty containers (MTY) differently. Therefore, weights were allocated to each job category as follows, and a weighted random sample was drawn from each job category.

TABLE I
SAMPLE SELECTION AND RESPONSE RECEIVED

Job category	Weights	Sample size	No. of responses received
Chief executives	0.2	22	20
Operations managers	0.5	56	53
Container controllers	0.3	34	32
Total	1.0	112	105

Accordingly, 112 questionnaires were sent, with only seven respondents not participating. The questionnaire consisted of only seven questions making it very simple to respond. Usually, the shipping community is reluctant to provide information about their operational activities, thus no demographic data were requested as to increase the response rate.

VI. Data Analysis and Discussions

The biggest challenge to create a new paradigm in efficient and effective CIM will be the present myopic view in the industry about CII. As noted in the interviews with industry experts, the majority of them feel that the container imbalance situation is the direct consequence of trade imbalance, which is beyond the control of the CSL, On the other hand, CSLs perceive that the empty reposition cost is inevitable in the liner shipping industry. As the carriers can conveniently pass the costs associated with empty containers to the customers, they do not wish to take a risk or explore solution to this problem. The container exchange, irrespective of some advantages, may generate complications particularly in terms of legal parameters. This myopic view of the industry is in fact discouraging the CSL to explore the possibilities in finding a solution through container exchange. Therefore, the concept of container exchange should be proved to the industry with the use of real industry data with respect to opportunities available. In other words, the number of CSL that need empty containers (offeree) and those who can provide containers to them (offeror) at a given time at a given location should be highlighted. This factor has some relevance to the queuing theory as well. For example, the industry gauges the seriousness of the container imbalance simply calculating the stock levels in the beginning of the year and the end of the year. However, there are more activities taking place during the year when consider the monthly or weekly imbalances. Therefore, a case study to investigate the realistic movement on a monthly basis (or weekly basis provided data are available) by each CSL should be recommended. This may need a theoretical modelling of collaboration among CSL with respect to container sharing and proposing a unit of measurement to quantify the outcome of container exchange.

Usually, a CSL has three sources of empty containers that are used for their export bookings: 1) the carrier-owned containers (COC), 2) on-hire or leased containers, and 3) shipper-owned containers (SOC). Therefore, at a given time carriers may have containers of all these categories dispersed globally, in sailing ships, in the hands of exporters, importers, container yards, port terminals, customs warehouses, on the roads on trucks, on rails or simply abandoned with a third party due to some issues. Therefore, monitoring the container inventory is a serious activity of a carrier. With the introduction of alliance agreements between carriers and commencement of slot sharing activities, this situation was further complicated. Now, the containers are commonly in the alliance vessels; this has created a situation where CSL have to handle their competitors' containers in addition to their own. Similarly, CSL have to release their containers into the hands of competitors according to the alliance agreements. Initially, this scenario has created many marketing disadvantages for CSL as their highly secure sensitive customer data may be lost. Subsequent to the successful implementation of the container exchange system, there can be a possibility of an export cargo belong to exporter e, stuffed into a container belonging to carrier c, freight handled by forwarder f, loaded on board a ship owned/chartered by carrier s, stacked in a slot owned by carrier a. Therefore, in the event of a legal implication, the number of parties that will be involved is getting higher and higher.

TABLE II
RELIABILITY STATISTICS

Cronbach's alpha	Number of Items
0.959	8

As Cronbach's alpha is 0.959, it can be concluded that there is a strong internal consistency of the questions. It is evident that sampling method of the research is in order according to Kaiser-Meyer-Olkin (KMO) value (i.e. 0.7). Also, the applicability of factor analysis is further confirmed by the significance of Bartletts' Test as mentioned in Table III.

TABLE III
KMO AND BARTLETT'S TEST

KMO Measure of Sampling Adequacy.		0.891
Bartlett's Test of Sphericity	Approx. Chi-Square	763.502
	df	21
	Sig.	0.000

As per Table IV, three components could be derived from the extracted model and these components explain 89% of total variance of the proposed variables. This is a good indication about the comprehensiveness of the variable selection.

TABLE IV
ROTATED COMPONENT MATRIX

	Component		
	1	2	3
FRT	0.664	0.542	0.484
FCT	0.292	0.309	0.883
FBL	0.884	0.268	0.195
LGT	0.512	0.564	0.458
MCI	0.340	0.863	0.302
CIT	0.634	0.412	0.489
CED	0.775	0.351	0.364

According to Table IV, the following conclusions were arrived at:

- Factor 1 = F (FRT, FBL, CED, CIT)
- Factor 2 = F (LGT, MCI)
- Factor 3 = F (FCT)

TABLE V
FORMATION OF 3C MATRIX OF VCY

Commercial	FRT (Freight rate) is a key consideration if VCY is to be successful
	FBL (Flexibility in CIM decision making) is the key to VCY
	CED (Expectation of higher customer satisfaction) is the driver of creating combined efforts of the whole decision-making process
	CIT (Expectation of lower container idle time) is the driver of creating combined efforts of the whole decision-making process
Capable	LGT (Ensure efficient and effective logistics practices) of container inventory is one of the key determinants of an exchange decision
	MCI (Competence in CIM) leads to successful exchange decisions
Conjecture	FCT (Carriers ability to do accurate forecast) provides confidence to exchange containers

This scenario can be explained as follows and three components are derived as follows. This could be named as the VCY operations model or 3C's Matrix. The 3C's stand for commercial, capable, and conjecture.

TABLE VI
TEST STATISTICS[A,B]

	F1	F2	F3
Kruskal-Wallis H	79.233	77.694	52.152
df	3	3	3
Asymp. Sig.	0.000	0.000	0.000

a. Kruskal Wallis Test
b. Grouping Variable: EXC

Ho: EXC is not depend on i^{th} Factor
H1: EXC is depend on i^{th} Factor.

According to the Kruskal–Wallis statistics, it can be seen that EXC depends on all factors extracted from the factor analysis model since the respective P-Values are significant (P-Value < 0.05). Accordingly, container exchange is influenced by lower container idle time and higher customer satisfaction.

VII. CONCLUSIONS AND RECOMMENDATIONS

The study concludes that container exchange is influenced by lower container idle time and higher customer satisfaction and seven components namely, FRT, FCT, FBL, LGT, MCI, CIT, and CED. It also proposes the VCY operations model or 3C's VCY Matrix. The overall results reiterated that container exchange could provide a solution to resolve the CII issue and the VCY is a possible approach. However, since the industry have so far failed to implement this concept, the comments received during the interviews revealed that the CSL pay serious concern to neither the escalating costs resulting from the present CIM mechanism, nor its significant impact to the environment. The additional costs are simply passed to the consumers, and there is no statuary obligation for CSL to minimize the environmental hazard caused by excessive empty container repositioning, despite that these factors could be reduced using VCY. The fact remains, both repercussions could be minimized through responsible thinking and understanding of accountability.

It was evident that container inventory mismanagement by carriers creates substantial costs. It is imperative that all such costs are inadvertently added to freight rates paid by importers and exporters. This additional transportation cost subsequently leads to higher prices of consumer goods. Therefore, this is not a problem of the shipping industry alone, but a global issue. The associations who represent exporters, importers, and consumers need to push for a paradigm shift since the present system is not working for common interests. Governments should seriously address this matter as the prices of consumer goods can be brought down if the VCY is implemented. Environmental authorities need to gear up and pressure CSL to take measures to reduce the carbon footprint caused by the unwanted empty container transport.

In complying with sustainable marketing fundamentals, any business needs to be mindful about its social responsibility when identifying, satisfying and anticipating customers' needs and wants. The CSL industry is an oligopoly market in which a few firms dominate. When a market is shared between a few firms, it is said to be highly concentrated. The change should take place before it is too late. Although only a few firms dominate, it is possible that many small firms may also operate in such market. With more and more joint venture agreements and acquisitions, taking place in container shipping industry, corporate objectives will be common to all partners. Such background may work well for container sharing. In other words, this is the right time for a paradigm shift in the container inventory malmanagement. Given its substantial impact to the wellbeing of the society (i.e. reduction of cost of consumer goods and environmental pollution), implementation of VCY will be the most practical solution in CIM.

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Lalith Edirisinghe holds a PhD, in Transportation planning and Logistics Management from the Dalian Maritime University affiliated to World Maritime University, Sweden. And a MBA in International Trade and Logistics offered by University of Sri Jayawardanepura and University of Canberra, Australia. He has Distinction passes in Executive Diploma in Marketing and Postgraduate Diploma in Business Management awarded by University of Colombo. He commenced his carrier in 1981 as a Cadet Officer in Merchant Navy under Ceylon Shipping Corporation. He counts 36 years' work experience in the fields of maritime; marketing, supply chain management in both government and private sector organizations. Dr. Edirisinghe is a past student of Ananda College. At present, he is the Dean of Faculty of Management in CINEC Campus. Prof. .Edirisinghe is a member of Sri Lanka's National Export Strategy 2018-2022 and many other policy forums. He is the current Secretary of the Institute of Logistics and Transport (CILT). He counts 36 years' work experience in the fields of maritime; Marketing, supply chain management in both government and private sector organizations.

Zhihong Jin is a Doctoral Tutor in Dalian Maritime University, Dalian, China.

He earned his Doctor degree in Nagoya Institute of Technology in 2000. His research fields are logistics system optimisation and simulation, and supply chain management.

A.W. Wijeratne obtained his Doctoral in Mathematics from the Harbin Institute of Technology, China, in 2008. He has been working as a Senior Lecturer in Statistics and Mathematics at the Department of Agribusiness Management, Sabaragamuwa University of Sri Lanka. He has published over two dozens of research papers in refereed journals, covering a wide range of subjects. He has given his active contribution as a statistician for projects at the national level. His research interests include mathematical modelling in business, experimental designs and applied statistics.

Hansa Edirisinghe obtained his MSc in Information Technology from the University of Cardiff Metropolitan, UK after completing BSc (Hons.) in Computing awarded by the University of Portsmouth, UK. He presently reads for his Master of Philosophy in ICT. He carries ten years industry experience in computing and ICT and presently attached to the Board of Investment (BoI) Sri Lanka as an information Technology officer.

Lakshmi Ranwala obtained M.Sc. in Applied Statistics having completed BSc in Physical Science. She is the Head of Department, Department of Logistics and Transport, Faculty of Management and Social Sciences, CINEC Campus

Rashika Mudunkotuwa holds Master of Science in Business Statistics from University of Moratuwa and Bachelor of Business Administration in Business Economics from University of Colombo. She is attached to CINEC Campus, Sri Lanka as a Senior lecturer.