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The Virtual Container Yard: Identifying the Persuasive Factors in Container Interchange

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***Abstract*—**The virtual container yard is an effective solution to the container inventory imbalance problem which is a global issue. It causes substantial cost to carriers, which inadvertently adds to the prices of consumer goods. The virtual container yard is rooted in the fundamentals of container interchange between carriers. If carriers opt to interchange their excess containers with those who are deficit, a substantial part of the empty reposition cost could be eliminated. Unlike in other types of ships, cargo cannot be directly loaded to a container ship. Slots and containers are supplementary components; thus, without containers, a carrier cannot ship cargo if the containers are not available and vice versa. Few decades ago, carriers recognized slot (the unit of space in a container ship) interchange as a viable solution for the imbalance of shipping space. Carriers interchange slots among them and it also increases the advantage of scale of economies in container shipping. Some of these service agreements between mega carriers have provisions to interchange containers too. However, the interchange mechanism is still not popular among carriers for containers. This is the paradox that prevails in the liner shipping industry. At present, carriers reposition their excess empty containers to areas where they are in demand. This research applied factor analysis statistical method. The paper reveals that five major components may influence the virtual container yard namely organisation, practice and culture, legal and environment, international nature, and marketing. There are 12 variables that may impact the virtual container yard, and these are explained in the paper.

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

I. Introduction

THE Virtual Container Yard (VCY) is a concept that explains the container interchange between carriers on a global platform. It refers to an ideal situation in which the container shortage of a carrier is filled by another carrier that has excess container inventory and vice versa. Each carrier has the virtual control of their containers globally and may release them to others only when they are in empty status. The VCY is underlining the principle of maintaining a balanced container inventory in a port through an interchange between carriers. This interchange is possible when there are carriers with deficit inventories while others have excess containers. Container shipping lines (CSL) interchange ship space (slots) to gain the advantage of economies of scale. However, they do not interchange containers at present according to industry sources. Mutual agreements exist between CSL for collaborative activities and these agreements cover various activities, inter alia, container interchange; although it does not happen. It was revealed that there has been some ad-hoc interchange of containers between carriers when their exporters erroneously stuffed cargo in other shipping lines' containers. However, such interchanges were done as a corrective measure for a situation only, on a case-by-case basis. Since there is no regular practice of interchanging containers between carriers, they are unable to reduce the cost of empty repositioning of containers. The ultimate result being that they never opt to strike a balance between the container inventories, even within active consortiums (alliances). Therefore, it is obvious that the behavioural patterns of carriers with respect to these two phenomena (i.e. sharing ship space and pooling containers) are not the same.

Containerisation has changed everything in the world; it expedited the globalisation through efficient and economical sea transportation. It helped intermodal transportation through efficient and cost-effective cargo handling. Global statistics reveals that there are 6,144 active ships (including 5,290 fully cellular) that carry 22,835,497 TEU (22,434,931 TEU fully cellular) in sea transport [1]. This concept was the brainchild of American trucking magnate Malcolm McLean [2]. This system has significantly expanded the opportunities for international trade as it holds good characteristics of sea transportation [3] and was developed and first commercially implemented in the US in the mid-1950s [4].

Container inventory imbalance (CII) is an inevitable phenomenon that has a global impact [5] worldwide, empty containers account for approximately 20% of container flows at sea. Controlling logistics costs allows companies to maintain a competitive edge, since lower logistics costs translate into competitive external trade [6]. A mutual relationship among CSLs would improve this problem through the collaborative approach and would positively benefit economies of scale for the entire shipping industry. Collaborative supply chain practices act as important tools to achieve competitive advantage [7].

If transport costs are brought down, the price of goods and services are expected to reduce. Accordingly, the reduction of shipping costs may ultimately reflect on consumer prices. The primary objective of the VCY is to reduce the cost incurred by CSL due to CII. This would help a country to bring down its inflation. Similarly, lower transportation costs can make a country's exports more competitive in the global market. These factors have a direct impact on the welfare of a country.

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Striking the right balance between the exporters' demand and the carriers' ability to supply containers is the main challenge faced by the liner shipping industry. The management of container fleets, regardless of type and size, is a rather costly operation [8]. Improving the utilization rate of containerships depends on providing exporters with empty containers in a timely fashion [9]. Therefore, the availability of required container inventory at a given location at a specific time is a vital factor in liner container shipping. Prior to containerization, each package, pallet, bag, box was handled individually; therefore, transferring from one mode to another involved double handling of such cargo. In contrast, a container that contains hundreds of such packages can be transferred from one transport mode to another with just one move. Therefore, handling one container means handling hundreds of packages in a single operation. In other words, containers help efficient multimodal transport without intermediate reloading at mid points [10]. This paper proposes that the exchange of containers between CSLs is a feasible solution to the container inventory imbalance problem. For example, it was established that the estimated annual saving through VCY is approximately US$12.6 million in Sri Lanka. Had the CSLs opted for this option, the export freight rate from Sri Lanka could have been reduced by US$47 per 20-foot container or 20 equivalent units (TEU) [11]. However, paradoxically, CSLs are still reluctant to implement this concept. Accordingly, the primary objective of the paper is to examine the factors that could persuade CSLs implementing the VCY as a solution to the CII problem.

II. Literature Review

Although container interchange is not yet a popular mechanism, CSLs used to interchange their ship space (slots) since three decades ago. When CSL realized that they should collaborate to fill their ships they formed strategic alliances. It took considerable time to form shipping alliances and exchange slots. However, later slot exchange became a buzz word after the economic benefits it offered were understood. Reference [12] proposed external container sharing as a strategic option. It refers to pooling container fleets among different ocean CSLs. Reference [11] identifies seven components that may influence container exchange namely, operational, legal, branding, benefits, feasibility, confidential data, and competitors. On the other hand, [13] suggests five barriers to a collaborative approach by CSLs. These include a) confidentiality of marketing information, b) legal issues and insurance, c) ethnic issues, d) business philosophy or company policy, and e) competition in which companies believe that collaboration may provide an indirect support to new entrants [14]. Reference [10] identifies container availability as one of the criteria that determines the service quality of ocean container CSLs. The container inventory imbalance generates various costs and has a direct impact to the shipping lines and their agents [13]. According to [14], empty container movements would not exist in a perfect world, because there would always be cargo to fill every container when and where it was emptied [15]. However, shipping is not a direct demand, but a derived demand of the international trade. Therefore, CSLs are faced with a dilemma as they are unable to strike a balance between the container demand and supply [16]. This is a global problem. For example, low production costs and the need for empty boxes to transport Chinese exports, made China the natural location for setting up factories for the construction of containers [17]. Given global warming and other sustainability issues, there is intense pressure to CSLs to reduce the carbon footprint in shipping business [18].

The proposed VCY is a higher state of collaboration between CSLs. The primary objective of collaboration is the willingness do a task jointly with another party and to achieve shared goals. Inter-competitor cooperation is different from other types of inter-firm cooperation [9]. Reference [19] suggests twelve factors that may potentially influence container inventory management strategies, which are: a) The strength of retaining customers irrespective of non-availability of containers (Cost of Customers); b) Impact on brand name due to inconsistency of container availability (Impact on Brand); c) The threat caused by container shortage to the sustainability of service (Threat on Service); d) The degree of confidence to perform budgeted exports/imports (Loss of Revenue); e) Comfort on freight (Slot cost) incurred on empty repositioning (Empty Slot Cost); f) Port handing cost incurred on empty repositioning (Empty Port Handling); g) High rent involved at Container Freight Stations (CFS) or port for storage of containers (Cost of Rent); h) Comfort on empty container handling cost at CFS (Cost of Yard); i) The degree of possibility of achieving ROI-return on investment of containers belong to the shipping line; j) Comfort on repair and painting cost due to rust etc. because of long storage (Ware and Tare cost); k) The container idle time at a named location (Minimum Idle Time); and, l) Vessel underutilization in certain ports due to non-availability of containers (Vessel underutilization).

Most liner shipping companies compete in the industry with almost equivalent products/service features. The expected collaboration should take place between these competitors though. Inter-firm cooperation is a source of competitive advantage [20]. A general sense of suspicion is often related to inter-competitor cooperation. Infrastructure is a necessary condition for efficient cargo handling operations [11]; thus, after containerization, ports were compelled to invest heavily in more efficient and effective terminals commensurate with the speed of container operation demanded by the CSLs. Due to the nature of the liner shipping industry it is very difficult to match supply and demand [14]. In other words, given the common imbalance in the trade [15], the inward and outward flow of container inventory at a given location is rarely balanced. International trade patterns are usually not consistent or balanced with respect to imports and exports of a country. The consequence of these imbalances in worldwide trade distribution leads to container inventory imbalance [21]. The uncertainties of global needs and wants, increased service location of CSLs due to widespread customer base, the volatility and complexity of the container shipping industry [22], and the type of commodities to be moved in containers,

multiple types and sizes of containers etc., are other factors that contribute to this scenario.

The CSLs have not made any notable attempts to evaluate the benefits of container exchange because they perceive that there is no opportunity for container exchange in the absence of any scientific research until the recent past. Accordingly, stakeholders in the industry believe that the intrinsic trade imbalance is commonly applicable to all CSLs leaving no room for interchange [18]. The use of foldable containers is another solution to reduce the repositioning cost as they occupy less space. However, the use of foldable containers does not impact on reducing the number of units that need repositioning, with the exception of the fact that the numbers of slots that occupy the same number of units have been reduced [23].

The core issue that prevails in the liner shipping industry is to find a mechanism to decrease the costs incurred by container inventory imbalance and thus better utilize resources [24]. The absence of collaboration is mainly due to CSLs' uncertainty about the feasibility of container interchange and the success of VCP mainly depends on the ability of overcoming this psychological barrier [24]. However, a firm's performance increases when supply chain members work together in cooperation [5]. The primary objective of this research is to identify the key factors that influence container interchange between shipping CSLs. Secondly, it discusses the CSLs' perceptions about the VCY. Finding a solution to mitigate container inventory imbalance [25] would benefit primary shippers, consignees and shipping lines, and then countries, regions and the entire world at macro level. Containerisation has its own problems despite the huge benefits it provides [23]. Usually, efficient cargo handling operations are dependent on the necessary infrastructure [14]. Commercial traffic never seems to be in balance [15]. Very rarely does a port experience a well-balanced container inventory of a shipping line due to many practical reasons. International trade patterns [21], uncertainties of customer demands, widespread allocation of container ports and customers, and the dynamic nature and of increased complexity of the container shipping [22] and the types of commodities to be moved etc., are the key factors that contribute to this situation. Reference [10] identifies container availability as one of the criteria that determine the service quality of ocean container CSLs. The container inventory imbalance generates various costs and has a direct impact to shipping lines and their agents [26]. Shipping companies spend on average $110 billion per year in the management of their container fleets (purchase, maintenance and repairs), of which, $16 billion is set aside for the repositioning of empty containers [9]. According to [27], empty container movements would not exist in a perfect world, because there would always be cargo to fill every container when and where it was emptied [15].

Globalization has increased the need for interconnectedness [28] and it continues to hold the command in today's global community [29]. Logistics and supply chain practices should be regularly improved to assure the competitiveness of businesses [30] and to act as important tools to achieve competitive advantage [7]. Logistics chains are assumed to be at the core of production processes [31]. Exporters have limited patience and container shipping is a highly competitive sector; therefore, unmet demands within a given period due to insufficient empty containers will be lost [22]. However, global supply chains are extremely varied and complex [32]. Container handling within the chain may be completed in numerous ways including the use of shipping agents [33]. Resource maximization in the container shipping industry is a fundamental problem as sometimes empty containers used to be idle in one place. Containers are manufactured for consistent moving with cargo and not to stand idled in one location. When considering the five key transport modes namely, water, air, road, rail and pipelines there is a substantial cost benefit of water transport [34]. Container ships carry an estimated 52% of global seaborne trade in terms of value [35].

Shipping is not a direct demand, but a derived demand of international trade. Therefore, shipping CSL firms are faced with a dilemma to strike a balance between supply and demand [11]. Since container ships cannot operate without containers, providing containers in every port of call help increases the utilization rate of containerships [9]. Therefore, the right balances of 'container inventory' at a given location are a vital factor in liner shipping. Containers can transport efficiently over long distances and facilitate multimodal transport without intermediate reloading at any mid points [36]. Due to the perishability factor in liner shipping services, underutilized ship space is lost forever and cannot be stored and reused later. Usually, the demand for empty containers and the arrival of laden import containers (to be reused after de-stuffing cargo) will not match [12]. Well planned, accurately forecasted, realistically allocated, and effectively managed container flows ensure that materials and goods are globally supplied on time, in a cost-efficient way [37]. A decisive factor for CSL competitiveness is the availability of containers at a place and time to meet customer orders, avoiding immobilization costs [38]. The expected cost of empty container reposition is subject to the space constraints of ships and the geographic location of ports that have excess containers [39]. Sector collaboration in building networks can lead to the realization of synergistic gains [40].

The concept of VCY is all about collaboration among competitors. The main purpose of the collaboration is to attain competitive advantages through achieving excellence in core business processes and expanding market share [41]. Such collaboration is evident among CSLs with respect to slot sharing. However, container interchange is yet to be implemented, despite that many service agreements already have provisions in place to interchange equipment. This may need a strategic change that can only be achieved by helping individuals reflect on and gain new insights into their situation [42]. The construction of agreements and way in which the relationships are managed displays the potential benefits from the collaboration [40]. Logistics plays a key role in the economy of any country [41]. Better supply chain

responsiveness can be achieved in two ways: by reducing uncertainties and by improving supply chain flexibility [43]. However, it is important to ensure that the costs incurred in the coalition will be fairly allocated to the CSLs participating in the cooperation agreement [39]. The mutual relationship among the CSLs would improve through the collaborative approach. Best practices that could be implemented among the CSLs may act as important tools to achieve competitive advantage [7].

III. Methodology

The study was conducted in Sri Lanka with the intention of generalizing its outcome in the global context. The primary data collection was twofold. Accordingly, an opinion survey was conducted through 128 respondents using a questionnaire and interviews were carried out with five CSL industry specialists. The questionnaire for the survey was developed mainly based on the data gathered from interviews. As far as the secondary data are concerned, the statistics of government institutes such as the Sri Lanka Ports Authority, Central Bank of Sri Lanka and the Board of Investment of Sri Lanka were referred. The Sri Lanka Shippers Council, Ceylon Chamber of Commerce (CASA), Sri Lanka Apparel Exporters Association and the Ceylon Association of Shipping Agents, are among the other institutes that were consulted to clarify certain doubts about the industry data. Reports published by the World Bank have also been referred.

This research applied reliability analysis; KMO and Bartlett's test, total variance, and factor rotation. Cronbach's alpha is the most common and popular measure of internal consistency or reliability. The suitability of data for the factor analysis can be measured using the Keiser-Meyer-Oklin (KMO) measure of sampling adequacy, while the internal consistency of the variables can be determined through reliability testing. Factor rotation has been completed according to the varimax rotation method to gain the meaningful factors.

The researchers are confident that the results obtained could be generalised for the benefit of global shipping communality given the maritime background of Sri Lanka, with some 17 out of the top 20 CSL in the world operating regular services in the busiest commercial port in the country, Colombo, due to the country's strategic geographic location. Approximately 75% of global container capacity is operated [44] by these CSL. Therefore, the sample used in this study is expected to be reflective to the general view of the global shipping industry. CASA membership comprises 135 CSL agents, representing all international shipping lines of repute.

The questionnaire consisted of 18 questions. It was mainly to encourage more responses knowing the very moderate interest by the CSLs. The demographics section consists of seven questions related to container stock position and the company's container inventory management (CIM) policy namely, annual empty container movement, cost associated with empty container movements, empty reposition cost as a percentage of freight earning, the frequency of inventory monitoring, characteristics of imbalance, frequency of imbalance, and whether the respondent considers the concept of container exchange as an effective solution. Finally, the questionnaire asked respondents if they would consider container exchange on a case-by-case basis if a mechanism was available to evaluate the overall benefit in financial terms. The second part of the questionnaire consisted of questions pertaining to five major components namely, organisation, practice and culture, legal and environment, international nature, and marketing. Under these components, 12 factors are identified that may influence the collaborative behaviour of CSL. Table I explains these components and factors.

TABLE I
Components and Factors that Influence Collaboration

Factor	Code
Decision-making level of the organisation (upper or middle) is a barrier to implementation.	DMO
Level of freedom to take decisions independently (Principal/Agent)	IDM
Level of consideration by management regarding the losses due to retaining empty containers	REC
There will be a mismatch in organisational level support for container exchange (Principal/Agent)	CVM
Level of complexity of inventory control of the CSL may influence container exchange	INV
Capacity of the container inventory belonging to the CSL has an impact on the exchange decision	CAP
The agent or principal is guided by the business culture towards container sharing	CUL
Complying with the legal procedures will be an additional burden to exchange containers	LPN
Container exchange can reduce environmental pollution	EPE
CSLs have tailor-made container tracking systems. Availability of common tracking system will be very complicated	CTS
CSLs represent various countries, therefore the presence of international politics will be a barrier in implementing this	PIP
There is an impact of organisational marketing rational towards container sharing	MKT
Incorporation of empty repo costs when offering freight rates have an impact on agents to agree to container exchange	FRT

IV. Results and Discussions

Respondents were required to mark their preferences to all questions. The Likert-type scale consisting of 11 scales of score ranging from +5 to -5 representing highly agree to highly disagree, respectively, and neutral (0). The response to the questionnaire was analysed using descriptive statistics and regression analysis.

The respondents have been categorised according to the range of the annual empty container movement in Sri Lanka. Most respondents had annual movement of 101 to 1,000 empty containers.

Respondents were asked whether they exchange containers with other CSLs. The responses were negative from all respondents. However, during the interviews with five CSL industry experts, it was revealed that containers are sometimes exchanged (just one or two) in certain ad-hoc situations where exporters stuff cargo in containers belonging to another CSL and no time is available to re-work the containers. Two industry representatives indicated that they have had experience of this nature (i.e. container exchange between CSL). It was noted from the senior industry people that only 100 containers have been exchanged in the past to their knowledge. However, this too was between two alliance partners. And it was only an isolated case.

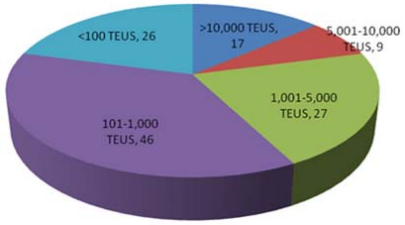

Fig. 1 Number of respondents based on empty container movements

Respondents were asked how often the container inventory imbalance occurs in their respective CSL, whether 1) always, 2) often, 3) sometimes, or 4) rarely. Based on the responses, the majority (67) of 128 say they face the container imbalance problem often, while 36 said they always face this issue. Accordingly, 80% of respondents face the container imbalance issue either often or always. Therefore, the issue has a substantial importance to investigate and find a suitable solution.

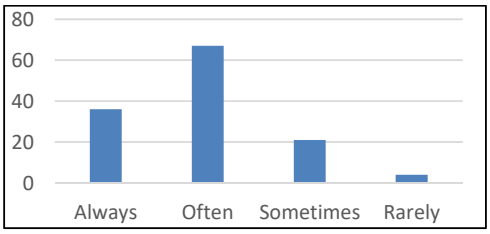

Fig. 2 Number of responses on the occurrence of the empty container problem

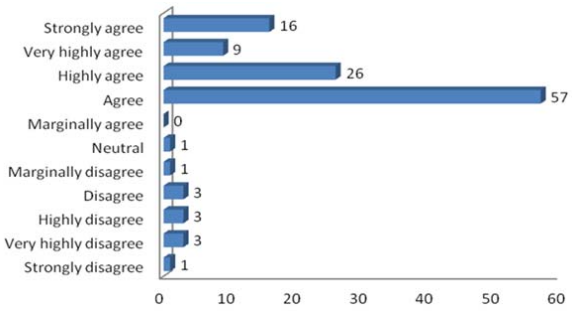

Fig. 3 The agreeability/disagreeability of respondents to the container exchange concept

The remainder of the questions was based on the conceptual model introduced in the early part of the article. Respondents were also asked how they perceive container exchange as an effective solution to overcome the container imbalance.

It is evident from the responses that there is an overall agreement for the concept of container exchange. While eight respondents did not answer the question, 48% of those who responded agree, 13% strongly agree, 22% highly agree, and 8% very highly agree. There is no tested mechanism to quantify the benefits of container exchange. It is one of the main obstacles finding a solution to the problem. The respondents were asked whether they would consider container exchange if a mechanism was available to evaluate the overall financial benefits on a case-by-case basis. The responses are as follows:

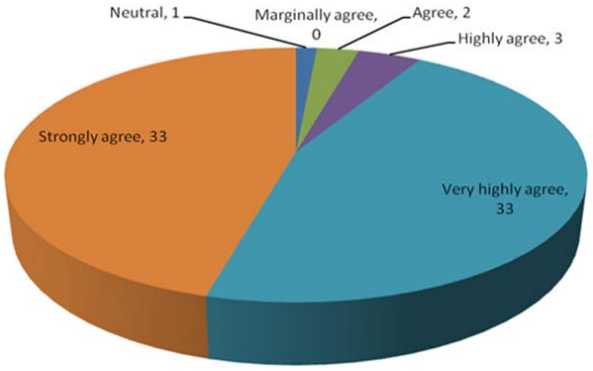

Fig. 4 The CSLs interest to exchange containers if the benefits can be assessed prior to exchange

According to this analysis, almost all respondents say they are willing to participate in the VCY concept provided the benefits can be assessed in monetary terms. However, participation should be considered on a case-by-case basis, as the requirements vary from time to time, location to location, and CSL to CSL.

The internal consistency of the variables can be determined through reliability test. The survey questionnaire mainly consisted Likert-type scale-based questions. Therefore, a reliability test was conducted to determine each factor among categorised variables. If the internal consistency is high, those items can be used to create the variables. Based on the value, decisions are taken about the acceptability of the variables cut, if Cronbach's alpha less than 0.5 it is unacceptable. The Cronbach's alpha value recorded in this research was 0.6; this is considered acceptable to proceed.

Next, the KMO and Bartlett's test was exercised. Suitability of data for the factor analysis can be measured by the Keiser-Meyer-Oklin (KMO) measure of sampling adequacy. KMO denotes the sample size of the data. In this research, the value of KMO measure of sampling adequacy recorded at 0.60, confirming to the recommended value standards. Total variance represents the total percentage of variance of components which is described by the variables.

According to Table II, which lists the eigenvalues

associated with each linear factor before extraction, after extraction and after rotation, the analysis has identified 13 factors within the data set. The extraction sums of the squared loading part show factors which met the criterions. The statistical tool extracts all factors with eigenvalues greater than 1. It can be seen altogether these five components explain the 74% variation of total variance. It was then decided to precede the study by realigning the five components by considering extraction sums of squared loading. The factor rotation has been completed according to the varimax rotation method to gain the meaningful factors. These variables were variance between -1 to +1. Furthermore, significance value should be greater than the 0.5. The purpose of factor rotation is to deduct the number of factors which ensure high loading. Factor loading of the five-factor model that offers varimax rotation is shown in Table III.

TABLE II
TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.588	27.602	27.602	3.588	27.602	27.602	3.364	25.880	25.880
2	2.123	16.331	43.934	2.123	16.331	43.934	2.102	16.168	42.048
3	1.632	12.551	56.484	1.632	12.551	56.484	1.754	13.489	55.537
4	1.211	9.318	65.802	1.211	9.318	65.802	1.303	10.021	65.558
5	1.028	7.910	73.712	1.028	7.910	73.712	1.060	8.155	73.712
6	0.902	6.939	80.651						
7	0.824	6.339	86.990						
8	0.634	4.876	91.865						
9	0.435	3.349	95.214						
10	0.317	2.439	97.653						
11	0.192	1.480	99.133						
12	0.063	0.486	99.619						
13	0.049	0.381	100.000						

TABLE III
ROTATION COMPONENT MATRIX

	Component				
Variable	1	2	3	4	5
MKT	0.238	0.042	0.411	-0.261	-0.614
LPN	0.162	0.212	0.786	-0.076	0.046
CTS	-0.021	-0.028	0.053	0.848	-0.025
EPE	-0.008	-0.221	0.844	0.174	-0.042
PIP	0.051	-0.119	0.432	-0.514	0.331
DMO	0.897	-0.106	0.141	-0.056	0.064
IDM	0.918	0	0.104	-0.01	0.034
REC	0.885	-0.133	-0.003	-0.048	0.021
CAP	0.022	0.322	0.121	0.432	0.293
INV	-0.064	0.967	0	0.037	0.042
CUL	-0.074	0.956	-0.041	0.061	0.004
CVM	0.894	0.074	0.023	0.037	0.014
FRT	0.196	0.073	0.127	-0.132	0.690

According to Table III, factor loadings for DMO, IDM, REC, and CVM have higher loadings compared to other variables within component 1. Thus, it can be considered the variables of DMO, IDM, REC, and CVM are highly significant and more influential than other variables. Thus, factor one can be formed as using these four variables.

$$\text{Factor } 1 - f(\text{DMO, IDM, REC, CVM})$$

Considering the industry norms, practices and as per general understanding, a factor can be named, Organization. Exercising the same methodology, factor 2, factor 3, factor 4, and factor 5 were named, practice and culture, legal and environmental, international nature, and marketing, respectively.

A. Organisation

TABLE IV
VCY FIVE FACTOR MODEL

Component	Variable Code
Organization	DMO
	IDM
	REC
Practice and Culture	CVM
	INV
	CUL
Legal and Environment	LPN
	EPE
International Nature	CTS
	PIP
	CAP
Marketing	MKT
	FRT

Organisational structure, tasks and policies are the factors to consider here. Each CSL has different tasks according to the corporate objectives, vision and mission. Therefore, organisational tasks will have an impact on the perception. This paper hypothesised that the CSL's corporate vision and mission has an impact on container exchange. Another vital factor is the firm's communication channel which provides visibility with respect to container availability in different locations. Firstly, the right flow of information should take place within the firm covering everyone who influences the decision-making process. Secondly, this information should be strategically shared with collaborating partners. One of the

potential constraints that need to be analysed is the possible legal obligations related to antitrust laws that may create barriers in sharing information between competitors. Therefore, the decision-making level of the organisation (i.e. whether upper or middle) will be examined.

The DMO factor refers to the decision-making level of the organisation. In some CSL, local managers have the authority to take decisions with respect to containers, while in some forms, it needs a higher authority. Employees in a hierarchical structure may perceive a sharing solution differently than in a flatter employee organisational structure. The latter is more prompt in decision making and therefore, a CSL that has a flat model may perceive this idea more favourably. The level of freedom of agents to take decisions independently also affects container exchange. Usually, the principal CSL has strict control about the container inventory management leaving no room for the agent even to take independent decisions with respect to common situations. Shipping has more characteristics of a 'service' than a 'product', and thus the people factor plays a significant role. Taking into consideration the heterogeneity factor of a service organisation, it is evident that the people component may act as an independent variable in this model. Therefore, in the questionnaire survey, it was questioned whether the decision makers of the respective organisation have the freedom to take decisions independently. The level of consideration by the management on the losses due to retaining empty containers (REC) is another variable that may influence a CSL when planning to interchange containers. There will be a mismatch of organisational level support (CVM) between the principal and the shipping agent. This may have some impact on the container interchange decision.

B. Practice and Culture

This component primarily considers the business culture and external environment. Shipping is a derived demand of international trading. Therefore, CSL that operates in different organisational/business environments may have different perceptions with respect to container sharing. The agent or principal is usually guided by the business culture (CUL) towards container sharing. Complexity of container inventory management and control (INV) is referred to under this section. Management of container inventory is a complicated issue due to its international nature and the unpredictability of supply and demand factors.

C. Legal and Environment

Legal implications and industry practices will be considered under this factor. Shipping is an international business, thus once exchanged, the CSLs are under obligation to handle properties belonging to competitors under different legal regimes in many countries. This includes damages, losses, insurance, the use of containers for illegal purposes, and to carry dangerous goods (classified under International Maritime Dangerous Goods Code) or commodities such as carbon black, metal scrap which are considered as dirty cargo. There are certain industry practices that help safeguard the interests of trade, which not all CSLs adhere to. Since there is no guarantee that all players in a common container pool follow such practices, CSL may reluctant to share containers. This component refers to the additional burden of CSL to comply with the legal procedures when interchange containers (LPN). On the other hand, the VCY help reduce environmental pollution (EPE).

D. International Nature

CSLs represent various countries. Some countries have political differences due to various international conflicts. If the CSLs come from such conflicting nations, then it is very unlikely to form a collaboration. Therefore, the presence of international politics will be a barrier in implementing this concept. On the other hand, since CSL were established in different countries, their internal operating systems are very different. CSLs also have tailor-made container tracking systems. Usually these individual systems follow the business norms and practices in the respective country. Therefore, a common tracking system (CTS) that caters to the needs of all CSLs will be very complicated. The total capacity of the container inventory (CAP) belonging to the individual shipping line may have an impact on the exchange decision.

E. Marketing

This part refers to the CSL's marketing rationale of organisation and competitor tactics. It was also revealed that CSL practice various competitive tactics to sustain and improve their individual market share. For example, when a CSL is short of containers, their competitors try to grab the corporate customers of that CSL by providing containers. The decision of the CSL to not share empty containers, despite incurring a loss to their organisation, as a competitive tactic will matter. Also, the larger CSL have relatively bigger container inventory. This makes such CSL more resilient than small CSLs that own a skeleton stock. Therefore, the strength of resilience on CSLs decision making about container inventory was examined. CSL with a competitive edge in certain trade lanes may incorporate the empty reposition costs when they quote freight rates to pass the burden on to the customer. This factor too will be tested in the survey.

Stakeholders in the container industry have a variety of individual interests. Exporters want empty containers available at their disposal at any given time at the lowest freight rate and with the shortest possible notice. CSL want their import container volumes to be balanced with their export levels to avoid empty repositions and lean inventories at every port so as to optimize container utilization. Usually, the customers of CSL obtain services through agents in respective countries. Irrespective of the CSL's business strategies, the shipping agent wants to maintain sufficient containers at any given time (agile inventories) to cater to the exporters' demand and avoid any booking cancellations due to non-availability of containers.

The oligopoly nature of the shipping industry drives CSLs and their agents to maintain confidentiality of key data such as inventories. In other words, it is a market with few sellers,

each oligopolist is likely to be aware of the actions of the others. Therefore, the decisions of one firm may influence (and are influenced) by the decisions of other firms. In this kind of aggressive competition between CSLs, each party prefers to play a safe role and do not take actions that could indirectly help the competitor. CSLs understand that the container sharing may relieve them from the current inventory problem, but they are more concerned about its perceived marketing advantages to the other party. For example, the offeror (who give containers in the exchange process) saves the cost of reposition, but the offeree (who receives the containers) secures a business that would have lost otherwise. This complexity leads CSLs to evaluate the trade-off between the interchange of containers and absorb the cost of reposition. Therefore, there can be an impact of organisational marketing rational (MKT) towards container sharing. CSLs would incorporate empty repo cost when offering freight rates (FRT) to keep the profit margin intact. This factor also will have an impact on agents to agree to container exchange.

TABLE V
COMMUNALITIES

	Initial	Extraction
MKT	1	0.672
LPN	1	0.697
CTS	1	0.723
EPE	1	0.794
PIP	1	0.578
DMO	1	0.844
IDM	1	0.854
REC	1	0.804
CAP	1	0.391
INV	1	0.942
CUL	1	0.924
CVM	1	0.806
FRT	1	0.553

The commonalities indicate the amount of variance in each variable that accounted for the underlying factors. The extraction column of Table IV reflects the common variance in the data set. Accordingly, it can be concluded that more than 50% variance of the original data is explained by five extracted components, except for CAP which reflects only 39%.

V. Conclusions and Recommendations

This study revealed that container exchange has the potential to solve the container imbalance issue. However, the shipping industry does not show unanimous agreement to the concept. In the interviews, respondents revealed that CSL are not highly influenced with the concept mainly because of branding issues. For example, the container is considered one of the key components namely, “physical evidence” in terms the 7Ps in services marketing. Therefore, CSLs do not want their branded containers are being used by their competitors and vice versa.

The shipping industry lacks comprehensive scientific research about the container interchange or VCY. Therefore, the benefits of the VCY are not effectively conveyed to the CSL. A container interchange can only take place when one CSL has excess containers while another CSL is short of containers. However due to the lack of proper analysis about the real inventory situation of each CSL in a port, a strong argument cannot be made about the feasibility of VCY. In general, CSLs believe that container inventory imbalance is inevitable if a country has a trade imbalance (i.e. the variation between imports and imports). This is a logical argument but deeper analysis about container statistics provides more conflicting conclusions about this matter. Therefore, it is vital that the container inventory of every CSL are comprehensively analysed for short and long periods. For example, if a port is served by 25 CSLs, the imports and exports of all these CSLs would be firstly compiled on weekly/monthly and annual basis. In other words, the number of CSLs that need empty containers (offeree) and those that can provide containers (offeror) at a given time at a given port should be identified. This phenomenon has some relevance to the queuing theory as well. Queuing theory is the mathematical study of waiting lines, or queues. A queuing model is constructed so that queue lengths and waiting time can be predicted. In the present scenario, waiting lines are replaced by container inventories. For example, the container inventory imbalance at the end of year is not necessarily the same as the total monthly imbalance of the said year. This is the same argument in the case of a waiting queue. However, usually the CSLs presently quantify the container inventory imbalance by simply calculating the variance of stock levels at the beginning and the end of the year. If each CSL compare the CII levels at the end of each week (or month for simplicity), they would find many opportunities to interchange their containers. References [18] and [45] explain the feasibility of VCY in Sri Lanka and similar researches could be carried out in other countries and compare results.

It would be necessary to identify and evaluate the existing practices to mitigate the container inventory imbalance problem. A recent research recognized 22 common CIM strategies and published a model (3F CIM Model) identifying three components in container inventory management [46]. It could be possible that container inventory management practices vary from country to country and CSL to CSL; therefore, it may be worthwhile to study these practices adopted by various CSL under different geographic regions. Through a scientific research it could evaluate a country’s CIM competence level. If the competence is low, the respective country needs more efforts in rectifying their shortcomings to improve their index. The country index invariably reflects the overall CIM competence of individual CSL, and thus the competence of individual CSL also could be measured. Accordingly, international recognition to a Global CIM competence index (GCCI) is recommended. When the industry sets standards, it helps the stakeholders to improve their standards continuously. Reference [37] introduces an index that could evaluate carriers’ competence in CIM. This index has two facets, namely, the CIM competence of an individual carrier and the country index of CIM that represents

the overall CIM competence of all carriers that operates in a country. The country index is termed as the multidimensional CIM index5 (MCI)® while the individual carrier's index is labelled as carriers' CIM competence (CCI)®.

Once the groundwork for an effective CIM mechanism is constructed, the study may require exploring container exchange possibilities based on real data. It was noted that container exchange has not been effective even though CSL in principle agree with the concept. This is a paradox which needs further study. Usually, the shipping industry is directly influenced by its peculiar supply and demand scenario. Therefore, an extended research could investigate this paradox for the benefit of the industry. Shipping is a derived demand of international trading. Similarly, its supply component also has many complicated dependencies. For example, a factory that produces TVs may increase the supply through simply increasing quantity of production. In contrast, a CSL can increase/decrease the shipping supply without building more ships but adjusting ship speed or reducing the port stay through operations productivity of ports of call etc. Therefore, further research is required to understand the behavioural aspects of CSL under a peculiar market scenario. The potential for collaboration between CSLs and possible impediments should be evaluated. This should be followed by the development of a container exchange simulation model and the introduction of virtual container pool. Another recent research identifies eight key components consisting of 22 statistically significant factors that may influence container exchange [14]

To attract CSL to exchange containers and minimize the empty container reposition cost requires more research to be carried out. Firstly, the opportunities for this concept need to be established. Reference [18] suggests that CII could be reduced by 14% through VCY. Secondly, the factors that influence VCY and the potential benefits of container exchange between CSL should be highlighted. The `Container Interchange Matrix' (6R model) provides guidance for effective CIM [47] and it is recommended that these findings should be appraised in different countries under varied market conditions.

Carriers can simulate their individual cases using this model and administer the container exchange mechanism, and thus strike the right balance between the exporters' demand and the carriers' ability to supply.

It is recommended to conduct further research with respect to optimization of container inventory utilization through minimizing empty container repositioning. A container exchange simulation model may be used in this connection. From [48], a solution to bridge this gap through Dynamic Planning Model is sought and it could be instrumental in further extensive research. It is highly recommended to consider views of industry experts and develop a web-based software application to facilitate implementation of VCY.

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