Evaluation of expected payoff through container interchange between shipping lines: a solution to container inventory imbalance in Sri Lanka

Lalith Edirisinghe*

Faculty of Management,
Colombo International Nautical and
Engineering College – CINEC Campus,
Millennium Drive, IT Park, Malabe, Sri Lanka
and
College of Transportation Management,
Dalian Maritime University,
No. 1 Linghai Rd, Ganjingzi,
Dalian, Liaoning, China
Email: lalithedirisinghe2@gmail.com
Email: edirisinghe@cinec.edu
*Corresponding author

A.W. Wijeratne

Department of Agribusiness Management,
Faculty of Agricultural Sciences,
Sabaragamuwa University of Sri Lanka,
Belihuloya 70140, Sri Lanka
Email: aw.wijeratne@gmail.com

Jin Zhihong

Dalian Maritime University,
1 Linghai Rd, Ganjingzi,
Dalian, Liaoning, China
Email: jinzhihong@dlmu.edu.cn

Abstract: This paper evaluates the expected economic benefit that could be achieved by interchanging containers between shipping lines by employing the popular game theoretic approach. It comprehensively discusses the causes underlying the container inventory imbalance; the absence of collaboration (work alone) with respect to containers; the models of collaboration (win-win situation); and the quantitative and qualitative benefits that could be achieved through shipping alliances. This paper suggests barriers to a collaborative approach by carriers as confidentiality of information; regulatory, competition and social issues; and business philosophy of firms. This paper identifies the core areas relevant to empty maritime container inventory imbalance including external trade volumes, commodity types, logistical issues, seasonality, container types and sizes. The ultimate objective is to ascertain the appropriateness of collaboration as a solution to container inventory imbalance in Sri Lanka. Therefore, attempts were made to calculate economic benefits of

container interchange using specific models. Furthermore, this paper looks into those aspects that make the implementation of collaboration more difficult (inhibitors) despite the existence of active agreements between shipping lines and the opportunities and facilitators.

Keywords: containers; shipping; management; container inventory; TEU; imbalance; logistics systems; Sri Lanka.

Reference to this paper should be made as follows: Edirisinghe, L., Wijeratne, A.W. and Zhihong, J. (2015) 'Evaluation of expected payoff through container interchange between shipping lines: a solution to container inventory imbalance in Sri Lanka', *Int. J. Logistics Systems and Management*, Vol. 21, No. 4, pp.503–533.

Biographical notes: Lalith Edirisinghe is a Doctoral candidate in Transport Planning and Logistics Management at the CINEC Maritime Campus, Sri Lanka (SL), affiliated to the Dalian Maritime University, China. He received his Master's in International Trade and Logistics at the University of Sri Jayawardanepura-SL and University of Canberra-Australia. He holds a Postgraduate Diploma in Business Management (distinction pass) and an Executive Diploma in Marketing (distinction pass) from the University of Colombo SL. He counts 30 years experience in shipping and presently works as the Head of School at CINEC Maritime Campus-City Branch in Colombo. He is a chartered member of Institute of Logistics and Transport and also a Chartered Marketer (2010/12). His research interests include maritime affairs, logistics and transport, international trade, border management and marketing.

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.

Jin Zhihong 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.

1 Introduction

It is acknowledged that more than 90% of global trade is carried by sea. The topic discussed in this paper is derived from the most economical transport mode (i.e., shipping) encompassing the imbalance of container inventory (CI) at various ports that are transported by cellular container ships. Containerisation has made a significant change globally in the system of freight transport. The system, which is believed to have developed after World War II, led to greatly reduced transport costs, and supported a vast increase in international trade. From 1981 to 2009, global transport of containerised cargo increased approximately 3.3 times faster than the world's GDP (UNCTAD, 2011). The total existing fully cellular[1] fleet as at 25th March 2014 (all sizes/all positions) stands at

4,971 ships for 17,310,772 TEU (alphaliner.com, 2014). Containers are built to standardised dimensions, and can be loaded and unloaded, stacked, capable of being transported efficiently over long distances, and transferred from one mode of transport to another without intermediate reloading at any mid points. These modes include container ships, rail and semi-trailer trucks. The management of container fleets, regardless of type and size, is a rather costly operation (Lagoudis et al., 2010).

The enhancement of technology has rendered the utility of the container in a more efficient and effective manner. However, containers subsequently created a serious negative 'after effect' in the form of excess or deficit of empty containers (MTYs). A major challenge revolves around repositioning empty reusable containers (Ross et al., 2010). The growing imbalance of containers globally creates a substantial additional expenses as well as environmental issues. Shipping companies spend on average $110 billion per year in the management of their container fleets (purchase, maintenance and repairs) of which $16 billion for the repositioning of empties (Rodrigue, 2013). Effectively deploying empty containers in order to meet demand and to reduce inefficiency in an uncertain environment is a challenge (Long et al., 2012). According to Drewry Shipping Consultants, in the year 2002 empty containers accounted for 23% of port handlings worldwide. This percentage has remained fairly consistent for the past 20 years (Ker, 2011).

The first ever container was unloaded in the port of Colombo-Sri Lanka in 1973 (Ratnayake and Wijeratne, 2012). With respect to Sri Lanka, 259,479 TEUs[2] empty containers were evacuated from port of Colombo during the year 2013. This figure reflects 50.3% out of 515,875 TEUs total domestic exports of the country in this year. (CASA Per. Review, 2014). The MTY evacuation from Colombo has increased by 5% in 2013 compared to 2012. Paradoxically, shipping lines have imported 39,120 TEUs of MTYs in 2013 to already overflowing Colombo Port. The significance and complexity of the issue is evident from these statistics.

Exporters have limited patience and container shipping is a highly competitive sector. Therefore, unmet demands within a given period due to insufficient MTYs will be lost (Dong et al., 2013). Because of the trade and weight imbalance, transpacific carriers need to return substantial numbers of MTYs back to Asia (FMC, 2012). Container liner shipping not only suffers from lower volumes, but also has to endure cheaper freight rates (Mason and Nair, 2013). It is estimated that the cost of balancing the CI through MTY repositioning in Sri Lanka was approximately USD 100 million per year. Different repositioning policy may incur significantly different operational cost (Dong et al., 2013). This includes port handling costs (PHC), slot fee for the sea passage, land transport costs, ground rent and handing costs at CFS, etc. In addition to those direct costs, the cost of wear and tear and cleaning, etc. are also to be considered. It is needless to say that these costs would eventually result in higher transport charges to shippers and consignees thus high commodity prices owing to the additional costs that will be incorporated in the freight rates[3] by CSL.

In order to obtain the economies of scale advantage CSL used to form consortia and share the ship space.[4] Cooperation between liner companies in different forms of partnership, such as slot purchase and exchange, vessel-sharing agreements, and joint services were evident in the recent past (UNESCAP, 2007). In addition to vessel sharing these alliances gradually extended the collaboration to other areas such as, service rationalisation, operating expense sharing, equipment[5] interchange, and joint service

contracts. Inter-firm cooperation is a source of competitive advantage (Solesvik and Encheva, 2010). Since the status (types and sizes) of CI of CSL is different from one to another (i.e., deficit or excess) there is possibility to interchange. However, it was noted that no active 'containers interchange' is taking place in the industry despite all other collaborative measures is being very popular among CSL. Under the circumstances, this paper presents an attempt to analyse the suitability of 'container exchange' by CSL using game theory that follows a formal way to analyse interaction among a group of rational agents (players) who behave strategically.

2 Literature review

Cross-border transportation is an engine to promote the foreign trade (Zhihong and Qi, 2012). Shipping is the most favoured mode of international transportation in Sri Lanka and 86% of ships arrived port of Colombo in 2013 is container ships (CASA Per. Review, 2014). Carrying capacity of shipping firms positively affects their firm performance (Lun and Browne, 2009). The carrying capacity of container ships is restricted to the availability of containers of a port. Feng and Chang (2010) in their study have formulated a model, incorporating the expected cost of MTY reposition subject to constraints of vessel capacity, container demand and MTY supply. Supplying of MTYs to exporters is an essential link of the chain in container shipping. Cost-effectively reposition MTYs is a challenge (Dong et al., 2013). The CI imbalance generates various costs to the carriers and their agents as well. Container handling within the chain may be completed in numerous ways including the use of shipping agents (González-Torre et al., 2013). Stability is a major property of a supply chain (Scholz-Reiter et al., 2011). However, it is very rare that a CSL has a naturally balanced container inventories (i.e., identical number in each size and type of containers that are imported as laden[6] units will be exported as laden containers). Therefore, frequent supply is a real challenge to shipping agents.

Multiple and conflicting objectives usually need to be considered in designing a real-life logistics network (Zhou et al., 2011). Improvements in logistics and supply chain practices are essential to the competitiveness of businesses (Diaz et al., 2011). In an innovative approach, CSL presently share (interchange) ship space with competitors. Innovation not only stems from a firm's internal investments but also relies on input from external sources (Lauritzen et al., 2013). In order to obtain the economies of scale advantage CSL used to form consortia and share the ship space.[7] However, it is important to ensure that the costs incurred in the coalition will be fairly allocated to participating companies in the coalition (Cheng et al., 2013). A consortium is an association of two or more companies with the objective of participating in a common activity or 'pooling their resources' for achieving a common goal. Some benefits from joining the chain are difficult to quantify in monetary terms (Chiadamrong and Wajcharapornjinda, 2012). Organisations constantly strive to enhance its performance through collaborative supply chain management techniques (Borade and Bansod, 2012). Collaborative arrangements not only secure economies of scale, but broaden the range of services that a shipping line can offer and to spread risk associated with investment (UNESCAP, 2007). Supply chain practices act as important tools to achieve competitive advantage (Gorane and Kant, 2014). Article 14(c) and Article 17(a) of Rotterdam Rules[8] identifies the association between containers and the specific obligations applicable to the voyage by sea and

liability of the carrier for loss, damage or delay. Policy measures and the threat of public indictment have acted as powerful incentives for transport operators to green their global supply chains (Acciaro, 2011). The 'product' component in container shipping comprises of both ship space and containers. CSL in principle agree to pool the ship's space already. Therefore, arguably nothing prevents CSL sharing containers too.

Economic Commission for Latin America and the Caribbean report identifies three principle objectives that motivate most alliances, mergers and other forms of concentration in shipping, inter alia, "To achieve greater market domination so as to increase earnings. This includes more frequent and broader transport services and the possibility of reducing individual trade imbalances" (United Nations, 1998). Song and Carter (2009), in their study, proposed external container sharing as a strategic option. It refers to pooling container fleets among different ocean carriers. Another study by Francesco et al. (2009) show that multi-scenario policies put shipping companies in the position of satisfying MTY demands for different values that may be taken by uncertain parameters.

Use of foldable containers is another solution to reduce the repositioning cost as it occupies lesser space. However, it does not make any impact on reducing the number of units that needs repositioning. Purchasing cost and the transportation cost affect the use of foldable containers (Moon et al., 2013). Flexible destination ports policy is another application in practice. It only specifies the direction of the MTY flows, whereas ports of destinations are not determined in advance and MTYs are unloaded from vessels as needed (Song and Dong, 2011). The effectiveness of this method is only limited to the respective line's service routes, CI and fleet size. In contrast collaboration between CSL may directly reduce the number of containers that needs repositioning. Therefore, it would significantly improve the effectiveness of other solutions too thus may be supplementary to each other through its synergy effect.

3 Causes underlying CI imbalance

Container means an article of transport equipment of a permanent character and accordingly strong enough to be suitable for repeated use (ICSC, 1972). However, the global container imbalance disrupts the effectiveness of 'repeated use' by container shipping lines thus impacting the efficiency of the carrier's equipment control system.

There are three main sources of CI.

1 the LDN imports

2 MTY imports (or manufactured[9] newly in the same port)

3 leased[10] containers. Since the containers are a part of carriers' branding strategy CSL prefer to use their own containers as much as possible rather than using leased units.

Depending on carrier's business strategy, the amount of owned equipment can vary between 50% and 90%. Several operators, especially the smaller and regional lines rely 100% on rented boxes (Lai et al., 2010). The consequences of the container fleet imbalance are ultimately borne by all the stake holders[11] of international trade. Therefore, finding a solution to mitigate such impact would benefit primarily shippers, consignees and shipping lines and then countries, regions and whole world at macro level. The

positioning of MTYs is thus one of the most complex problems concerning global freight distribution, an issue being underlined by the fact that about 2.5 million TEU of containers are being stored MTY, and waiting to be used (Rodrigue, 2013). Therefore, the causes underlying the CI imbalance should be discussed taking this complexity into consideration.

3.1 External trade volume

The primary cause for imbalance could be the unbalanced external trade volumes of a particular port or a country. "…..there is no such market where imports and exports are well balanced…" (Karmelic et al., 2012). In other words, when the volume of domestic imports (in containers) of a country are greater than its exports such location would ultimately end up with a surplus MTY stocks. This problem has been identified as a structural and chronic problem (Karmelic et al., 2012)

Table 1 Container traffic between Europe and seven overseas regions 2009, in full TEU

Market	*Export*	*Import*	*Imbalance*
Europe–North America	2,824,459	2,496,601	327,858
Europe–Asia	5,458,298	11,493,357	6,035,059
Europe–Sub-Saharan Africa	1,093,687	591,975	501,712
Europe–ISC/Middle East	2,483,922	1,527,035	956,887
Intra Europe (only between ports in Europe)	1,026,767	736,689	290,078
Europe–Central and S. America	940,262	1,497,517	557,255
Europe–Australia and Oceania	374,901	181,527	193,374
Total Europe–all directions	18,522,701	14,202,295	4,320,406

Source: European Liner Affairs Association, http://www.elaa as cited in Karmelic et al. (2012)

For 100 containers entering the USA, half will be repositioned empty to foreign markets (Rodrigue, 2013). This phenomenon is plainly visible in the context of Sri Lanka as well (i.e., total domestic LDN imports accounts for 64% of total external trade). In terms of TEUs LDN imports in Sri Lanka accounted for 476,982 TEUs while domestic LDN exports were only 256,396 TEUs during 2013 (CASA Per. Review, 2014). In other words, for every 216 containers entering to Sri Lanka, 100 will be repositioned empty to foreign ports. It appears the situation is even worst in some other countries.

3.2 Commodity types

All cargo that can be carried by sea however cannot be containerised because certain goods are technically unsuitable for containerisation. The composition of the world fleet reflects the demands for seaborne trade of different commodities, including dry and liquid bulk and particularly manufactured goods. Normal merchandise and goods, often packed in boxes/cartons or bags, e.g., clothing, furniture, toys, components, plastic products and much more. This type of cargo includes raw materials, components for manufacturing, and finished goods and are increasingly containerised. Goods requiring a temperature- or humidity-controlled environment during transport are carried in special refrigerated containers (RF). Odd-sized goods that do not fit into a standard container,

e.g., windmills and large machinery are considered out of gauge cargo. When a country imports commodities that can be containerised in greater quantities while their exports commodities cannot be containerised the obvious outcome is an imbalance.

3.3 Container types and sizes

CI imbalance is a complex phenomenon as it involves different sizes such as 20', 40' and 45' in sizes. Similarly, it comes in different types to cater different needs of customers such as standard, open top (OT), flat rack (FR), reefer[12], and flat bed (FB). The export and import markets are usually volatile and hard to predict accurately thus it is very difficult to maintain a balanced inventory at a given location. Therefore, CSL may respond to the phenomenon differently based on the container stock at a specific location at a given time.

In the context of SL majority of imports (in containers) are 20's while the exports are predominantly stuffed in 40's. This factor is obvious when analysing the goods that are moved in containers. In general, shipping commodities tends to rely on 20' containers (one TEU) simply because of that they can each load around 26 to 28 tons thus load approximately 55 tons in two 20' containers (2 TEUs). In contrast one 40' container (2 TEUs) has a loading capacity of only about 30 tons due to structural integrity issues.

But this argument should be reversed when the volume of cargo supersedes the weight of cargo. This is the very reason that leads to discriminations between certain commodities in the 20' or 40' container choice.

The maximum capacity (by volume) of a 20' container is approx. 33 CBM (if you filled it with water) but the 'true cargo maximum' is probably closer to 28 CBM. For example, the cargo weight of a 40' container of garments is between 8–12 tons but they occupy almost 55–58 CBM of the container. Therefore, commodities such as tea, fibre, and textiles usually demands 40's while 20's are demanded by rubber, tires, and tiles exporters. In international shipping, containers follow standard measurements which allow for efficient handling in terminals and onboard vessels. Standard lengths are 20 and 40 feet and are called general purpose (GP) containers. Additionally, 45 foot containers may be available. Standard height is 8 feet and 6 inches. Containers with extra 6 inches in height are referred to as high cube (HC) containers. Other types include FR containers, OT containers, and reefer containers (RF).

3.4 Logistical issues and Seasonality

The container sizes demanded by the customers also subject to various other logistics factors such as overland weight limitations, road access or the infrastructure in the warehouse, etc. of the exporter and consignee.

During certain parts of the year the domestics imports (in containers) tend to increase based on the increase demand for some specific goods. The importation of food items, textiles and festive items will increase during November, December due to Christmas. In the case of Sri Lanka this is repeated in March, April too to cater increased consumer demand for traditional New Year festival in the country. The unpublished industry statistics reveal that MTY evacuation from SL usually increases during these periods. This applies to exports of seasonal agricultural crops or weather patterns of a country, etc.

3.5 Port rotation and round trip

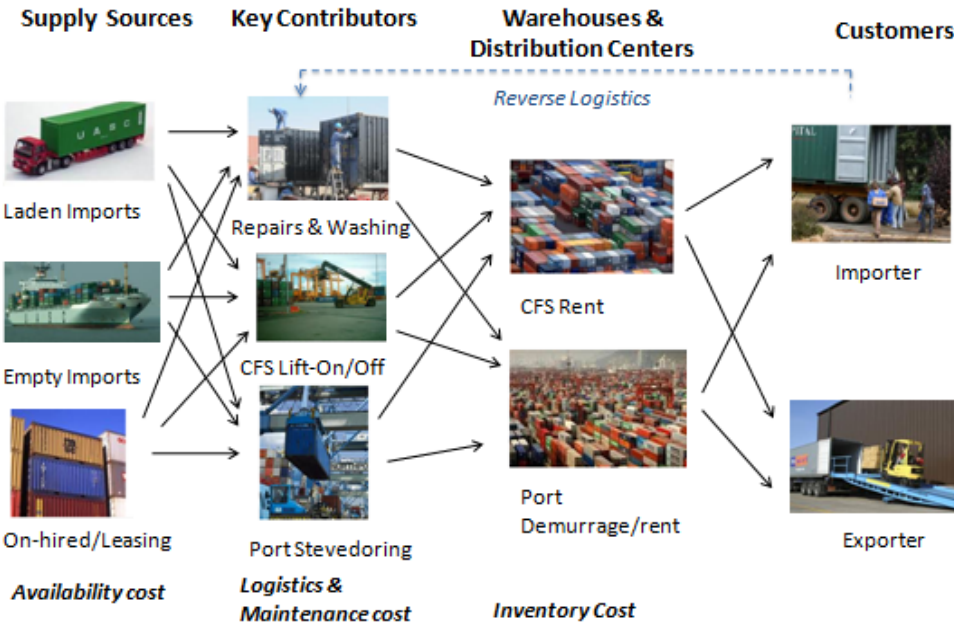
Container ships operated on the basis of 'liner' in which ships transit regular routes on fixed schedules. Usually, the ship calls same ports on the west bound (WB) voyage and east bound (EB) voyage. In certain cases, the ship skips certain ports and may add different ports in the WB schedule. There is a likelihood of MTY getting stagnated in such locations. Sri Lanka is vulnerable to such situation given the geographic and commercial reasons. Some ships skip Colombo on the EB voyage when there is not much of export cargo or if the port stay is not justified.

4 Need for balanced in/out movements

4.1 Container demand and supply

A container designed primarily for the use and re-use in the transport of goods. Therefore, it has to be able to be transported and re-transported several times before its life-time comes to an end. As cited in Brito and Konings (n.d.), containers remain for about half the time of their lifetime being idle as they are either being maintained, repaired or in storage or in transit. The container supply chain of a CSL is illustrated in Figure 1. The total costs per MTY including transport and handling are estimated at USD 675. The MTY stocks also occupy ground space used for storage thus creating recognisable environmental hazards.

Figure 1 Container supply chain of a CSL (see online version for colours)

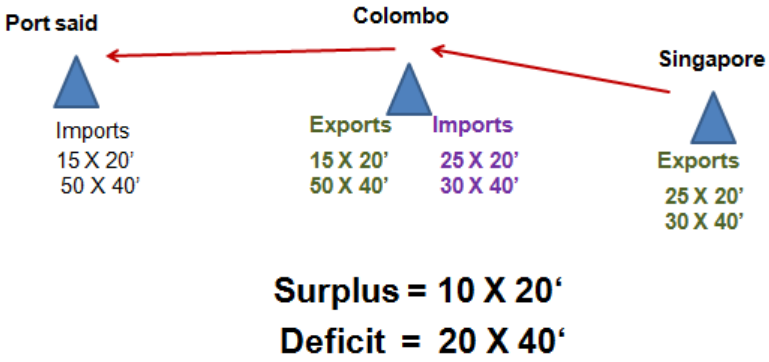


As stated elsewhere before, shipping denotes a derived demand in international trade. In liner shipping, therefore, the demand for shipping is subject to fluctuations in world trading patterns. The supply of shipping capacity, therefore, is subject to volatility in demand in shipping. Cargo cannot be shipped without containers to carry the cargo and, therefore, the supply of shipping facilities cannot be materialised only by making the ship space (slot) available for the exporter. Therefore, MTYs should be made available at each port that the ships are scheduled to call. Ideally, the available quantity of MTY should be equal to the space (slots) available in the ship.

4.2 The imbalance

The imbalances usually occur when the number of laden containers imported to a particular port is different from the MTYs required for exports from that port. Since there are different types and sizes of containers used in shipping this situation gets more complicated. Figure 2 illustrates a situation that involves 20' and 40' standard containers concerning three ports.

Figure 2 Example of inventory imbalance in Colombo (see online version for colours)



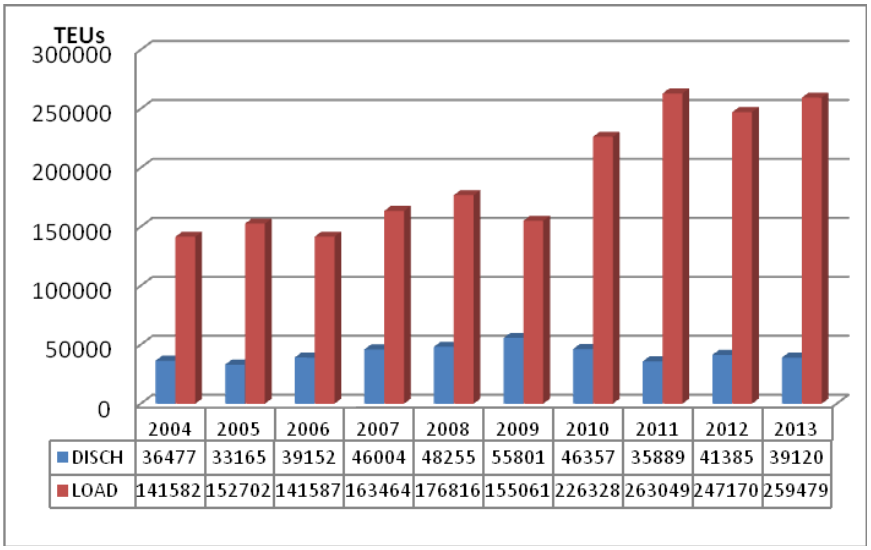
In this example, Colombo imports 25 × 20'containers but it only exports 15 × 20's thus creating a surplus of 20's in Colombo. Similarly, it imports only 30 × 40's but has a demand for exports in 50 × 40's. This situation creates a deficit of 40's in Colombo. Therefore, ideally, in order to help maintain balance between supply and demand of containers, when a certain carrier brings into a port a certain number of containers, there should be an equal number of containers to be carried away from that port. However, the prevailing situation may often be something highly contradictory to the ideal situation. The flow of containers in one direction may be greater than the flow of containers in other direction yielding imbalance in the flow. This may produce either a greater surplus or a significant deficit in containers.

4.3 MTY movement in Sri Lanka

Containers are built with the purpose of transportation (laden) of goods in them; and not to let them lie idling in one location or to be used for storage. If the containers are stored in one location there will be no return on investment. As such, the container carriers chose to transport them (even on empty status) from the location of idling to those

locations where the demand for containers may be prevalent. Similarly, if a particular port does not have sufficient quantities of MTYs at their disposal so as to facilitate their export demand, they will be required to import them from some location where they may be available. Figure 3 illustrates the MTY movements in Sri Lanka during past ten years. Accordingly, there is a substantial 83% increase in loading and a 7% increase in discharging of MTYs in Sri Lanka between 2004 and 2013.

Figure 3 Empty container discharging and loading in Sri Lanka – 2004–2013 (see online version for colours)



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
DISCH	36477	33165	39152	46004	48255	55801	46357	35889	41385	39120
LOAD	141582	152702	141587	163464	176816	155061	226328	263049	247170	259479

Source: CASA Per. Review (2014)

However, this yields a repositioning cost of 15% of the operational costs related to container assets. To cover these costs, shipping companies have imposed surcharges on full containers on a number of export routes. These surcharges may vary from USD 100 to USD 1,000 per TEU which arise as a significant share of the shipping costs towards the exports emanating from developing countries in Africa, Asia and the Caribbean. The outcome of this is the higher costs for imported goods in the imported country (Rodrigue, 2013).

4.4 Cost incurred due to imbalance

The container imbalance creates different costs to the carrier. The surplus MTYs at one location needs to be transported to a location where there is a deficit of them. For example, when evacuating an excess container from Colombo to Singapore[13] a CSL spends USD 402.60 for 20-footer and USD 632 for 40-footer. In the case of a deficit situation when CSL requires to transport a MTY from Nhavashiva to Colombo in order for catering the demand by its exporters, CSL spends USD 298.60 for 20-footer and USD 504.20 for 40-footer. The total sum spent on repositioning of a MTY is a complex calculation because the cost parameters are numerous and varied. The carriers also count the cost in differing ways (Ker, 2011).

It is clear from Table 2 that cost of 40-footer is not exactly the double of 20-footer although the shipping statistics are published usually terms of TEUs. In an attempt to make of a comprehensive approach, therefore, it requires to break down the container capacity into two segments as 20-footer and 40-footer. Following are the cost breakdown of incurred by the carriers in above example.

Table 2 Cost of importing empty containers from Nhavashiva and exporting to Singapore

Exporting MTYs to Singapore from Colombo		
Description of cost	*20' empty*	*40' empty*
Lift on charge at CFS	USD 7.00	USD 14.00
Transport CFS to port	USD 25.00	USD 35.00
Colombo PHC for loading (port handling charge)	USD 118.60	USD 179.20
Slot cost (Colombo to Singapore)	USD 40.00	USD 80.00
Singapore discharge PHC	USD 180.00	USD 275.00
Transport from port to CFS	USD 25.00	USD 35.00
Lift off charge at CFS	USD 7.00	USD 14.00
Total	*USD 402.60*	*USD 632.20*
Importing MTYs to Colombo from Nhavashiva		
Description of cost	*20' empty*	*40' empty*
Lift on charge at CFS	USD 2.00	USD 4.00
Transport CFS to port	USD 20.00	USD 40.00
Nhavashiva PHC for loading (port handling charge)	USD 57.00	USD 87.00
Slot cost (Nhavashiva to Singapore)	USD 75.00	USD 150.00
Colombo discharge PHC	USD 118.60	USD 179.20
Transport from port to CFS	USD 19.00	USD 30.00
Lift off charge at CFS	USD 7.00	USD 14.00
Total	*USD 298.60*	*USD 504.20*

According to unpublished industry source, in 2012, a total of 141,136 of 20-footers and 53,017 of 40-footers have been transported away from Colombo whilst some 3,965 of 20-footers and 18,710 of 40-footers have been brought in to Colombo. Assuming that all MTYs required were imported from Nhavashiva and all excess (empty) containers were transported to Singapore, the carriers have been required to bear a significant sum of USD 100,956,232 bridging the gap between the deficit and surplus in 2012.

5 Alliances of CSL

5.1 The role of alliances

Globalisation, complexity, volatility in shipping, and increasing uncertainty in the business environment paved the way for collaborative approach such as alliances. Collaboration in the supply chain is becoming a vitally important strategy to achieve competitive advantage, and to develop core capabilities (Kumar and Banerjee, 2012).

Strategic alliance is an agreement between two or more organisations to cooperate in a specific business activity, so that each benefits from the strengths of the other, and gains competitive advantage (IšoraItė, 2009) while remaining independent organisations.

The strategic alliance is one of the most important types of relationship or partnership due to the high degree of commitment and influence over the other party that is involved. (Olavarrieta and Ellinger, 1997) and offers significant value creation opportunities (Ritala, 2009). There are alliances among CSL already in place evidencing the acceptance of collaborative approach in the shipping industry. Collaboration provides a valuable business model and enhanced performance (Hawkins and Little, 2011) but demands a high degree of interdependence between companies that may continue to compete against each other in the marketplace (Hughes and Weiss, 2007). Strategic alliances involve the sharing of knowledge and expertise between partners thus alliances between competitors are traditionally considered risky.

The creation and expansion of multi-trade operational alliances ('global strategic alliances') among ocean carriers to expand service networks was one of the trends in liner shipping during the period prior to the reform[14] initiative (FMC, 2012). According to these agreements, partners may provide the strategic alliance with joint service on rates, vessels, equipment, sailing schedule, port calls information exchange, capacity, services, etc.

Table 3 Market shares of major alliances and vessel sharing agreements – US/North Europe sector

	Alliances	*2006*	*2007*	*2008*	*2009*	*2010*
1	New World Alliance Agreement (NWA)	10.2%	9.7%	10.2%	9.6%	10.8%
2	The Grand Alliance Agreement II	26.1%	26.2%	27.9%	31.3%	30.7%
3	COSCO/KL/YMUK/Hanjin Worldwide Slot Allocation and Sailing Agreement	8.3%	7.5%	6.1%	4.7%	3.5%
	Alliances including partners	*2006*	*2007*	*2008*	*2009*	*2010*
4	New World Alliance/Maersk Line Slot Exchange Agreement	24.6%	23.2%	24.5%	23.2%	21.3%
5	The Grand Alliance/Zim Atlantic Vessel Sharing Agreement	--	--	29.9%	--	--
6	The Grand Alliance/Zim/HSDG Atlantic Space Charter Agreement	--	--	--	36.0%	36.9%
7	ELJSA/CKYH Vessel Sharing Agreement – Trans Atlantic Express Service	--	--	--	11.0%	7.4%
	A Market share of alliances	*44.6%*	*43.4%*	*44.2%*	*45.7%*	*45.0%*
	B Market share of alliances including partners	*59.0%*	*56.9%*	*60.5%*	*70.2%*	*65.5%*

Source: FMC (2012)

In Table 3, item A provides the market share of alliance while item B gives the market share including the partners' total volumes. For example, in 2008, item A = (1 + 2 + 3) while item B = (4 + 3 + 5).

5.2 Container interchange in alliances

Prior to forming of these alliances CSL believed that sharing a ship by multiple shipping lines would result in exposing confidential marketing information to competitors. In fact, this is true as the cargo manifest of all containers will be finally end up in the hands of another CSL (who competes in the same route) who operates the respective vessel. Despite this serious concern CSL subsequently found that collaboration is an effective solution.

Fundamentally, interchange between those who have excess and those who have shortages at a specific location is the simplest way of balancing container inventories. Alliances facilitate the respective partners to deliver comprehensive solutions to their issues thorough collaboration. For two parties of an exchange relationship, higher levels of trust can lead to better interactions and trust is an important factor affecting their supply chain partnerships (Wu et al., 2012). Such arrangement has been possible through common understanding between CSL and similar strategy is presently working well with respect to ship space (i.e., sharing the ship space between multiple firms such as CKYH[15] and G6 Alliance[16]). The statistics in Table 3 speak for itself for the impact of alliance with respect to market share.

The paradox for 'CI' comes in this circumstances. CSLs in Sri Lanka are still not prepared to share the CI between them despite they share vessel space. According to industry sources, CSL do not pool their containers and interchange even if the contract agreements[17] provide necessary provisions for same. Usually, sharing of ship space appears operationally more complicated than sharing containers. Accordingly, existing alliances of CSL have failed to derive the benefits through the provisions inbuilt in respective agreements to interchange containers. The barriers to a collaborative approach by carriers could be identified as:

a confidentiality of marketing information

b legal issues and insurance

c ethnic issues

d business philosophy or company policy

e competition in which companies believe that collaboration may provide an indirect support to new entrants.

Ultimate result is that they never opt to strike a balance between the container inventories even within the active consortia (alliances). It is quite obvious that the behavioural patterns of CSL with respect to these two phenomena (i.e., sharing ship space; and pooling containers) are not the same. Therefore, a significant contribution to the industry is expected through this research because there is usually very moderate interest exists in the liner shipping industry for scientific studies.

5.3 The models of collaboration

Given the complex nature of CI handling two hypothetical models were used to illustrate the possible container exchange strategy. The application of the model within a particular port/location explained in Figure 4 while Figure 5 illustrates the application in two ports simultaneously.

Figure 4 illustrates the proposed collaborative approach between three CSLs. Lets presume that line A has 300 × 20' (300 TEUS) excess MTYs during the week in question while short of 35 × 40' (70 TEUS) to cater to their exporters demand. Line B has 50 × 40' (100 TEUS) excess MTYs during the same week while short of 40 × 20' (40 TEUS). Line C has 60 × 40' (120 TEUS) excess while short of 30 × 20'. The corresponding costs have been calculated using Table 2.

In a collaborative approach line A offers 40 × 20' (40 TEUS) to line B and accepts 20 × 40' (40 TEUS). This will solve line A's shortage partly while reducing evacuation cost of 20's. The transaction between two companies (i.e., lines A and B) is balanced in terms of TEUS. (i.e., 40 TEUS have been exchanged). Similarly, line grants 30 × 20' (30 TEUS) to line C and takes 15 × 40' (30 TEUS) from line C. The transaction between lines A and C also balanced in terms of TEUS.

Figure 4 The matrix of intra-port collaboration (hypothetical case) (see online version for colours)

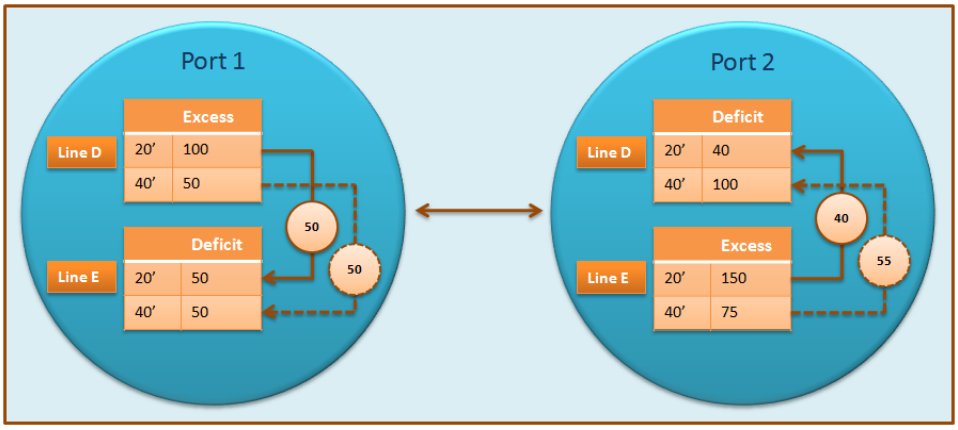
Players	Weekly Excess		Weekly Deficit		Before collaboration		After Collaboration		Weekly Cost saving through collaboration
	20'	40'	20'	40'	Outcome	Cost USD	Outcome	Cost USD	
Line A	300	--	--	35	*Export 300 x 20'*	*120,780*	*Export 230 x 20'*	*92,598*	*USD 28,182*
					Import 35 x 40'	*17,647*	*Import 00x 40'*	*0*	*USD 17,647*
Line B	--	50	40	--	*Export 50 x 40'*	*31,610*	*Export 30 x 40'*	*18,966*	*USD 12,644*
					Import 40 x20'	*11,944*	*Import 00x 20'*	*0*	*USD 11,944*
Line C	--	60	30	--	*Export 60 x 40'*	*37,932*	*Export 45 x 40'*	*28,449*	*USD 9,483*
					Import 30 x20'	*8,958*	*Import 00x 20'*	*0*	*USD 8,958*
Total						*228,871*		*140,013*	*USD 88,858*

The final outcome is that shipping lines A, B, and C saves USD 45,829, USD 24,588, and USD 18,441, respectively. In other words, total saving to the industry as a whole will be USD 88,858 or 39% (of total cost of USD 228,871 in non-collaboration scenario) saving per week as a result of the collaboration.

However, above mechanism is not workable with lines that have deficit containers only or lines that have excess containers only. Figure 5 illustrates the sharing mechanism that could be implemented by such CSL. Presume line D and line E operating in two ports/locations. Line D has excess containers only and line E has deficit inventory. For example line D in port 1 has excess 100 × 20' and 50 × 40' and offers 50 × 20' and 50 × 40' (150 TEUS in total) that is required by line E. Line E reciprocally offer 40 × 20' and 55 × 40' (150 TEUS in total) that is required by line D at port 2. The financial benefits to lines D and E can be calculated on the basis that line D need not export 50 × 20' and 50 × 40 empties from port 1 while line E need not import same quantity from elsewhere to port 1. Similarly, line E need not export 40 × 20' and 55 × 40 (150 TEUS) empties from port 2 while line D need not import same quantity from elsewhere to port 2. However, it is to be noted that various operational costs associated with a 40' are not always the double of the cost incurred by a 20'. The feasibility of

interchange should be calculated based on consolidated financial cost and consideration of non-financial benefits such as marketing advantages as well.

Figure 5 The matrix of inter-port collaboration (hypothetical case) (see online version for colours)



The popular game theoretic approach could be used to describe this phenomenon. We consider this situation as 'many-player transferable utility (TU) game' where players (shipping lines) can use mutually beneficial strategies. The structure of the game can be studied by coalitional form of a many-player TU game. Then the expected economic benefit achieved by coalition (sharing the containers) among players (shipping lines) can also be evaluated as a TU. As Kearns et al. (2001) have described, an n-player, two action game is defined by a set of n matrices M_i ($1 \le i \le n$), each with n indices. In general, a cooperative game consists of n number of players and a characteristic function v: $2^n \rightarrow$ R. Let $N = \{1, 2, \ldots, n\}$ is the set of shipping lines and each line has two actions (collaborate, work alone) then the set of coalitions, 2^N consists of 2^n elements. The coalition X is then a subset of N. The zero coalition is defined by an empty set and the grand coalition is the set N. The economics $E\{\}$ of coalition is the savings obtained by each shipping lines in monetary terms, which can be given by

$$v(x_{ij}) = \Sigma_{e \in s} E(\varnothing) - E(x_{ij}).$$

For example, if there are three shipping lines there are eight forms of coalitions $\{\varnothing, \{1\}, \{2\}, (3), \{1, 2\}, \{1, 3\}, \{2, 3\}, \{1, 2, 3\}\}$. Let us depict the situation taking three shipping lines for example (Table 4). The strategy profile (x_{ij}) is given in the table where $i = 1, 2, \ldots, n$ (number of shipping lines) and $j = 1, 2$ (1 = not willing to collaborate, 2 = willing to collaborate).

In this example, the element $\varnothing$ of 2^N set indicates strategy profiles where no coalition would take place. The subset $\{\{1\}, \{2, 3\}\}$ indicates that the shipping line 1 is not willing to collaborate while 2 and 3 are willing to collaborate. If 2 and 3 decide to enter into a coalition, they would realise and enjoy the benefit of sharing the empty containers. The expected utility/payoff (economics of coalition) could be calculated through monetary terms. For this the complete information of such collaboration should be made available.

Table 4 The matrix of strategy profile for three shipping lines

Shipping line	*Willingness to collaborate (strategy profile)*							
1	x_{11}	x_{11}	x_{11}	x_{11}	x_{12}	x_{12}	x_{12}	x_{12}
2	x_{21}	x_{21}	x_{22}	x_{22}	x_{21}	x_{21}	x_{22}	x_{22}
3	x_{31}	x_{32}	x_{31}	x_{32}	x_{31}	x_{32}	$x_{3}1$	x_{32}
Subsets of 2^N set	$\varnothing$	{{1}, {2, 3}}	$\varnothing$	{{2}, {1, 3}}	{{3}, {1, 2}}	{1, 2, 3}		

6 Methodology

The container imbalance has a direct impact to Shipping lines and their agents. It was suggested at the exploratory study that 'sharing' is one feasible solution to the issue. Ceylon Association of Ships Agents' (CASA) membership comprises 135 licensed ships' Agents, representing all international shipping lines of repute. The other association, Sri Lanka Association of Vessel Operators comprises 14 members. Twelve of them except CSL-OOCL[18] are members of CASA.

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 executive, operation manager, and container controller (three strata). Every agent has one employee from each stratum reflecting 336 employees in total. It was learnt that each stratum influence the decision with respect to MTY differently. Therefore, weights were allocated to each job category as follows and a weighted random sample was drawn from each job category.

Table 5 Sample selection and response received

Job category	*Weights*	*Sample size*	*No. of responses received*
Chief executives	0.20	22	12
Operations managers	0.50	56	37
Container controllers	0.30	34	18
Total	1.00	112	67

(37 respondents refused to participate and 75 questionnaires were sent but eight did not respond. According to key informants, this response rate was acceptable given the industry norms as some agents were not allowed to reveal data due to confidentiality nature.)

The questionnaire consisted of 25 questions. Four questions were used to understand the respondents' stock position and eight questions related to container re-position cost; feasibility of substituting different sizes; pros and cons of container sharing. The question Q8 and Q13 focused on identifying the decision making process of container stocks, Q15 to Q18 concerned about the benefits and repercussion of container sharing. Q19 refers to a specific question 'Do you prefer to collaborate with other carriers or work alone?' The Q20–25 was used to determine the potential factors that obstruct collaboration among shipping lines even if the respondent wishes to do so.

Respondents were required to mark their preferences in the rest of 21 questions fewer than 11 scales of score ranging from +5 to –5 representing highly agree to highly disagree respectively and neutral (0). Questionnaire was made very brief and deliberately in objective form given the nature of respondents and based on previous experience.

7 Results and the discussion

Approximately 3,000 20-footers and 17,000 40-footers of empties are imported to Colombo every year while there is an excess of 143,000 20-footers and 55,000 40-footers of empties piled up in container yards. In a hypothetical scenario, CSL could reduce importation of empties by nearly 2% and 30% for 20's and 40's, respectively if CSL interchange their containers.

Table 6 shows the frequency distribution of the surveyed sample according to the type and the status of containers. More than 80% of respondents indicate that their shipping line have excess 20 footer containers while only 6% claims a deficit in 20's. On the other hand, 37% of respondents indicate that their shipping line have excess 40 footer containers while 45% claims a deficit in 40's. CI can be deficit in 40's while excess in 20's. The situation will be more complicated if all the types[19] of containers were considered. (This study refers only to GP containers for the simplicity.)

Table 6 The frequency distribution of type and status of containers

Type and status of containers	*Frequency (%)*
Deficit of 20'containers	4 (5.97)
Deficit of 40'containers	30 (44.78)
Excess of 20'containers	55 (82.09)
Excess of 40' containers	25 (37.31)

The results suggest that container imbalance is a common phenomenon in the container shipping industry. According to this study, nearly 90% of the shipping lines are either deficit, or excess or, both with respect to their container stocks. Approximately 12% of respondents are neither deficit nor excess which is the ideal situation for shipping lines. Some CSL that operate in small container inventories mange to balance inward and outward flow for a short period. Apart from this, there will be three other status, i.e., deficit containers only; excess containers only; and either deficit or excess. According to the results of the study, nearly 90% of the shipping lines comprising these categories will be benefited by sharing their resources. Therefore, the status of each shipping lines was redefined as shown in Table 7.

Table 7 Frequency distribution of status of shipping lines

Status of shipping lines	*Status label*	*Frequency (%)*
Deficit of containers only	S1	2 (2.99)
Excess of containers only	S2	27 (40.30)
Both deficit and excess, i.e., deficit at certain times/excess at certain times	S3	30 (44.78)
Balanced container count	S4	8 (11.94)

These results were derived from the responses to Q1–Q4. Respondents were advised in advance that they are free to consider the general trend of empty stock movements in the recent past when answering a question such as 'Do you have deficit of 20'containers in Colombo?' The analysis of data revealed that this contemplation has improved the qualitative nature of the study. For an example, some respondents have answered in the following manner in Table 8.

Table 8 Extract from an answered questionnaire

	(Please tick X)	*Yes*	*No*
1	Do you have deficit of 20' containers in Colombo?	x	
2	Do you have deficit of 40' containers in Colombo?	x	
3	Do you have excess of 20' containers in Colombo?	x	
4	Do you have excess of 40' containers in Colombo?		x

If the respondent has considered only the current week/day the answer to Q1 and Q3 cannot be 'Yes' as these two questions suggest two extreme situations (i.e., CSL cannot have excess and deficit 20' container stocks simultaneously). But this is possible to occur during a reasonable time span say one month.

Table 9 shows the general opinion of the respondents towards each aspect based on the arithmetic mean, standard deviation (SD) and the median (Med.). When both mean and median provide consistent results (overlapping confidence intervals for mean and median), the opinion is interpreted based on the mean score. When there are inconsistent results (none overlapping confidence intervals for mean and median), the opinion is interpreted based on the median score because the median is more representative over the mean as a measure of centre for asymmetric distributions. Thereby, it is expected to avoid the risk of misinterpretation of data when asymmetric distributions occur. Romano et al. (2006) also provide detailed explanation on the appropriate statistics for ordinal level data.

The Q5 reports a median score of 4 indicating the positive agreement of the respondents. Nevertheless, S1 reports the highest mean (4.5) followed by S4, S3 and S2. Concerning the results of Q5, (median is 4.00 and the mean is 2.38) it indicates that respondents hold a positive perception that sharing of containers with fellow operators could minimise cost associated with empty container repositioning. Apart from S2 all the other status categories indicate positive perception towards the aspect.

Respondents hold similar perception towards Q6, i.e., shipping lines now share ships space with competitors hence they can also share containers (median is 3.00 and the mean is 2.06). SL in the past operated weekly services individually; each SL had their own ship and they loaded/discharged only their containers (except those who carried SOC[20]). In order to obtain the economies of scale advantage SL used to form consortia and share the ship space.

Apart from the practical realty Article 14(c) and Article 17(a) of Rotterdam Rules[21] identify the association between containers and the specific obligations applicable to the voyage by sea and liability of the carrier for loss, damage or delay. Therefore, arguably nothing prevent SL sharing containers because the 'product' component in container shipping comprises of both ship space and containers thus if SL in principle agree to pool the ship's space.

Table 9 The general opinion of shipping lines with respect to collaboration

Aspect		*Overall*		*By status*							
				S1		*S2*		*S3*		*S4*	
		Mean (SD)	*Med.*	*Mean (SD)*	*Med.*	*Mean (SD)*	*Med.*	*Mean (SD)*	*Med.*	*Mean (SD)*	*Med.*
Q5	Sharing of containers in Colombo with fellow operators will minimise empty container Repositioning cost.	2.38 (2.94)	4.00	4.50 (0.71)	4.50	0.96 (2.41)	0.00	3.03 (3.30)	4.00	4.25 (0.46)	4.00
Q6	Shipping lines now share ships space with competitors hence they can also share containers.	2.06 (2.60)	3.00	4.00 (0.70)	4.00	0.04 (2.03)	0.00	3.03 (3.31)	4.00	4.25 (0.47)	4.00
Q7	It is always possible to substitute a 40' requirement with two 20' units thus we can minimise empty REPO cost.	0.54 (3.92)	1.00	4.50 (0.71)	4.50	–2.93 (3.28)	–5.00	3.17 (2.18)	4.00	1.38 (1.92)	0.00
Q9	Sharing of containers helps shipping lines to offer cheaper freight rates.	1.48 (3.31)	2.00	3.50 (0.71)	3.50	–0.11 (2.55)	1.00	2.63 (3.73)	5.00	2.00 (2.14)	2.00
Q10	The benefits are greater by sharing containers belong to competitor lines despite potential legal obligations such as insurance.	1.79 (2.91)	2.00	–1.50 (4.95)	–1.50	0.04 (2.53)	1.00	3.17 (2.51)	4.50	3.38 (0.74)	3.00
Q11	I perceive that sharing of containers will bring forth a win-win situation.	1.96 (2.95)	3.00	3.50 (2.12)	3.50	–0.30 (2.43)	0.00	3.33 (2.51)	5.00	4.00 (0.53)	4.00
Q12	Share containers with other lines will create new administrative problems.	2.06 (1.87)	3.00	1.00 (1.41)	1.00	2.85 (1.32)	3.00	1.67 (2.12)	0.00	3.00 (0.53)	3.00
Q13	The collaboration with other shipping lines may need a lot of changes in the present system	1.22 (2.33)	2.00	–0.50 (3.54)	–0.50	1.44 (2.24)	1.00	0.53 (2.27)	0.00	3.50 (0.53)	3.50
Q14	Sharing containers is a temporary solution when there are unexpected market fluctuations/shipping demands.	0.91 (2.69)	0.00	2.50 (3.54)	2.50	1.26 (2.49)	2.00	–0.37 (2.33)	0.00	4.12 (0.99)	4.50

The Q7 represents a paradox. Theoretically, it should be possible to substitute a 40' requirement with two 20' units thus S3 (those who are both deficit and excess) could minimise empty reposition cost. However, this does not stand valid in practice because of complexities in the logistic operation. Depth interviews with some respondents revealed that operational cost including transport cost, customs and port handing cost of handling two 20's is higher than one 40'. Some SL even had gone to the extent of offering freight rates that compensate all such additional cost of a particular shipment in order to attract exporters. The response had been very moderate as there were constrains in qualitative nature such as transporting a 40' in the exporters'/consignees' warehouse, cartoon sizes that the cargo is being stuffed were not suitable for 20's, etc. According to results of survey respondents had a marginal overall positive perception for the Q7. The median recorded as 1 while the mean was 0.54 with SD of 3.92. There is a noticeable inconsistency between S1 and S3 as against S2 while S4 is almost neutral. It appears that S2 (who has excess containers only) would have failed their previous attempts in this respect. Sharing of containers does not help shipping lines to offer cheaper freight rates according to the results of Q9. However, the researchers suggest that SL may consequently reduce freight rates in the long run as they are keen on reducing cost of empty container repositioning.

There are potential legal obligations or complexities such as insurance for the containers that usually prevent SL considering sharing as a feasible option. This is clear from the overall perception (Median is 2.00 and mean and SD are 1.79 and 2.91, respectively). The status category S3 however perceives that the benefits are greater by sharing containers belong to competitor lines despite these potential legal issues as per the result of Q10.

The Q12 and Q13 suggest disadvantages of sharing, i.e., creating new administrative problems, need of changes in the present system, etc. The status category S3 has almost neutral perception while the overall response endorses the fact of creating new administrative problems. The status category S4, who does not suffer a deficit or excess, perceives that sharing may need of changes in the present system but others who really suffer due to this problem responded in a moderately positive manner to Q13. The overall response is neutral for Q14 while S3 perceives it moderately negative (Median 0 and mean, 0.37). The status category S4 however perceive that sharing containers as a temporary solution.

Table 10 indicates the outcome of collaboration as perceived by shipping lines. With regard to Q15, respondents perceive that there will be a saving to the carrier if lines start sharing containers but for Q16 respondents hold strong positive perception that sharing containers may be good for the industry as a whole. Generally, such arrangement would reduce occurrence of container shortages thus help minimising exporters losing their prospective buyers; delaying of shipment pending arrival of empties; loss of customer confidence on service reliability. Supply chain performance is measured in time, cost, reliability, and flexibility (Edirisinghe and Muller, 2014).

The Q17 and Q18 refer to two consequential issues that could result from sharing containers. The ship space and containers are the two vital components in the container liner service. The general perception among CSL is that, there could be legal and monitoring issues associated with respect to interchanging of containers. Respondents have held moderately positive perception in both occasions (Median is 2.00). However, in reality contracts of leading CSL already have provisions to interchange containers. For an example, CMA CGM/CSCL Cross Space Charter, Sailing And CWA-Central

China/US West Coast, Yang Tse/AAC2 Service agreements include clauses, inter alia, 'equipment interchange' (FMC, 2012).

In Q22, the respondents answer to the question; 'I am unable to share containers with other carriers because it could indirectly help my competitor to encroach to my clients'. The responses to this are expected to provide a key insight to the issue. While the consortia agreements facilitate container interchange the respective partners paradoxically reluctant to pool them. Usually, the members of a consortium offer service to trade lanes common to all partners. Therefore, there is a possibility that the partners approaching donor's customers that increase the competition. According to results of survey, respondents had an overall moderate positive perception for the Q22 reflecting the median recorded as 2 while the mean was 1.75 with SD of 2.75.

The Q23 refers to tracking of containers which is one of complicated areas pertaining to CI. CSL employ substantial resources in order to maintain the inventory visibility at global level as containers move from place to place without any standard schedule. Therefore, keeping a track of all the containers is a difficult task even when it is not shared with another party. The median recorded as 1 while the mean was 1.58 with SD of 2.51. There is a noticeable inconsistency between S2 and rest of others. S3 was neutral with respect to median while the mean was 0.60 with a SD of 2.08. It appears that S2 (who has excess containers only) do not encourage sharing at all as it would make tracking more troublesome.

Since the containers will be moving through the international supply chain there could be instances of misused containers by some elements. For example, some parties use containers for storage purpose without the knowledge of the CSL. Responses to Q24 reveal an overall median of 3 and mean of 1.83 which gives a fairly positive perception. However, the response from S3 (those who are both deficit and/or excess) was almost neutral at 0.50 and 0.93 respectively relating to median and mean.

According to the study respondents have a neutral perception to Q25. Overall median was 0 and mean was – 0.78. Therefore, it appears that respondents have a fair understanding about the financial outcome of sharing containers. Whenever there are empty container movements (either exports or imports) a comprehensive study will be done with respect to the cost and sometimes the shipping line agent will have to bear a part of the cost.

Usually, the SL agent is responsible to maintain the right balance of equipments (container stock) at a given time. Some SL imposes penalties if empty containers are idled more than a specific period. However, the mechanism of balancing containers should be found by SL internally. When there is a deficit at a particular port SL (carrier) arrange empty containers to be sent from another (excess) port or 'on-hire' containers from a container leasing company. For some SL, these are usually top management's decision.

Table 11 shows the perception towards identifying the decision making authority for prospective sharing mechanism. For Q8 except for S2 other categories have responded positively about sharing of containers with competitor lines as a decision of carrier's top management. The Q8, Q20, and Q21 attempt to understand who ultimately decide whether to share or not containers owned by respective shipping lines. The response to these questions would be critical in finding an effective and efficient solution to the empty container issue.

Table 10 The outcome of collaboration as perceived by shipping lines

Aspect		*Overall*		*By status*							
				S1		*S2*		*S3*		*S4*	
		Mean (SD)	*Med.*	*Mean (SD)*	*Med.*	*Mean (SD)*	*Med.*	*Mean (SD)*	*Med.*	*Mean (SD)*	*Med.*
Q15	It will be a saving to the carrier if lines start sharing containers	1.69 (3.13)	2.00	3.50 (2.12)	3.50	–0.44 (2.93)	0.00	3.67 2.19	5.00	1.00 (2.14)	1.00
Q16	It may be good for the industry as a whole if lines start sharing containers	3.24 (1.93)	4.00	2.00 (4.24)	2.00	2.30 (1.59)	1.00	3.77 (1.92)	5.00	4.75 (0.46)	5.00
Q17	There will be legal implications to carriers if lines start sharing containers	1.57 (2.16)	2.00	0.50 (0.71)	0.50	2.52 (1.63)	3.00	0.17 (1.93)	0.00	3.88 (0.64)	4.00
Q18	There will be Container monitoring issues if lines start sharing containers	1.54 (2.33)	2.00	2.00 (2.83)	2.00	2.59 (1.74)	3.00	0.20 (2.37)	0.00	2.86 (1.13)	2.50
Q22	I am unable to share containers with other carriers because it could indirectly help my competitor to encroach to my clients	1.75 (2.75)	2.00	2.50 (3.54)	2.50	2.96 (2.38)	4.00	1.33 (1.90)	1.00	–1.00 (4.28)	–1.00
Q23	I am unable to share containers with other carriers because it may create undue burden on tracking my containers	1.58 (2.51)	1.00	2.00 (2.83)	2.00	2.74 (2.60)	4.00	0.60 (2,08)	0.00	1.25 (2.44)	1.00
Q24	I do not wish to share containers with other carriers because there is no standard practice to share the agent would be held responsible in case of misuse of container	1.83 (2,66)	3.00	4.00 (1.41)	4.00	2.89 (2.47)	4.00	0.93 (2.61)	0.50	1.25 (2.44)	1.00
Q25	I am unable to share containers with other carriers because I have no idea of the financial outcome of sharing containers	–0.78 (2.47)	0.00	2.00 (2.83)	2.00	–0.85 (2.57)	0.00	–1.30 (2.02)	0.00	0.75 (2.96)	1.50

Table 11 Identification the decision making authority for prospective sharing mechanism

Aspect		*Overall*		*By status*							
				S1		*S2*		*S3*		*S4*	
		Mean (SD)	*Med.*	*Mean (SD)*	*Med.*	*Mean (SD)*	*Med.*	*Mean (SD)*	*Med.*	*Mean (SD)*	*Med.*
Q8	Sharing of containers with competitor lines is a top management of carrier's decision.	3.37 (1.88)	4.00	4.00 (0.00)	4.00	1.81 (1.88)	2.00	4.30 (0.95)	5.00	5.00 (0.00)	5.00
Q20	I am unable to share containers with other carriers because it is my principal's decision	3.73 (2.07)	5.00	5.00 (0.00)	5.00	3.56 (2.19)	5.00	3.53 (2.22)	5.00	4.75 (0.46)	5.00
Q21	I am unable to share containers with other carriers because it is my superior's (Local office) decision	–0.12 (3.72)	0.00	2.00 (4.24)	2.00	0.52 (4.11)	0.00	–1.33 (3.22)	–1.00	1.75 (2.96)	1.50

There are usually two types of line of authoritative relationships between the principal and the agent with respect to CSL. i.e.:

1 The agents are given freedom to take commercial decisions in the domestic context subject to final approval by the liner managers of principal. Therefore, the agent is fully encouraged to scan market trends and propose very effective marketing or operations strategies thus take proactive decisions. In fact, this is the whole idea of nominating a local agent in each country as per the practice in international marketing.

2 Other type is that the principal wants to implement their corporate policies and strategies in all countries irrespective of the PESTEL[22] of a particular country.

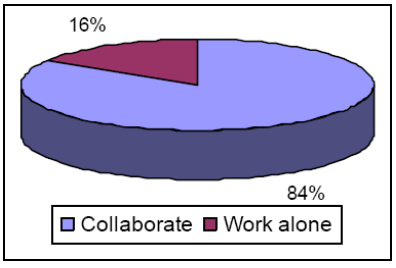
Obviously, the organisational culture in this type of firm does not permit the agent to study the domestic market in a vigilant manner and to contribute to the overall country specific decisions of the CSL. Q8 and Q20 were designed for this purpose. In both situations, the organisational culture of the agent also makes an impact. In one extreme, the top management of some agents encourages the liner managers to take initiatives on naval concepts while others play a conservative role. Therefore, irrespective of the principal's operating style the concept of sharing of containers may be influenced by this factor as well and was tested through Q21.

The agent is supposed to closely monitor the market and update its principal with regard to domestic market trends, exporters booking forecasts, etc. Based on such ground reality and the SL's overall vision, mission and objectives the final decision with regard to suitable marketing strategies will be defined by the principal. Even if the agents perceive that collaboration is an effective solution they are not supposed to share containers with another SL. Concerning the results of Q20 (median 5.00 and mean 3.73) it indicates that respondents hold positive perception that they are unable to share containers with other carriers because it is their principal's decision.

However, with respect to Q21 (median 0.00 and mean 0.12) it reveals that results are neutral or propensity towards negative that they are unable to share containers with other carriers because of local office is not in favour.

Figure 6 shows percentage of SL those who are willing to operate collaboratively or otherwise. According to the figure, out of the total SL surveyed, 84% are willing to operate collaboratively for sharing the empty containers.

Figure 6 Willingness to collaborate (see online version for colours)



However, paradoxically no sharing of containers takes place in the industry. Shipping agents in Sri Lanka has been traditionally reluctant to adapt to new methods. This was evident at the time CSL introduced the slot exchange with competitors. Similarly, agents

do not wish to take a lead in sharing containers as there is no existing practice (Q24). Another issue is that it may create undue accountability on agents if they take initiatives when principals keep silent on this option. Also, there could be possible legal implications to carriers when third parties use their containers. It also creates container monitoring and tracking issues when units are handled by other lines. CSL face serious marketing disadvantages if a particular CSL cannot provide empty containers to exporters. Therefore, CSL naturally avoid helping a competitor in such situations and try to make it to their advantage.

Table 12 The matrix of expected benefit (quantitative) through sharing containers

Players balance (TEU) benefit		*Deficit*			
		20 footer		*40 footer*	
Excess	20 footer	(A) 55, 4 (YES to Q3, Q1) 20' – (141,136–3,965) = 137,171 benefits (Total USD 2,780,258)		(B) 55,30(YES to Q3, Q2) (18,710 × 40'–3,965 × 20') = 16,728 × 40' benefits (Total USD 2,595,633)	
		1	USD 1,183,949 – (cost of importing 3,965 × 20 MTYs @ USD 298.60)	1	USD 999,324 – (cost of importing 1,982 × 40 MTYs @ USD 504.20)
		2	USD 1,596,309 (cost of Re-positioning similar number of 20's from the prevailing excess stock @ USD 402.60)	2	USD 1,596,309 (cost of exporting 3,965 × 20's from the prevailing excess stock @ USD 402.60)
	40 footer	(C) 25,4(YES to Q4,Q1) (53,017 × 40'–3,965 × 20') = 49,052 × 40' benefits (Total USD 3,690,622)		(D) 25, 30 (YES to Q4,Q2) 40' – (53,017–18,710) = 34,307 benefits (Total USD 21,262,044)	
		1	USD 1,183,949 – (cost of importing 3,965 × 20 MTYs @ USD 298.60)	1	USD 9,433,582 – (cost of importing18,710 X 40 MTYs @ USD 504.20
		2	USD 2,506,673 (cost of exporting 3,965 × 40's from the prevailing excess stock @ USD 632.20)	2	USD 11,828,462 (cost of exporting similar number of 40's from the prevailing excess stock @ USD 632.20

Table 12 indicates the details of expected benefit through sharing containers among companies. According to the results of the survey, there are 55 companies with the excess of 20 footers and four companies with the deficit of 20 footers. The number of companies with the excess and deficit of 40 footers are 25 and 30, respectively. Based on statistics with respect to 20' and 40' containers' statistics in 2012 in Sri Lanka, 3,965 × 20's have been imported as MTY despite prevailing excess of 141,136 × 20's in Colombo. If CSLs who had excess 20's interchanged these 3,965 units with others who were deficit the industry as a whole would have avoided the importation cost (i.e., USD 1,183,949).

Consequently, it would have automatically set off 3,965 × 20's from the existing excess stock thus it would eliminate the need of exporting (evacuating) 3,965 × 20's from Colombo which is another saving of USD 1,572,519. The same terminology applies with respect to 40s also. Accordingly, the quantitative benefit projected through sharing 40 footers is USD 21,258,302 realising a total saving of USD 24,014,770 with respect to both 20' and 40's.

The prospective outcome of container sharing may realise in two ways (i.e., quantitative and qualitative). In quantitative terms, it reduces the cost of transporting empty containers. Table 12 shows the estimated benefits calculated based on empty container movement in Sri Lanka in 2012.

In addition to quantitative benefits explained above there are qualitative benefits as well. The outcome of the collaboration would improve the service quality through catering exporters' demands promptly and reliably. CSL play a very vital role in the supply chain between the manufacture and the consumer. The buyers place orders with respective exporters relying solely on the CSL of safely and timely delivery of cargo. In case the CSL finds a deficit in containers at the respective loading port the entire supply chain will be disturbed. Unfortunately, this is a common phenomena in certain regions. For example, some US exporters from time-to-time may experience capacity and equipment shortages (FMC, 2012).

CSL presently mitigate the impact of CI imbalance through internal controls. For example, some CSL (principals) penalise their regional offices or agents for any idle containers remain in their respective territories.

As a result the agents may compel to keep 'lean stocks' which are vulnerable to frequent shortages. Therefore, such controls are not healthy and effective as the company may frequently lose potential bookings due to shortages at a given location.

In addition to this CSL are now passing the part of additional cost incurred owing to having transport empty containers to the customer (i.e., shipper or consignee) as a container imbalance surcharge. The equipment imbalance surcharge is being implemented due to an increasingly severe equipment imbalance at Toronto container yards, leading to significantly higher empty repositioning costs (Maersk Line, 2013).

It is evident through some alliance agreements (FMC, 2012) CSL seem accepting that sharing of containers with fellow operators minimises cost associated with empty container repositioning. However, there is no industry practice at present for sharing containers by lines. The necessity for a true collaborative approach with respect to containers obviously demands under these circumstances.

The limitation of highlighting game theoretic analysis in this study is the absence of empty container handling data at shipping line level. A future research should be formulated to calculate the real benefit that could be achieved by forming coalition among shipping lines

8 Conclusions

The ship space and containers are decisive components in the container liner service whilst the CI imbalance is an industry specific phenomenon. According to the study conducted, nearly 90% of the shipping lines are affected by this situation. Effective and efficient management of CI is generally the responsibility of the respective agents of

CSL. However, keeping the right balance is rarely achieved by agents due to various reasons including those beyond the control of CSL or their agents.

The research establishes that the CSL can benefit from the program for collaboration. The respondents (except S2) of the survey have highly have endorsed the arguments contained in the proposal. CSL have formed alliances to share their resources including containers.

In principle, CSL show their willingness to collaborate with each other. It was noted that leading CSLs already have provisions in their contracts to interchange containers though it is not being practiced. Key reasons as to why they do not collaborate when there are associated benefits were revealed in here and which includes legal implications to carriers; container monitoring and tracking issues; indirect marketing advantages to competitors; and undue accountability on agents.

Nearly 60% of respondents agreed that sharing of containers with fellow operators could minimise the cost associated with empty container repositioning. However, those amongst CSL who had excess containers (S2) had a neutral position in this regard. This sentiment may be because of the marketing advantage the competitors get through such activity. Usually, agents could avoid penalties through vigilant action in consultation with CSL but if they lose customers to competition by making them 'strong' through having supplied containers to them, they will find it hard to correct. However, researchers argue of the prudence for S2 to reduce empty evacuating cost by offering excess containers and handling the marketing issues differently.

Substituting a 40-foot container with two 20-foot container is one possible solution according to 48% of respondents. However, 40% (S2) have negatively responded to this solution. It appears that CSL may be able to offer lower freight rates if CSL chose to interchange the containers. Interchanging containers may cause certain legal implications but the overall perception is that the expected financial benefits are greater than the cost of the negative impacts. It is inevitable that many changes may require in the present operating systems if container interchange mechanism is adopted. Therefore, the overall response endorses the fact of creating new administrative challenges in CSL that needs to be addressed subsequently. On the positive side, the respondents perceive a 'win-win' situation through collaboration; it will bring forth a saving to CSL; and it may be beneficial for the industry as a whole.

Leading CSL already has provisions in their contracts to interchange containers. However, the general perception among CSL is that, there could be CI monitoring issues associated with respect to interchanging of containers. In S4, those who are neither deficit nor excess perceive that container interchange is a temporary solution but the overall view is neutral to this aspect.

CSL do not collaborate as there is no such practice prevailing at present and thus if few leading lines take the initiative in sharing containers the rest may follow suit. The matrix of 'expected benefit' (Table 12) provides estimated savings of collaboration in Sri Lanka. This would create an interest among CSL to visualise the individual financial benefits that may supersede any disadvantages perceived by them. It is recommended that CSL carry out in depth analysis using the proposed 'matrixes of collaboration' (Figures 4 and 5) and work out the benefits available to them through sharing mechanism. Ultimately, it would attract CSL to exchange containers thus solve the problem of non-collaboration in container shipping.

Acknowledgements

The authors wish to express their gratitude to Professor J.A. Karunaratne (Director of Research CINEC Maritime Campus), Mr. Ralph Anandappa (eminent scholar in maritime studies) for their valuable inputs into the research and to several anonymous reviewers for their valuable suggestions on an earlier draft of this paper.

References

Acciaro, M. (2011) 'Pricing in sustainable global container transport', *International Journal of Decision Sciences, Risk and Management*, Vol. 3, Nos. 3/4, pp.293–310.

alphaliner.com (2014) *Alphaliner – TOP 100* [online] http://www.alphaliner.com/top100/ (accessed 7 March 2014).

Borade, A.B. and Bansod, S.V. (2012) 'Vendor managed inventory practices in Indian SMEs: select differences in manufacturing and service sector', *Int. J. of Logistics Systems and Management*, Vol. 11, No. 4, pp.450–472.

Brito, M.P.d. and Konings, R. (n.d.) *Container Management Strategies to Deal with the East-West Flows Imbalance* [online] http://www.fucam.ac.be/S%C3%A9minaires,%20conf%C3%A9rences%20et%20colloques/Nectar/images/debrito_konings.pdf (accessed 26 April 2013).

CASA Per. Review (2014) Circular to the members, No. 09/2014, 23 January 2013, Colombo.

Cheng,,. Y., Tan, J. and Lin, W-H. (2013) 'Allocating the cost of empty railcar miles in a dynamic railroad network', *International Journal of Shipping and Transport Logistics*, Vol. 5, No. 3, pp.350–366.

Chiadamrong, N. and Wajcharapornjinda, P. (2012) 'Developing an economic cost model for quantifying supply chain costs', *Int. J. of Logistics Systems and Management*, Vol. 13, No. 4, pp.540–571.

Diaz, A., Solis, L. and Claes, B. (2011) 'Improving logistics and supply chain management in Spain: an analysis of current practices and future requirements', *Int. J. of Logistics Systems and Management*, Vol. 9, No. 2, pp.150–169.

Dong, J-X., Xu, J. and Song, D-P. (2013) 'Assessment of empty container repositioning policies in maritime transport', *The International Journal of Logistics Management*, Vol. 24, No. 1, pp.49–72.

Edirisinghe, L. and Muller, S. (2014) *Converting Sri Lanka into a Commercial Hub in Asia: an Assessment of Postwar Progress with Insights to the Way Forward – A Case Study*, pp.486–492, General Sir John Kotalawala Defense University, Ratmalana.

Feng, C-M. and Chang, C-H. (2010) 'Optimal slot allocation with empty container reposition problem for Asia ocean carriers', *Int. J. of Shipping and Transport Logistics*, Vol. 2, No. 1, pp.22–43.

FMC (2012) *Study of the 2008 Repeal of the Liner Conference Exemption from European Union Competition Law*, Federal Maritime Commission, Washington, DC.

Francesco, M.D., Crainicc, T.G. and Zuddasa, P. (2009) 'The effect of multi-scenario policies on empty container repositioning', *Transportation Research Part E: Logistics and Transportation Review*, Vol. 45, No. 5, pp.758–770.

González-Torre, P., Sarkis, J. and Ade, B. (2013) 'Shipping agents and container management: an exploratory analysis of infrastructural and cost concerns', *International Journal of Shipping and Transport Logistics*, Vol. 5, No. 3, pp.322–349.

Gorane, S.J. and Kant, R. (2014) 'Supply chain practices: study and framework for future development', *Int. J. of Logistics Systems and Management*, Vol. 17, No. 1, pp.83–103.

Hawkins, D. and Little, B. (2011) 'Embedding collaboration through standards – part 2: the key aspects of BS 11000', *Industrial and Commercial Training*, Vol. 43, No. 4, pp.239–246.

Hughes, J. and Weiss, J. (2007) *Simple Rules for Making Alliances Work* [online] http://hbr.org/2007/11/simple-rules-for-making-alliances-work/ar/1 (accessed 11 April 2014).

ICSC (1972) *International Convention for Safe Containers* [online] http://www.imo.org/About/Conventions/ListOfConventions/Pages/ international-Convention-for-Safe-Containers-(CSC).aspx (accessed 18 June 2013).

IšoraItė, M. (2009) 'Importance of strategic alliances in company's activity', *Intellectual Economica*, Vol. 1, No. 5, pp.39–46.

Karmelic, J., Dundovic, Č. and Kolanovic, I. (2012) 'Empty container logistics', *Traffic & Transportation*, Vol. 24, No. 3, pp.223–230.

Kearns, M., Littman, M. and Singh, S. (2001) *Graphical Models for Game Theory*, pp.253—260, Morgan Kaufmann, San Francisco, CA.

Ker, S. (2011) *Greyslot* [online] http://www.ourwordourbond.net/ShippingNetwork/no-1-issue2/advertisers/greyslot.htm (accessed 2 May 2013).

Kumar, G. and Banerjee, R.N. (2012) 'Collaboration in supply chain An assessment of hierarchical model using partial least squares (PLS)', *International Journal of Productivity and Performance Management*, Vol. 61, No. 8, pp.897–918.

Lagoudis, I.N., Fragkos, S.N. and Litinas, N.A. (2010) 'Estimating optimum container and vessel fleet sizes in a cyclic liner service using a holistic approach', *Int. J. of Shipping and Transport Logistics*, Vol. 2, No. 1, pp.4–21.

Lai, K-h., Chen, T.D. and Lun, Y.V. (2010) *Shipping and Logistics Management*, in s.l., Springer, London, Dordrecht, Heidelberg, New York.

Lauritzen, G.D., Salomo, S. and Cour, A.L. (2013) 'Dynamic boundaries of user communities: exploiting synergies rather than managing dilemmas', *Int. J. of Technology Management*, Vol. 63, Nos. 3/4, pp.148–168.

Long, Y., Lee, L.H. and Chew, E.P. (2012) 'The sample average approximation method for empty container repositioning with uncertainties', *European Journal of Operational Research*, Vol. 222, No. 1, pp.65–75.

Lun, Y.V. and Browne, M. (2009) 'Fleet mix in container shipping operations', *Int. J. of Shipping and Transport Logistics*, Vol. 1, No. 2, pp.103–118.

Maersk Line (2013) *Maersk Line* [online] https://www.maerskline.com/link/?page=brochure&path=/our_services/adv2010/1003/transpacific&utm_source=surcharges&utm_medium=email_sc&utm_campaign=weekly_highlight1003 (accessed 1 June 2013).

Mason, R. and Nair, R. (2013) 'Supply-side strategic flexibility capabilities in container liner shipping', *The International Journal of Logistics Management*, Vol. 24, No. 1, pp.22–48.

Moon, I., Ngoc, A-D.D. and Konings, R. (2013) 'Foldable and standard containers in empty container repositioning', *Transportation Research Part E*, Vol. 49, No. 1, pp.107–124.

Olavarrieta, S. and Ellinger, A.E. (1997) 'Resource-based theory and strategic logistics research', *International Journal of Physical Distribution & Logistics Management*, Vol. 27, Nos. 9/10, pp.559–587.

Ratnayake, J. and Wijeratne, A.W. (2012) 'Second container port in Sri lanka: Hambantota or Trincomalee: an analysis using the game theory', *Int. J. Logistics Systems and Management*, Vol. 13, No. 3, pp.358–378.

Ritala, P. (2009) 'Is coopetition different from cooperation? The impact of market rivalry on value creation in alliances', *International Journal of Intellectual Property Management*, Vol. 3, No. 1, pp.39–55.

Rodrigue, J-P. (2013) *The Repositioning of Empty Containers* [online] http://people.hofstra.edu/geotrans/eng/ch5en/appl5en/ch5a3en.html (accessed 1 June 2013).

Romano, J., Kromney, R., Coraggio, J. and Skowronek, J. (2006) *Appropriate Statistics for Ordinal Level Data: Should we really be using t-test and Cohen's d for Evaluating Group Differences on the NSSE and other Surveys?*, Florida Association of Institutional Research, Cocoa Beach, Florida.

Ross, A.D., Jayaraman, V., Rodrigues, A. and Mollenkopf, D.A. (2010) 'Repositioning of reusable containers in a sustainable global supply chain environment', *International Journal of Mathematics in Operational Research*, Vol. 2, No. 2, pp.178–204.

Scholz-Reiter, B. et al. (2011) 'A comparison of mathematical modelling approaches for stability analysis of supply chains', *Int. J. of Logistics Systems and Management*, Vol. 10, No. 2, pp.208–223.

Solesvik, M.Z. and Encheva, S. (2010) 'Partner selection for interfirm collaboration in ship design', *Industrial Management & Data Systems*, Vol. 110, No. 5, pp.701–717.

Song, D-P. and Carter, J. (2009) 'Empty container repositioning in liner shipping1', *Maritime Policy & Management: The Flagship Journal of International Shipping and Port Research*, Vol. 36, No. 4, pp.291–307.

Song, D-P. and Dong, J-X. (2011) 'Effectiveness of an empty container repositioning policy with flexible destination ports', *Transport Policy*, Vol. 18, No. 1, pp.92–101.

UNCTAD (2011) *Review of Maritime Transport*, United Nations Conference on Trade and Development, New York and Geneva.

UNESCAP (2007) *Regional Shipping and Port Development* [online] http://www.unescap.org/sites/default/files/pub_2484_CH2.pdf (accessed 20 May 2013).

United Nations (1998) *Concentration in Liner Shipping – Its Causes and Impacts for Ports and Shipping Services in Developing Regions* [online] http://www.eclac.cl/publicaciones/xml/5/5175/LC_G.2027.pdf (accessed 2 March 2013).

Wu, M-Y., Weng, Y-C. and Huang, I-C. (2012) 'A study of supply chain partnerships based on the commitment-trust theory', *Asia Pacific Journal of Marketing and Logistics*, Vol. 24, No. 4, pp.690–707.

Zhihong, J. and Qi, X. (2012) 'The realization of decision support system for cross-border transportation based on the multidimensional database', *Journal of Software*, Vol. 7, No. 5, pp.974–981.

Zhou, L., Xu, X. and Deng, S. (2011) 'A multi-objective programming approach for designing complicated logistics network', *Int. J. of Logistics Systems and Management*, Vol. 9, No. 4, pp.419–437.

Notes

1 Cellular fleet – the fleet of container vessels.

2 Twenty equivalent units (i.e., one 20' = I TEU; one 40' = 2 TEUs).

3 Transport charge applied in the shipping industry.

4 The 'product' component in container shipping comprises 'ship space' and 'containers'.

5 Containers.

6 Container loaded with cargo.

7 The 'product' component in container shipping comprises 'ship space' and 'containers'.

8 Rotterdam rules = United Nations Convention on Contracts for the International Carriage of Goods Wholly or Partly by Sea.

9 Each year, about 2 to 2.5 million TEUs worth of containers are manufactured, the great majority of them in China, taking advantage of its containerised export surplus (Rodrigue, 2013).

10 There are container leasing companies who supply containers on lease.

11 Exporters, importers, consumers, traders and other logistics players in the cargo supply chain.

12 Containers today account for about 60% of reefer cargo, and new container ships increasingly include large reefer capacities.

13 Empty containers are exported to and imported from many ports from/to Colombo depending on various operational and situational requirements of the CSL. Singapore and Nhavashiva is considered to be major ports for Sri Lanka with respect to empty container exports and imports.

14 Ocean Shipping Reform Act of 1998.

15 Container carrier consortia comprising Cosco Line, Kline, YangMing Line, and Hanjin Line.

16 Container carrier consortia comprising Hapag-Lloyd, NYK Line, Orient Overseas Container Line, APL, Hyundai Merchant Marine and MOL.

17 According to FMC (2012), the Grand Alliance II (NYK, OOCL, HL); APL/HLAG Space Charter Agreement; CMA CGM/MSC Reciprocal Space Charter, Sailing and Cooperative Working Agreement; HMM/MOL Space Charter Agreement; CMA CGM/CSCL Cross Space Charter, Sailing And CWA-Central China/US West Coast, Yang Tse/AAC2 Service agreements include, inter alia, 'equipment interchange'.

18 CSL = Ceylon Shipping Corporation; OOCL = Orient Overseas Container Line.

19 GP; OT; FR; FB; RF.

20 SOC – shipper owned containers.

21 Rotterdam rules = United Nations Convention on Contracts for the International Carriage of Goods Wholly or Partly by Sea.

22 Country specific 'political; economical; social; technological; environmental; legal' factors.