The Global Impact of Container Inventory Imbalance and the Factors that Influence Container Inventory Management Strategies

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Abstract

Container shipping celebrates its 60th anniversary in 2016, as an innovation that had a tremendous impact on the global supply chain. This paper focuses on the impact of container inventory imbalance that mounts a substantial pressure on global supply chains. The primary objective of this paper is to explore best market practices and ascertain as to what factors influence these strategies. It also evaluates the impact of container inventory imbalance to the global supply chain. The study refers to interviews with industry experts and questionnaire responses from shipping lines operated in Sri Lanka in addition to the desk research to explain the impact of the container inventory problem in the global scale. If carriers provide the right quantity of containers demanded by exporters at the right location at the right time, the optimum supply chain performance could be guaranteed. The consequences of container fleet imbalances are ultimately borne by exporters, importers, consumers, traders and even—inadvertently—other players in the cargo supply chain of international trade. Therefore, carriers need an effective solution to the global container inventory imbalance problem.

Keywords: Container Inventory Imbalance, Freight, Forecasting, Flexibility, Strategy

INTRODUCTION

Global supply chain and Containerization

The container help reduce the global supply chain cost; however, the management of container inventory has become a serious concern with its gradual increase in volume over the past decades. Worldwide, empty containers account for approximately 20% of container flows at sea. Container inventory imbalances can primarily be attributed to global trade imbalances. Therefore, the core issue in the industry is the identification of the best method to minimize the idle time of containers, thus optimizing their utilization that will reduce supply chain cost substantially. Shipping is a business that grew up with the world economy ,exploring and exploiting the ebb and flow of trade (Stopford, 2009). Cross-border transportation is an engine to promote the foreign trade (Zhihong & Qi, 2012). The system, that proved its potential as an increasingly efficient and swift method of transport, led to greatly reduced transport costs, and supported a vast increase in international trade. It is needless to mention that the carrier actions, and their reactions to various market conditions particularly the demand for shipping have direct impact to supply chains. Some serious and recurring issues produce a degree of uncertainty which impact supply chain processes. Global container inventory imbalance is one of such problems that is part and partial of container shipping. This problem therefore needs closer look due to the ever increasing volumes of container shipping business.

A considerable amount of investments have been made in purchasing containers and vessels and building port infrastructures. (Dong, et al., 2013) Container ports provide the primary interface where physical exchange between buyers and sellers of containerized shipping capacity can be consolidated and realized (Yapa & Nottebooma, 2011). Containers are usually supplied to exporters for stuffing of cargo at respective ports by the agents of carriers (Some exporters have their own container fleet for private use and this study does not consider their practices). The containers have a useful life of about 12 to 15 years (Rodrigue, 2013) and the standard 20 foot container costs about $2,000 to manufacture while 40 footer costs about $3,000. Therefore, a twenty foot container costs $1.71 per cubic feet to manufacture while a forty foot container costs $0.80, which underlines the preference for larger volumes as a more effective usage of assets (Rodrigue, 2013). However, according to Alderton, (2004) the life expectancy of a container depends on many factors, but it is approximately 8 years and it frequently needed repairs and maintenance. Technically, containers are governed by the ISO (the International Standards Organization) and the CSC (the Container Safety Convention). In 1968, the ISO defined a container as an 'article of transport equipment'(Alderton, 2004).

Efficient and effective management of empty containers (Song & Carter, 2009) and empty container repositioning is an important issue (Dong, et al., 2013) in the liner[1] shipping industry. The growing imbalance of containers globally creates a substantial additional expenses as well as environmental issues. The consequences of the container fleet imbalance are ultimately borne by Exporters, Importers, Consumers, Traders and even other players in the cargo supply chain of international trade inadvertently. Leading carriers have already implemented Container Imbalance Surcharge adding a direct cost to the consumer. Maersk Line, (2013) advised their customers that the Equipment Imbalance Surcharge was implemented due to an increasingly severe equipment imbalance at Toronto container yards, leading to significantly higher empty repositioning costs. Therefore finding a solution to mitigate such impact would benefit primary shippers, consignees and shipping lines and then countries, regions and whole world at macro level

There are no commonly accepted standard container inventory management (CIM) strategies adopted by carriers. The respective container controllers of carriers take CIM decisions based on their individual skills and competencies in managing the inventories. This is a serious concern for the industry because the industry hardly gets any learning curve advantage through the current CIM practices. Therefore, a problem exists at present as to what factors that influence the CIM strategies adopted by carriers.

This paper briefly evaluates the impact of container inventory imbalance to the global supply chain and reveals various CIM strategies adopted by carriers. Thereafter, it identifies the factors that influence the each CIM strategy that the carriers usually adopt under different market scenarios and as to what extent they are significant in CIM.

[1] A liner service is a fleet of ships, with a common ownership or management, which provide a fixed service, at regular intervals, between named ports, and offer transport to any goods in the catchment area served by those ports and ready for transit by their sailing dates (Stopford, 2009).

The findings may help practitioners to review their present practices and analyse the CIM problem in a boarder context. It helps them to gain the due learning curve advantage over the current practices to the industry as a whole that leads to effective and efficient CIM. An effective container inventory management system will optimize container inventory utilization and reduce the cost of empty container repositioning thereby enhances the effectiveness and efficiency of the global container supply chain.

LITERATURE REVIEW

Global Container Movement

One of the most striking developments in the global economy since World War II has been the tremendous growth in international trade (Bernhofen, et al., 2013). Once countries get embedded in the global supply chains they feel part of something much bigger than their own business (Friedman, 2005). By means of water-carriage more extensive market is opened to every sort of industry than what land-carriage alone can afford it (Smith, 1776). About 90% of world trade is carried by the international shipping industry (I.C.S., 2013). Water transportation systems provides low speed and relatively low accessibility, but extremly high capacities (Banks, 2004). Containerisation which changed everything was the brainchild of Malcom McLean, an American trucking magnate (The Economist, 2013). McLean understood that reducing the cost of shipping goods required not just a metal box but an entire new way of handling freight (Marc, 2006). Containerization which is believed to have developed after World War II has made a significant change globally in the system of freight transport. The first deep-sea container service was introduced in 1966 and in the next 20 years containers came to dominate the transport of general cargo, with shipments of over 50 million units per year (Stopford, 2009). Container inventory imbalance is a complex phenomena as it involves different sizes such as 20’, 40’, and 45’ in sizes. Similarly, it comes in different types such as Standard, Open top, Flat rack, Reefer, Flat bed. The export and import markets are usually volatile and hard to predict accurately thus it is very difficult to maintain a balanced stock at a given location. Therefore, CSL may respond to the phenomena differently based on the container stock at a specific location at a given time.

Containers are not 'one time investment'. Alderton (2004) suggests that one of those years will be spent out of services for repairs.

Demand for container shipping services is derived from demand for container trade (Lai, et al., 2010). In other wards demand for containers is derived from the demand for movements of cargo by exporters and importers. Supplying of empty containers to exporters is an essential part of the chain in container shipping. The import and export volume is not equal with each other in the foreign trade of the world countries, so empty container repositioning problem is caused by trade imbalanced exactly because of the different economic needs in different regions (YUR & Esmer, 2011). As cited in Lai, et al., (2010) Demend for sea transport is derived from demand for goods to be transported (Jansson and Schneerson 1987). Container handling within the chain may be completed in numerous ways including the use of shipping agents (González-Torre, et al., 2013). As the demand for products increases so the demand for transport facilities will increase (Cole, 2006). The shipping market regulates shipping supply and demand. (Lai, et al., 2010). The worldwide demand for a container was about 15% that was higher than supply situation (Mhonyai, et al., 2013). Olivo et.al., (2005) consider that in a perfect world, empty movements would not exist because there would always be cargo to fill every container when and where it was emptied. (YUR & Esmer, 2011). Due to global trade imbalance, shipping companies tend to accumulate empty containers in import-dominant regions where they are not needed, whereas export-dominants face a shortage of this equipment. (Di Francesco, 2007).

As far as the supply side is concerned the owners of containers are primarily ocean carriers and leasing companies. The supply chain focus in today's marketplace is increasingly important (Kiessling & C¸omez, 2012). Supplying of MTYs to exporters is an essential link of the chain in container shipping. 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[2] units will be exported as laden containers).

[2] Container loaded with cargo

The container supply sources

There are three main sources of container inventory. (1) The laden container imports; (2) Empty container imports (or manufactured[3] newly in the same port); and (3) Leased[4] containers. 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 most economical and efficient way is to reuse the containers that were arrived to the port with cargo (laden) from another port. The other option is to on hire containers from container leasing[5] companies. Otherwise the carriers may send empty containers from a nearby port in order to cater to the exporters' requirement if time permit. MTY reuse is a strategy in which carriers try to match local export cargo with available containers (Lai, et al., 2010). If this is not possible the carrier may send empty containers from a nearby port in order to cater to the exporters' requirement if time permit. Third option is to on hire containers from container leasing[6] companies. In the case of a shortage of containers in certain areas , carriers may sign master leasing contracts with leasing companies allowing shippers to pick up MTYs at areas they desire (Lai, et al., 2010)

The life expectancy of a container depends on many factors, but it is approximately 8 years and it frequently needed repairs and maintenance. Alderton (2004) suggests that one of those years will be spent out of services for repairs. There are other components in the container cost structure in which container imbalance contributes significantly.

Table1: Container costs

Container costs	Percentage share of total costs
Capital	32
Repair and refurbishment	25
Imbalance	22
Clearing and maintance	11
Insurance	10

[3] 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 containerized export surplus. (Rodrigue, 2013)
[4] There are container leasing companies who supply containers on lease
[5] Those who engage in leasing marine cargo containers to vessel operators and other organizations on a broad international basis
[6] Those who engage in leasing marine cargo containers to vessel operators and other organizations on a broad international basis

Source: (Alderton, 2004)

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[7] by CSL.

The increased attention by the researchers in the recent past shows the ever increasing impact of container imbalance to the world. For example only 14 publications were evident during 1972-2005 (33 years) compared to 50 publications during 2006-2011 (5 years) as revealed by YUR & Esmer (2011). Although the issue of empty container repositioning first attracted attention in the mid 90's, interest in this problem seems to have grown even further in the last five years. Considering the last five years as the pre- and post-global crisis period, the repositioning issue has gained even greater importance as various problems have been encountered in supplying empty containers. The literature review has revealed that 62 of the studies since 1972 have dealt with repositioning empty containers. 31 of such studies have appeared in journals, 22 of them seem to have published in conference proceedings, but the sources of 7 of them have not been reached.

In the modelling oriented analyses of the 62 studies published in various journals and conference and/or congress proceedings, two distinct methods approaches have been adopted. The studies analyzed have been categorized either as mathematical modelling or heuristic products. 50 of those studies analyzing the problem through mathematical modelling seem to have used such modelling techniques as numerical experiments, mathematical programming, genetic algorithms, regression analysis, simulation, integer programming, dynamic programming, statistics, linear programming, optimization programming, game theory and deterministic modelling. In the 12 heuristic studies, the methods used have been case study and literature review, and 1 of such studies seems to have preferred to use reverse logistics theory (YUR & Esmer, 2011).

[7] Transport charge applied in the shipping industry

The research papers referred in YUR & Esmer, (2011) has been further analysed in order to ascertain the core issue that has been focused in those studies and summarised under five catagories. It is noted that majority of work is been done with respect to Empty Container Repositioning. This study, in contrast, focuses on minimizing of Empty Container Repositioning. It attempts to avoid as much as possible the necessity of repositioning. Only 9 papers were written on Empty Container Allocation while 05 on Empty Container Distribution. 12 papers have covered various aspects of Empty Container Management which is somewhat relevant to this study. There are 4 researches done on Empty Container Reuse which reflects the similar approach of this study because the researcher accept the fact that it is rather unrealistic to totally eliminate the imbalance therefore “reuse” will directly reduce the need for repositioning. There is only one paper concerning Foldable Containers referred in YUR & Esmer, (2011) which again represent a way of reducing the cost of repositioning but not reducing the need for trepositioning. Before 2009 most researchers only fixed their attention on the slot allocation for empty containers, often called empty container relocation problem. As cited in Qu, et al., (2013) Crainic et al. have raised two dynamic deterministic formulations to deal with the single and multi-commodity cases; for empty container relocation they also put forward an ordinary model. Cheung and Chen adopted a two-stage stochastic network model to optimize the empty container relocation problem and ascertained the minimum quantity of leased containers. Feng and Chang] used a two-stage model considering both inventory management and the nature of the shipping network to deal with the empty container relocation problem.

Empty container management model (Lun & Quaddus, 2009) consists of four key elements namely, Strategic planning; procurement of empty containers; movement of empty containers; and technical efficiency. Therefore, a comprehensive assessment on operating policies in Maritime Transport with respect to Container Utility would be vital in finding a solution to container imbalance problem in Sri Lanka. Also the results of this research may be relevant and important to any other country as well. The outcome of the study could also be extended for further research (Song & Carter, 2009). The research of (Dang, Nielsen, & Yun, 2013) focuses on the problem of positioning empty containers in a port area with multiple depots. Three options are considered: positioning from other overseas ports, inland positioning between depots and leasing. According to YUR & Esmer, (2011) the aims of the studies which are used mathematical programming to solve empty container repositioning problem, minimize the total empty container repositioning costs and produce a optimistic estimation of empty container movements. But, because of dynamic and uncertain environment, it cannot eliminate the empty repositioning problem exactly and reveal a more imbalanced world trade and container shipping will have to face the challenges of empty repositioning. On the other hand, some authors prefer foldable containers solution to solve an empty container repositioning problem. According to these authors the foldable containers can contribute to substantial cost savings in empty container repositioning between the seaport and its hinterland (Konings & Thijs, 2001) and transhipment and storage costs. It was noted from the review of literature that previous studies predominantly contain various mechanisms to optimize the repositioning activity but not to reduce the number of container that needs to be repositioned. Researcher views this as a reactive approach rather than a proactive one. Therefore, there is a necessarily for more studies with the objective of reducing the number of empty containers that frequently pile up in various ports.

METHODOLOGY

The researchers are confident that results could be generalized for the benefit of global shipping communality given the maritime background in Sri Lanka. Seventeen out of top twenty CSL in the world operate regular services in the busiest commercial port in the country, Colombo; this is primarily due to the country's strategic geographic location. Approximately 75 percent of global container capacity is operated (alphaliner.com, 2014) by the said carriers. Therefore, the sample is expected to be fairly reflective to the general view of the global shipping industry. The research approach has been three facets namely, desk research, interviews, and questionnaire survey. The study was conducted in Sri Lanka with the intention of generalizing its outcome in the global context.

Interviews with industry experts

This is the key source of identifying the CIM strategies that are practiced by carriers. Since CSL have no standard practices or commonly known strategies for CIM the only way to find out those is the depth interviews with those who closely involved in the container supply chain. The interviews were conducted using five senior representatives (comprising administration, marketing, and container control and vessel operations departments) of CSL. However, in reality it was the responses from nearly 30 different views because each of the five respondents obtained at least six of their staff members of colleagues in the industry. The interviews were conducted during nearly one month period as a series of meetings took place with each respondent. Therefore, the researchers are confident about the comprehensiveness of data obtained. The responses were tabulated and the questions for the survey have been developed based on these information.

Questionnaire survey

Apart from the basic demographics of respondents the questionnaire consisted of 12 questions each concerning the factors that are expected to be influencing the CIM strategies (FIS) of carriers. Since the questions are not based on the literature a pilot survey has been carried out. Appropriate adjustments to the questions were made based on the results of the pilot survey.

RESULTS AND DISCUSSIONS

Desk research

There are two asymmetries evidenced in the global containers imbalance. Firstly, the asymmetry between domestic import containerized cargo movement and that of exports is the fundamental reason for the container imbalance of a given location. Reconciling the availability of containers in a distribution system where imports and exports logistics are very different is thus problematic, with an enduring problem to find available maritime containers inland. (Rodrigue, 2013). For example the external trade data of Sri lanka reveals approximately 65 percent of import crago volumes and 35 percent of export cargo in containers. This has resulted that the port of Colombo is usually floded with containers. Secondly, it should be noted that the type of containers also contributes to the final outcome and the imbalance problem. Following data represents the defference between the types of containers required by the exporters against that of imports in to Sri Lanka.

Table 2: Asymmetry of Inbound and Outbound container flows in Sri Lanka according to Container types

2013	% of 20GP	% of 40GP	% of 40HC	% of 45
Exports	47.75	15.47	35.51	01.28
Imports	64.06	07.77	28.03	0.14
Variation	+16.31	-07.70	-07.48	-01,14

(Source: unpublished industry data)

Key: (+) = Excess inventory; (-) = Deficit inventory

With respect to Sri Lanka, majority of imports (in containers) are 20’s while the exports are predominantly stuffed in 40’s. This factor is obvious when analyzing 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 major export movements in Sri Lanka attract 40 footers than 20’s simply because they are volume cargo. Major commodities such as Garments and Tea need more capacity in volumes than weight larger container sizes, notably the "40 footer". Larger sizes confer economies of scale in loading, handling and unloading, which are preferred for long distance shipping as well as by customers shipping large batches of containerized commodities. (Rodrigue, 2013)

Based on the results of interviews it concluded that six strategies are being extensively used by carriers in the container inventory management. These container inventory management strategies include Freight Drop Import; Freight Drop Export; Service Agreements; Budget Synchronize; Inventory Agile; and Priority export.

Table3: Descriptive Statistics of CIM Strategies

Strategy	Minimum	Maximum	Mean	Std. Deviation
Freight Drop Import	0	4	2.51	1.088
Freight Drop Export	0	5	2.74	1.289
SVC Agreements	0	5	2.67	1.199
BGT Synchronize	-2	5	2.49	1.332
Inventory Agile	-3	3	2.19	1.562
Priority export	-2	3	1.36	1.595

The questionnaire survey considers the factors that influence the above mentioned container inventory management strategies.

Regression analyses on twelve questions have been carried out to determine the significance of these factors to the various practices. Based on that analysis, only ten of the factors were found to be significant.

Table 4: The factors that may influence carriers CIMS

No.	Factors that are potentially influencing the CIM strategies (FIS)
Q1	The strength of retaining customers irrespective of non availability of containers (Cost of Customers)
Q2	Impact on brand name due to inconsistency of container availability (Impact on Brand)
Q3	The threat caused by container shortage to the sustainability of service (Threat on Service)
Q4	The degree of confidence to perform budgeted exports/imports (Loss of Revenue)
Q5	Comfort on freight (Slot cost) incurred on empty repositioning (Empty Slot Cost)
Q6	Port handing cost incurred on empty repositioning (Empty Port Handling)
Q7	High rent involved at Container Freight Stations (CFS) or port for storage of containers (Cost of Rent)
Q8	Comfort on empty container handling cost at CFS (Cost of Yard)
Q9	The degree of possibility of achieving ROI-return on investment of containers belong to the shipping line
Q10	Comfort on repair and painting cost due to rust etc as a result of long storage (Ware and Tare cost)
Q11	The container idle time at a named location (Minimum Idle Time)
Q12	Vessel under utilization in certain ports due to non availability of containers (Vessel underutilization)

Initially the correlation analysis was performed and found the correlations are significant in following combinations. Freight Drop Import is found statistically significant with the loss of Revenue; cost of Yard; and the vessel underutilization. This signifies that the degree of confidence to perform budgeted exports/imports by carriers; the comfort on empty container handling cost at CFS; and the vessel under utilization in certain ports due to non availability of containers has an impact on freight drop import. Freight Drop Export is influenced by the strength of retaining customers irrespective of non availability of containers; impact on brand name due to inconsistency of container availability; and the threat caused by container shortage to the sustainability of service. In other words, the variable Freight Drop is found statistically significant with cost of customers; impact on Brand; and the threat on service. SVC Agreements is statistically significant with the threat caused by container shortage to the sustainability of service. **BGT Synchronize and the i**mpact on brand name due to inconsistency of container availability are significantly correlated. Similarly the Vessel underutilization is correlated. The **v**essel under utilization in certain ports due to non availability of containers is common occurrence with many lines. The variable, inventory agile does not show statistically significant correlation with any of the independent variables. This obviously means that there is no impact to the CIM stagey from the status of inventory. i.e. whether to have lean inventory or agile inventory is not a matter. **Priority export** show a statistically significant correlation with the port handing cost incurred on empty repositioning. This means that cost of carriers' empty port handling makes an impact on the respective carrier giving priority for exports. Thereafter, the researchers carried out the regression analysis with using the stepwise command to identify the major factors which are highly effective on separate CIM strategies.

Reduce Freight rates for Imports into the deficit locations (Freight Drop- Import):

Table 5 shows the regression results between Freight Drop Import (dependent variable) and COC, COY, ESC, ARI, COR, MIT, LOR, EPH (independent variables). The F statistic is significant at 0.000 (<0.05) for all variables in the table. The relationship between the two variables of each case is negative.

Table5: Regression Analysis of Freight Drop Import

Regression equation FRTdropI =	Predictor	Coefficient	Standard error	T	P	F	P
5.63 - 1.32 Q1	constant	5.63	0.218	25.78	<0.001	222.43	<0.001
	Q1	-1.32	0.088	-14.91	<0.001		
3.07 - 0.694 Q8	constant	3.07	0.086	35.92	<0.001	151.85	<0.001
	Q8	-0.69	0.056	-12.32	<0.001		
4.67 - 0.844 Q5	constant	4.67	0.222	21.03	<0.001	108.70	<0.001
	Q5	-0.84	0.081	-10.43	<0.001		
5.08 - 1.02 Q9	constant	5.08	0.342	14.86	<0.001	61.04	<0.001

	Q9	-1.02	0.130	-7.81	<0.001		
5.11 - 1.05 Q7	constant	5.11	0.399	12.84	<0.001	45.48	<0.001
	Q7	-1.05	0.156	-6.74	<0.001		
3.80 - 0.528 Q11	constant	3.80	0.288	13.21	<0.001	23.45	<0.001
	Q11	-0.53	0.109	-4.84	<0.001		
6.13 - 1.11 Q4	constant	6.13	0.802	7.64	<0.001	20.74	<0.001
	Q4	-1.11	0.244	-4.55	<0.001		
5.08 - 0.987 Q6	constant	5.08	0.622	8.17	<0.001	17.61	<0.001
	Q6	-0.99	0.235	-4.20	<0.001		

Accordingly, Freight Drop -Import and the carriers' strength of retaining customers (despite non availability of containers) are inversely related. In other words the more the strength that carrier has to retain customers irrespective of the marketing disadvantages of container shortage, the lesser it will be interested in reducing freight for imports to the port in question. The similar approach with respect to the Carrier's ability to negotiate a lower empty container handling cost at CFS (Cost of Yard); and freight (Slot cost) for empty repositioning (Empty Slot Cost) could be seen in above analysis. Other variables that the F statistic is significant at 0.000 (<0.05) namely, The degree of possibility of achieving ROI-return on investment of containers belong to the shipping line; Comfort on rent involved at CFS or port for storage of containers (Cost of Rent); The strength to maximise the utilization of containers through minimizing idle time; The degree of confidence to perform budgeted exports/imports (Loss of Revenue); and Comfort on port handing cost incurred on empty repositioning (Empty Port Handling) explain a negative relationship. And in this case these five predictors show negative relationship with the carriers' CIM strategy of reducing freight for imports to the port in question. When the degree of possibility of achieving ROI of containers is lower the carriers tend to apply more freight reductions on imports to the respective location. Similarly, when the rent involved at CFS or port for storage of containers (Cost of Rent) is lower, they will offer more freight reductions for imports. According to the above analysis, if the container idle time of a carrier at a given port is lower, it attracts more 'freight drop' mechanisms on imports to that port. When the degree of confidence of carriers to perform budgeted exports/imports (Loss of Revenue) is lower and that leads to more freight reduction activities on imports. Last but not least, when the port handing cost incurred for empty repositioning (Empty Port Handling) is lower, it would increase the occurrence of freight drop actions for imports to the respective location by the carriers.

Reduce Freight rates for Exports from the excess locations (Freight Drop- Export):

Similar to the previous strategy, carriers also strategically reduce freight rates for their exports originated from a particular port in order to control the container inventory imbalance. This is considered as more of a reactive approach because it is usually implemented when the port accumulates empty containers due to some unexpected changes in the market. It was noted that except for the Q 3 The strength of sustainability of service (Threat on Service) all other predictors that were found significant.

According the table 6 the regression results are statistically significant. It shows the regression results between Freight Drop- Export and COC, COY, ESC, ARI, COR, MIT, LOR, EPH, TOS. The F statistic is significant at $P < 0.001$ for all variables in the table. The relationship between the two variables of all cases are negative (except Q3 which is positively related) and significant at $P < 0.001$

Table.6 Regression Analysis of Freight Drop-Export

Regression equation FRTdropE =	Predictor	Coefficient	Standard error	T	P	F	P
6.16 - 1.45 Q1	constant	6.16	0.311	19.79	<0.001	123.14	<0.001
	Q1	-1.45	0.126	-11.50	<0.001		
3.32 - 0.727 Q8	constant	3.32	0.123	26.96	<0.001	80.23	<0.001
	Q8	-0.73	0.081	-8.96	<0.001		
4.96 - 0.870 Q5	constant	4.96	0.309	16.06	<0.001	59.73	<0.001
	Q5	-0.87	0.113	-7.73	<0.001		
5.40 - 1.05 Q9	constant	5.40	0.445	12.15	<0.001	38.85	<0.001
	Q9	-1.05	0.170	-6.23	<0.001		
5.46 - 1.10 Q7	constant	5.46	0.504	10.84	<0.001	31.27	<0.001
	Q7	-1.10	0.197	-5.59	<0.001		
6.98 - 1.31 Q4	constant	6.98	0.954	7.32	<0.001	20.23	<0.001
	Q4	-1.31	0.290	-4.50	<0.001		

4.02 - 0.526 Q11	constant	4.02	0.357	11.25	<0.001	15.12	<0.001
	Q11	-0.53	0.135	-3.89	<0.001		
5.53 - 1.08 Q6	constant	5.53	0.75	7.37	<0.001	14.36	<0.001
	Q6	-1.08	0.284	-3.79	<0.001		
- 2.67 + 1.41 Q3	constant	-2.67	1.510	-1.77	<0.001	12.94	0.001
	Q3	1.41	0.391	3.60	<0.001		

Long term Service Agreements with Customers (SVC Agreements):

Table 7 illustrates the regression results between Service Agreement strategy and LOR, COY, ARI, LOR, COR, ESC, WTC, EPH, MIT. The model shows lower R^2 for those predictors however the F statistic is significant at <0.05 for all variables in the table. The relationship between the strategy (dependent variable) and predictor (independent variables) of each case is statistically significant at <0.05 and positive related. The carriers' ability to negotiate more beneficial terms with stakeholders mentioned above such as port, CFS will tend to attract more long term service contacts with customers.

Table 7 Regression Analysis of SVC Agreements

Regression equation SVCagr =	Predictor	Coefficient	Standard error	T	P	F	P
- 1.76 + 1.49 Q1	constant	-1.76	0.875	-2.02	0.047	17.62	<0.001
	Q4	1.49	0.355	4.20	<0.001		
1.12 + 0.784 Q8	constant	1.12	0.302	3.70	<0.001	15.54	<0.001
	Q8	0.78	0.199	3.94	<0.001		
- 1.08 + 1.12 Q9	constant	-1.08	0.963	-1.12	<0.001	9.36	0.003
	Q9	1.12	0.366	3.06	<0.001		
- 3.81 + 1.71 Q4	constant	-3.81	1.886	-2.02	0.047	8.85	0.004
	Q4	1.71	0.575	2.98	0.004		
- 1.18 + 1.19 Q7	constant	-1.18	1.061	-1.11	0.269	8.15	<0.001
	Q7	1.19	0.415	2.86	0.006		
- 0.030 + 0.697 Q5	constant	-0.30	0.743	-0.04	0.968	6.61	<0.001
	Q5	0.70	0.271	2.57	0.012		
- 2.55 + 1.43 Q10	constant	-2.55	1.700	-1.50	0.138	6.57	0.013
	Q10	1.43	0.557	2.56	<0.001		
- 1.66 + 1.31 Q6	constant	-1.66	1.467	-1.13	0.261	5.60	0.021
	Q6	1.31	0.555	2.37	0.021		
0.248 + 0.618 Q11	constant	0.25	0.701	0.35	0.725	5.40	0.023
	Q11	0.62	0.266	2.32	<0.001		

Synchronize the Annual Budget with Monthly import/export Forecast (BGT Synchronize):

As explained elsewhere before, shipping forecasts are directly related to the global trading patterns. Carriers are used to work very closely with their agents in every port/location to derive the most realistic forecast on long, medium and short term basis. When the annual budget of each agent is synchronized with these forecasts agents are heavily and consistently accountable to perform with no or least variation from each other. Some carriers expect their agents to maintain 90-95 % consistency between the annual budget and the cumulative export/import monthly forecasts. The regression results between Budget synchronization strategy and COC, ESC, EPH, ARI, COR, MIT are tabulated in table8.

Table 8: Regression Analysis of (BGT Synchronize)

Regression equation bdgt syncro =	Predictor	Coefficient	Standard error	T	P	F	P
- 2.60 + 1.73 Q1	constant	-2.60	0.830	-3.13	0.003	26.44	<0.001
	Q1	1.47	0.372	3.95	<0.001		
- 4.23 + 1.76 Q4	constant	-4.23	1.870	-2.26	0.027	9.52	0.003
	Q4	1.76	0.570	3.09	0.003		
- 0.884 + 0.927 Q5	constant	-0.89	0.712	-1.24	0.219	12.77	0.001
	Q5	0.92	0.260	3.57	0.001		
- 1.53 + 1.16 Q6	constant	-1.53	1.473	-1.04	0.303	4.33	0.041
	Q6	1.16	0.556	2.08	0.041		
- 1.81 + 1.31 Q9	constant	-1.81	0.935	-1.94	0.056	13.49	<0.001
	Q9	1.31	0.355	3.67	<0.001		
- 1.94 + 1.38 Q7	constant	-1.94	1.033	-1.88	0.065	11.74	0.001
	Q7	1.39	0.404	3.43	0.001		
0.772 + 0.887 Q8	constant	0.77	0.291	2.65	0.010	21.46	<0.001
	Q11	0.89	0.191	4.63	<0.001		

Maintaining agile Container Inventory Irrespective of Cost (Inventory Agile):

The liner shipping industry faces a huge competition between carriers. Therefore, container carriers are usually very careful about the customer care. Shipping is a derived demand of international trading thus volatile in nature. Therefore, carriers always try to maintain agile container inventory levels considering the volatile nature of demand for shipping. It was noted that except for the Q 3 (the strength of sustainability of service) all other predictors in the 9 are inversely related.

The regression results between Inventory Agile and COC, COY, ARI, ESC, COR, MIT, LOR, EPH are tabulated in the table. The F statistic is significant at 0.000 for all variables (except 0.006 for Q 6) in the table. The relationship between the two variables of all cases are negative (except Q3 which is positively related) and significant at 0.000 (<0.05).

Table 9: Regression Analysis of Inventory Agile

Regression equation INVTagile =	Predictor	Coefficient	Standard error	T	P	F	P
6.50 - 1.92 Q1	constant	6.50	0.399	16.31	<0.001	140.86	0.000
	Q1	-1.92	0.162	-11.87	<0.001		
2.82 - 1.05 Q8	constant	2.82	0.139	20.26	<0.001	131.57	<0.001
	Q8	-1.05	0.092	-11.47	<0.001		
6.23 - 1.69 Q9	constant	6.23	0.495	12.58	<0.001	80.09	<0.001
	Q9	-1.69	0.188	-8.95	<0.001		
5.03 - 1.20 Q5	constant	5.03	0.386	13.05	<0.001	72.54	<0.001
	Q5	-1.20	0.141	-8.52	<0.001		
6.27 - 1.74 Q7	constant	6.27	0.589	10.94	<0.001	56.84	<0.001
	Q7	-1.74	0.231	-7.54	<0.001		
7.95 - 1.84 Q4	constant	7.95	1.219	6.52	<0.001	24.53	<0.001
	Q4	-1.84	0.371	-4.95	<0.001		
3.81 - 0.755 Q11	constant	3.81	0.457	8.34	<0.001	19.02	<0.001
	Q11	-.0.76	0.173	-4.36	<0.001		
- 5.33 + 1.90 Q3	constant	-5.33	1.963	-2.72	<0.001	13.97	<0.001
	Q3	1.90	0.508	3.74	<0.001		
4.79 - 1.09 Q6	constant	4.79	1.023	4.69	<0.001	7.87	0.006
	Q6	-1.09	0.387	-2.81	<0.001		

The regression results between Inventory Agile and COC, COY, ARI, ESC, COR, MIT, LOR, EPH are tabulated below. The F statistic is significant at P < 0.001 for all variables in the table. The relationship between the two variables of all cases is negative (except Q3 which is positively related)

The threat caused by container shortage to the sustainability of service (Threat on Service) and the Inventory Agile strategy shows statistically significant (P= 000) positive relationship. In other words, when there are greater threats to carriers in terms of service sustainability, it will tend to hold highly agile inventory thus provide uninterrupted service to customers. In the meantime, other variables namely, high rent involved at Container Freight Stations (CFS) or port for storage of containers (Cost of Rent); the degree of confidence to perform budgeted exports/imports (Loss of Revenue); the container idle time at a named location (MIT) and the carriers ability negotiate effective port handing cost incurred on empty repositioning (Empty Port Handling) have statistically significant inverse relationships with the strategy of agile inventory.

Give Priority for Exports irrespective of any associated Cost (Priority Export):

The F statistic is significant at 0.000 to 0.043 (<0.05) for all variables in the table. The relationship between the two variables of each case is negative and significant at 0.000 (<0.05). According to the 10 the regression results are statistically significant.

Table 10: Regression Analysis of Priority Export

Regression equation PRTexp =	Predictor	Coefficient	Standard error	T	P	F	P
- 0.393 + 0.884 Q8	constant	-0.39	0.366	-1.07	0.286	13.48	<0.001
	Q8	0.88	0.241	3.67	<0.001		
- 3.74 + 1.64 Q7	constant	-3.74	1.244	-3.00	0.004	11.36	0.001
	Q7	1.64	0.487	3.37	<0.001		
- 3.34 + 1.45 Q9	constant	-3.34	1.139	-2.93	<0.001	11.14	0.001
	Q9	1.45	0.433	3.34	<0.001		
- 3.08 + 1.44 Q1	constant	-3.08	1.091	-2.82	<0.001	10.58	0.002
	Q1	1.44	0.443	3.25	<0.001		
11.3 - 2.84 Q3	constant	11.25	3.391	3.32	0.001	10.49	0.002
	Q3	-2.84	0.878	10.49	<0.001		
- 2.18 + 0.978 Q5	constant	-2.18	0.873	-2.50	<0.001	9.45	0.003
	Q5	0.98	0.318	3.07	0.003		
- 1.29 + 0.662 Q11	constant	-1.29	0.846	-1.53	0.132	4.27	0.043
	Q11	0.66	0.321	2.07	0.043		

In this strategy carriers tend to give priority for exports originated from a particular port and take all operational decisions pertaining to containers in order to facilitate those efforts. It was noted that when the idle time of containers at a given port is high the carriers tend to give higher priorities for exports from that location.

Conclusions

Ninety six percent of respondents consider CII as a serious issue but only 58% have a standard CIM policy. Moreover, only 42% of carrier representatives are satisfied with the existing CIM policy. These basic statistics give a clear indication that container shipping lines needs to develop a proper CIM system to bridge the industry gap. Apart from the direct cost of empty container repositions it also increases the carbon footprint through excessive transport. If carriers prioritise this as a pressing issue and reduce the ever increasing cost of empty reposition through effective and efficient CIM system, it will bring immense benefit to respective carriers initially and then to the domestic market and finally to the global shipping community. It subsequently help reduce environmental hazard due to empty container logistics issues. Shipping is a derived demand of international trading; therefore these benefits will ultimately help reduce the consumer prices of the world. Thus, carriers have a social responsibility towards reducing the empty container reposition through an effective CIM system.

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