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EMPTY CONTAINER LOGISTICS

ABSTRACT

Within the whole world container traffic, the largest share of containers is in the status of repositioning. Container repositioning results from the need for harmonization between the point of empty container accumulation and the point of demand, and waiting time for the availability of the first next transport of cargo. This status of containers on the container market is the consequence of imbalances in the worldwide trade distribution on most important shipping routes. The need for fast and effective reallocation of empty containers causes high costs and often represents an obstacle affecting the efficiency of port container terminals and inland carriers.

In accordance with the above issue, this paper is mainly focused on the analysis of the data concerning global container capacities and the roots of container equipment imbalances, with the aim of determining the importance of empty container management and the need for empty container micro-logistic planning at the spread port area.

KEY WORDS

empty containers, logistics, imbalance, repositioning

1. INTRODUCTION

As containers are spotted onboard different means of transport (ship, train, lorry, river barge) or in any port or inland terminal, they may be either full (transporting goods either in import or export or in transit), or empty.

The global full container trade reached 130.9 million of TEU in 2008, with the port turnover (including handling of full, empty, and containers in transit) of 522.1 million of TEU in the same year [1].

According to various sources, as many as 2.5 million of TEU are being stored empty in different container terminals worldwide at any moment, and 20.5% of the world total port turnover refers to empty container handling [2].

The fundamental reason behind the accumulation of empty containers at terminals is seen in the imbalanced overseas trade between individual markets, or in the prevalently import-oriented economy of some, and prevalently export-oriented economy of other markets.

Even in highly developed countries, where import and export trades stand side by side, empty containers are being accumulated as well, due to imbalanced imports and exports by the container type. For instance, containers mostly used in the import of prevalently final products are the 40` standard and *high cube* containers, whereas in the export of raw and semi-raw materials the 20` standard containers are used most frequently.

In situations of the overall imbalance of trade and imbalance by the container type, in addition to seasonal imbalances of trade between particular markets, we are faced with the 'surplus' or empty container equipment accumulation on one side or with 'shortage' or excessive demand for empty containers on the other.

Costs of empty container repositioning include the inland transport charges, terminal dues (storage and handling charges) and carriage by sea to the market/port where empty containers required for export cargoes are in short supply.

According to an investigation carried out by the "International Asset System", more than 50% of container total life span a container spends empty or "waiting" for the availability of cargo for transport, or being repositioned to the point of demand [3].

According to estimates, empty container repositioning costs alone accounted for USD 20 billion on the global level in 2002 [4].

Considering these costs, including the need for empty containers to be repositioned from the point of "container surplus" to the point of "container shortage" in the fastest and most cost-effective manner, and also that accumulation of empty containers is

becoming an obstacle for efficient operation of port container terminals and ties up valuable port and urban property, logistics of empty containers is becoming a very demanding and complex problem, and for this reason, the search for the best models that would enable reduction in logistical costs and in empty container accumulation has been going on at the level of owners/operators, leasing companies, port authorities, terminal operators, and town administrations.

Logistics of empty containers has been seldom the topic of investigation in scientific and technical literature. This study has been based on a true example experienced by a container shipping company and maritime agent as well as author's direct experience.

The major contribution of this paper concerns the empty container logistics systematic analysis from the shipping company's point of view and identification of the world containerization structural problems attributable to trade imbalances (exports and imports) in all the world markets. Participants involved in the empty container management are herewith defined, repositioning levels are explained, and the empty container micro-logistics in the spread port area is analyzed.

2. ANALYSIS OF GLOBAL CONTAINER CAPACITIES

Table 1 presents a breakdown of container equipment position in January 2010. The total container equipment available was 27,085,000 TEU, out of which 41% owned by leasing companies, and 59% by owners/liner container service operators. The top 10 leasing companies have concentrated 88% of the total container capacity owned by the leasing companies.

Owners/operators and leasing companies have opposing interests. The operators are, namely, taking advantage of container equipment leasing flexibility by entering leasing arrangements in respect of empty containers available on the markets (ports and inland depots) with great demand for, i.e. shortage of containers, which are returned empty after usage on the markets with empty container surplus or reduced demand.

Container leasing arrangements fall into three major categories:

- voyage lease,
- medium-term lease,
- long-term lease (5 - 8 years).

The quantitative distribution of containers by the type shows that 40` containers participate with as much as 57% in the total number of containers, which can be easily understood since containers are being mostly used for the transport of final products which are light in weight but occupy more space, 20` containers account for 27%, and the remaining 16% refer to reefer containers and other special equipment [5].

Table 1 - A breakdown of container equipment owned by leasing companies (as of January 2010) in 000

Leasing company	Share %	Container capacity
Textainer	20	2,245
Florens	14	1,580
Triton Container	13	1,435
TAL International	9	1,010
GESaCo	8	905
CAI	7	740
Cronos	6	645
Gold Container	4	485
Seacastle	4	420
Dong Fang International	3	350
UES International	2	250
Beacon International	1	155
Blue Sky International	1	96
CARU	1	92
Waterfront	1	65
Others	4	492
Leasing companies total	100	10,965
Owners/operators total	-	16,120
Leasing companies + owners/operators altogether	-	27,085

Source: *www.dynamar, DynaLiners, 22/2010 according to World Cargo News*

Table 2 gives a breakdown of the global container fleet: the number of container vessels has been broken down by the size and by the pertaining container capacities. It is indicative of containerization that out of the total vessels' capacity of 13.5 million TEU, as much as 52% refers to charter arrangements entered by owners/liner container service operators, and the remaining portion to their own vessel capacities.

Table 3 brings a breakdown of vessel's container capacities for the top 10 owners/operators. Vessels' capacities also show a concentration insofar as the top 10 owners/operators are holders of 62% of the world's total container capacity. The breakdown shows how many capacity units are owned by owners/operators and how many are chartered.

Out of the world's total container vessel capacity of 13.56 million TEU, Maersk holds 14.6%, the Mediterranean Shipping Company 11.8%, CMA CGM 7.9%, APL 4.2%, and Evergreen 40%, and so on.

3. CONTAINERIZATION AND SEABORNE TRADE IMBALANCES

Imbalances in the containerized seaborne trade are best manifested in several examples involving important shipping routes. Table 4 shows a quantitative

Table 2 - A breakdown of the global container fleet as of 01.06.2010

Vessels' capacity TEU	Total		of which chartered		
	Vessels	TEU	Vessels	TEU	% Chartered
10000-15500	44	530,530	3	39,520	7.4
7500-9999	254	2,174,900	93	789,293	36.3
5100-7499	417	2,535,124	184	1,121,927	44.3
4000-5099	649	2,932,453	355	1,591,872	54.3
3000-3999	312	1,062,665	163	557,437	52.5
2000-2999	718	1,821,396	533	1,356,583	74.5
1500-1999	575	973,988	385	652,908	67.0
1000-1499	700	826,389	440	519,008	62.8
500-999	827	608,468	543	405,428	66.6
100-499	292	95,460	87	29,600	31.0
TOTAL	4,788	13,561,373	2,786	7,063,576	52.1

Source: Alphaliner, http://www1.axsmarine.com/liner2/research_files/liner_studies/nofleet/BRS-FleetMthly.pdf

Table 3 - A breakdown of vessel's container capacities for the top 10 owners/operators as of 05.06.2010

Ord. No.	Owner/ Operator	Total		Owned		Chartered		
		TEU	Vessels	TEU	Vessels	TEU	Vessels	% chartered
1	APM-Maersk	2,065,405	550	1,119,757	207	945,648	343	45.8
2	Mediterranean Shg Co	1,666,513	423	858,591	202	807,922	221	48.5
3	CMA CGM Group	1,119,100	390	343,351	85	775,749	305	69.3
4	APL	594,694	147	170,373	45	424,321	102	71.4
5	Evergreen Line	568,955	158	332,352	90	236,603	68	41.6
6	Hapag-Lloyd	544,361	123	292,613	60	251,748	63	46.2
7	CSAV Group	498,559	136	41,410	8	457,149	128	91.7
8	COSCO Container L.	496,090	132	276,339	88	219,751	44	44.3
9	Hanjin Shipping	448,051	98	104,068	19	343,983	79	76.8
10	CSCL	440,236	122	250,099	71	190,137	51	43.2

Source: Alphaliner, <http://www.alphaliner.com/top100/index.php>

difference between imports and exports on three important shipping routes.

An analysis of import and export traffic on a dozen of the most important maritime routes (East - West, North - South) leads to the conclusion that there is no such market where imports and exports are well balanced, but it is only the level of imbalance that could be questioned or the degree to which exports are levelled up with imports. It is the very issue of "unlevelled exports and imports" that generates repositioning and pertaining costs.

4. EMPTY CONTAINER LOGISTICS ON OPERATORS' SIDE

In consideration of the fact that seaborne trade imbalances and container equipment imbalances represent chronic and structural problems within global container transports, the empty container logistics and management represent a challenge for numerous

Table 4 - Full container traffic on different shipping routes in TEU, 2009

Far East – the Mediterranean/Europe	
Far East – the Mediterranean/Europe	11,494,000
The Mediterranean/Europe – Far East	5,458,000
TEU imbalance	6,038,000
Imbalance %	53%
Transatlantic	
Europe - North America	3,152,000
North America - Europe	1,872,000
TEU imbalance	1,280,000
Imbalance %	40%
Transpacific	
Far East - North America	12,070,000
North America – Far East	4,510,000
TEU imbalance	7,560,000
Imbalance %	63%

Source: DynaLiners Trades Review, Dynamar, Noorderkade, 2010, pp. 14 and 27

subjects participating in the process of containerization. However, owing to the fact that owners/operators are becoming owners of ever increasing container capacities, terminal operators and inland transport and logistic operators, as well as empty container managers, owners/operators have been growing to become a dominant factor.

The major tasks within the scope of a container liner shipping company logistics department may be divided into several categories:

- container equipment follow-up (follow-up of any movement of each particular container at any terminal and depot worldwide and keeping entries in the company IS up-to-date),
- container maintenance and repair,
- container leasing and return,
- purchase of new container equipment,
- empty container equipment repositioning,
- entering agreements with carriers, depots, and container repair shops.

In order to optimize their empty container logistics, owners/operators must consider the following factors:

- in determining a liner service, trade imbalances between particular markets should be taken into account, commercial interest and the desired market share should be determined, and the respective vessel share participation should be allocated either within their own liner service or within a joint service/consortium with partners,
- in determining container capacities, the type of container equipment should be taken account of (20', 40' ST, 40' HC, open top containers, reefer containers...) as to adequately meet the requirements of dominant goods on particular markets / regions covered by the liner container service,
- in determining container capacities, the ratio between the number of their own containers and those to be leased should be considered,
- once the decision on the number and type of containers to be leased has been made, the optimal leasing arrangement category should be selected (voyage, short-term, long-term),

- find out whether new containers are available for purchase on the markets covered by the liner service,
- following the "surplus" containers market analysis (imports exceeding exports) and the "shortage" containers market analysis (exports exceeding imports), the optimal repositioning routes and levels should be determined, special empty container repositioning tariffs should be agreed with carriers, as well as special empty container storage tariffs with container terminals and depots.

In carrying out a particular market analysis, it is particularly important for the seaborne trade on particular markets/line routes to be determined, as well as whether there will be only one, more than one, or worldwide liner services operated by the owner/operator. In the situation, namely, involving a single liner service being operated on a particular market by the owner/operator, their operation is affected by the specific quality (trade imbalance) attaching exclusively to that line. Where more liner services or global liner services are being operated by the owner/operator with the entire world markets included, their operation is affected by the intermingling specific qualities of different liner routes, their synergic effects, and much improved empty container management optimization.

The duties involving empty container equipment logistics and management within the frame of modern liner container operation cannot be separated from commercial ones. The decisions, namely, concerning the required container equipment quantity and repositioning issues must be made in synergy with commercial departments.

An analysis of statistical data presented in *Table 5* referring to container traffic between Europe and different regions of the world covered by liner container services offers several facts of essential importance:

- total import and export imbalance (in Europe) amounts to 4,320,406 TEU,
- import and export imbalance varies from one particular market to another,
- the routes Europe - Asia and Europe - Central and South America feature import and export imbalance.

Table 5 - Container traffic between Europe and 7 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	1,026,767	736,689	290,078
Europe - Centr. 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>

ances, with imports exceeding exports, whereby container equipment imbalances or empty container “surpluses” are generated,

- the routes Europe – North America, Europe – Sub-Saharan Africa, Europe – ISC/Middle East, and Europe – Australia and Oceania feature the opposite situation, i.e. exports exceeding imports, whereby container equipment “shortages” are generated on those routes.

In cases where a particular operator operates liner service exclusively between Europe and Asia, specific qualities of trade imbalance being present only on that route and equipment imbalance affect the decision-making in respect to any important business issues toward container equipment management optimization in that liner service only. However, provided yet another liner service being operated by the same operator, let's say between Europe and North America, the container equipment “surplus” present on the route to Asia would be utilized on the container equipment “shortage” market on the route for North America at the local repositioning level, and without any regional or overseas repositioning being involved, containers would be leased or new containers would be purchased from manufacturers present on that market.

An analysis by the container type on the two liner routes, to be followed by a seasonal import and export analysis, would provide a lot of precise indicators, whereby the issue of empty container logistics would grow more complex and would require wide knowledge, experience and management skills.

5. PARTICIPANTS IN EMPTY CONTAINER LOGISTICS

In order to understand the empty container logistic dynamics, it is necessary to understand the roles played by different legal entities participating in empty container management.

Empty container accumulation at terminals represents a serious problem for various subjects, each of them taking part in a certain way in empty container logistics and management, such as:

- owners / liner container service operators,
- terminal operators,
- inland and river operators,
- leasing companies,
- local public authorities,
- exporters / importers.

It is immanent for operators who are either owners or lease users of container equipment to strive for as high container turnover rate as possible, in consideration of the fact that container lease charges or their own container depreciation rates incur in any case, and thus an empty container will only generate expenditures and will not make any income (freight rate). Re-

gardless of the repositioning form, and notably where regional and overseas repositioning is involved, empty container repositioning with respective terminal handling and storage fees represents pure expenditure.

For terminal operators, empty container traffic means lower income, since empty container handling fees are usually lower than those for full container handling. So, despite the fee being applied for empty containers and terminal handlings, empty container traffic, and in particular occupation of valuable terminal space, result unacceptable, and the outcome is the development of empty container satellite inland depots, outside ports, yet the concept's terminal result is a more expensive terminal service, and thus, any port / terminal operator being short of adequate terminal space to accommodate large quantities of empty containers falls out of competitiveness.

For inland carriers (railway operators) and inland navigation operators, empty container traffic means lower income, in consideration of empty container carriage lower tariff rates.

Where leasing companies are involved, container equipment “surplus” on particular markets also represents a problem, having in mind that in case of the “surplus” containers being returned by their users in compliance with the agreement, it will be upon the leasing company to arrange on its own account for their repositioning on markets where empty containers are in demand.

For local public authorities (town administration), empty container traffic is regarded as a problem affecting urban traffic congestion (where empty containers are being returned to the port after unstuffing, later to be carried empty to the stuffing point, urban traffic is doubly affected), environment pollution and noise generating source, in addition to occupying valuable property / satellite port depots next to the port.

Owing to imbalanced trade and imbalanced utilisation of containers by the type and size, the operators are compelled in making their freight rate quotations to take repositioning / logistic charges into account as well. Thus, a significant portion of the problem created by empty container accumulation is being redirected at importers' and exporters' expense and ultimately at consumers' expense.

6. MOVEMENT FLOWS AND EMPTY CONTAINER LOGISTICS

Empty container management is an integral part of the global transport system. Once a full container has been unloaded from the vessel within the import cycle, the question is, in dependence on the party with whom the customer had contracted the “door” on-carriage, by whom the inland transport to the container unstuffing point will be performed. In the case where

multimodal transport of goods has been agreed upon by the customer and the vessel operator (so called "Carrier Haulage"), the operator is obliged to carry out the inland transport to the point of final destination. Where the carriage has been agreed "to the port /container terminal", the customer and/or the consignee has the option to choose the inland transport operator for the inland transport to be performed from the port to the final destination (so called Merchant Haulage).

In either case, the point for empty containers to be returned to must be defined by the operator or their logistic service beforehand.

Scheme 1 displays possible empty container movement flows.

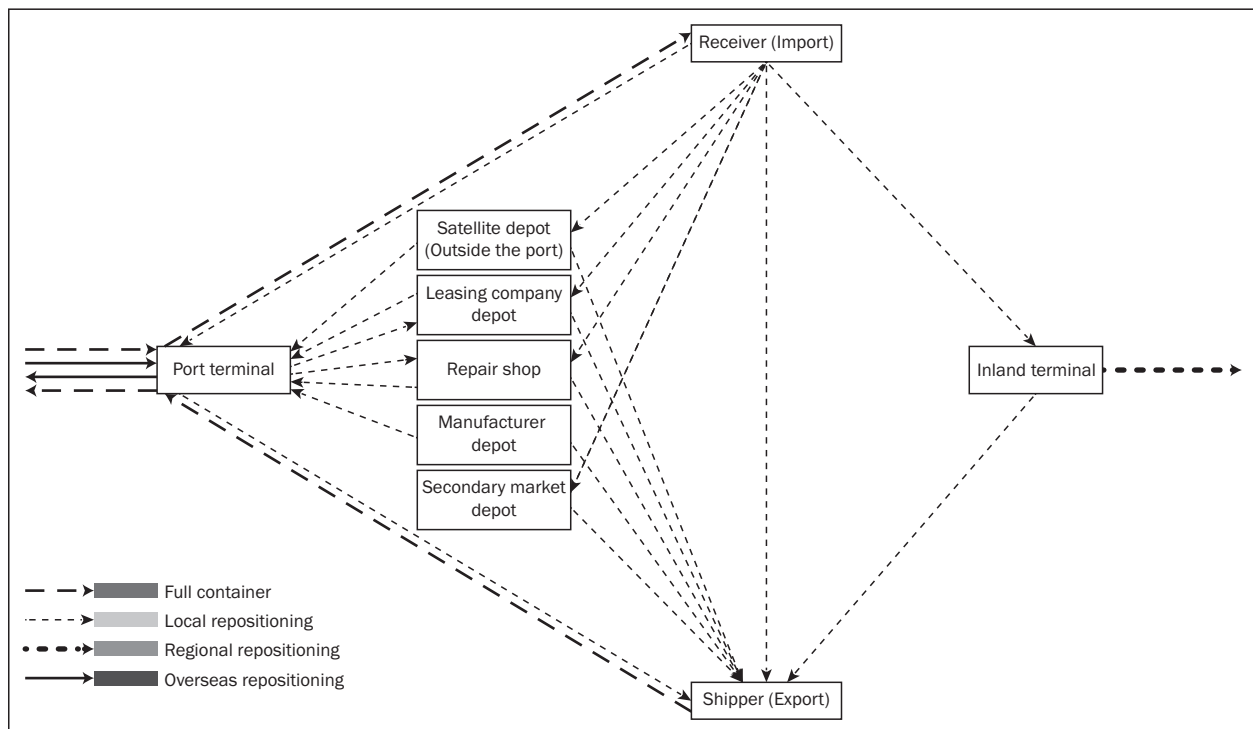
Once a container has been stripped, there are different possibilities at disposal for the empty container optimal point of return to be determined:

- where the container has not left the port/container terminal because unstuffing was performed at the port warehouse upon consignee's request, the empty container will be repositioned to the empty container stacking area within the container terminal,
- where transport to the final inland destination is being performed either by the owner/operator or by the transport operator designated by the customer or by the consignee, and the container has been unstuffed, empty container may be:
 - returned to the port container terminal, provided empty container space availability,
 - returned to the port empty container satellite depot, outside the port area, provided empty contain-

er space availability within the designated port/terminal,

- left on the transport means (from import) on account of the export cycle or stuffing of the same box having been agreed (triangulation),
- returned to the leasing company depot on account of the subject container return having been agreed in the leasing arrangement,
- left at the specified inland container terminal, in order for the empty container to be positioned "closer" to the next container user in the export cycle, or for groups of empty containers to be further repositioned to the closest regional market short of empty containers required for the export leg,
- left at consignee's industrial depot, to be used by the same user in the next export cycle,
- left at the designated river container terminal for further repositioning by inland waterways,
- left at the container buyer's depot for the secondary market (civil engineering companies, container repair shops, individual buyers, and the like), where it has been decided for old containers' repair not to be profitable any more,
- left at the container terminal or depot agreed upon for container equipment interchange with another operator,
- left at the container repair shop depot, where container repair has been agreed upon.

Empty container repositioning, i.e. shifting and carriage from the empty container "surplus" point or empty container accumulation point to the empty con-



Scheme 1 - Empty container movement flows

tainer "shortage" point, may be carried out at three different geographical levels:

- Local repositioning; repositioning within a region. For instance, an empty container having arrived to Rijeka from import is being transported empty to Zagreb for stuffing in export;
- Regional repositioning; repositioning between nearby regions where one is with container "surplus" or imports exceeding exports, and the other with container "shortage" or exports exceeding imports. For instance, empty containers from Rijeka are being repositioned either by rail to Austria or by sea to Italian ports.
- Overseas repositioning; empty container repositioning by maritime liner container services from ports with container equipment "surplus" (imports exceeding exports) to overseas markets with container equipment "shortage" (exports exceeding imports). For instance, empty container carriage by sea from Rijeka to Chinese ports.

In quite opposite situations, where a particular market is experiencing container equipment shortage (or exports exceeding imports), the operators have the following options:

- container equipment import repositioning from markets/ports with empty container surpluses, both at the regional and overseas level,
- container equipment leasing from leasing companies,
- purchase of new containers from container equipment manufacturers,
- container equipment interchange with other operators (where there are other operators in the area with empty container equipment "surplus" at the moment).

It is upon the operators' logistic departments to make decisions regarding repositioning strategies, with the above factors and their variability taken into consideration, and to follow up any market developments in order to be able to make optimal decisions in the given circumstances, always in close cooperation with the commercial department strictly updated on bookings through business contacts with potential shippers.

7. CONCLUSION

Owing to imbalances affecting seaborne trade worldwide, as well as the fact that some markets are experiencing more empty containers being unloaded in import than loaded in export, the outcome is thus generated container equipment surplus. In the opposite case, where full container exports on a particular market exceed imports, the outcome is container equipment shortage. This problem has been identified as a structural and chronic problem affecting contain-

erisation at the global level, accounting for container owners/operators losses measured in billions of USD on a yearly level.

The study outcomes point to the fact that the logistics of empty containers represents a complex system with a large number of subjects involved (owners/operators, leasing companies, port authorities, terminal operators, and local public authorities). Empty container management from the micro-logistics of a port area to the repositioning at various geographical regions has been aimed at finding out best logistic solutions and logistic cost reduction to the minimum. Where modern container lines are concerned, the logistics of empty containers has been based on team cooperation between logistics and commercial departments and it represents an integral part of the global transport system. On the owners' side, the logistics of empty containers is seen as a series of activities from the container equipment movement follow-up, maintenance and repair, container hire in and hire out, and purchase of new equipment to empty container repositioning activities. Where the empty container logistics optimization is concerned, issues like trade imbalances on certain markets, container capacities required by the type, the ratio between the owned and leased-in containers, as well as the tariff negotiations with inland carriers, terminals, depots, and container repair shops should be taken into consideration.

This study represents the basis for further targeted research such as container equipment stock optimization in the wider port area (port terminal, satellite port depot, land terminal...), precise savings calculations based on the logistics optimization carried out, owners' precise financial indices calculations depending on leased-in container equipment, and the like.

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SAŽETAK

LOGISTIKA PRAZNIH KONTEJNERA

U cjelokupnom svjetskom kontejnerskom prometu, najveći udio kontejnera nalazi se u statusu repositioniranja. Repozicioniranje kontejnera je posljedica potrebe za usklađivanjem određenog broja akumuliranih praznih kontejnera i mjesta na kojem postoji potražnja za istim, te čekanja na daljnju potražnju za prijevozom kontejneriziranog tereta. Ovakav status kontejnera na tržištu posljedica je neujednačene prekomorske robne razmjene na

najznačajnijim pomorskim pravcima. Potreba za brзом i učinkovitom preraspodjelom praznih kontejnera, uzrokuje velike troškove, a nerijetko utječe i na ekonomičnost rada lučkih kontejnerskih terminala i kopnenih prijevoznika.

U skladu s navedenom problematikom, u radu se analiziraju podaci o svjetskom kapacitetu kontejnera te razlozi nastajanja imbalansa kontejnerske opreme sa svrhom utvrđivanja važnosti upravljanja praznim kontejnerima i potrebi mikrologističkog planiranja praznih kontejnera na širem lučkom području.

KLJUČNE RIJEČI

prazni kontejneri, logistika, imbalans, repozicioniranje

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