A Survey of Empty Container Flow Balance in Turkish Ports

Türk Limanlarındaki Boş Konteyner Akış Dengesinin Araştırılması

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ABSTRACT

Container transportation is the most preferred maritime commercial freight distribution in entire world except liquefied product transportation by tankers and bulk carriers. Totally 95% volume of general cargo is transported by container ships in the world due to fast, cheap and safe carrying potential of the goods transfer. Containerization has become recent phenomena in the field of maritime transportation and the quantity of goods transported by containers is increasing day by day as well as the total container number to use for the commercial activity. Due to very high mobility in the field of container transportation, port traffic estimation, availability of containers, storage, deposition and allocation of empty containers have become recent problems in maritime transportation area. In this study some major container ports of Turkey which are stand for 80 % of total container operations are analyzed to seek for empty container balance. After detailed statistical evaluation of national container transportation figures for Haydarpaşa, Kumport, İzmir, Mardaş, Marport and Mersin, several interviews and discussions have been made with port authorities and governing departments. As a result, it is observed that there is no empty container accumulation problem in the examined ports except Haydarpaşa and Kumport. Based on general statistics, Turkish container ports currently do not suffer from empty container problem as overall container circulation close to equilibrium but the problem has a potential to create a risk on developing international trade of Turkey.

Keywords: Empty container, repositioning, container ports, Turkey

ÖZET

Konteyner taşımacılığı günümüz denizciliğinde sıvı yükler dışındaki yüklerde en fazla tercih edilen taşıma türüdür. Dünyada ki genel kargo yüklerinin % 95'i güvenilir, ucuz ve bir defada çok miktarda yük taşınabilmesi nedeniyle konteynerlerle taşınmakta olup, denizyolu ile gerçekleştirilen uluslararası ticaret hacmi, her geçen gün süratle artmaktadır. Dünyada kullanılan konteyner ağlarındaki hareketlilik yoğunlaştıkça, hem limanlardaki trafiğin tahmin edilmesi, hem de konteynerlerin temin edilmesi, depolanması ve sevk edilmesi, boş konteynerlerin yeniden konumlandırılması ve yönetilmesi büyük bir sorun haline gelmeye başlamıştır. Ticari faaliyetlerdeki dengesizlikler boş konteyner yönetiminin temel nedenini oluşturmaktadır. Bu dengesizlik sonucu kimi zaman liman veya depolarda konteyner yığınları oluşurken, kimi zaman da istenen yerde ve zamanda konteyner bulunamamaktadır. Durum yönetsel problem olarak ele alındığında maliyet ve teslimatta başlayan problemler, firma itibarını ve pazar durumunu etkileyen boyutlara kadar ulaşabilmektedir. Bu noktadan yola çıkılarak ülkemizin konteyner ticaret hacminin yaklaşık olarak % 80'ini oluşturan Gemport, Haydarpaşa, İzmir, Kumport, Mardaş, Marport ve Mersin limanlarının konteyner giriş ve çıkış istatiksel verileri değerlendirilmiştir. Liman otorite ve yetkilileri ile konuyla ilgili olarak görüşme ve mülakatlar yapılmıştır. Yapılan çalışmanın sonucunda incelenen limanlardan Haydarpaşa ve Kumport limanları dışındaki limanlarımızda boş konteyner yığılmasının yaşanmadığı görülmüştür. Genel olarak ülkemiz konteyner limanlarında boş konteyner sorununun yaşanmadığı fakat gelecekte yaşanması muhtemel bir risk olarak değerlendirilmesi gerektiği sonucuna ulaşılmıştır.

Anahtar Kelimeler: Boş konteyner, yeniden konumlandırma, konteyner limanları, Türkiye.

1. Introduction

Container usage for maritime transportation activities has led to open a new era in the field of logistics. Containers can be easily carried; handled and stored furthermore they perfectly suit for intermodal transportation. Containerization is the fastest and biggest developing sector in maritime commerce. It is estimated that by 2015 the overall trade will increase with 6.6 % and reach to 177.6 million TEU (Boile, 2006). Increasing container based transportation has led to a dramatic increase in total container number available for the maritime activities. Therefore, total container mobility, port traffic and providing of containers have become challenging problems (Theofanis and Boile, 2009). International trade imbalance is main reason for empty container problem. Due to ineffective empty container management strategies, container accumulations occur in some major importing ports. On the contrary, there are some acute container deficit tied to time and space in some international exporting ports (Breakers, 2012). Considering that the situation is a management problem, the problems started in costs and deliveries can reach to the dimensions influencing the firms' prestige and market situation (Crainic, 2002). In case of the absence of containers in desired place and time and desired quality, either high cost containers from alternative canals are tried to be provided or the route is to be changed and

the alternative centers are to be researched. Both of the situations resulted in disadvantages in the way of cost and time (Hanh, 2003).

Various statistics show that the number of the international containers were 16 million TEU in 2001, 18,8 million TEU in 2004 and 21 million TEU in 2005. It has been known that this number is above 25 million TEU in the year 2010 (Boile, 2006). Increasing container numbers influence the port performances badly in the most ports around the world especially in storage, shipment, replacement of the empty containers, and serious restriction of the port operation lands (Rodrigue, 2012).

The main purpose of this study is to determine the empty container accumulations in Turkish major ports by researching the empty container numbers. This study is mainly based on the assumption of accumulation of empty container as a result of imbalanced trade, filling of the storage lands, the transportation of empty containers from surplus regions to the demanding regions and negative influences of port performance and economy. It has been tried to come out the possible potential ventures in future and available situation in the port by counting the average container accumulation rate and by evaluating the container import and export statistics.

1.1. The Concept of Empty Container

Containers start to wait for their parcels to carry and the ports of call after the shipment operation. This wait sometimes takes for a few weeks and sometimes for months because repositioning of a container for a return leg can cost higher than storing it in a definite area. The concept of empty container subject occurs at this point. In order to keep international trade and service alive produced commodities need to be transferred from one point to another by taking cost minimization in to account. Re-shipment of an empty container could be more expensive than buying or leasing a new container (Instutute of Shipping Economics and Logistics, 2006). Therefore countries with production surplus determine overall container budget globally available as container manufacturers have to produce containers for companies to make the production cheaper. As a result the number of empty containers waiting in the ports increases (Figure 1) (Lam et al., 2007).
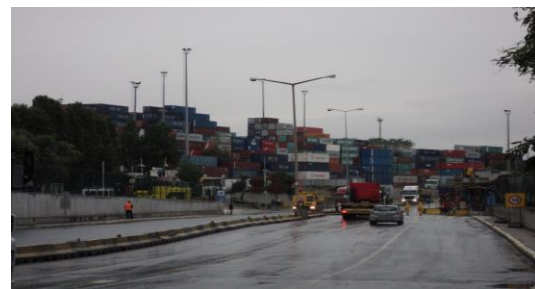
Figure 1: Piles of empty containers in Ambarlı Port.

During the last decade between 2006 and 2014 the containers handled in Turkish national ports increased 4 times and reached 7,5 milion Teu (Table 1).

In 'Table 2' the parcel demand predictions in the container ports of Turkey between 2015 and 2023 have been shown with pessimistic, average and optimistic scenarios.

In 'Table 2'; it has been predicted that the total demand for the ports handling containers in Turkey is going to be 7,2 million TEU in 2015 and 14,3 million TEU in 2023. According to these predictions, it has been shown that available 11,7 million TEU capacity is not going to be sufficient from the year 2020. Considering the available capacities apart from the Black Sea Region, the capacity

problem is going to be seen by the year 2023 (Esmer and Oral, 2008).

Table 1: During the decade between 2000 and 2009 the containers handled teu in Turkey ports (ubak, 2015).

Years	Loading (Teu)			Unloading (Teu)			Total (Teu)
	Cabotage	Export	Total	Cabotage	Import	Total	
2006	14.008	2.212.228	1.915.902	6.913	1.933.110	1.940.023	3.855.924
2007	34.005	2.212.228	2.246.233	27.128	2.284.867	2.311.995	4.558.227
2008	86.867	2.488.497	2.575.364	82.934	2.533.450	2.616.384	5.191.747
2009	70.329	2.132.113	2.205.464	71.696	2.117.762	2.198.978	4.404.442
2010	78.766	2.229.129	2.287.895	79.072	2.165.783	2.204.855	5.492.750
2011	83.682	2.578.202	2.598.884	83.334	2.498.081	2.511.415	6.110.298
2012	86.579	2.685.019	2.691.598	83.167	2.664.501	2.672.668	6.364.266
2013	88.008	3.212.228	2.915.902	86.913	2.933.110	2.940.023	6.855.924
2014	90.005	3.212.228	2.246.233	77.128	3.284.867	3.311.995	7.558.227

Table 2: The pessimistic, average and optimistic scenarios on the parcel demand predictions between 2015 and 2023 in the container ports of Turkey (Esmer et al., 2009).

	Total quantity of all ports (TEU)					
Years	Pessimistic	Increase Compared to 2009 (%)	Average	Increase Compared to 2009 (%)	Optimistic	Increase Compared to 2009 (%)
2015	6.815.467	79,9	7.296.501	92,6	7.798.122	105,8
2020	10.087.387	166,2	11.276.873	197,6	12.570.983	231,8
2023	12.536.240	230,9	14.353.090	278,8	16.381.240	332,4

It can be seen from the given statistics as in the rest of the world, in Turkey one can talk about the linearly increasing container transportation as well. Corresponding with the increasing container transportation, there is a raise in the number of the containers. In parallel with the developing transportation systems and increasing technological opportunities, an improving process has been formed by enormous container ships' being launched, building of huge container ports, producing lots of container handling equipments and providing connections between railway or highway and container (Zhang et al., 2004). There are some problems assosciated with container ports such as storage problem of thousands of containers in and around the port, loading priorities, transportation of the containers thousands of kilometers away at sea around the world with door-to-door transportation, damage and cost (Theofanis and Boile, 2009).

The imbalance in trade activities forms the main reason for the management of empty containers. Considering that the situation is a management problem, the problems started in costs and deliveries can reach to the dimensions influencing the firms' prestige and market situation (Boile et al., 2006). In case of the absence of containers in desired place and time and desired quality, either high cost containers from an alternative dealer are tried to be provided or the route is to be changed and the alternative centers are to be researched (Yur and Esmer, 2011). Both of the situations resulted in disadvantages in the way of cost and time. The more the mobility in container webs being used around the world gets intensified, the more problems in the operations like the prediction of the traffic in the ports, providing, storage and forwarding the containers are tend to occur (Cong Liu et al., 2010). Apart from the imbalance of the trade activities, another factor contributed to the accumulation of empty containers in a region stems from price tariff. It is mostly searched that as the prices get higher in the places the campaign done, in the contrary place, the prices gets lower (Yazıcı, 2008). The most expensive storage costs around the world can be seen in the most demanding ports like Hong Kong, South Korea and China. The same costs have been seen as lower in some regions where secondary markets (secondary market for containers) developed like North America and Europe. It has been indicated that in such a situation, container lessors either need to direct their idle containers to the demanding Asian regions where leasing costs are high or to hold them in the cheap storage places (Rodrigue, 2013).

1.2. The Main Problems Created by Empty Container

As a general evaluation, the problems stemmed from the empty containers can be separated in two different fields the first one is economic and the other is environmental.

Economical Problems:

The most important disadvantage for transportation companies about the transport of the empty containers is that transporting empty container does not have any profit for them on the contrary it has important logistic costs (Brito and Konings, 2006). It is estimated that the cost of the transportation of the empty containers can surplus 80 billion USD in 2015, in addition, a few more USD is needed for the storage places and backgrounds (Shintani et al., 2010). The studies conducted in 2001 showed that every year 16,8 billions of dollars are spent on inactive works like transportation of the empty containers in container operations (Ioannou et al., 2006). In 2003, the empty containers formed %20 of the total container mobility and they caused about 11 billion USD cost per year. At the beginning of 2004 the unforeseen increase in steel prices influenced the container prices. The container transporters wanted to change their old containers got into a jam and had to buy new containers %40 more expensively. On the contrary, in 2003 the number of containers in Sydney port brought imported productions raised %50 as a result of a drought season in Australia because of the decrease in the production and exportation of agricultural productions. The redelivery costs of the empty containers were accounted as 300.650 USD and the influences of 200.000 extra containers on the countries economy started to be thought (Mittal, 2008). Similarly; long-termed storage places in Port Elizabeth (New Jersey) have recently covered 170 hectare fields. Facing such a problem New Jersey state

authorities have been working on the encouragement of the usage of these valuable places mostly for transportation purposes and on the contribution of these places to economy by preventing the usage of the important areas around the port as a container storage places. In this context, taxation studies have been started in the region for the idle containers stayed in the place more than 90 days and also for the stored containers they brought some limitations about their weights and heights in their storage places (Boile, 2006).

Environmental Problems:

It has been seen that in some various parts of the world especially in port cities and transition zones because of the accumulation of the empty containers there are some environmental problems related to container transportation. For example the containers fall off container ship down to sea for various reasons can be great threat for the big and small sea crafts marine operations as well as causing pollution in sensitive marine areas (Francesco, 2007). In the land the storage places formed by excessive accumulations cause the restriction of the port zones and they start to be important problems for city regional planning by degrading visual landscape quality of the region (Mittal, 2008).

2. Materıal and Method

Study area and data collection:

In the context of national empty container survey, Gemport, Haydarpaşa, İzmir, Kumport, Mardaş, Marport and Mersin ports' which they account for 80.64% of Turkey's container transportation volume have been surveyed (www.denizcilik.gov.tr, 12 April 2015). To obtain reliable and high quality data each port is visited and examined by the authors. The data is gathered from the databases about container handling amounts, related ports' Administrative Managements, Port Presidency, the TSI (Turkish Statistical Institute), Customs General Management and the Under Secretariat of Maritime Affairs were examined (www.tuik.gov.tr, 17 October 2015, www.ubak.gov.tr, 12 April 2015). Additional interviews were carried out with port authorities and data from questionnaires was compiled. The study consists of 7 container transporting ports from different geographies of Turkey (Figure 2).

Figure 2: Study area

The management of the empty container is extremely important for each port's productivity as well as the empty container balance in international sea transportation. In this study it has been examined by using analytic and intuitional flow balance approaching methods in the determined primary container mode transportation ports like Gemport, Haydarpaşa, İzmir, Kumport, Mardaş, Marport and Mersin port. The applied methods were briefly explained below.

If the number of imported containers is more than exported containers, one can talk about the accumulation of empty containers in a port. Normally empty container flow balance is the difference between the numbers of exported and imported containers. Generally the rate of this flow is given with the following formula (Dunaicevs, 2010),

$$B = \frac{Vi - Ve}{Vmax} \text{ x } 100$$

Where, *"B"* represents the rate of empty container flow balance, *"Vi"* represents the amount of imported containers, *"Ve"* represents the amount of exported containers, *"Vmax"* is the total amounts of containers entered and left the port. Port statistics were used as an input to calculate empty container flow balance. Considering the loading, emptying, transit loads, and the stable situation has been occurred in the port by counting the differences between the importing and exporting of the container numbers and sizes.

A previously designed questionnaire with open-ended questions was conducted with each port authority to examine uncountable reasons for empty container problem. In order to increase the reliability and validity of the research, interview method has been supported with observations and statistical data. A relative solution from each respondent regarding empty container problem is evaluated and discussed. Furthermore, open space related problems are also considered for future capacity projections.

3. Results

Empty container problem is created by international trade imbalances. As an international trade member Turkey is not an exception and one of the biggest country in the Middle East with approximately 180 billion USD imports volume annually. Transshipment of total containers can reach 5 million TEU per annum in the ports that handling containers in Turkey.

According to findings of the carried research, for the ports under investigation the empty container imbalance is calculated by considering total handled container numbers between 2009 and 2014. Consequently empty container balance is given in Table 3 after detailed analysis of the port import/export statistics it can be seen from Table 3 that except Haydarpaşa and Kumport there is no pronounced empty container accumulation problem in all other major container ports of Turkey. There are some changes related to port activity as it is in the case of Gemport. If the data for the year 2010 is analyzed it can be seen that Gemport is represented by an empty container balance value "0.94" (B=0.94) which is an indicator of empty container problem. However, beginning from 2011, Gemport has been changed the international trade activity toward an export-oriented type and has negative values (B<0) in terms of empty container balance. For instance for the year 2011 empty container balance index was equal to "-14.5" which was the sharpest turnover point for Gemport and similar tendency has been observed for the years 2012, 2013 and 2014. Therefore,

based on extensive field work and interviews with port authorities, it was concluded that Gemport did not suffer from empty container accumulation. It was also confirmed by examining the port area and personal communications of the local port management officers. Mersin, Mardaş, Marport and İzmir ports showed similar patterns in terms of empty container balance. Among them İzmir has the highest container handling average annual load volume which can exceed 0.5 Million TEU. Marport and Mersin were the other biggest container importing centers of Turkish maritime industry with 0.3 and 0.4 Million TEU average annual total container handling figures respectively.

Different from other container ports in Turkey, Kumport and Haydarpasa have shown positive "B" values for the time period 2006-2010. At Haydarpaşa port B value was around "3" for 2010-2014 and reached the maximum value "8.75" in 2014. Similar empty container flow balance was observed for the Kumport for the same time period.

4. Discussion

The productivity of international maritime ports is important indicator of wealth and economic conditions of a country. Social and economic situation in nearby areas and hinterlands are mainly determined by adjacent port structures and transportation volumes. Therefore port performance and economic value are important issues for both internal and external wellbeing. Consequently, the empty container issue has become an important scientific topic not only for Turkey but also for all major ports in the world. Appropriate management of empty container can improve the overall productivity of the port facility. The administration of empty container subject have become an important logistic factor with the changing of maritime transportation from conventional to container transportation in order to increase the productivity of the ports and to decrease the costs. Accumulations of empty container then become an important parameter that determines transportation costs. Therefore DPT (Turkish State Planning Organization) declares the necessity of the foundation of coastal constructions in the ninth development plan and stresses that management of those places is one of the weakest points of the country. Even though, DPT has a general comment on coastal establishments it can be easily agreed on that one of the most important coastal investments is port construction. From that point of view, infrastructure of port construction in Turkey is under developed in terms of both physical and technical perspectives. There are some problems associated with site selection procedures as well as technical functionality. The site selection problem is beyond the scope of the current work but technical considerations are necessary as it affects empty container flow balance. Recently, port information management systems have been widely used to optimize the logistic affectivity in the world's container ports. There are such examples from Marport, Turkey. These are mainly optimization oriented software aiding international customers to check the loaded parcel flow online via web domain. Therefore, it is a necessity for other container ports to be equipped with such systems to increase the port productivity and reduce empty container load. There has been a sharp increase in number of total handled containers recently in Turkish ports but there is no any effort to meet the increasing demand of container handling capacity for better management of container ports. Therefore

it is highly probable to see a container flow balance problem in Turkish ports in near future if the current conditions are to be remained unresolved. Alternatively, new technologies have been developed to optimize the handling procedure of the containers. One of those innovations is the "foldable container" which is a good solution for ports that suffer from limited space in port area.

5. Conclusion

Empty container management is an important logistic problem that stands in front of transportation community. It is an optimization problem that can be solved numerically or heuristically. In order to determine if the empty container is going to be a problem for a country in a national or local scale, a country wide container flow balance should be first carried out. Therefore as beginning step to management of empty container in Turkey, this study revealed that for the period between 2010-2014 there is not a serious problem regarding empty container accumulation in major Turkish ports. Only local accumulations were observed in Kumport and Haydarpaşa ports which are two of biggest container ports in Turkey. As a future perspective considering the increasing international trade activities for Turkey, there might be an empty container problem in ports situated close to big cities such as İstanbul and İzmir. Therefore, a management plan for possible empty container problem should be prepared by the management authorities to overcome and balance the problem in future. For instance, port management authority of Kumport in Istanbul has personally commented during the interview that there has been serious accumulation of empty containers in and around the port terminal area. Similarly, Haydarpasa port authorities tried to overcome the same problem by establishing inland container terminals in places such as İç Erenköy and Merdivenköy. Esatablising inland container is also not desirable solutins in terms of in terms of logistic as it increases the transportation cost per parcel load. For close range inland terminals, container transfers are mainly done by using highways which is expensive and troublesome technique as increases the traffic congestion on main traffic network. Alternatively, transfer of the containers to the inner regions by using railway would provide the prevention of the accumulation, increase of port's performance and decrease the costs.

Finally, it can be concluded that even though there is not a pronounced problem regarding empty container accumulation and flow balance in Turkey. It does not mean that the logistic community in Turkey will not face such a problem in near future. Therefore, an empty container management plan strategy should be prepared in guidance of logistic professionals and port authorities to foreseen and be ready for such a problem.

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Table 3. Accumulation of total empty container amounts in all ports (2010-2014)

	Accumulation of Total Empty Container Amounts															
	Years															
	2010			**2011**			**2012**			**2013**			**2014**			
NOTE **IN**: Imported containers **OUT**: Exported containers	*IN*	*OUT*	*B*	*IN*	*OUT*	*B*	*IN*	*OUT*	*B*	*IN*	*OUT*	*B*	*IN*	*OUT*	*B*	*Amount of Total Accumulating Empty Container at Ports for 5 Years*
PORTS	20+40	20+40		20+40	20+40		20+40	20+40		20+40	20+40		20+40	20+40		20+40
Gemport	53198 + 42773	52531 (+) 41642	0.94	55565 + 56980	60247 + 55777	-14.5	55002 + 53714	59885 + 51742	-1.32	32444 + 37215	32634 + 37274	-0.17	42948 + 43772	45543 + 47819	-3.68	(-) 11483
Haydarpaşa	70069 + 681117	62606 + 65529	3.75	71044 + 66084	63121 + 65152	3.33	67785 + 56655	60577 + 57300	2.7	37367 + 28906	33050 + 29568	2.83	36709 + 28825	27869 + 27120	8.75	(+) 39669
İzmir	157770 + 132842	160706 + 132153	-0.38	177314 + 136651	179321 + 133960	0.1	188188 + 123983	188028 + 130362	-0.98	164808 + 122273	178173+ 119109	-1.66	158163 + 104691	157947 + 101092	0.73	(-) 12168
Kumport	61934 + 93258	58338 + 83696	4.42	68678 + 104876	76749 + 99072	-0.64	65816 + 98566	67645 + 89868	2.13	48916 + 66069	53233 + 55100	2.97	78412 + 115358	69511 + 98566	7.1	(+) 50375
Mardaş	23284 + 24844	2715 + 29892	-8.45	3280 + 32696	36372 + 34766	-3.86	30533 + 47259	37392 + 46423	-1.55	23044 + 32549	29471 + 36154	-8.27	30385 + 40940	37068 + 47742	-8.63	(-) 43718
Marport	57476 + 72499	61887 + 79710	-4.27	77100 + 88193	67331 + 80782	6	73706 + 90921	69154 + 98084	-0.78	64915 + 88590	70459 + 82344	0.22	69184 + 107858	70563 + 112119	-1.56	(-) 2081
Mersin	107197 + 109432	106949 + 105356	1	34145 + 42636	32022 + 40371	2.94	149355 + 117400	136871 + 106775	4.52	130667 + 98618	143612 + 112553	-5.85	173879 + 126115	173382 + 130587	-0.65	(-) 20284