EVOLVING PATTERNS OF TRANSSHIPMENT ACTIVITIES AND CONTAINER FLOWS IN THE EASTERN MEDITERRANEAN – NINE YEARS LATER

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ABSTRACT

This paper examines the structure of Eastern Mediterranean container shipping, with a focus on transshipment activities. Such characterization is mostly unavailable in existing references for the Eastern Mediterranean region, limiting the ability of researchers and policy makers to engage in container shipping analysis and multimodal freight planning in that region. The first author presented a paper at the 2001 WCTR Conference that addressed these issues and which has been widely requested and sought in the region. The analysis presented in this paper is meant to be a follow-up to the previous research to track the evolving structure of transshipment activities in this region, and similarly considers three aspects of the Eastern Mediterranean transshipment context (i) regional ports and their characteristics, (ii) industry structure and shipping routes, and (iii) projected growth trends. Historical trends in container traffic handled at transshipment ports in the region are identified, and trend-line projections developed. The objective is to provide estimates of the overall level of container shipping and handling activity at the region's ports. These estimates represent an important input to strategic intermodal freight mobility planning studies of the region, and can also provide a basis for assessing the reasonableness of particular container traffic scenarios at existing as well as proposed port terminals in the region. With anticipated growth in container traffic globally and increasing importance of transshipment in the economics of shipping line operations, several ports in the Mediterranean have been investing in aggressive development and improvement of container handling capabilities. Some of the planned

developments for ports in the region are summarized, including increases in container terminal yard areas and in storage areas for container stacking, adding new equipment to the terminal, constructing additional quays for handling containers, and dredging to increase the sea depth for larger ships.

INTRODUCTION

In addition to serving their local markets, Eastern Mediterranean ports have historically served as a gateway to a large hinterland in the Middle East (e.g. Iraq, Iran, and the Arabian Peninsula), and are emerging as a potential link in intermodal freight routes serving the growing new economies of land-locked Central Asian countries. The first author presented a paper at the 2001 WCTR Conference that addressed the growth pattern in transhipment activities in the Eastern Mediterranean ports (Kaysi and Mahmassani, 2001). The analysis presented in this paper is meant to be a follow-up to the previous research to track the evolving structure of transshipment activities in this region, and similarly considers three aspects of the Eastern Mediterranean transshipment context (i) regional ports and their characteristics, (ii) industry structure and (iii) projected growth trends.

The paper first identifies the set of ports in the Mediterranean region that are significant either as origins, destinations or transshipment points for container traffic. Each port in the study region is classified as either a “transshipment” or a “market” port, though some transshipment ports are important destinations in their own right and are hence also market ports. Each of the transshipment ports is characterized in terms of infrastructure and equipment, particularly with regard to container handling capacity and level of service, which are important determinants of a shipping line’s decision to use that particular port.

With anticipated growth in container traffic globally and increasing importance of transshipment in the economics of shipping line operations, several ports in the Mediterranean have invested in aggressive development and improvement of container handling capabilities. Some of the planned developments for ports in the region are summarized, including increases in container terminal yard areas and in storage areas for container stacking, adding new equipment to the terminal, constructing additional quays for handling containers, and dredging to increase the sea depth for larger ships, especially post-panamax mother ships.

Also of relevance to understanding the container shipping structure in the Eastern Mediterranean are the existing shipping line services through the Mediterranean. The top 20 carriers worldwide are presented.

Historical trends in total container traffic handled at transshipment ports in the region are identified and trend-line projections developed. The objective is to provide estimates of the overall level of container shipping and handling activity at the region’s ports. These estimates represent an important input to strategic intermodal freight mobility planning studies of the region, and can also provide a basis for assessing the reasonableness of particular container traffic scenarios at existing as well as proposed port terminals in the region. In addition, an evaluation of forecasts that were developed in earlier research (Kaysi and Mahmassani, 2001) is conducted.

PHYSICAL CHARACTERISTICS OF PORTS IN THE STUDY REGION

The paper first identifies the set of ports in the Mediterranean region that are significant either as origins, destinations or transshipment points for container traffic. As noted earlier, each port in the study region is classified as either a “transshipment” or a “market” port. Facilities, equipment and services at each of these ports are characterized. The container terminal infrastructure elements surveyed include: terminal area for handling containers, quay length, maximum depth (determines largest container vessel that the terminal can receive), and availability of open storage. These elements were used to determine the nominal capacity of ports in terms of the maximum number of containers (TEU’s) that the port can handle per year.

Identification of ports in the study region

The ports in the study area consist of two main categories, namely, (i) hub ports, with major transshipment activity, and (ii) market ports that serve primarily as final origins or destinations of container traffic. The latter category includes ports that serve the potential extended hinterland that one could define for a new container terminal in the eastern Mediterranean. Ports in the two categories are listed below.

Hub ports with major transshipment activity

The Mediterranean is subdivided into three zones for the purpose of identifying relevant competing hub ports. The first category includes east Mediterranean transshipment ports, which serve markets in the Middle East and Black Sea. These ports include Alexandria, El-Dekheila, Damietta, and Port Said in Egypt, Haifa and Ashdod in Israel, Beirut in Lebanon, Limassol in Cyprus, and Piraeus in Greece. The second category comprises central Mediterranean transshipment ports with meaningful traffic to the eastern Mediterranean. The two main ports in this category are Marsaxlokk in Malta, and Gioia Tauro in Italy. The third and final category refers to west Mediterranean transshipment ports, which serve a more diverse mix of traffic markets, and are included in the present analysis because they interact with Eastern Mediterranean traffic. The two ports in this category are Algeciras and Valencia in Spain.

Container market ports

Taking a broad definition of the potential hinterland for a container terminal in the eastern Mediterranean, three groups of market ports may be defined. The first group consists of Mediterranean seaports including Larnaca in Cyprus, Lattakia in Syria, as well as Mersin in Turkey. The second group comprises Red sea and gulf ports. The ports in this category are

Aqaba in Jordan, Jeddah in Saudi Arabia, and Jebel Ali in United Arab Emirates. The final group refers to Black sea gateway ports. The ports considered to fall in this category include Thessaloniki in Greece as well as Haydarpassa, Ambarli, and Izmir in Turkey.

In this paper, the focus is on the first category, namely hub ports, as it is the most relevant in considering transshipment activities in the eastern Mediterranean.

Port Infrastructure

The container terminal infrastructure of the Mediterranean transshipment ports identified in the previous section for the study region is documented in summary form in Table 1 (CIY 2008). The table includes the following updated container terminal infrastructure elements, which play a major role in determining the nominal capacity and level of service of a container terminal in a port, thus affecting a shipping line's decision to use that particular port. In the case of ports where the nominal capacity seems to be inadequate to serve container traffic volumes, port authorities are expected to develop additional port infrastructure to expand on this capacity.

1. Terminal area: inland area where containers are handled (loaded, unloaded, stored, transported …). Note that some ports do not have a specific container terminal, but containers are handled in the multipurpose terminal (MPT); other ports have a container terminal but still handle containers in the multipurpose terminal.

2. Quay length: length of the quay where containers are loaded or unloaded from/onto vessels. The quay length has a direct effect on the capacity of the container terminal. A commonly used value to estimate capacity is that each 1 meter of quay length can handle about 800 TEUs per year, though this value may vary across ports depending on the infrastructure and equipment facilities.

3. Maximum depth: maximum sea depth dredged in order to receive the largest container vessel.

4. Open storage: inland area where containers are transported and stacked.

5. Nominal capacity: maximum number of TEU containers that the port can handle per year. This value was estimated in certain cases based on quay length and other parameters which appear in table 1.

***Table 1** - Transshipment Ports Container Terminal Infrastructure*

Port	Container Terminal(s)	Terminal Area [a] (sq.m)	Quay Length [b] (m)	Maximum Depth (m)	Open Storage (TEU)	Nominal Capacity (TEU/year)
Alexandria	Alexandria	163,000	520.0	14.0	11,000	416,000
El-Dekheila	El-Dekheila	380,000	1040.0	14.0	20,000	832,000
	El-Dekheila International	190,000	510.0	12.0	NA	408,000
Damietta	Damietta	600,000	1050.0	14.5	30,000	840,000
Port Said	Port Said Container and Cargo	467,130	970.0	14.0	24,000	776,000
	Suez Canal	600,000	1200.0	16.5	41,159	960,000
Ashdod	Ashdod	NA	1515.0	15.5	29,700	1,212,000
Haifa	Eastern	400,000	960.0	14.0	15,800	768,000
	Western & Kishon	100,000	400.0	10.5	1,000	320,000
Beirut	Beirut	244,600	600.0	15.5	NA	480,000
Limassol	West Side	342,500	620.0	14.0	10,000	496,000
Piraeus	Venizelos	900,000	3100.0	16.5	30,500	2,480,000
Marsaxlokk	Terminal One	387,743	1000.0	15.5	NA	800,000
	Terminal Two	227,194	1258.0	15.5	NA	1,006,000
Gioia Tauro	Medcenter	1,300,000	3011.0	15.0	60,000	2,409,000
Valencia	Multi-purpose	34,900	943.0	11.0	425	754,000
	Terminal Muelle de Levante	320,000	1332.0	15.0	6,580	1,066,000
	Terminales del Turia	200,000	973.0	12.0	NA	778,000
	Valencia public	1,580,000	1780.0	16.0	80,484	1,424,000
Algeciras	APM	605,184	1491.0	16.0	12,902	1,193,000
	Isla Verde	180,000	680	14.5	5,400	544,000

(a) This area is either allocated for container handling in some ports or used as a multipurpose terminal (MPT) in other ports

(b) This length is either allocated for container handling in some ports or used for multipurpose handling (MPT) in other ports

Planned port infrastructure improvement activities

With continuing anticipated growth in container traffic globally and increasing importance of transshipment in the economics of shipping line operations, several ports in the Mediterranean are investing in aggressive development and improvement of container handling capabilities (CIY 2006). Figure 1 below illustrates the prevailing container terminal capacities in 2008.

Table 2 summarizes some of the planned developments for the ports included in the study region (CIY 2008). These developments include increasing the area of the container terminal yard, increasing the storage area for container stacking, constructing additional quay for handling containers, and dredging to increase the sea depth where vessels are received in order to handle larger ships, especially post-panamax mother ships. In some cases the improvements are restricted to acquiring new quay or yard cranes or other equipment. All of these activities, taken individually or in combination, are generally intended to enhance, in quality and quantity, the container handling capacity of the port.

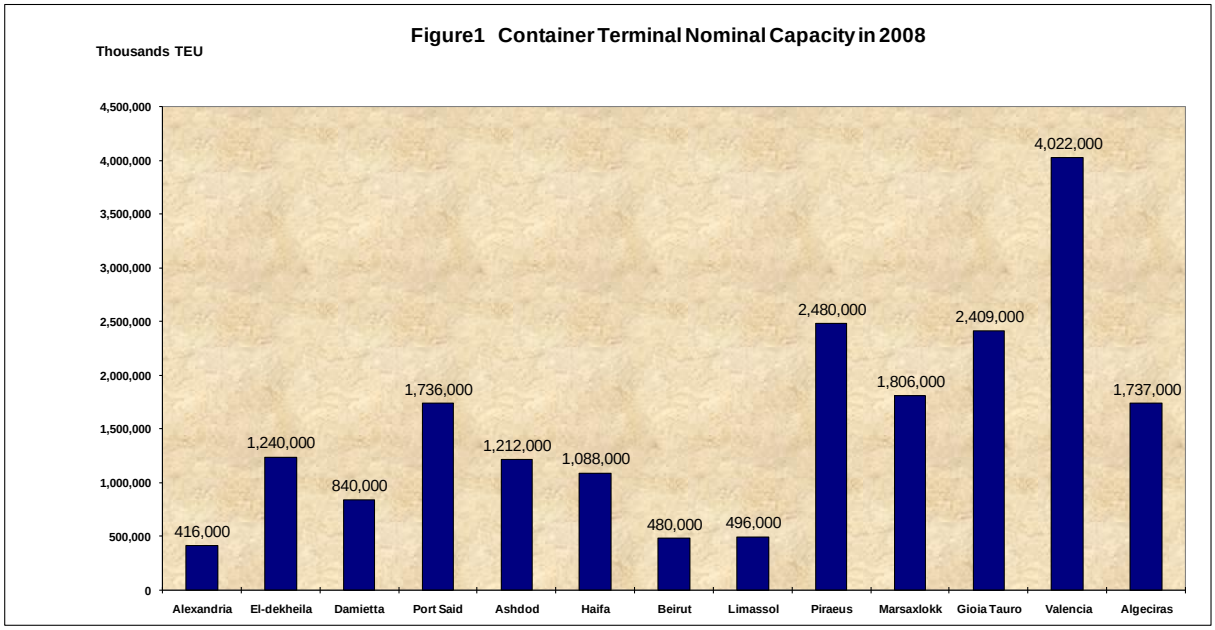

Figure 1 *– Container terminal nominal capacity in 2008 (TEU/year)*

***Table 2** - Planned Development of Container Terminals at Transshipment Ports*

Port	CIY 2008
Alexandria	New ship-shore post-panamax gantry cranes and 2 new 40t RTGs have been ordered
El-Dekheila	2 super post-panamax gantry cranes, 8 RTGs with 45t capacity & 100 yard trailers to be purchased
Damietta	New CTIS+ New yard for import containers. 10 tractors, 2RTGs and 1 forklift 34t have been ordered.
Port Said	Port Said Container & Cargo handling Co: Expanding terminal by adding 400m extension to the main container quay with 16m depth and 15m draft. The total terminal length of quays will be 1,370m and be supported by 3 gantry cranes besides yard cranes, tractors and semi-trailers. Total back reach area 28,000m^2. Contracting to supply the 8th super post-panamax gantry crane and 8 tractors + GPS communication system
	Suez Canal Container Terminal (SCCT): Phase 1: 1200 m of quay line with land behind the quay 500 m deep (600,000m2) with a capacity of 2.2 million TEU per annum. Phase 2: extension of the quay by a further 1200m. SCCT to operate Phase 2 in 2008
Haifa	Haifa Port Co Ltd: Development of the Hacarmel Terminal (700m quay, 15.5m depth). First berth to be operated in the middle of 2009; the whole terminal by the end of 2009.
	Eastern terminal: Reclamation and extension of two rail-mounted gantry (RMG) runs. Expansion of the stacking area.
	Western & Kishon Terminals: East Kishon quay, 580m long and 50m wide, to be operated during 2009.
Ashdod	New intermodal yard next to Hayovel Terminal with 3 loading tracks (1,300m).
Beirut	-
Limassol	Expansion of west terminal container quays + Acquisition of additional gantry cranes.
Piraeus	Expansion of Pier 1 to be completed in 2008. Construction of eastern part of Pier 3 to last from 2007-2010.
Marsaxlokk	Purchase quay and yard equipment (5 quay cranes, 20 RTGs, 30 yard tractors, 55 trailers, 2 RSs, 1 empty handler). Develop in phases 100,000m^2 of land behind terminal one for further container stacking (to be completed by end of 2008). Increase quay length from 2000m to 3000 m. Increase North Quay berth depth to 17m, and Terminal one West Quay to 13m.
Gioia Tauro	394,000 m2 expansion and 4 ZPMC super post-panamax ship-shore container gantries on order.
Valencia	Muelle de Levante: 2 super post-panamax gantries by end of 2007.
	Valencia Public: Completion of a third berth with 500m of berthing line (16m depth) + additional area 50,000m^2. New equipment: 4 ship- shore container gantry cranes, 12 RTGs.

	Total development: 2,340m berthing line (16m) + 1,580,000 m2 terminal area + 1,080,000 m2 stacking area + yard capacity for 80,484 TEU + 720 reefer connections; to increase annual handling capacity to 1,800,000 TEUs.
Algeciras	Isla Verde: 7 Portainers, 12 RTGs, 28 terminal tractors, 32 platforms, 6 RSs.

SHIPPING LINES

Major shipping lines worldwide and industry structure

Mediterranean shipping is examined in its global context, relating regional traffic to its worldwide patterns. The maritime shipping industry consists of several major actors who play significant roles in moving shipments from origin to destination. The primary actors are the shippers, freight forwarders, agents, and shipping lines, in addition to the terminal port operator. Our focus is on shipping lines, the primary decision-makers regarding which ports to call and the associated route structure. Table 3 (Fremont, 2009) presents the top twenty shipping lines in November 2008 in % of world fleet capacity in TEU. The trend among shipping lines has been to form alliances and partnerships. The three major alliances in April 2008 were as follows (Fremont, 2009):

- CKYH (1.4 million TEUs; Cosco, K line, Yang Ming)
- Grand Alliance (1.3 million TEUs; Hapag-Lloyd, NYK line, MSC, OOCL)
- The New World Alliance (1 million TEUs; APL, Hyundai, Mitsui OSK Lines)

The trend to form alliances and partnerships has resulted in a significant proportion of total capacity being under the control of the top ten carriers/groups (about 60% of world fleet capacity, estimated at 12.9 million TEU in 2008, Fremont, 2009). These alliances have witnessed significant changes over the past few years.

***Table 3** – Top Twenty Shipping Lines in 2008 and their percentage of TEU world capacity (Fremont, 2009)*

Rank	Operator	Nationality	%
1	Maersk	Denmark	15.7
2	Mediterranean Shg Co	Italian/Swiss	11.1
3	CMA-CGM	France	7.6
4	Evergreen Line	Taiwan	4.8
5	Hapag-Lloyd	Germany	3.8
6	COSCO Container L.	China	3.8
7	APL	Singapore	3.8
8	CSCL	China	3.4
9	NYK	Japan	3.2
10	Hanjin / Senator	South Korea	2.9
Share of top 10			**60.2**
11	MOL	Japan	2.9
12	OOCL	Hong Kong	2.8
13	K Line	Japan	2.5
14	Yang Ming Line	Taiwan	2.4
15	Hamburg Süd Group	Germany	2.3
16	CSAV Group	Chile	2.2
17	Zim	Israel	2.2
18	Hyundai M.M.	South Korea	1.9
19	PIL (Pacific Int. Line)	Singapore	1.4
20	UASC	United Arab Emirates	1.2
Share of top 20			**82.0**
World total			**100.0**
of which			
European shipping lines			40.6
Asian shipping lines			35.8

CONTAINER TRAFFIC TRENDS AND FUTURE PROJECTIONS

Historical trends in total container traffic handled at transshipment ports in the region are identified, trend-line projections developed. The objective is to provide estimates of the overall level of container shipping and handling activity at the region's ports. These estimates are important input to strategic intermodal freight mobility planning studies of the region. They can also provide a basis for assessing the reasonableness of particular container traffic scenarios at existing as well as proposed port terminals in the region. The primary concern in this analysis is the total container traffic handled at each of the ports under consideration, and the number of transshipped containers (in TEU) handled at the hub ports. In addition, an evaluation is conducted of forecasts that were developed in earlier research by the first author; the research results were presented at the 2001 WCTR. Such an evaluation would shed light on the different forecasting approaches that were suggested at that time by comparing forecast values with actual transshipment traffic that materialized in the group of hub ports under consideration.

Recent trends in container traffic growth

This section describes the recent historical trends in container traffic handled at transshipment ports in the study region, and develops projections based on the overall trend reflected in the data. The objective of this task is not to produce detailed forecasts for any individual port, but rather to provide an estimate of the overall level of container shipping and handling activity at the region's ports. This is intended to provide a basis against which to assess the reasonableness of particular container traffic scenarios. In interpreting the numbers herein, it should be noted that some inconsistencies may exist in the reporting practices of different port operators and/or of the different sources from which this information was obtained. Nonetheless, these are "best available" estimates, which have been cross-checked against multiple sources.

The primary concern in this analysis is in the total container traffic handled at each of the ports under consideration. This refers to the total number of containers (in TEU) handled per year at the port; in this total, transshipped containers are counted twice, reflecting handling as an incoming as well as an outgoing container, consistent with industry reporting practices. Table 4 presents the total container traffic values (in thousands of TEU) for 1995-2006 (or 2007) for the selected subset of the ports in the Mediterranean study region. The traffic volumes for these ports are included in the analysis and projections presented next.

Annual container traffic for each port is examined for the years 1995-2006 (CIY 1998 through 2008). Over that period, transshipment ports experienced growth in the number of containers handled from 5.7 to 18.6 million TEU, consistent with the global growth of containerization in freight transport. Total container traffic trends are plotted in Figure 2 for 1995-2006, for the transshipment ports. The Figure confirms the global growth trend of containerization in freight transport, which has been taking place at an increasing growth rate.

***Table 4** - Total Container Traffic (in thousands of TEU's) at Ports in Mediterranean Study Region*

Transshipment Port	**1995**	**1996**	**1997**	**1998**	**1999**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Alexandria	302	332	389	496	538	511	495[a]	495[b]	343	375	-
Damietta	764	809	604	310	434	750	955	1263[a]	1130	841	913[d]
El-Dekheila	-	-	-	-	-	-	-	-	334	358	403
Port Said	240	362	460	483	507	563	822[c]	1199[b]	1621	2680	-
Ashdod[e]	-	-	-	-	-	-	-	-	-	693	-
Haifa	525	548	669	832	749	749	679	1033	1107	1053	1143[d]
Beirut[e]	-	-	-	-	-	-	-	-	461	595	944[d]
Piraeus	600	575	684	933	984	1390	1605	1542	1395	1403	-
Limassol	266	399	237	213	238	266	255	298	320	361	365
Marsaxlokk	515	593	663	1072	1045	1045	1300	1461	1321	1485	1900[d]
Gioia Tauro	16	572	1449	2126	2253	2897	3149	3261	3161	2900	-
Valencia	672	708	832	1005	1150	1771	1993	2145	2410	2612	-
Algeciras	1155	1307	1538	1826	1833	2229	2516	2937	3180	3257	-
Total	**5,162**	**6,370**	**7,690**	**9,296**	**9,731**	**12,171**	**13,768**	**15,634**	**16,783**	**18,612**	-

a Estimated by CIY 2006

b Estimated by interpolation and/or extrapolation

c Fiscal year ending March 31

d Estimated by CIY 2008

e Ashdod and Beirut started transshipment operations in 2006 and 2005, respectively.

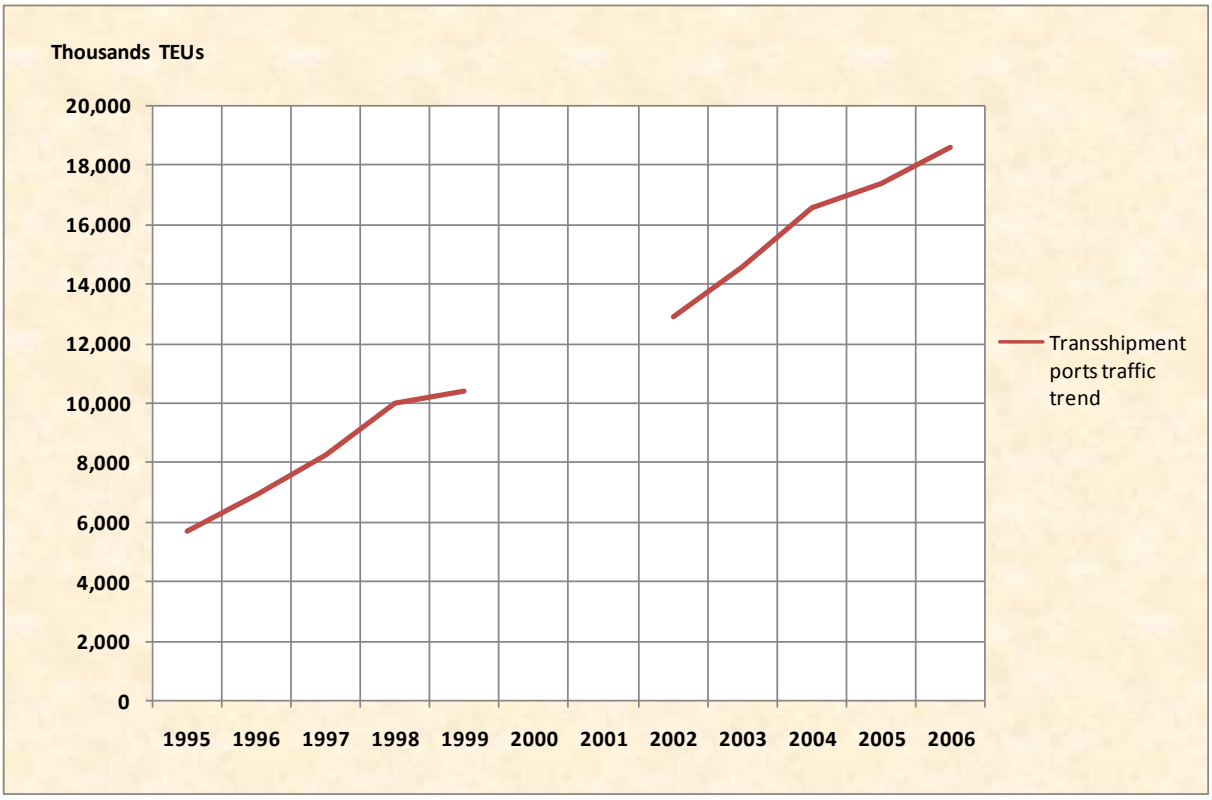

***Figure 2** – Total container traffic trend in transhipment ports in Mediterranean study region*

Projections of container traffic growth

Projecting the historical trends in the near term, to the year 2015, should reflect recent growth trends. Three sets of forecasts are presented next for the considered transshipment ports.

First, a linear forecast is obtained by extending the best fit line through the actual values for 1995 to 2006. Because it assumes a constant rate of growth, which possibly underestimates the increasing growth rate observed in the actual data, this projection should be viewed as a lower bound on anticipated container traffic in future years. Next, a non-linear expression of the exponential form was estimated based on the trend reflected in the 1995-2006 data. Finally, a different approach that still captures the “momentum” reflected in the actual data is obtained by projecting along the 2003-2004 gradient beyond 2007. This approach is considered to provide a good compromise between the optimistic exponential forecast and the conservative linear forecast.

Figure 3 contrasts the three sets of projections described above. This figure shows the gradient linear forecast as providing a compromise projection of container traffic handled by the transshipment ports of interest, with the simple linear and exponential extrapolations providing lower and upper bounds, respectively. Results indicate an anticipated total number of containers in the year 2015 ranging between 28.2 million and 50.1 million TEU handled by the transshipment ports in this study, with a mid-range value of about 35.4 million TEU in the year 2015.

Given the recent global economic downturn, and the significantly slower growth in maritime transport in the past couple of years, it would seem that the exponential forecast may be too optimistic and would provide unlikely expectations for the future. In this case, the linear and gradient-linear forecast may provide more realistic expectations of future volumes that are likely to occur within the time horizon being considered.

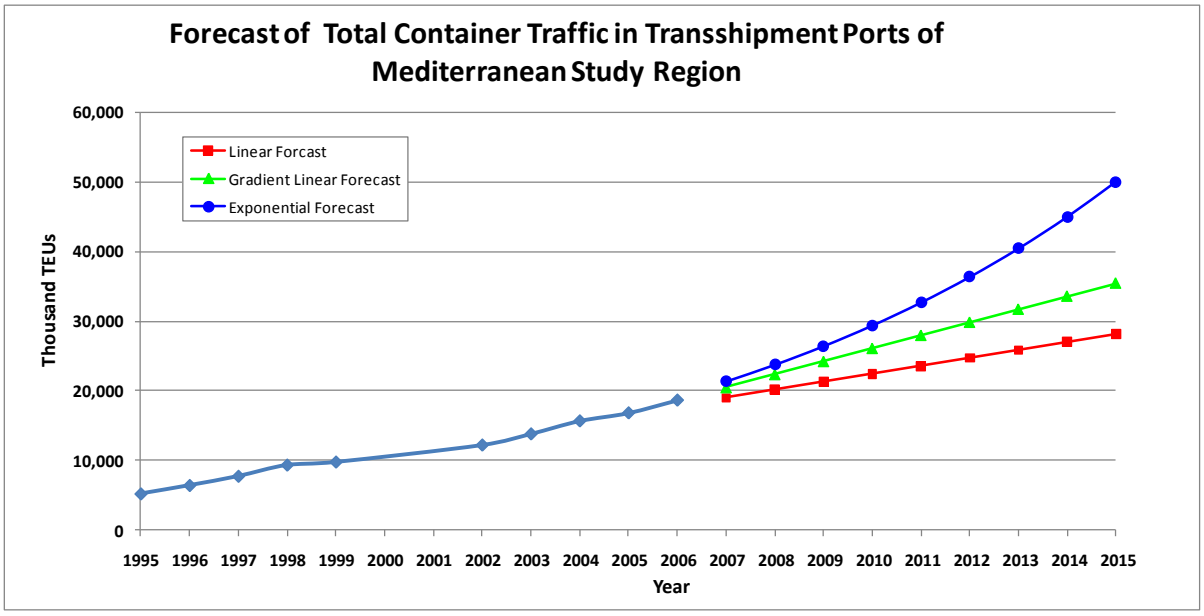

Figure 3 *– Forecast of total container traffic in transhipment ports of Mediterranean study region*

Evaluation of Earlier Forecast

A comparison of earlier forecasts presented in the previous paper (Kaysi and Mahmassani, 2001) with actual container traffic for the years 2002 – 2006 was conducted and is presented in Figure 4.

In the earlier forecasts, similarly, three sets of forecasts were developed. First, a linear forecast was obtained by extending the best fit line through the actual values for 1992 to 1999. Because it assumed a constant rate of growth, which underestimates the increasing growth rate observed in the actual data, this projection was viewed as a lower bound on anticipated container traffic in future years. Next, to capture the trend reflected in the 1992-1999 data, a non-linear expression of the exponential form was estimated and found to provide considerably better fit than the linear model. Finally, a more conservative approach that still captures the “momentum” reflected in the actual data was obtained by projecting along the 1997-1998 gradient beyond 2000. This approach was thought to provide a good compromise between the optimistic exponential forecast and the conservative linear forecast. It is clear from Figure 4 that the linear forecast turned out to be closest to actual values for 2002 and 2003, while the actual volumes for 2004 to 2006 lie between the linear and gradient forecasts. This comparison indicates that it would have been overly optimistic to rely

on the exponential forecast as it highly overestimated the likely growth in transshipment traffic, even though such an exponential function seemed to provide a better fit of the actual data between 1992 and 1999. Since shipping volumes, and in particular transshipment traffic, are sensitive to global economic conditions, slowdowns in such conditions that occurred during the period from 1999 to 2006 are likely to be behind such a conclusion.

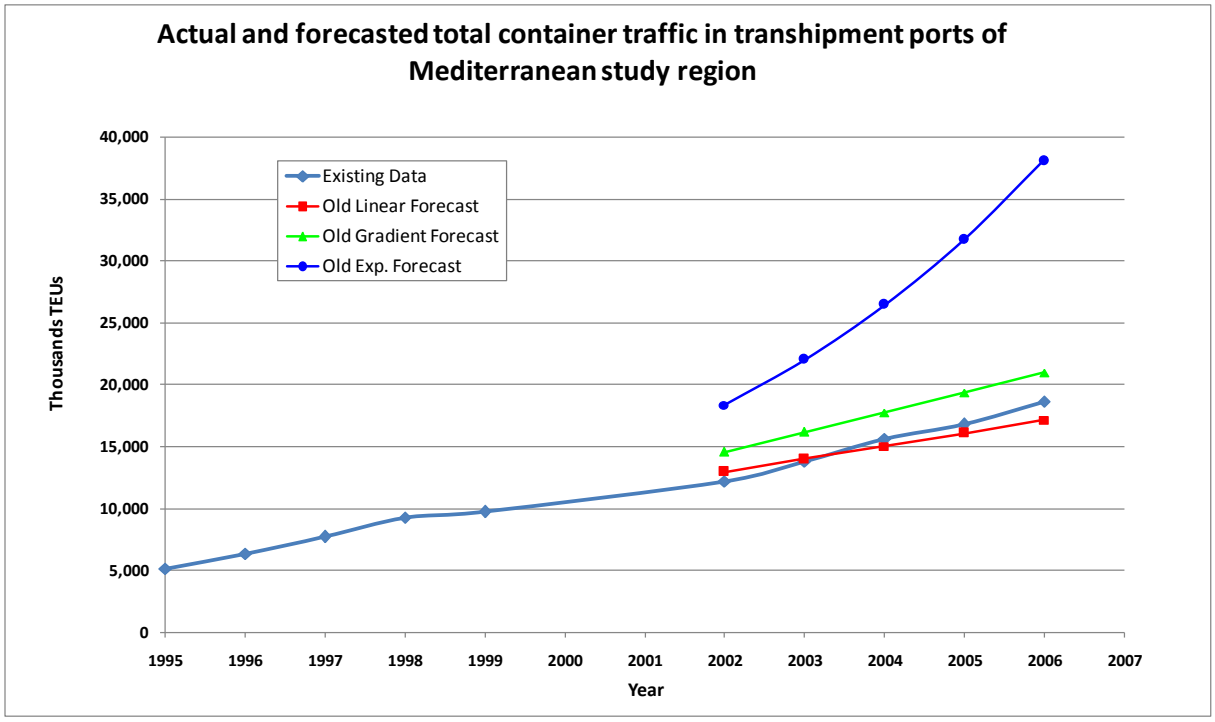

Figure 4 *– Actual and forecasted total container traffic in transhipment ports of Mediterranean study region*

CONCLUSIONS

This paper examined the structure of Eastern Mediterranean container shipping, with a focus on transshipment activities. The analysis considered three aspects of the Eastern Mediterranean transshipment context, namely, regional ports and their characteristics, industry structure, and projected growth trends in container volumes. With anticipated growth in container traffic globally and increasing importance of transshipment in the economics of shipping line operations, several ports in the Mediterranean have invested in aggressive development and improvement of container handling capabilities and infrastructure. To finance the required investment, these ports expect a certain range of container traffic levels. The reasonableness and likelihood of attaining such a range may be assessed through comparison to prevailing and projected container traffic volumes in the region and at comparable or competing facilities. The conclusions and container volume projections presented in this paper would provide a solid basis for such an assessment.

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