Forecast of Container Vessel Specifications and Port Calls Within San Pedro Bay

Final Report

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Mercator Transport Group
2820 Northup Way, Suite 201
Bellevue, WA 98004

In Association With:

Herbert Engineering Corp.
Alameda, CA

MDS Transmodal, Ltd.
Chester, England

EXECUTIVE SUMMARY

❖ The weekly capacity of the Asia-North America fleet has increased by 280% since 1990, from 77,200 TEU/wk to 293,500 TEU/wk in Q3 2004. The increased capacity has resulted from an increase in both the number of weekly services and the average size of ships deployed. Since 1990, vessel services in the trade increased from 35 to 76, and average ship size increased from about 2,300 TEUs to 3900 TEUs.

❖ The following table summarizes Mercator Transport Group's (MTG's) projected weekly San Pedro Bay container vessel calls by ship size category to accommodate an expected average growth in annual throughput of 7% from now through the year 2020. Projected weekly ship calls and total vessel capacity calling the two ports increase 74 % and 170%, respectively, over the forecast period.

TEU Class	SPB Port Call Count - Per Week				
	2004	2007	2010	2015	2020
<1000	1	1	1		
1000 - 2000	9	7	4	2	1
2000 - 3000	12	9	11	11	9
3000 - 4000	11	5	7	6	10
4000 - 5000	15	17	20	21	23
5000 - 6000	9	10	11	13	16
6000 - 7000	4	8	10	12	15
7000 - 8000	1	5	6	9	12
8000 - 10000		7	8	9	11
10000 - 12000				4	11
	62	69	78	87	108

❖ The projected fleet calling SPB ports reflects a continuing growth in average ship size from approximately 3,700 TEUs in 2004 to 5,800 TEUs by year 2020. Fully 22 new weekly services are expected with vessels ranging in size from 8,000-12,000 TEUs. The demand for these larger vessels is due partly to the increasing cost efficiencies they provide. MTG estimates that an 8,000 TEU vessel in an Asia-US West Coast service reduces vessel-related costs by $99/TEU compared to a 4500 TEU vessel. A 10,000 TEU ship produces additional savings of $52/TEU.

❖ Growth in ship size is made feasible by the growing market which includes high density trade flows between San Pedro Bay and key ports in Asia. The deployment of larger tonnage is also supported by further consolidation and cooperation among carriers that is expected within the liner industry.

- o MTG projects that the Transpacific trade will evolve from the current 3-tier structure in which five carrier alliances / large independent lines (Grand Alliance, New World Alliance, CHKY Alliance, Maersk Sealand, and

Evergreen) operate 70% of capacity to a 2-tier structure in which 6-8 alliances / large lines operate about 95% of the capacity, as MSC, CMA-CGM, and CSCL implement their rapid expansion plans and as selected merger/acquisition transactions take place.

  - Even with increased ship size, however, an increase of service frequency will be provided to the market. The number of services making a first inbound call in San Pedro Bay is expected to increase from 40 in 2004 to 73 in 2020. MTG forecasts that over this same period, the total number of Asia-North America services to all coasts will increase from 76 to 153.

- MTG expects that the largest vessels in the Transpacific fleet will not exceed a nominal capacity of approximately 12,000 TEUs by 2020. This is based on several considerations including vessel cost, transit time and service frequency requirements, port productivity and overall cargo volumes.

- MTG's analysis of vessel cost showed that ships up to 18,000 TEUs in size achieve incremental cost savings, albeit at a diminishing rate. However, savings achieved by increasing vessel capacity from 10,000 TEU to 12,000-14,000 TEU are marginal since a more costly twin-screw propulsion system is required to power the 12,000+ TEU vessels. Ship size must grow to over 14,000 TEUs before adequate incremental cost efficiencies re-emerge.

- The physical limitations of the major ports in the Far East will not impede the deployment of the largest ships projected for the Transpacific trade. At least ten major Asian ports (geographically covering most of the region's largest cargo production zones) presently have, or are developing, terminals with channel/quayside water depths and overhead clearances that can accommodate 10,000-12,000 TEU vessels.

- There are several North American ports outside San Pedro Bay that also have sufficiently deep water to accommodate 10,000-12,000 TEU vessels. Those on the West Coast (Prince Rupert, Vancouver, Seattle, Tacoma, and Lazaro Cardenas) would all require substantial improvements to rail yards and rail lines in order to handle the unit train volumes that would be generated by first-inbound calls. On the East Coast, only Halifax and Hampton Roads have adequate channel and berth depth.

- If the Panama Canal Authority constructs a new set of locks, MTG projects that many carrier groups would deploy at least one string of 6,000-10,000 TEU vessels in a Far East – US East Coast all-water service. The expected impact on San Pedro Bay would initially be a slight reduction in average vessel size (and increase in number of services calling) as a result of the redeployment of 4000 TEU vessels from Panama routes to SPB routes. The net long-term impact on total vessel calls in San Pedro Bay, however, would not be significant.

INTRODUCTION

This report summarizes a series of detailed analyses undertaken by Mercator Transport Group, in collaboration with Herbert Engineering Corporation and MDS Transmodal Ltd., for the Ports of Long Beach and Los Angeles, in order to forecast future container vessel activity levels in San Pedro Bay. In producing these forecasts, the Mercator Project Team (Mercator) utilized a three-phased work plan, in accordance with the component analyses contained in the Ports' Request for Proposal.

In the first phase, Mercator reviewed and analyzed vessel fleets and services from 1990 to early 2004, beginning at an aggregate, global level, then focusing on the trans-Pacific trades, and finally examining activity levels just in the San Pedro Bay ports. Our analyses here were carrier-specific, and also encompassed reviews of SPB container volumes, in addition to ship deployments and movements.

In the second phase, building upon the preceding analyses and considering current trends, the Project Team constructed near-term forecasts (for the 2005-2007 period) of the demand and supply for container shipping service, with particular emphasis on the trans-Pacific trade and the sub-set of that trade pertaining to the San Pedro Bay gateway. Mercator then conducted separate analyses and assessments of each of the following fundamental drivers of future patterns and characteristics for the vessels and liner services to be calling at the Ports, over the period from 2008 until 2020:

- Developments and constraints in vessel design, engineering, and technology
- Changes in vessel capital and operating costs, on both absolute and unit bases
- Capacity-related conditions and constraints at the major container ports of Asia and at the North American ports that compete with SPB for trans-Pacific intermodal traffic
- Changes in the structure of the liner industry, as a result of mergers, acquisitions, and other carrier consolidations
- Capacity-related conditions and constraints at the Panama Canal
- Forecasted levels of containerized trade between Asia and North America, by origin country and destination region for the inbound, head-haul direction

In the third phase, Mercator consolidated its assessments of the various fundamental drivers listed above and built upon its near-term forecasts to project how carriers' global and trans-Pacific service networks would be likely to evolve between 2008 and 2020, in terms of vessel deployment patterns and geographical configurations, as well as in terms of ship sizes and other key vessel characteristics. These projections were then used to estimate vessel service patterns, vessel call activity levels, and load factors – by ship size – for the two San Pedro Bay ports.

Section I: HISTORICAL OVERVIEW

In this section of the report, Mercator discusses how the global liner shipping industry has evolved since 1990, in terms of both trade volumes and the evolution of the world's containership fleet. Additional material is then presented on the changes in Transpacific vessel services and fleets during the same period, as well as on containership activity in San Pedro Bay.

Task I-1: Global Demand for Containerized Shipping Services

Over the last 15 years, the Ports of Long Beach and Los Angeles have experienced remarkable growth in container handling volume. The growth of these ports has been a part of a worldwide increase in container trade. Between 1990 and 2003, container volumes carried on the principal East-West routes, namely the Transpacific (Asia-North America), Asia-Europe, and Transatlantic (Europe-North America) routes, has nearly tripled, posting a compound annual growth rate (CAGR) of 8.6%. An understanding of the current situation and future outlook for SPB Ports requires familiarity with the trends within these broader worldwide trades. The particulars of each trade are described below.

<u>Transatlantic Trade</u>

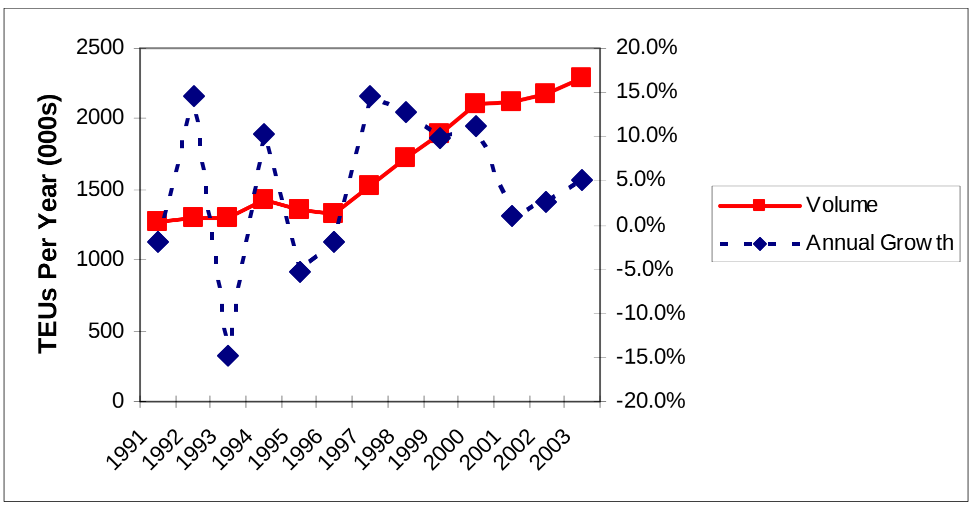
Of the three main east-west trades, the Transatlantic is the smallest and has been the slowest-growing. As shown in Table I-1, compound growth in this trade has been 4.7% between 1990 and 2003[1]. Up through the mid-1990s, the trade was fairly balanced in terms of the volume of loaded containers moving in each direction. Since 1997, however, container flows have been much stronger in the westbound (US import) direction.

[1] Volumes reflect the so-called "headhaul" or high volume direction for loaded containers. The headhaul direction sets the requirements for the transport infrastructure, including the design and capacity of ports and vessels.

Table I-1 - Transatlantic Headhaul Container Volumes

Transatlantic TEUS (000)			
Year	Dir	Volume	Annual Growth
1990	**W/B**	1262	-
1991	**E/B**	1275	-1.9%
1992	**E/B**	1297	14.5%
1993	**W/B**	1299	-14.8%
1994	**W/B**	1432	10.2%
1995	**E/B**	1357	-5.2%
1996	**E/B**	1331	-1.9%
1997	**W/B**	1524	14.5%
1998	**W/B**	1720	12.9%
1999	**W/B**	1890	9.9%
2000	**W/B**	2101	11.2%
2001	**W/B**	2124	1.1%
2002	**W/B**	2181	2.7%
2003	**W/B**	2290	5.0%
Compound Annual Growth Rate (CAGR)			4.7%

Sources: Drewry & CI-Online
North America includes US, CDA and Mexico

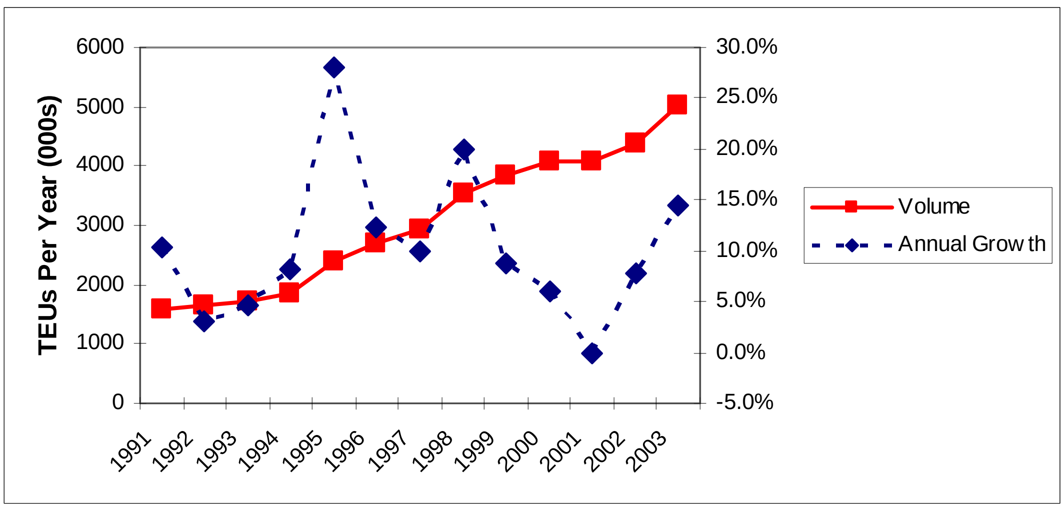


Asia-Europe Trade

The Asia-North Europe trade has grown much faster than the Transatlantic trade. Driven by growth in Asia, the Asia-North Europe trade is now more than two times the size of the Transatlantic, whereas in 1990 they were of roughly comparable size. The headhaul direction for this trade is westbound, in the direction of Asian exports, with about 1.6 (full) TEUs for each one moving eastbound. Year-by-year statistics are provided in Table I-2.

Table I-2 - Asia-North Europe Container Volumes

Far East to North Europe TEUS (000)		
Year	**Volume**	**Annual Growth**
1990	1450	-
1991	1600	10.3%
1992	1650	3.1%
1993	1725	4.5%
1994	1865	8.1%
1995	2386	27.9%
1996	2681	12.4%
1997	2948	10.0%
1998	3538	20.0%
1999	3846	8.7%
2000	4077	6.0%
2001	4075	0.0%
2002	4394	7.8%
2003	5026	14.4%
Compound Annual Growth Rate (CAGR)		10.0%



Sources: Drewry & CI-Online

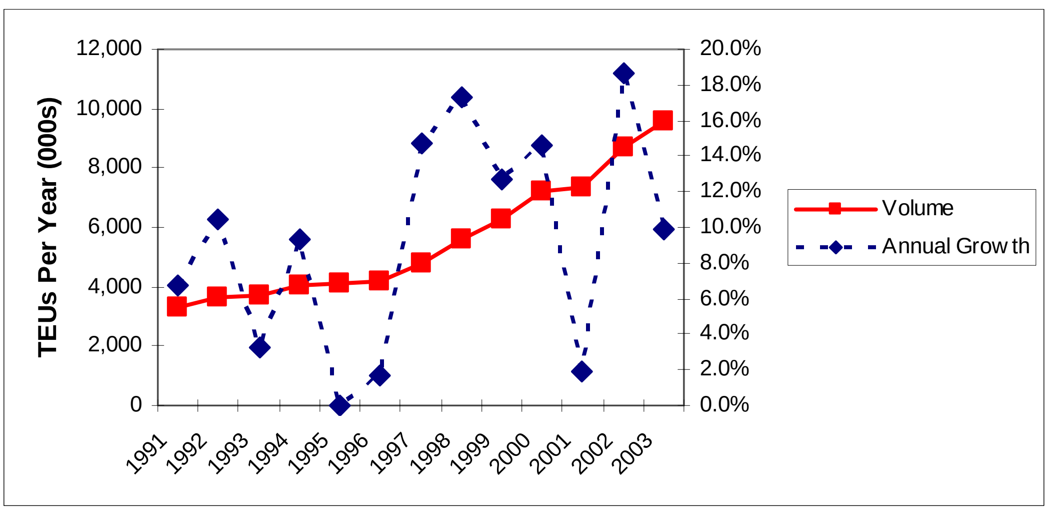
<u>Transpacific Trade</u>

The Transpacific Trade (Far East to North America) was in 1990 and remains today the world's highest volume arterial tradelane, growing from 3 million TEUs in 1990 to nearly 10 million TEUs in 2003. Trade volume for 2004 will likely be close to 10.5 million TEUs. Year-by-year statistics are provided in Table 3. Growth has been volatile, with year-on-year rates as high as 18.6% and as low as 0.0%, but without any years of actual contraction. The high volume headhaul direction is of course eastbound, in the direction of US imports. Loaded import containers outnumber loaded westbound export containers by a ratio of about 2.2 to 1. Yearly volumes for the trade are presented in Table I-3.

Table I-3 - Far-East North America Container Volumes

	Asia to North America TEUS (000)	
Year	**Volume**	**Annual Growth**
1990	3,065	-
1991	3,270	6.7%
1992	3,613	10.5%
1993	3,729	3.2%
1994	4,077	9.3%
1995	4,079	0.0%
1996	4,147	1.7%
1997	4,758	14.7%
1998	5,581	17.3%
1999	6,290	12.7%
2000	7,211	14.6%
2001	7,352	2.0%
2002	8,721	18.6%
2003	9,580	9.8%
Compound Annual Growth Rate (CAGR)		9.2%

Sources: Drewry & CI-Online
North America includes US, CDA and Mexico



Other Important Tradelanes

In addition to the main arterial East-West trades discussed above, there are a number of other trades with significant container volumes, some of which impact upon the container traffic at San Pedro Bay Ports.

The "North South Trades" encompass a variety of tradelanes, the principal ones being:

North America – Central / South America

Europe –	Central / South America
Europe –	Africa
North America –	Africa
Asia –	Africa
Europe -	Oceania
North America –	Oceania
Asia -	Oceania

In addition to the north/south trades, there are high volume intra-regional trades within East Asia and within North Europe and the Mediterranean. Vessels serving these intra-regional trades provide both on-carriage of containers from the east-west trades and service to intra-regional traffic.

Volume data for these trades is not as readily available as for the larger east west trades, given the complexity of tracking the many unique flows, and determining exactly how activity should be counted. Nonetheless, the North South trades listed above are estimated to have had a headhaul volume of approximately 7.8 million TEUs in 2003. Based on a review of historical port volume in Latin America, Africa and Oceania, Mercator estimates the North/South trades have been growing at a CAGR of about 6.6% since 1990.

The intra-Asia trade is said to be the world's largest, with annual traffic in 2003 estimated to be 18 million TEUs, up 375 % from an estimated figure of 4.8 million for 1992, for a CAGR of 12.8%.

Container Traffic Through San Pedro Bay Ports

For San Pedro Bay ports, the Transpacific tradelane is obviously the most important. Growth through San Pedro Bay ports during this period has been the result of both the overall growth in the trade, as well as by the capture of increased market share. Containerized cargo growth in the import direction has been at the compound annual rate of 9.9 % during this period, slightly faster than the 9.2% rate of growth for the Transpaciifc eastbound trade.

Table I-4 - Volume History For San Pedro Bay Ports
(POLB & POLA Combined)

Year	Loaded Inbound	Loaded Outbound	Total Loaded	Total Mtys	Total TEU	% Change	Rolling 5yr-CAGR	Rolling 10yr-CAGR	Rolling 15yr-CAGR
						In Total TEU Handled			
	Combined - San Pedro Bay Ports								
2004 (est)	*7,035,690*	*2,162,938*	*9,198,628*	*3,864,661*	*13,063,289*	10.4%	**9.7%**	**9.9%**	**8.9%**
2003	6,224,050	2,067,884	8,291,934	3,545,130	11,837,064	11.3%	**9.6%**	**10.5%**	**9.1%**
2002	5,684,901	1,949,009	7,633,910	2,998,318	10,632,228	10.2%	**10.5%**	**9.9%**	**8.7%**
2001	5,104,344	1,990,640	7,094,984	2,551,503	9,646,487	1.8%	**10.9%**	**9.7%**	**8.7%**
2000	4,948,734	2,029,004	6,977,738	2,502,477	9,480,216	15.1%	**11.9%**	**9.8%**	
1999	4,282,903	1,806,802	6,089,704	2,147,626	8,237,331	10.2%	**10.1%**	**8.5%**	
1998	3,812,314	1,768,317	5,580,631	1,895,276	7,475,907	15.6%	**11.3%**	**8.9%**	
1997	3,269,407	1,978,250	5,247,657	1,216,659	6,464,316	12.4%	**9.3%**	**7.8%**	
1996	2,841,053	1,918,322	4,759,375	990,984	5,750,359	6.5%	**8.6%**	**7.6%**	
1995	2,604,920	1,860,538	4,465,458	933,250	5,398,708	6.0%	**7.8%**		
1994	2,550,810	1,550,602	4,101,412	991,033	5,092,445	16.6%	**7.0%**		
1993	2,190,980	1,295,045	3,486,025	882,737	4,368,762	5.3%	**6.5%**		
1992	2,083,540	1,213,746	3,297,286	851,091	4,148,377	9.0%	**6.4%**		
1991	1,905,599	1,209,337	3,114,936	692,057	3,806,993	2.5%	**6.7%**		
1990	1,826,205	1,132,147	2,958,352	756,136	3,714,488	2.3%			

Source: Ports of Long Beach and Los Angeles

These statistics indicate a consistent underlying growth pattern, with the CAGR for any 5-year period always above 6%, and sometimes as high as 12%. Overlaid on top of this strong growth is a fairly high level of volatility, with year-to-year growth ranging between 2% and 17%. In no years, however, did combined SPB container handling volume actually decline. For reference, Appendix I.1a contains the separate throughput figures for POLA and POLB.

Task I-2: World Fleet Development

The world container vessel fleet has undergone profound change during the period considered above (1990-present), with total container capacity increased by 308% and the average capacity of vessels increasing by 72%. The number of vessels in the world fleet, grouped according to nominal TEU capacity, is presented in Table I-5.

Changes in the size and composition of the fleet in terms of speed, length, beam, draft, reefer plug count, deadweight and age are presented through a series of tables that are included in Appendix I.2a.

A closer look at the fleet as it stood at mid-year 2004 is presented in Appendix I.2b. These tables present fleet characteristics as of a single point in time, and allow examination of the various parameters as defined above (length, beam, draft, reefer plug count, deadweight, and age) as a function of capacity. In Task II.-2, we extend this analysis to include vessels to be delivered over the next three years to present similar data for the fleet as we expect it to exist at the end of 2007. The 2007 fleet tables are presented in Appendix II.2a.

Table I-5 - Development of the World Container Vessel Fleet

FULLY CELLULAR WORLD FLEET - Vessel Count and TEU Capacity - 1990 - 2004

A) Number of Vessels

TEU SIZE BAND	UNDER PANAMAX FLEET 1990	1995	2000	2004	OVER PANAMAX FLEET 1990	1995	2000	2004	TOTAL FLEET 1990	1995	2000	2004	% change 1990-2004
<=500	431	308	485	472	0	0	0	0	431	308	485	472	10%
501 - 1000	263	301	480	547	0	0	0	0	263	301	480	547	108%
1001 - 1500	246	329	497	540	0	0	0	0	246	329	497	540	120%
1501 - 2000	167	231	334	392	0	0	0	0	167	231	334	392	135%
2001 - 2500	63	114	226	284	0	0	0	0	63	114	226	284	351%
2501 - 3000	133	141	183	255	0	0	0	0	133	141	183	255	92%
3001 - 4000	70	144	209	247	0	0	0	0	70	144	209	247	253%
4001 - 5000	2	39	128	222	5	25	35	40	7	64	163	262	3643%
5001 - 6000	0	0	0	11	0	0	61	155	0	0	61	166	..
6001 - 7000	0	0	0	0	0	0	23	97	0	0	23	97	..
7001 - 8000	0	0	0	0	0	0	0	10	0	0	0	10	..
8001 - 9000	0	0	0	0	0	0	0	8	0	0	0	8	..
TOTAL	**1375**	**1607**	**2542**	**2970**	**5**	**25**	**119**	**310**	**1380**	**1632**	**2661**	**3280**	138%

B) Nominal Capacity - TEU (000s)

TEU SIZE BAND	UNDER PANAMAX FLEET 1990	1995	2000	2004	OVER PANAMAX FLEET 1990	1995	2000	2004	TOTAL FLEET 1990	1995	2000	2004	% change 1990-2004
<=500	125	98	155	151	0	0	0	0	125	98	155	151	21%
501 - 1000	193	226	344	393	0	0	0	0	193	226	344	393	103%
1001 - 1500	298	399	595	644	0	0	0	0	298	399	595	644	116%
1501 - 2000	295	403	566	663	0	0	0	0	295	403	566	663	125%
2001 - 2500	141	259	507	645	0	0	0	0	141	259	507	645	359%
2501 - 3000	365	383	508	695	0	0	0	0	365	383	508	695	91%
3001 - 4000	236	494	720	845	0	0	0	0	236	494	720	845	258%
4001 - 5000	8	164	551	959	22	113	161	186	30	277	712	1145	3767%
5001 - 6000	0	0	0	56	0	0	334	858	0	0	334	914	..
6001 - 7000	0	0	0	0	0	0	149	630	0	0	149	630	..
7001 - 8000	0	0	0	0	0	0	0	74	0	0	0	74	..
8001 - 9000	0	0	0	0	0	0	0	65	0	0	0	65	..
TOTAL	**1,661**	**2,427**	**3,945**	**5,050**	**22**	**113**	**644**	**1,813**	**1,683**	**2,540**	**4,589**	**6,863**	308%

Source: MDS/Transmodal

Table I-5 illustrates the significant change in the world fleet over the last decade. Not even yet existing in 1995, vessels over 5000 TEU now number approximately 300, and are commonplace on the major East/West trade routes. These ships now account for nearly 50% of the container throughput at SPB ports (see sub-section I-5).

Containerships are commonly referred-to according to their “nominal” TEU capacity, which is a theoretical volumetric capacity that typically does not consider the real-world constraints of vessel deadweight, stability, and cargo securing. The effective capacity of a vessel in service in the Transpacific, which is the actual volume of loaded containers that it can carry, is typically about 85-95% of the declared nominal capacity. Because nominal capacity figures are the ones that are universally available, existing and future fleet tables and port call forecasts are all made on this basis.

The foregoing analysis of fleet characteristics was done on a macro basis, considering primarily the evolution of ship capacity and the corresponding dimensional parameters. To make this analysis more useful in terms of understanding the port facility requirements of ships of different nominal TEU capacities, a set of representative vessels has been assembled, with more complete description of their individual characteristics. This information is presented in a series of tables contained in Appendix I.2c. For each size category, as many as 6-8 vessels are profiled, with a wide range of physical and operating characteristics presented for each vessel. For easy reference, a representative vessel from each size group is presented in Table I-6, at the end of this section.

Review of Key Containership Design Changes Since 1985

As evidenced by the foregoing data tables, the state-of-the-art in containership design has advanced significantly over the last 20 years. Key advances in the design of containerships which facilitated the rapid growth in size and efficiency of the fleet included the following:

Increasing Container Ship Breadth Beyond 32.2 Meters

The APL C10 containerships were delivered in 1988, and are notable as the first containerships with a breadth that exceeded the 32.2 m limit of the Panama Canal. While panamax container ship designs were still evolving and continue to increase in size and capacity to this day, improvements in their efficiency and economic effectiveness were constrained by the limitation in beam. Since 1985, the capacity of the largest containerships, has more than doubled. The maximum breadth of large containerships has increased from 32.2m to 42.8m. The increased breadth of large containerships provides better stability characteristics and in general reduces ballasting requirements.

Improvements in Speed, Powering and Propulsion

As the size of the largest containerships increased so has the requirement for speed and the ability of the vessels to maintain schedule to make them effective on the major east-west trade routes. Since 1985, the typical design speed for large containerships has increased from 23.0 knots to 25.0 - 25.5 knots. Concurrent with the growth in ship size and speed have been advancements in the design of low speed diesel engines and propellers.

The APL C10 containerships delivered in 1988 had a 12 cylinder low speed diesel engine with 840 mm diameter pistons that developed 41,920 kW. These engines were among the largest in the world at that time. Today, that same engine is available but with a maximum rating of 48,600 kW – a 16% increase in output. The largest engine available today is a 14 cylinder 1080 mm bore, low speed engine rated for 97,300 kW – more than twice as much power as the APL C10. With these newest engine designs, the limitation on ship's powering is now the shafting and propeller sizes that can be reasonably designed and produced.

To achieve the higher speeds required, the container ship hull form has also been refined through tank testing and research. In general these hulls are very fine and tend to have significant bow flare and large overhanging structure in way of the stern in order to maximize container stowage.

Improved Utilization of Under-Deck Cargo Space

The capacity of container ships is often limited by vessel intact stability. By increasing container stowage below deck, the overall cargo center of gravity can be lowered and the ship capacity and effectiveness is enhanced. Three containership design changes that permitted greater stowage below deck are noteworthy. Hatch width increased not only in physical measurement but also as a percentage of the overall breadth. The longitudinal hatch girders that were utilized to support the inboard sides of the hatch covers were eliminated. Container cell guide systems and entry guides were improved to reduce the transverse spacing between container stacks while still maintaining and possibly even improving cargo operations. The net result of these changes is that current designs permit an additional container stack below deck. For example, most panamax containerships are 11 wide below deck versus 10 wide that was more common before 1985.

Increased Hatch Width & Increased Depth

As the transverse hatch opening increased, containerships, and particularly post-panamax vessels, became more susceptible to torsional warping and longitudinal bending. At the same time, the width of effective longitudinal Main Deck plating was reduced. Compensation for the loss in longitudinal strength and stiffness was through increased vessel depth.

Improvements in On-Deck Container Securing Systems

The increased breadth of post-panamax designs enhanced vessel stability and permitted more cargo to be stowed on-deck. To effectively utilize this capacity, increased container stack weights were achieved through improvements in container securing systems. One ship design feature that is characteristic of large container ships is an elevated lashing bridge. This structure allows the restraining force of the lashing assemblies to be applied at a more effect angle. As a result, permissible container stack weights have increased by as much as 20 to 25 tonnes per stack and the number of tiers has increased from 5-high to 6- and 7-high.

Maximum achievable stack weights both below deck and on-deck are closely related to the strength ratings of containers. Class Societies that approve ship designs also review and approve container designs and verify construction standards. In recent years container strength ratings in both corner post compression and corner post tension have been increased thus permitting improved stack weights.

Increases in Stowage Flexibility, 45ft Container Capacity and Reefer Capacity:

Over the last 20 years, container ship designs were developed with more stowage flexibility, both on deck and below deck. Below deck, newbuildings typically have the capability to stow two 20ft container below deck within 40ft cell guides, ranging from a minimum of four high up to six or seven high. Fixed 20ft cell guides are not typically installed. An important feature for the US trade that has developed since the early 1980’s is the provision for alternate 45ft stowage capability on deck. More reefer cargo is being moved in self contained refrigerated containers and the reefer capacity on all sizes of containerships has increased accordingly, both in the number of receptacles and in auxiliary generator capacity.

Through these changes in vessel design, it was possible to increase the size and speed of containerships to the present 8000+ TEU level.

Table I-6 - Representative Vessels From The Existing Fleet

Item / Description	Ship Name	CAPE BONAVISTA	CECILIE MAERSK	Manukai	TMM Colima	MSC Linzie	OOCL SAN FRANCISCO	OOCL Shenzhen
Nominal Slot Container Capacity	TEU	**930**	**1827**	**2890**	**3237**	**5060**	**5714**	**8063**
Delivery Date		2/26/1992	4/24/1994	9/8/2003	10/2/2002	2003	9/15/2000	4/30/2003
Delivery Year		1992	1994	2003	2002	2003	2000	2003
Approximate Age	years	12	10	1	2	1	4	1
LOA	m	140.00	190.48	217.00	243.35	294.05	277.35	322.97
LBP	m	126.40	180.15	200.24	232.40	283.00	264.00	308.00
Breadth	m	22.70	27.80	32.20	32.20	32.20	40.00	42.80
Depth	m	10.80	15.23	19.40	19.50	21.60	24.00	24.60
Gross Tonnage		8,936	20,842	32,600	40,146	54,881	66,677	89,097
Panama Tonnage								
Suez Tonnage (Gross / Net)								
Displacement at Design Draft (tonnes)	tonnes	14,770	28,022	42,800	56,206	74,542	74,744	116,525
LS Weight (tonnes)	tonnes	4,360	8,492	12,800	15,728	18,642	25,027	34,325
Design Deadweight	tonnes	10,410	19,530	30,000		55,900	49,717	82,200
Scantling Deadweight	tonnes	10,481	28,550	38,200	40,146	68,201	67,286	99,518
Design Draft (m)	m	7.50	8.25	11.00	10.50	12.00	12.00	13.00
Scantling Draft (m)	m	7.62	10.30	12.50	11.00	13.50	14.00	14.528
Keel to top of antenna	m	40.1	46.5	53.4	55	53	59.95	61.5
Ships Ratios and Proportions (Calculated)								
Beam / Depth		2.10	1.83	1.66	1.65	1.49	1.67	1.74
LBP / Depth		11.70	11.83	10.32	11.92	13.10	11.00	12.52
LBP / Beam		5.57	6.48	6.22	7.22	8.79	6.60	7.20
Design Draft / Depth		0.69	0.54	0.34	0.33	0.56	0.50	0.53
Cubic Number (LBP x Beam x Depth / 100)		310	763	1251	1459	1968	2534	3243
Block Coefficient		0.686	0.678	0.603	0.715	0.682	0.590	0.680
Power & Engine Rating								
Speed (knots)		16.55	19	22.5	21.6	23.06	25.2	25.0
% MCR		80%	92%	90%	90%	90%	85%	85%
% Sea Margin			0%	20%	20%	15%	30%	
Fuel Oil Capacity	m^3	690	1378	3700	3902	6670	8004	10400
Diesel Oil Capacity	m^3	156	124	180	117	430	318	400
SWB Tankage	m^3	4860	10824	11600	15167	19200	17394	25500
HT Steel %		16.0%			55%	62.9%	50%	50%
Main Engine - Make	Make	MaK	Mitsubishi	MAN B&W	MAN B&W	MAN B&W	MAN B&W	MAN B&W
Main Engine - Model	Model	6M601C	9UEC50LS11	8K80MC-C	8K80MC-C	9K90MC-C	12K90MC(Mk6)	12K98MC-C
Main Engine - Type	Type	4-Stroke	2-Stroke	2-Stroke	2-Stroke	2-Stroke	2-Stroke	2-Stroke
Main Engine - Output - MCR kW	Output kW	6600	11415	28800	28832	39780	54898	68520
Main Engine - RPM @ MCR	RPM	425	120.7	104	104	104	94	104
Main Engine Driven Alternator	kW	1200	No	No	No	No	2100	3000
Total Aux. Power Instal'd (w/o emerg gen)	kW	1200	3750	5780	8550	6360	9600	12000
Bow Thruster kW	kW	500	736	1300	1700	1900	2000	2500
Stern Thruster kW	kW		No	No	No		No	No
Boiler Type - Oil, Exhaust, Composite		O + E	O + E	C	O	C	Oil	Osaka OEV-700-24w
Boiler Rating	kg / hr	2 X 1250	1600 + 1100	3200	3200	4000/3500	4000	7000
Ship Service Load - at Sea	kW	557	1741	2683	3969	2952	4457	5571
- Maneuvering	kW	915	2858	4405	6516	4847	7316	9146
- in Port	kW	459	1435	2212	3272	2434	3674	4592
Fuel Consumption - at Sea	t/day	30	49.4	122.1	125.4	164.7	229.3	286.3
- Maneuvering	t/day	20.1	41.4	89.7	100.8	117.4	165.3	206.4
- in Port	t/day	2.4	7.5	11.5	17.1	12.7	19.2	24.0
Cargo & Crew Details								
No of Cargo Cranes		2	1		4			
TEU Capacity - ON DECK	TEU	602	1108		1817	2778	3092	4348
TEU Capacity -in HOLD	TEU	328	719		1420	2282	2622	3715
TEU Capacity - TOTAL	TEU	930	1827	2890	3237	5060	5714	8063
TEU Capacity (14 ton per TEU)	14t TEU	560	N/A	2172	2370	3360	4190	6270
Reefer Capacity	# of outlets	80	164	300	400	400	628	700
Tiers/Across - On Deck		5/9	5/11	6/13	6/13	7/13	7/16; CG's 8/16	7/17
Tiers/Across - In Hold		4/7	5/9	7/11	7/11	8/11	9/14	9/15
Crew Size/No.Cabins		16/19	14/20	21/26	28/?	29/?	24/25	28/?

Source: Compiled by Herbert Engineering Corp.

Task I-3: Global and Regional Fleet Comparisons

The Transpacific and Asia-Europe Fleets

Most of the large capacity vessels, in particular those with the potential to drive the design and development of advanced port facilities, are deployed in the Transpacific and Asia-Europe tradelanes. At the present time, these are the only tradelanes with sufficient overall trade volume and sufficient concentration at specific ports to support the efficient deployment of the largest vessels. Before considering how the development of the world fleet in total will impact activity at San Pedro Bay ports, we consider the evolution of the vessel fleets that are serving these major trades.

Table I-7 - Overview of Vessels Fleets Serving Transpacific and Asia-Europe Markets

Count of Vessels, By TEU Size Band

Transpacific Vessels

	Year			
Vsl TEU	1990	1995	2000	2004
<1000	2	3	3	3
1-2000	54	59	66	27
2-3000	141	172	83	95
3-4000	32	54	153	134
4-5000	5	26	98	151
5-6000			43	79
6-7000			13	26
7-8000				6
Total	234	314	459	521
Increase vs prior		34%	46%	14%

Asia-Europe Vessels

	Year			
Vsl TEU	1990	1995	2000	2004
<1000	7			
1-2000	107	82	5	6
2-3000	95	105	85	79
3-4000	41	79	127	48
4-5000		36	95	82
5-6000			28	107
6-7000			21	87
7-8000				8
Total	250	302	361	417
Increase vs prior		21%	20%	16%

Source: Derived from MDST Containership Databank

Some vessels are deployed in services that span both the Transpacific and Asia-Europe trades (9 such services existed during 2004). Vessels in these services are included in both tables.

Table I-8 - Number of Vessel Services Operated in Each Trade

Count of Services By Avg TEU Size Band

Transpacific Services

	Year			
Vsl TEU	1990	1995	2000	2004
<1000	1	1	1	1
1-2000	10	8	11	4
2-3000	20	22	13	16
3-4000	3	8	17	19
4-5000	1	4	11	20
5-6000			7	11
6-7000			1	4
7-8000				1
Total	35	43	61	76
Increase vs prior		34%	46%	14%

Asia-Europe Services

	Year			
Vsl TEU	1990	1995	2000	2004
<1000	2			
1-2000	13	10	1	1
2-3000	9	10	9	10
3-4000	4	9	13	5
4-5000		4	10	9
5-6000			3	12
6-7000			2	10
7-8000				1
Total	28	33	38	48
Increase vs prior		34%	46%	14%

Source: Derived from MDST Containership Databank

Table I-9 - Nominal Capacity (per week) of Services Operated in Each Trade

Capacity Deployed (TEU per week)

Transpacific

	Year			
Size Band	1990	1995	2000	2004
<1000	99	209	233	233
1-2000	14,407	13,827	16,156	6,102
2-3000	48,312	56,423	33,364	41,138
3-4000	10,055	27,771	56,626	65,003
4-5000	4,300	16,953	48,048	87,970
5-6000	-	-	37,655	60,702
6-7000	-	-	6,508	25,201
7-8000	-	-	-	7,170
Grand Total	77,173	115,184	198,590	293,519

Asia-Europe

	Year			
Size Band	1990	1995	2000	2004
<1000	867	-	-	-
1-2000	13,016	13,626	1,380	1,456
2-3000	23,055	25,414	21,810	24,787
3-4000	13,847	31,103	46,610	17,169
4-5000	-	17,222	44,628	39,377
5-6000	-	-	16,298	66,658
6-7000	-	-	12,932	64,797
7-8000	-	-	-	7,780
Grand Total	50,785	87,365	143,658	222,024

Source: Derived from MDST Containership Databank

A better understanding of each trade is obtained by considering the general types of deployment configurations and markets served. For Asia-North America, deployment configurations may be broken down into four main types:

- *Panama:* Those services that cross the Pacific, transit the Panama Canal, and continue at least as far as the US Gulf Coast and/or US East Coast, before returning to Asia
- *Round The World (RTW)*: As the name implies, these services operate in a continuous round-the-world loop.
- *Suez / East Coast North America*: These services run between Asia and the East Coast of North America (ECNA) via the Suez Canal.
- *Transpacific – West Coast North America*: These services connect Asia ports with Ports on the West coast of North America only. These are typically simple “shuttle” services, but could also be part of longer deployments that continue to the Middle east or Europe.

For Asia-Europe, the deployment configurations that are most relevant are the following:

- *North Europe*: Those that continue beyond the Mediterranean to northwest Europe
- *Mediterranean*: Those that turn around in the Med
- *Pendulum*: Those that are part of a larger deployment, generally involving transpacific segments.

In the following tables, we characterize the vessels deployed in the Asia-North America and Asia-North Europe trades according to the type of deployment in which they operate.

Table I-10 - Number of Services By Deployment Configuration in Transpacific and Asia-Europe Trades

Number of Services, By Deployment Configuration

Asia-North America

	Year			
Route Type	1990	1995	2000	2004
Panama	6	5	10	17
RTW	5	4	2	1
Suez ECNA		4	2	1
TP WCNA	24	30	47	57
Total	35	43	61	76

Asia-Europe

	Year			
Route Type	1990	1995	2000	2004
Med	6	6	7	14
NW Eur	12	17	20	25
Pend	10	10	11	9
Total	28	33	38	48

Source: Derived from MDST Containership Databank

Table I-11 - Average Vessel Capacity By Deployment Configuration

Average Capacity per Vessel

Asia-North America

	Year			
Route Type	1990	1995	2000	2004
Panama	2,514	3,078	3,218	3,923
RTW	2,464	3,138	4,184	2,830
Suez ECNA		1,756	4,008	3,298
TP WCNA	2,226	2,726	3,236	3,892
Overall	2,309	2,715	3,290	3,877

Asia-Europe

	Year			
Route Type	1990	1995	2000	2004
Med	1,360	1,782	2,721	3,333
NW Eur	2,345	3,266	4,059	5,545
Pend	2,056	2,577	4,021	4,483
Overall	2,031	2,787	3,802	4,701

Source: Derived from MDST Containership Databank

Table I-12 - Largest Vessels In Operation, By Deployment Configuration

Largest Vessels Deployed (TEU)

Asia-North America

	Year			
Route Type	1990	1995	2000	2004
Panama	4,000	4,024	4,626	5,050
RTW	3,428	4,229	4,229	3,090
Suez ECNA		2,146	4,626	4,864
TP WCNA	4,300	4,800	6,600	8,468
Overall	4,300	4,800	6,600	8,468

Asia-Europe

	Year			
Route Type	1990	1995	2000	2004
Med	2,700	3,568	3,765	6,750
NW Eur	4,038	4,743	6,674	8,060
Pend	4,000	4,229	6,600	6,600
Overall	4,038	4,743	6,674	8,060

Source: Derived from MDST Containership Databank

Vessels operating in the Asia-North Europe trade are larger on average (nearly 25% more) than those in the North America service, driven by the fact that there are fewer small-vessel strings in those trades, and by the fact that a carrier's newest and largest ships are usually deployed first into Asia-Europe. The preference for concentrating larger vessels in the Asia-Europe routes is primarily due to the length of the voyages (the economic advantage of larger vessels increases with longer voyages), but also related to the relatively smaller number of port coverage variations that are possible. In spite of the difference in average vessels sizes, there is little difference in the size of the largest vessels deployed in each of the two trades.

Using this same format, further comparisons can be made between the Asia-North America Fleet and the Asia-North Europe fleet, considering speed, age and reefer capacity. Tables I-13 through I-16 present some high level comparisons of these parameters.

Table I-13 - Average Speed For The Asia-North America and Asia-North Europe Trades

Average Service Speed

Asia-North America

	Year			
Route Type	1990	1995	2000	2004
Panama	20.2	22.2	21.7	23.5
RTW	19.7	21.3	23.6	22.0
Suez ECNA		18.9	23.4	23.4
TP WCNA	20.7	21.5	21.9	22.8
Overall	20.5	21.3	22.0	23.0

Asia-Europe

	Year			
Route Type	1990	1995	2000	2004
Med	19.0	19.7	21.9	22.2
NW Eur	20.7	22.3	23.2	24.8
Pend	19.4	20.2	22.9	23.6
Overall	19.9	21.2	22.8	23.8

Source: Derived from MDST Containership Databank

Table I-14 - Average Vessel Age For The Asia-North America and Asia-North Europe Trades

Average Age of Vessels

Asia-North America

	Year			
Route Type	1990	1995	2000	2004
Panama	6.3	9.4	10.0	8.5
RTW	5.3	4.9	4.6	4.8
Suez ECNA		12.8	6.1	10.7
TP WCNA	9.0	9.4	7.3	8.2
Grand Total	8.0	9.3	7.6	8.2

Asia-Europe

	Year			
Route Type	1990	1995	2000	2004
Med	11.1	15.4	9.2	9.0
NW Eur	7.9	6.5	6.0	3.8
Pend	7.0	6.5	4.6	5.3
Grand Total	8.2	8.1	6.2	5.6

Source: Derived from MDST Containership Databank

Table I-15 - Average Reefer Plugs per Vessel: Asia-North America and Asia-North Europe Fleets

Average Reefer Plugs Per Service

Asia-North America

	Year			
Route Type	1990	1995	2000	2004
Panama	195	244	243	319
RTW	156	208	446	404
Suez ECNA		140	293	296
TP WCNA	264	237	270	342
Grand Total	237	226	272	337

Asia-Europe

	Year			
Route Type	1990	1995	2000	2004
Med	131	118	199	283
NW Eur	184	229	297	480
Pend	150	179	341	427
Grand Total	160	194	291	413

Source: Derived from MDST Containership Databank

Table I-16 - Reefer Capacity As a % of Total Nominal Capacity

Reefer Capacity As % of Total (Nominal) Vessel Capacity

Asia-North America

	Year			
Route Type	1990	1995	2000	2004
Panama	16%	16%	15%	16%
RTW	13%	13%	21%	29%
Suez ECNA		16%	15%	18%
TP WCNA	24%	17%	17%	18%
Grand Total	21%	17%	17%	17%

Asia-Europe

	Year			
Route Type	1990	1995	2000	2004
Med	19%	13%	15%	17%
NW Eur	16%	14%	15%	17%
Pend	15%	14%	17%	19%
Grand Total	16%	14%	15%	18%

Source: Derived from MDST Containership Databank

Further Definition of The Asia-North America Fleet

The types of deployments operated in the Asia-North America trade may be further broken down to gain better insight into carrier deployment strategies.

- Panama services are subdivided into those that call the East Coast only, those that call both the West Coast and East Coast, and those that call the East Coast and continue across the Atlantic to Europe.
- RTW services are subdivided into those travelling eastbound and those travelling westbound.
- TP WCNA services are subdivided into those that are simple Pacific Loop or shuttle services, and those that continue eastward as far as the Middle East/ISC and those that transit the Suez Canal

A breakdown of the Asia-North America services according to these deployment types is provided in Table I-17.

Table I-17 - Breakdown of Asia-North America Services By Deployment Pattern

		Year			
Route Type		1990	1995	2000	2004
Panama	Pan EC	2	2	5	10
	Pan EC Eur		3	4	4
	Pan WC/EC	4		1	3
Panama Total		6	5	10	17
RTW	RTW E/B	3	2	1	
	RTW W/B	2	2	1	1
RTW Total		5	4	2	1
Suez ECNA	Suez ECNA		4	2	1
Suez ECNA Total			4	2	1
TP WCNA	Pac Loop	24	28	41	49
	TP/Mideast				2
	TP/Suez		2	6	6
TP WCNA Total		24	30	47	57
Grand Total		35	43	61	76

Source: Derived from MDST Containership Databank

This table demonstrates the growing importance of services from Asia to the USEC via Panama during the late 1990s, and especially since 2000. None of these new services continue onward to Europe, a pattern that in 1995 was followed by more than half of the panama services. It can also be seen that the Panama services have largely replaced the Suez-ECNA services, primarily because North Asia/China is now so much more important to US trade than South Asia, and because China-USEC cargo is better served via Panama. Pendulum services combining T-P legs with Asia-North Europe and Asia-Mideast legs have largely replaced Round-The-World (RTW) services. One reason for this is the increased use of post-Panamax vessels, which of course are unsuitable for an RTW deployment.

The speed and capacity of vessels used for each of these deployment types is presented in Table I-18.

Table I-18 - Speed and Capacity of Asia-North America Vessels
By Route Configuration

		Average Vessel TEU Capacity				Average Vessel Speeds			
		Year				Year			
Route Type		1990	1995	2000	2004	1990	1995	2000	2004
Panama	Pan EC	2,147	3,032	2,988	3,693	18.9	22.0	21.7	23.2
	Pan EC Eur		3,109	3,622	4,217		22.4	22.3	23.6
	Pan WC/EC	2,697		2,752	4,300	20.9		20.0	24.1
Panama Total		2,514	3,078	3,218	3,923	20.2	22.2	21.7	23.5
RTW	RTW E/B	2,528	2,852	4,229		19.8	21.0	22.7	
	RTW W/B	2,367	3,423	4,138	2,830	19.4	21.5	24.6	22.0
RTW Total		2,464	3,138	4,184	2,830	19.7	21.3	23.6	22.0
Suez ECNA	Suez ECNA		1,756	4,008	3,298		18.9	23.4	23.4
Suez ECNA Total			1,756	4,008	3,298		18.9	23.4	23.4
TP WCNA	Pac Loop	2,226	2,729	3,037	3,780	20.7	21.5	21.6	22.7
	TP/Mideast				2,884				21.6
	TP/Suez		2,683	4,600	5,143		21.1	23.7	24.3
TP WCNA Total		2,226	2,726	3,236	3,892	20.7	21.5	21.9	22.8
Grand Total		2,309	2,715	3,290	3,877	20.5	21.3	22.0	23.0

Source: Derived from MDST Containership Databank

Table I-19 - Distribution of Asia-North America Vessels By Route Configuration, Nominal TEU and Age

Service Type	**TEU Group**	**Average Age of Vessels, By Service - Years**						**Total**
		0-4	**5-9**	**10-14**	**15-19**	**20-24**	**>24**	**Services**
Panama	2000	1			1			2
	3000		4	1	1			6
	4000	3	5	1				9
Panama Total		4	9	2	2			17
RTW	2000	1						1
RTW Total		1						1
Suez ECN	3000			1				1
Suez ECNA Total				1				1
TP WCNA	0		1					1
	1000	1	3					4
	2000	1	5	3	1	2	1	13
	3000	1	3	6	2			12
	4000	5	3	3				11
	5000	5	6					11
	6000	4						4
	7000	1						1
TP WCNA Total		18	21	12	3	2	1	57
Grand Total		23	30	15	5	2	1	76

Source: Derived from MDST Containership Databank

Following the vessel replacements that occurred over the last decade, most of the Panama services are now being run with 4000+ TEU vessels, which are the largest vessels that can be accommodated through the Panama Canal (refer to Tables I-18 and I-19). Unless and until the Panama Canal is expanded, there is only modest room to further increase capacity through the canal by vessel "up-sizing", so the majority of future capacity increases must come through deployment of additional services.

Table I-20 - Slowest Vessel In Each Asia-North America Service, By TEU Capacity and Route Configuration

Year	2004	Distribution of Vessel Services Based on Minimum Speed Vessel In The Service

Type	Avg TEU	15.0	17.0	17.5	18.0	19.0	19.5	**20.0**	20.5	**21.0**	21.5	**22.0**	22.5	**23.0**	23.5	**24.0**	24.4	24.5	**25.0**	25.5	26.5	Grand Total
Pac Loop	0	1																				1
	1000				1	1		1														3
	2000		1	1		1	2	1	2	5												13
	3000								1	4		2	1		2	1						11
	4000															5		3	1			9
	5000													1		2		3	2			8
	6000													1				1			1	3
	7000																	1				1
Pac Loop Total		1	1	1	1	2	2	2	3	9		2	1	2	2	8		8	3		1	49
Pan EC	2000					1				1												2
	3000										1		2			1						4
	4000													1	1	2						4
Pan EC Total						1				1	1		2	1	1	3						10
Pan EC Eur	3000												1	1								2
	4000										1			1								2
Pan EC Eur Total											1		1	2								4
Pan WC/EC	4000													1	1		1					3
Pan WC/EC Total														1	1		1					3
RTW W/B	2000									1												1
RTW W/B Total										1												1
Suez ECNA	3000												1									1
Suez ECNA Total													1									1
TP/Mideast	1000					1																1
	4000													1								1
TP/Mideast Total						1								1								2
TP/Suez	3000									1												1
	4000														1							1
	5000															1			1	1		3
	6000																	1				1
TP/Suez Total										1					1	1		1	1	1		6
Grand Total		1	1	1	1	4	2	2	3	12	2	2	5	7	5	12	1	9	4	1	1	76
Cumulative % of Services		1%	3%	4%	5%	11%	13%	16%	20%	36%	38%	41%	47%	57%	63%	79%	80%	92%	97%	99%	100%	

Source: Derived from MDST Containership Databank

Average speeds have increased along with the sizes of vessels. As of August 2004, approximately 60% of all services utilize ships of 22 knots or faster, 43% use ships of 23 knots or faster, and 21% use ships of 24 knots or faster. In terms of capacity offered, 67% is at speeds of 23 knots or higher, and 48% at 24 knots or higher. Roughly 10 years ago (in 1995), only 25% of capacity was 23 knots or faster.

The "Asia-San Pedro Bay" Fleet

Because the Ports of Long Beach and Los Angeles are the most important ports in the Asia-North America trade, the vessels calling on those ports represent a very significant subset of the overall Asia-North America fleet described above. In order to better define the mix of ships calling at San Pedro Bay ports, we have segregated the Transpacific services and vessels into those that call at SPB ports and those that do not.

Table I-21 - The San Pedro Bay Calling Fleet Versus the T-P Fleet Overall

Count of **Vessels** Deployed In Trans-Pacific, By TEU Size Band and Route Type

		All Transpacific Services				**NOT** Calling SPB Ports				Services **Calling** SPB Ports			
						LA/LB (Year							
Sum of Vsls		Year				N				Y			
NA Svc Type	Avg TEU Grp	1990	1995	2000	2004	1990	1995	2000	2004	1990	1995	2000	2004
Panama	1000	7				7							
	2000	45	35	28	17	6	9	18	17	39	26	10	
	3000	11	21	68	56		9	27	32	11	12	41	24
	4000			11	87				33			11	54
Panama Total		63	56	107	160	13	18	45	82	50	38	62	78
RTW	1000	13								13			
	2000	12	35		12					12	35		12
	3000	21								21			
	4000		10	20							10	20	
RTW Total		46	45	20	12					46	45	20	12
Suez ECNA	1000		39				39						
	3000			15	9			15	9				
	4000			14								14	
Suez ECNA Total			39	29	9		39	15	9			14	
TP WCNA	0	2	3	3	3					2	3	3	3
	1000	34	20	66	27	15	5	4	9	19	15	62	18
	2000	84	102	55	66	26	53	27	20	58	49	28	46
	3000		33	70	69			20	23		33	50	46
	4000	5	16	53	64				10	5	16	53	54
	5000			43	79			5	18			38	61
	6000			13	26							13	26
	7000				6								6
TP WCNA Total		125	174	303	340	41	58	56	80	84	116	247	260
Grand Total		234	314	459	521	54	115	116	171	180	199	343	350

Source: Derived from MDST Containership Databank

A more complete definition of the "San Pedro Bay fleet" is presented in Appendix I.3c. What can be concluded from the above table and Appendix I.3c is that, not surprisingly, the largest, fastest, and newest vessels deployed in the trade call at the San Pedro Bay ports.

Fleet Profiles By Carrier

The development between1990 and the present of the worldwide vessel fleets of each major carrier, and the concurrent development of their respective Transpacific and Asia-Europe fleets, are described in Appendix I.3b.

Task I-4: Trans-Pacific Carrier Services and Fleets

The evolution of vessel type and deployment strategies and the expansion of services offered by leading transpacific carriers are discussed in this section. The approach taken here is to group carriers and organize the material according to affiliations as they currently exist in 2004, and discuss the path of development that has led to the existing arrangements. This material will provide the foundation for a discussion of future changes to industry structure that will be presented in Section II-9.

Before analysing the service development of key carriers in the Pacific trade, we introduce the subject through several tables describing the services and capacity offered by the major carriers / carrier groups over the last 10-15 years. This material is presented in Table I-21. For each current carrier group, the figures include for prior years all services that had previously been offered by member carriers, whether as part of that alliance, independently, or through some other grouping.

Table I-21 – Services Offered By Major Carrier Groups – 1990-2004

		Services Offered				**Capacity Per Week (Total)**				**Average TEU per Service**			
Count of SERVICE		Year				Year				Year			
2004 Group	Svc Type	1990	1995	2000	2004	1990	1995	2000	2004	1990	1995	2000	2004
CHKY	Panama	3	1	3	3	6,663	3,346	10,255	11,616	2,221	3,346	3,418	3,872
	RTW	3	2			6,221	5,440			2,074	2,720		
	Suez ECNA		2				3,558				1,779		
	TP WCNA	5	11	13	13	9,903	31,305	43,407	54,256	1,981	2,846	3,339	4,174
CHKY Total		11	16	16	16	22,787	43,649	53,662	65,872	2,072	2,728	3,354	4,117
CMA-CGM	TP WCNA			1	3			3,316	10,503			3,316	3,501
CMA-CGM Total				1	3			3,316	10,503			3,316	3,501
CMA-CGM / PONL	Panama			1	2			2,635	6,664			2,635	3,332
CMA-CGM / PONL Total				1	2			2,635	6,664			2,635	3,332
CP Ships	TP WCNA			2	3			3,582	7,594			1,791	2,531
CP Ships Total				2	3			3,582	7,594			1,791	2,531
CSCL	Panama			1	1			2,635	4,079			2,635	4,079
	RTW				1				2,830				2,830
	TP WCNA			2	3			4,996	11,251			2,498	3,750
CSCL Total				3	5			7,631	18,160			2,544	3,632
Evergreen	Panama			1	3			2,041	10,945			2,041	3,648
	RTW	2	2	2		6,098	7,110	8,367		3,049	3,555	4,184	
	TP WCNA	2	3	3	5	4,538	8,075	16,208	21,789	2,269	2,692	5,403	4,358
Evergreen Total		4	5	6	8	10,636	15,185	26,616	32,734	2,659	3,037	4,436	4,092
Grand	Panama	1	2	1	3	2,743	5,464	3,872	11,757	2,743	2,732	3,872	3,919
	RTW	1				3,066				3,066			
	Suez ECNA		1	1	1		1,942	3,828	3,298		1,942	3,828	3,298
	TP WCNA	5	8	5	7	11,030	23,217	20,307	33,971	2,206	2,902	4,061	4,853
Grand Total		7	11	7	11	16,839	30,623	28,007	49,026	2,406	2,784	4,001	4,457
Indep.	Suez ECNA		1				1,524				1,524		
	TP WCNA	1	1	8	6	430	639	11,752	11,650	430	639	1,469	1,942
Indep. Total		1	2	8	6	430	2,163	11,752	11,650	430	1,082	1,469	1,942
Maersk	Panama	1	1	2	2	3,619	3,922	7,049	8,392	3,619	3,922	3,525	4,196
	Suez ECNA			1				4,187				4,187	
	TP WCNA	4	5	3	6	8,975	12,249	13,034	23,041	2,244	2,450	4,345	3,840
Maersk Total		5	6	6	8	12,594	16,171	24,270	31,433	2,519	2,695	4,045	3,929
MSC	Panama				1				4,507				4,507
	TP WCNA			1	2			3,024	5,913			3,024	2,957
MSC Total				1	3			3,024	10,420			3,024	3,473
NWA	Panama	1	2	1	2	2,743	5,464	3,082	8,445	2,743	2,732	3,082	4,223
	RTW	1				3,066				3,066			
	Suez ECNA		1				1,942				1,942		
	TP WCNA	10	15	8	10	25,446	42,817	30,807	45,317	2,545	2,854	3,851	4,532
NWA Total		12	18	9	12	31,255	50,223	33,889	53,762	2,605	2,790	3,765	4,480
Zim	Panama	1	1	1	2	2,056	2,658	3,244	7,157	2,056	2,658	3,244	3,579
	TP WCNA			1	1			1,678	3,091			1,678	3,091
Zim Total		1	1	2	3	2,056	2,658	4,922	10,248	2,056	2,658	2,461	3,416

Notes: Capacity figures relate to the overall service, and are not apportioned to carriers.
Capacities and service counts shown exceed total actual capacity because services may be included under more than one carrier or alliance.

Source: Derived from MDST Containership Databank

As capacity and volume have expanded, the number of services offered and the number of direct ports called have also expanded. A listing of services and their characteristics is presented for reference in Appendix I.4a. The frequency of part calls offered to the trade, by region, is re-capped in Tables I-22 and I-23.

Table I-22 - Asia-North America Trade - Port Call Frequency Statistics

Recap of Port Call Frequency

	Jap	Kor	Bohai S	Yellow	Cen PR	S PRC	HKG	TWN	SE Asia	ISC	MidEas	Eur	BC	Wash	Oregon	No Cal	So Cal	W Mex	Cen A	Carib	USEC	Total
2004																						
Services Calling	34	39	4	11	38	48	54	31	16	7	5	13	17	20	4	34	53	7	13	13	18	
Total Calls Made	90	53	6	12	55	67	68	41	43	13	8	52	18	21	4	36	58	14	33	52	71	815
2000																						
Services Calling	38	27	1	6	17	26	54	42	18	8	6	14	15	21	3	30	46	6	11	14	16	
Total Calls Made	117	43	2	7	18	33	67	56	47	10	10	63	15	23	3	33	51	11	21	63	64	757
1995																						
Services Calling	32	19	1	1	1	2	35	34	20	7	5	13	5	14	6	24	28		3	13	13	
Total Calls Made	121	21	1	1	1	3	46	49	29	8	11	52	5	14	6	28	32		6	52	50	536
1990																						
Services Calling	29	17	1		2		28	30	9	3	3	7	5	12	3	21	24		3	7	11	
Total Calls Made	105	21	1		2		31	45	11	4	6	33	5	12	3	22	28		3	33	36	401

Source: Derived from MDST Containership Databank

The continued importance of San Pedro Ports can be seen from these statistics, and those in Table I-23. In 1990, 24 services made 28 port calls per week in SPB ports, out of a total of 35 T-P services (69%). In 2004, 53 of the 76 Transpacific services call in San Pedro Bay (70%).

Table I-23 – Eastbound and Westbound Port Calls Made in North America By Asia-North America Services

	North American Port Calls E/B								North American Port Calls W/B									
	LALB E/B	OAK E/B	SeTa E/B	POR E/B	BC E/B	Mex E/B	USEC E/B	USGC E/B	LALB W/B	OAK W/B	SeTa W/B	POR W/B	BC W/B	Mex W/B	USEC W/B	USGC W/B	Total E/B	Total W/B
2004																		
1st Calls	41	3	10		6	3	12		19	26	9	2	9	1	10		75	76
Total Calls	47	30	19	4	17	6	16	1	52	33	18	4	16	3	17	1	140	144
2000																		
1st Calls	36	3	10		4		7		10	22	9	3	5	2	8		60	59
Total Calls	41	27	18	3	14	6	12		41	28	17	3	13	3	13		121	118
1995																		
1st Calls	23	3	9				6		5	17	6	3	4		6		41	41
Total Calls	27	23	16	4	5		11		27	23	15	4	5		11		86	85
1990																		
1st Calls	19	3	9				2		5	14	8		3		2		33	32
Total Calls	22	18	12	3	4		9	1	21	20	12	3	4		8	1	69	69

Source: Derived from MDST Containership Databank

Carrier Service Strategy Development Since 1990

The development of service strategies by some of the leading carriers in the Transpacific trade is analysed and discussed in this section.

Maersk SeaLand

The world's largest liner company has evolved its Transpacific network substantially since 1990, when its predecessor components – Maersk Line and Sea-Land Service – operated two and three weekly strings, respectively.

In that year, Sea-Land deployed 17 ships to this sector, 12 of which were 2600-TEU, US-flag vessels and 5 of which were 2100-TEU, steam-powered, US-built vessels qualified to carry cabotage containers. Only one of this carrier's three weekly strings called in San Pedro Bay. The others, the "cabotage" string (PEX) was limited by schedule constraints to providing a Taiwan – PNW eastbound service (to match its PNW/Bay Area – to – Hawaii/Guam westbound service), while the third string's eastbound mission was to link Singapore, Hong Kong, Taiwan, and especially Japan base ports with the Tacoma gateway.

Japan was the largest Asian origin market for Sea-Land at this time, and the carrier's Japanese customers demanded (and received) direct services to both the Pacific Northwest and Pacific Southwest ports. Sea-Land's reliance at this time on 12 US-flag vessels (in addition to the cabotage-qualified ships) was a function of desiring access to flag-impelled military cargoes from the USA to North Asia, and also of capital spending constraints imposed by its parent corporation, CSX.

As a more recent entrant to the Transpacific trade, Maersk's capacity presence was slightly smaller than Sea-Land's and configured differently. The Danish line operated a 12-ship pendulum service (known as the "Panama" string) between Singapore, Hong Kong, Taiwan, Japan, California, the US East Coast, and North Europe, with relatively-new 4000-TEU ships. It also ran a PNW service linking Hong Kong, Taiwan, and Japan with Tacoma, using 5 smaller (2000 TEU) ships built in the mid-70s.

Sea-Land and Maersk would join forces the following year (1991) and commence a Transpacific vessel sharing agreement covering six weekly strings – a frequency level unmatched at that time by any other line. Indeed, this transaction catalyzed other carriers to forge their own alliances in the Transpacific to remain competitive.

By 1995, the Sea-Land/Maersk Line vessel sharing agreement had evolved to a limited extent from its original configuration. Maersk continued operating its 12-ship Panama string (with the same 4000-TEU vessels), along with a new 5-ship express service between Hong Kong/Taiwan and Southern California (using a collection of 23-knot vessels averaging 2800 TEU in size). Sea-Land continued running its 5-ship PEX service from Taiwan (and now Hong Kong) to Tacoma/Oakland (with a return via Honolulu and Guam), along with a 7-ship PSW string (extended to Singapore). Sea-Land had also inaugurated a 4-ship service from California to Honolulu to West Japan to California, mainly to provide a direct service from Southern California to Hawaii and also an express service from West Japan.

The two carriers had also rationalized their respective PNW strings into one jointly-operated string with 6 ships averaging 2200 TEU. The composition of the 6 strings reflected the growing importance of having an express eastbound service for the rapidly-expanding South China – Southern California market segment.

Although post-Panamax ships were just beginning to be considered by some carriers in the Transpacific trades between 1990 and 1995, Maersk Line and Sea-Land had instead established a collective priority for their VSA on maximizing sailing frequencies – partially due to Sea-Land's capital spending constraints, as well as its need to continue using both the US-built and the US-flag ships.

Nonetheless, it was during this same period that Maersk embarked on the construction of its first post-panamax vessels, the 6000 TEU K-Class. The first of six such vessels entered service in 1996, followed soon after by the first lengthened version, the so-called S-Class with a "declared" capacity of 6600 TEU, but more likely having a capacity in the 7600-8000 TEU range. With the introduction of these large new vessels, and a continuing program to build more of them at the company's Danish shipyard, Maersk was firmly committed to building its network around large vessels. Although the majority of Maersk S and K-class vessels were employed in the Asia-Europe trade, at least one string of these ships has been calling in SPB since approximately 1999.

By 2000, the Maersk Line/Sea-Land Transpacific VSA had evolved first into a Global VSA (in 1996) and then into a fully consolidated operation under one commercial entity, following A.P. Moller Group's purchase of Sea-Land's international shipping operations from CSX, at the end of 1999. This transaction gave Maersk greater flexibility in its fleet planning, resulting in substantial changes in the services and vessels deployed in the Transpacific sector.

For the latter half of 2000, the new Maersk Sea-Land line operated 6 weekly strings in the trade:

- The old "Panama" (TP3) service (now with just 11 of the original 4000 TEU ships and without a Singapore port call).

- A new, parallel pendulum string (TP2) was also deployed linking the Far East, California, and the US East Coast, using most of the 2600-TEU ships acquired from Sea-Land).

- The TP5/AE5 deployment that appended an eastbound Transpacific service from Salalah, Pelepas (Malaysia), Singapore, and Yantian direct to San Pedro Bay with a Far East – North Europe service, using 13 x 6600-TEU/24.5 knot ships

- The TP4/AE4/TP6 deployment, which had 14 ships (with an average capacity of 4100 TEU) running from the US East Coast through the Mediterranean and Suez Canal to Salalah/Malaysia/Singapore/Hong Kong/Taiwan, and then California, before reversing course back through the same regions to the US East Coast – effectively providing an all-water Asia – North America service from Hong Kong/Taiwan and Southeast Asia via the Suez Canal, as well as a conventional, express service from Southeast Asia and Hong Kong/Taiwan to Southern California

- The TP1 deployment, which was now converted to a jointly operated string with CSX Lines (the residual cabotage shipping operations of Sea-Land), in which the latter company utilized its vessels westbound to Hawaii and Guam, while Maersk Sealand purchased the eastbound voyage and slots from Hong Kong to Tacoma – still running with the same steam-powered ships as in 1990.

The Danish carrier's network plan at this time (as in prior periods) was driven not only by market share objectives and concentrations on particular Asian countries (such as China), but also by the need to keep its affiliated shipyard utilized. Over the following four years, Maersk Sealand added two additional deployments, but substantially modified its various pendulum services:

- The TP2 string was converted into a pure West Coast shuttle

- The TP3 string's Transatlantic voyage leg was discontinued, and the number of ships contracted to 9

- The TP5 deployment's North Europe – Salalah voyage leg was eliminated, 13 ships were contracted to 9, and the ship-class was scaled down to 4000+ TEU vessels

- The TP4/AE4/TP6 deployment's Transatlantic voyage leg between Algeciras and the US East Coast was converted into a Mediterranean – North Europe leg, with an accompanying reduction of 3 ships

Although Maersk Sealand eliminated its all-water US East Coast service via the Suez Canal, the carrier then replaced it with a new all-water string (TP7) via the Panama Canal. In addition, two new shuttle services to San Pedro Bay were initiated, one from Hong Kong/South China/Taiwan (TP8) and the other from Shanghai/Ningbo (TP9).

The scope of these changes reflected Maersk Sealand's desire to maintain competitive sailing frequencies (especially eastbound to Southern California), in response to the increased strings provided by the CHKY and the Grand Alliance, but also the carrier's needs for capacity and frequency in the Asia – Europe trades, where most of its largest ships were and are still deployed.

APL (and New World Alliance)

The carrier considered to be the premier Transpacific line during the 1980s began the 1990s with 3 weekly strings and a sector fleet of 15 US-flag ships:

- One of these three deployments (the PSX) was among the first in the trade to run directly from Hong Kong/Taiwan to San Pedro Bay, using what were then 5 "state-of-art", 4300-TEU/24-knot ships.

- Another string (the PIX, with 10-year old, 2800-TEU ships), linked San Pedro Bay with Guam westbound, and provided the carrier's Japan – Pacific Southwest eastbound service as well.

- The third string utilized 20-year old, 1900-TEU tonnage to give APL's customers a service link from Hong Kong, Taiwan, and Japan to Seattle.

Despite its highly competitive services from Hong Kong/Taiwan and from Japan to San Pedro Bay, APL felt compelled to respond to the Maersk/Sea-Land vessel sharing alliance, after the latter was announced, and assembled a VSA with OOCL in 1991. [The Taiwanese carrier was involved previously in separate vessel sharing agreements with Neptune Orient Lines (NOL) and K-Line.]

By 1995, the APL/OOCL collaboration furnished the market with 5 weekly sailings:

- APL continued to operate its PSX and PIX strings (with the same vessels as in 1990, and with essentially the same port rotations)

- OOCL was running 5 older ships (averaging 2500 TEU in size) in a Hong Kong/Taiwan/Japan – Seattle service (the PNX)

- The two lines jointly operated an express service (the STX) between Malaysia, Singapore, Hong Kong, Taiwan, and California (with a blend of new 4800-TEU, post-Panamax ships contributed by APL and older, slower 3000-TEU vessels from OOCL)

- APL and OOCL also deployed a supplemental service (SJX) between Korea, Taiwan, West Japan, and Seattle --- the distinctive mission of this latter deployment was to carry US military cargo westbound to Okinawa and Korea.

APL and OOCL eventually converted their joint STX string to a uniform deployment of 6 x 4800-TEU ships from APL in the following year. However, by 1997, this alliance was severely disrupted because the American carrier was in the process of being acquired by Singapore-based NOL. [The latter carrier had been involved in a tri-partite vessel sharing alliance with NYK and Hapag Lloyd that provided the trade with a competitive 5 weekly sailings.]

In a move that would cause several vessel alliances to be re-aligned, APL and NOL (now consolidated and operating under the APL banner) pulled out of the two agreements its component lines were party to, and entered into a new tri-partite VSA with Mitsui OSK Line (MOL) of Japan and Hyundai Merchant Marine (HMM) of Korea. [The Japanese carrier had previously been operating 5 Transpacific strings in tandem with K-Line, while the Korean line had been running 2 weekly services independently.]

By 2000, the "New World Alliance" (NWA) of APL, MOL, and HMM had expanded to an industry-leading 9 weekly strings, leveraging their combined fleets, which had been supplemented with new-buildings from two of the member lines. During the 1997-2000 period, HMM had taken delivery of 5 x 5500-TEU/25-knot ships (the third-largest class of vessels deployed in the Transpacific), while APL had introduced 6 x 4500 TEU/24.5 knot ships at approximately the same time.

Although the four lines (APL, NOL, MOL, and HMM) collectively had more than 55 ships assigned to the Transpacific sector in 1996, prior to the formation of the NWA, and could have potentially operated 9 (or at least 8) strings without new tonnage, they individually and collectively concluded that a migration of their fleet to larger and faster ships was necessary due to trade growth and competitive pressures, and that such a migration would be easier to implement by leveraging the combined marketing forces of the member-lines.

Only 1 of the 9 NWA strings in 2000 was actually operated jointly – a US East Coast service via the Panama Canal, with 9 ships averaging 3100 TEU of weekly capacity. Each of the three member carriers had effectively its own express service from Hong Kong/South China to Southern California, as well as its own service from Far East base ports to the Pacific Northwest. In addition, APL operated a 6-ship string (with its 4800-TEU ships) that provided customers with the first non-stop service from Singapore to San Pedro Bay, and also ran a joint service with Matson from California to Guam (returning via Qingdao, Korea, and Japan), as a modified successor to its earlier PIX string.

Between 2000 and 2004, the NWA has added two strings, and has also re-tonnaged and re-configured several of its services in response to volume growth, to shifts in the geographic distribution of the Transpacific trade within Asia, and to competitive pressures.

- The alliance enlarged its existing jointly-operated all-water service to 3800-TEU ships, and concurrently added another joint all-water service, using 4600-TEU ships.

- At the same time, HMM upsized both its PNW service (from 3000 TEU to 4400 TEU) and its PSW service (from 5500 TEU to 6400 TEU/26 knot new-builds), without any significant eastbound port rotation changes to either string.

    - In addition, HMM launched a new service – the PCX – linking Tianjin, Shanghai, and Ningbo directly with San Pedro Bay (with an intermediate stop in Busan), using older, 2900-TEU vessels.

- Conversely, MOL elected to discontinue its own PNW service, replacing it with its own direct service from Hong Kong/South China to San Pedro Bay (and upsizing from 2700-TEU to 4500-TEU ships in the process)

    - MOL simultaneously upsized its PS3 service from 2900-TEU to 4500-TEU ships (while adding a second PRC port call – Ningbo – to its eastbound rotation).

    - As a member of a Japanese keiretsu, MOL's decision to no longer operate its own vessels between Japan and Seattle was undoubtedly a difficult decision, but clearly reflects the decline in the volumes and revenue value of that particular market segment, relative to the corresponding growth in the eastbound trade from South China to the Southern California basin.

- APL chartered in 5500-TEU ships to upsize its Southeast Asia-focused string (SAX), but otherwise kept its existing deployments essentially the same.

These NWA deployment changes over the past four years, in which the alliance members increased their collective capacity by 35% despite depressed Transpacific trade conditions in 2001-2002, reflect the lack of coordination of the members' fleet planning efforts (especially between HMM and APL/MOL) and desires to maintain their own services in key markets, rather than an integrated approach to the market.

Evergreen

Of the carriers with a significant presence in the Transpacific trade since the mid-1980s, this Taiwanese line is the only one to have consistently operated on an independent basis, only recently entering into a few limited slot exchange agreements. Consequently, its fleet evolution reflects the management's views on market growth and their market share objectives, without the deployment planning complications arising from vessel sharing agreements.

In 1990, Evergreen had 3 weekly eastbound Transpacific strings, one of which was its core, 12-ship Round-the-World (RTW) eastbound service - started in 1984 with 2700-TEU/20-knot ships, and linking the Far East base ports of Singapore, Hong Kong, Kaohsiung, Busan, Osaka, and Tokyo with San Pedro Bay and the US East Coast. Evergreen also operated another 6 x 2700 TEU ships from Hong Kong/Taiwan to Southern California and 5 x 1800 TEU ships from Hong Kong/Taiwan/Japan to Seattle/Vancouver.

Five years later, Evergreen had expanded its trade frequency (from 3 to 4 weekly sailings), while also re-tonnaging all of its original strings:

- The RTW-EB string was upsized to 4200-TEU/23-knot ships (with the faster speed enabling a reduction in the number of vessels deployed)

- The PSW string was upsized to 3400-TEU ships

- The PNW string was appended to a Far East – Europe string and simultaneously upsized to 2700-TEU ships.

In addition, to compete with APL's direct STX service from Singapore, Evergreen had launched its own Singapore – San Pedro Bay string (also with an intermediate eastbound call in Hong Kong), with a blend of older ships that averaged 2000-TEU in size. Thus, Evergreen increased its average capacity during the first half of the decade from about 7200 TEU/week to roughly 12,200 TEU/week, an expansion of about 11% per year on average.

By 2000, Evergreen had added another Transpacific string and had again retonnaged and/or reconfigured most of its earlier services. Although the RTW-EB service had essentially the same ships and port rotation, the PNW service was detached from the Far East – Europe string it had previously been appended to (partially to improve its schedule reliability), with 5500-TEU/24.5 knot new-builds deployed into it. Evergreen had also substantially upsized its Hong Kong/Taiwan PSW express service to San Pedro Bay, from 3400-TEU ships to 5600-TEU/24.5 knot new-builds.

The Singapore Express service was discontinued and replaced with a 5-ship service (HTW) that used a mixture of relatively new ships (with an average capacity of 5100 TEU) to provide a second weekly express service in the Hong Kong/Taiwan – San Pedro Bay corridor, only with a slightly different port rotation to the PSW (now renamed as the TPS). Finally, Evergreen's incremental string, which was operated with 9 older ships having an average capacity of about 2000 TEU, enabled the line to offer all-water US East Coast service from Hong Kong/Taiwan via the Panama Canal without intermediate port calls in Korea, Japan, and California (which were incorporated into the RTW-EB itinerary).

Consequently, in the second half of the prior decade, Taiwan's leading carrier expanded its weekly Transpacific slot capacity from about 12,200 TEUs to 22,400 TEUs, with a higher average annual growth rate (about 13%) compared to the previous five years. Perhaps as importantly, the change in the composition of Evergreen's deployments during this period clearly reflects the carrier's *increasing concentration of services from the Hong Kong/Taiwan area* of the Far East, with all five of its strings calling in those two countries and with three of the deployments (TPS, HWT, and USEC) sailing directly to their respective destination markets from this region.

Between 2000 and 2004, Evergreen discontinued its long-running eastbound and westbound RTW services, but once again added another Transpacific string (bringing its total sailing frequency for the trade to six per week) and also made various deployment and tonnage changes:

- The all-water USEC express service from Hong Kong/Taiwan (re-named as the AUE) was upsized from 2000-TEU/20-knot ships to 4200-TEU/23-knot ships

- The HTW was contracted to 4 ships, with certain port calls eliminated, but preserving its prime mission of providing a direct Hong Kong – San Pedro Bay link

- The TPS was enlarged from a 5500-TEU string to one with 6200-TEU/24.5-knot newbuilds

- The RTW-EB was replaced by the new NUE service, operating with 12 ships averaging 4100 TEU in capacity, and linking the primary Far East base ports (excluding Singapore) with the US East Coast via California

- The TPN service was re-named (to the CPN), significantly down-sized (from 5400-TEU ships to 2700-TEU vessels), and re-configured (from making eastbound calls in Hong Kong, Taiwan, and Japan before sailing to Tacoma, to calling in Shanghai, Qingdao, and Busan instead)

In addition, Evergreen commenced a new service – the CPS – linking Shanghai and Ningbo with Oakland and then San Pedro Bay, using 5 x 3400 TEU ships. Despite the addition of this string, Evergreen's rate of capacity expansion during the past four years was lower than its 1995-2000 surge, reflecting the depressed rate conditions in the Transpacific eastbound trade from the second half of 2001 through the first half of 2003. From 2000 to 2004, the Taiwanese line increased its weekly slot provision by only 10%, to 24,700 TEU (or 2.5% per year, on average).

Conclusions on Carrier Deployment Strategies

As the preceding reviews have indicated, three major carriers all expanded their Transpacific frequencies and capacities significantly between 1990 and 2004, but in markedly different ways and for diverse reasons. While an examination of other carriers' respective deployment histories during this same period would reveal further variations in the timing, scope, and rationale for expansion, it would still indicate a few common drivers among all the major lines:

- A desire to capitalize on the unit slot cost economics of larger ships, and simultaneously on periods of depressed pricing from shipyards on newbuildings

- A desire to maintain parity with peers, in terms of sailing frequency and transit times, in the most important market segment

- A corollary desire to protect and expand market share.

Task I-5: Containership Activity in San Pedro Bay

Port of Long Beach vessel-by-vessel load and discharge data for a three year period was studied in order to identify the vessel turnover that is typical of port calls in San Pedro Bay.

The data used for this analysis was extracted by the POLB from the Port Wharfinger's cargo reporting system, and included each of the 4405 container vessel calls that were made at the POLB between May 2001 and June 2004.

The wharfinger data included the number of full and empty TEUs loaded to and discharged from each container vessel calling at the Port. The data included the vessel name and the date of each call. To determine the percent of each vessel that was discharged or loaded, the capacity of each vessel was identified by searching container vessel databases[2] (by vessel name) to identify the nominal capacity of the vessel. As might be expected, not all vessel names were identified in available vessel databases. However, vessel capacities were identified for vessels responsible for over 95% of the containers handled, and the %-discharged and %-loaded figures are based on these vessels.

Most vessels calling at POLB are operated within an alliance or space sharing agreement. The wharfinger data, however, does not include the trade served or a carrier's space allocation for vessel calls, so it was not possible to compute space utilization by carrier or by trade.

Output from this analysis is presented in Appendix I.5a. A summary of the results is provided in Table I-24.

Table I-24 - Container TEU Discharged and Loaded At POLB
By Vessel Capacity Group

Full + Empty Containers

Total TEU Discharged					
TEU Grp	2001	2002	2003	2004	Grand Total
<250	1,304	6,576	5,413	2,503	15,796
250	-	69	-	306	375
500	5,222	8,511	453	55	14,241
1,000	47,483	59,866	146,030	91,700	345,079
2,000	166,181	264,635	367,387	149,293	947,496
3,000	229,745	396,592	340,581	220,077	1,186,995
4,000	419,749	450,168	497,663	217,890	1,585,470
5,000	333,974	733,093	664,627	361,860	2,093,554
6,000	167,650	278,328	380,763	264,969	1,091,710
7,000	205,937	185,073	-	-	391,010
8,000	-	-	5,838	26,539	32,377
Subtotal	1,577,245	2,382,911	2,408,755	1,335,192	7,704,103
As % of Cap	57%	58%	55%	54%	56%
Uknown Cap Vsls	103,285	92,426	87,201	46,784	329,696
Grand Total	1,680,530	2,475,337	2,495,956	1,381,976	8,033,799
TEU/wk	48,015	47,603	47,999	53,153	

Full + Empty Containers

Total TEU Loaded					
TEU Grp	2001	2002	2003	2004	Grand Total
<250	1,340	6,852	6,198	3,254	17,644
250	-	56	-	94	150
500	5,791	7,818	962	272	14,843
1,000	65,194	73,455	135,936	93,560	368,145
2,000	147,170	227,572	335,363	148,707	858,812
3,000	206,046	357,171	262,026	174,280	999,523
4,000	365,434	374,707	441,177	183,221	1,364,539
5,000	262,958	589,641	553,087	278,629	1,684,315
6,000	106,237	191,229	292,490	213,214	803,170
7,000	115,938	113,493	-	-	229,431
8,000	-	-	7,245	28,005	35,250
Subtotal	1,276,108	1,941,994	2,034,484	1,123,236	6,375,822
As % of Cap	46%	47%	46%	45%	46%
Uknown Cap Vsls	86,146	72,777	83,075	39,285	281,283
Grand Total	1,362,254	2,014,771	2,117,559	1,162,521	6,657,105
TEU/wk	38,922	38,746	40,722	44,712	

Source: POLB Wharfinger

Analysis of the wharfinger data indicated that on average, the volume discharged from container vessels at POLB is about 50-60% of a vessel's nominal capacity (average in 1st half of 2004 was 54%). At the higher capacity levels, however, this figure increases. For ships in the 5000+ TEU size category, the percentage discharged (loads + empties) typically falls in the 75-80% range.

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[2] The following two vessel databases were consulted: the Clarkson's Containership Register and the vessel fleet database of CI-Online.

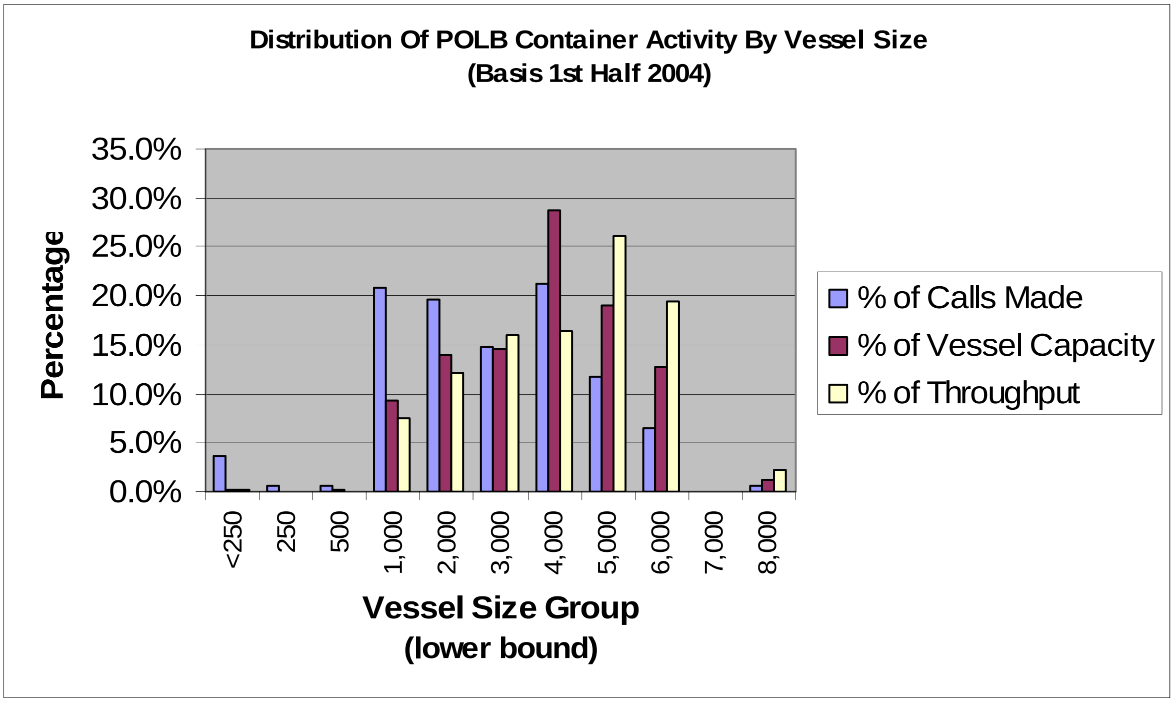
The distribution of container activity across vessel size groups is an important factor for calculating the number of future port calls that would be required to accommodate expected container traffic. This analysis illustrated the relative contribution of large and small ships in terms of port calls made and containers handled. The percentage of vessel calls, vessel capacity, and TEU throughput have been plotted for the most recent 6 month period available (Jan-Jun 2004), and are presented in Figure 1.

About 75% of port calls are made by ships within the 1000 to 5000 TEU size range, with a fairly even distribution of port calls by ships within the 1-2000, 2-3000, 3-4000, and 4-5000 TEU groups (each with about 20%, except 3-4000 with 15%). As a group, the 4000-5000 TEU category included the most calls. Vessels within this size range accounted for about 2/3 of the capacity and about ½ of the throughput.

Ships below 1000 TEU are inconsequential in terms of cargo handled (0.3% of the total), but accounted for nearly 5% of the port calls.

Ships over 5000 TEU accounted for about 19% of the port calls, about a third of the capacity, and about half of the throughput. Of all the size groups, vessels within the largest groups showed the highest percentage discharge, with TEU discharge in excess of 75%. This is seen as the result of fewer calls being made by the large ships on any given voyage, such that more of the ship's capacity is handled during the POLB call. As more ships of 5000-8000+ TEU are deployed on rotations with limited WCNA port calls, the SPB discharge percentage for Pacific loop services will likely trend higher, with the effect of reducing the number of vessel calls required to support a given level of box through-put.

Figure I-1 - Distribution of POLB Activity By Ship Size



Source: POLB Wharfinger

Section II: FACTORS INFLUENCING SAN PEDRO BAY PORT CALLS

In this section of the report, Mercator presents its projections for the Transpacific fleet for the 2005-2007 period, based on certain trade volume expectations and on known orders for new vessels. In addition, we present a series of analyses on selected, critical drivers of future deployment patterns for the Asia – North America trade, including ship design issues, comparative vessel economics, port infrastructure capabilities, potential Panama Canal expansion, and prospective changes in industry structure.

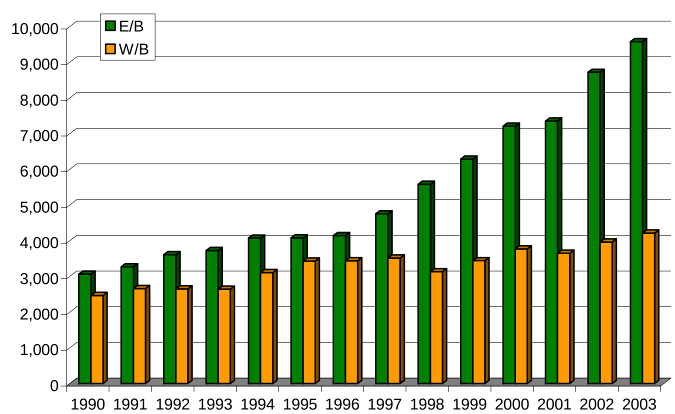
Task II-1: Trade Volume Scenarios For Fleet & Port Call Forecasting

A key input to the forecast of port call activity at San Pedro Bay ports is of course the expected level of container throughput. The Ports of Long Beach and Los Angeles last completed a long-term cargo forecast in 1998. Since that study was completed, cargo volumes have grown more strongly than anticipated. For this current study of vessel trends and future port call activity, Mercator was therefore asked to briefly review the earlier forecast and to update the figures to reflect recent activity. The objective of the MTG review was to establish a high - low growth range for alternate scenarios that bracket the range of foreseeable outcomes.

As shown in Table I-4, overall trade volume in and out of SPB ports is heavily imbalanced, with import volumes exceeding export volumes by more than 3:1. For the Transpacific trade overall, a similar imbalance exists, as shown in Table II-1. Given that the E/B (import) direction continues to grow faster than the W/B (export) direction, the flow imbalance is expected to persist for the foreseeable future. Because of this trade flow imbalance, it is the *import* volume that determines the number and size of vessel services calling the ports, and therefore our forecast will focus on the future import volume growth.

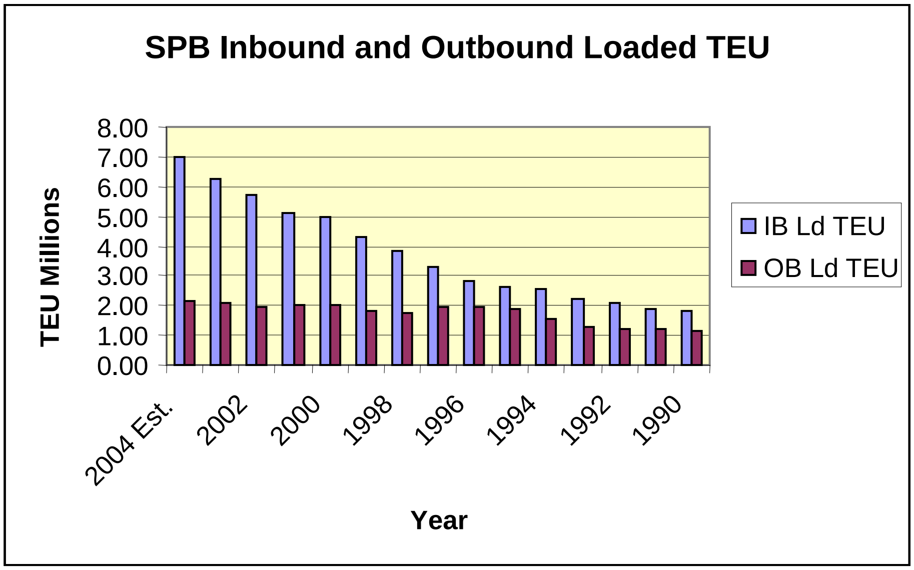
Table II-1 -Transpacific Trade Volumes: E/B vs. W/B Imbalance

Transpacific Trade TEUS (000)				
	Volume		Annual Growth	
Year	E/B	W/B	E/B	W/B
1990	3,065	2,468	-	-
1991	3,270	2,662	6.7%	7.9%
1992	3,613	2,652	10.5%	-0.4%
1993	3,729	2,644	3.2%	-0.3%
1994	4,077	3,112	9.3%	17.7%
1995	4,079	3,431	0.0%	10.3%
1996	4,147	3,444	1.7%	0.4%
1997	4,758	3,515	14.7%	2.1%
1998	5,581	3,134	17.3%	-10.8%
1999	6,290	3,445	12.7%	9.9%
2000	7,211	3,775	14.6%	9.6%
2001	7,352	3,654	2.0%	-3.2%
2002	8,721	3,964	18.6%	8.5%
2003	9,580	4,216	9.8%	6.4%
Cumlative Average Growth Rate			**9.2%**	**4.2%**



Sources: Drewry & CI-Online
North America includes US, CDA and Mexico

Figure II-1 - Import / Export Load Imbalance at SPB Ports



Source: Ports of Los Angeles and Long Beach

Because the port call forecast will be developed on a tradelane-specific basis, it is helpful to develop a growth forecast on the same tradelane basis. As an input to a tradelane-specific volume outlook, recent volume and growth data by tradelane is Presented in Table II-2.

Table II-2 - Recent Growth Of Tradelanes Involving Southern California[3]

Trade Volume and Growth To/From Southern California (TEUs in 000's)

		EXP					IMP					Combined				
F.Region	Tradelane	2000	2001	2002	2003	2004E	2000	2001	2002	2003	2004E	2000	2001	2002	2003	2004E
Aus-NZ	TEUs	109	91	86	97	123	51	44	39	39	62	160	134	125	137	185
	Ann Growth		-16%	-5%	13%	26%		-14%	-10%	0%	58%		-16%	-7%	9%	35%
	CAGR					3%					5%					4%
Trans-Pacific	Trans-Pacific	1,338	1,398	1,379	1,527	1,659	4,451	4,622	5,287	5,714	6,820	5,790	6,020	6,666	7,241	8,479
	Ann Growth		4%	-1%	11%	9%		4%	14%	8%	19%		4%	11%	9%	17%
	CAGR					6%					11%					10%
Trans-Panama	TEUs	102	82	74	93	100	207	210	205	217	240	309	292	279	310	340
	Ann Growth		-20%	-10%	26%	7%		1%	-2%	6%	11%		-6%	-5%	11%	10%
	CAGR					0%					4%					2%
WCSA	TEUs	36	31	27	23	31	66	59	72	51	75	101	90	99	75	106
	Ann Growth		-12%	-14%	-13%	33%		-11%	23%	-29%	47%		-11%	10%	-25%	43%
	CAGR					-3%					3%					1%
All Trades	TEUs	1,585	1,602	1,566	1,741	1,913	4,775	4,935	5,603	6,021	7,197	6,360	6,536	7,169	7,763	9,111
	Ann Growth		1%	-2%	11%	10%		3%	14%	7%	20%		3%	10%	8%	17%
	CAGR					5%					11%					9%

Source: JOC/Piers

[3] "Trans-Panama" tradelanes are those trades that move to and from SPB ports via the Panama Canal, and include trade involving countries in N. & E. Europe, the Med, Carib, Cen Amr, Africa. Transpacific includes N & S Asia, ISC, and the Middle East. Service patterns for these trades are more fully discussed in Section III of the report.

It is clear from this data that the Transpacific trade is the most important for SPB ports, and the principal driver for volume growth. Driven by the explosive growth of imports from the PRC, annual SPB Transpacific import growth has been 10% or more for much of the last decade[4]. Growth in Asia-North America lane, however, is expected to slow somewhat over the forecast period once PRC export growth stabilizes. Low / Expected / High growth scenarios for the Asia – SPB lane have thus been defined as 5%, 7% and 9% in order to bracket the likely growth rate for this trade. There are a variety of factors that are expected to contribute to the slowing of SPB's import growth from Asia, including, for example, the slowing of the rate of transfer of import sourcing to China from other countries such as Mexico, and the gradual redistribution of imports across more port gateways as importers seek to diversify their logistics networks.

Volume in other SPB tradelanes has been more volatile than the Asia import volumes. Although year-to-year volatility will likely persist, the long-term growth trends are nonetheless expected to remain close to the 4-6% level over the long term. In any case, because these trades are so much smaller than the Transpacific and have a much smaller influence on the number of port calls, port call forecast results do not depend strongly on the growth assumptions for these trades.

Demand growth assumptions (and corresponding capacity growth targets) are summarized in the following table.

Table II-3 - Summary of Growth Assumptions Used For Port Call Forecast Scenarios

	Low	Expected	High
Australia – New Zealand	3 %	5 %	7 %
Transpacific (Asia-North America)	5 %	7 %	9%
Trans-Panama Trades	3 %	4 %	5 %
WCSA	3 %	5 %	7 %

Although total port throughput is not an input to the port call forecast process, it can be estimated for 2020 based on the foregoing inputs and using the SPB ports' ratio of inbound to outbound TEUs. These figures are presented in the following table.

[4] See also Appendix I.1a.

Table II-4
Estimated Year 2020 SPB TEU Throughput
Consistent With Demand Growth Assumptions Used For Port Call Forecast

Tradelane	2004 Import TEUs (000s) *	Growth Rate Low	Growth Rate Expected	Growth Rate High	2020 Imports - TEU (000s) Low	2020 Imports - TEU (000s) Expected	2020 Imports - TEU (000s) High	2020 Total TEU** (000s) Low	2020 Total TEU** (000s) Expected	2020 Total TEU** (000s) High
Aus/NZ	62	3%	5%	7%	100	136	183	181	247	334
Trans-Pacific	6,820	5%	7%	9%	14,887	20,133	27,076	27,093	36,642	49,279
Trans-Panama	240	3%	5%	7%	386	524	709	702	954	1,291
WCSA	75	3%	5%	6%	121	164	191	220	299	348
Total	7,197	4.9%	6.9%	8.9%	15,493	20,957	28,160	28,196	38,142	51,251

* 2004 Import TEU by trade based on JOC/Piers data
** Total TEU estimate based on historical ratio of 0.82 OB TEU per IB TEU

The "expected scenario" with a 38.1 million TEU forecast for 2020 is comparable to the current outlook of 36.2 million TEU now being used by the SPB ports for long-term planning purposes. Certain economic or trade dislocations could occur within the expected scenario and lead to the low growth scenario. It is likely, however, that volume growth at the high level would outpace growth in the capacity of SPB port and inland transport infrastructure, which would prevent the high growth rate from being achieved throughout and to the end of the forecast period.

In developing the fleet and port call forecast under each scenario, vessel capacity is added to each tradelane such that deployed capacity calling in SPB ports increases in line with the forecast demand growth.

Task II-2: Near-Term Supply Forecast

Container carrying capacity in the Asia-North-America and Asia-Europe tradelanes is set to continue growing at double digit rates over the next three years. World container fleet capacity will grow by about 45% during this period, with the number of vessels increasing by 22%. Appendix II.2a presents a variety of data describing the vessels on order.

Most of the 391 ships over 4,000 TEU capacity that are on order for delivery during the next 3-4 years will be deployed in either of the high volume Asia-Europe or Asia-North America tradelanes. The number of Pacific services in the 4000 TEU and greater size category will increase by approximately 29, while the number of services of less than 4000 TEU will decline by approximately 17. In the Asia-Europe trade, the number of services of **5000** TEU and greater will increase by 17, with the number of services under **5000** TEU declining by 8. A listing and description of the services that are expected to be operated in each of these tradelanes is presented in Appendices II.2c and II.2d. Summaries of the projected changes in the mix of services in each tradelane by vessel capacity are shown below in Tables II-5 and II-6.

Table II-5 - Service Count - Asia-Europe Trade, By Vessel Capacity, 2004 - 2007

TEU Group		2004 Q3	2004 Q4	2005	2006	2007	'04-'07 Change	'04-'07 % Change
1	999	0	0	0	0	0	0	
1,000	1,999	4	3	2	2	2	-2	-50%
2,000	2,999	11	10	9	7	7	-4	-36%
3,000	3,999	3	4	4	4	4	1	33%
4,000	4,999	8	8	8	5	5	-3	-38%
5,000	5,999	12	13	14	16	17	5	42%
6,000	6,999	10	9	9	9	10	0	0%
7,000	7,999	1	3	6	7	4	3	300%
8,000		0	0	0	5	9	9	infinite
Total Services		49	50	52	55	58		
Wkly TEU (000s)		221	232	258	297	322		
Ann Cap Increase				11%	15%	9%	CAGR:	11.5%
Avg. TEU/Service		4,503	4,647	4,969	5,398	5,560		
% Cap. Incr. From Added Svcs				35.7%	38.7%	63.3%		41.2%
% of Added Capacity From Larger Ships				64.3%	61.3%	36.7%		58.8%

Source: MDST Tradelane Forecast

Table II-6 - Service Count - Transpacific Trade, By Vessel Capacity, 2004 – 2007

TEU Group		2004 Q3	2004 Q4	2005	2006	2007	'04-'07 Change	'04-'07 % Change
1	999	1	1	1	1	1	0	0%
1,000	1,999	4	4	3	3	3	-1	-25%
2,000	2,999	16	14	10	8	8	-8	-50%
3,000	3,999	19	20	20	16	11	-8	-42%
4,000	4,999	20	21	27	28	30	10	50%
5,000	5,999	11	10	11	12	14	3	27%
6,000	6,999	4	4	5	8	9	5	125%
7,000	7,999	1	2	1	6	5	4	400%
8,000	and up	0	1	3	3	7	7	infinite
Total Services		76	77	81	85	88	12	16%
Wkly TEU (000s)		294	304	339	387	423	129	44%
Ann Cap Increase				11%	14%	9%	CAGR:	11.6%
Avg. TEU/Service		3,867	3,953	4,188	4,556	4,807	940	24%
% Cap. Incr. From Added Svcs				42.7%	34.9%	38.3%		35.9%
% of Added Capacity From Larger Ships				57.3%	65.1%	61.7%		64.1%

Source: MDST Tradelane Forecast

Because future deployments are only “projected”, and because the actual port rotations are not yet known, it is not possible to project precisely the composition of the Transpacific Fleet that will be calling in San Pedro Bay. However, there is no reason to believe that the relationship between the San Pedro Bay fleet composition and the Transpacific fleet composition as it exists in 2004 will change significantly. The SPB ports, as the largest North American ports in the trade, will continue to attract the largest vessels in the trade. It can be expected that all of the new 8000+ TEU vessels being introduced into the trade over the next 4 years will call at San Pedro Bay ports.

Task II-3: Assessment of Long-term Vessel Designs

Overview

There has been considerable discussion within the shipping industry of the potential for ultra-large container vessels with capacities up to 18,000 TEUs. In order to consider the likelihood and implications of the development and deployment of such vessels, it is necessary to first define the basic physical parameters of both current vessels and the larger vessels that are being contemplated.

Containership characteristics for vessels in the range of 4,000 to 18,000 TEU's are presented in Table II-7. Characteristics of the vessels in the 4000 through 8000 TEU size are based on actual ships that have a nominal capacity at or slightly greater than indicated in the heading. The proportions of the 10,000 through 18,000 TEU ships are engineering projections based on current successful designs. Specific characteristics such as breadth and length reflect discreet steps in the number of container bays and in the number of athwartship container stacks.

Table II-7 - Containership Characteristics for Vessels Ranging from 4,000 to 18,000 TEU's

Containership Size Class	TEU's	4000	5000	6000	8000	10000	12000	14000	18000
LOA	**m**	289.5	280.0	304.0	323.0	363.8	393.3	407.9	439.4
LBP	**m**	277.0	267.0	292.0	308.0	350.0	379.5	394.1	425.6
Breadth	**m**	32.2	39.8	40.0	42.8	47.2	52.1	57.0	59.6
Depth	**m**	21.5	23.6	24.2	24.6	29.9	31.5	32.6	35.1
Design Deadweight	**tonnes**	54,600	56,000	61,700	82,200	114,900	140,600	165,800	206,700
Design Draft	**m**	12.0	12.5	12.0	13.0	15.4	15.7	16.2	18.0
Keel to Top of Antenna	**m**	54.5	60.0	62.2	62.7		76.1		86.9
Speed	**knots**	24.0	24.5	25.0	25.0	25.0	25.0	25.0	25.0
Main Engine - Output - MCR kW	**kW**	37,900	43,100	57,100	68,500	74,000	82,100	89,700	98,200
Total Installed Aux. Power (w/o emerg gen)	**kW**	6,500	9,120	12,900	12,000	12,000	14,000	16,000	19,000
Fuel Consumption - at sea	**mt/day**	158	184	246	286	307	342	375	415
- maneuvering	**mt/day**	114	136	184	206	219	246	271	303
- in port	**mt/day**	13	18	26	24	24	28	32	38
Reefer Capacity	**# outlets**	250	400	500	700	800	960	1120	1440
ON DECK - Tiers / Stacks Across		5/13	5/16	6/16	7/17	7/19	7/21	7/23	8/24
IN HOLD - Tiers / Stacks Across		8/10	9/14	9/14	9/15	11/16	11/18	12/19	13/20

Source: Herbert Engineering Corp.

Where the fuel consumption was not available for an existing ship or for a projected future ship, it has been estimated based upon the following power levels and consumption rates:

- at sea the main engine operates at 85% power with a FO consumption rate of 184g / kW-hr,
- while maneuvering the main engine operates at 50% power with a FO consumption rate of 193g / kW-hr, and
- the fuel oil consumption rate of the auxiliary engines is 217.5g / kW-hr.

It has also been assumed that auxiliary power usage at sea is 46% of the total installed power, 76% while maneuvering and 38% while in port. These percentages were derived from the electric load analyses for three existing containerships. The design electric loads with maximum reefers and without reefers for the in-port, maneuvering and at sea conditions were determined as a percentage of the total installed power and then averaged. The auxiliary power usage for each operating condition assumes that the live reefer load is, on average, 45% of the maximum design reefer capacity. Electrical load analyses assumed 7-7.5 kW per reefer.

Sketches of a 6,000, 12,000 and 18,000 TEU ship with a conventional arrangement are presented in Figures II-2, 3, and 4 on the pages to follow for reference and comparison.

Containerships of 12,000 TEU's and greater have been assumed to be twin screw with an efficient gondola hull form aft. The increase in hull wetted surface and resistance that is characteristic of twin screw designs is assumed to be offset by the improvement in propulsive efficiency that arises when propellers are located outboard, in regions with better water flow around the hull and therefore better flow into the propellers.

In order to achieve a stowage arrangement for 10,000 TEU ships (and larger) with below deck containers stacked 11 or more tiers high, it is envisioned that container strength ratings will be upgraded and that cargo pre-planning will allocate lighter boxes to the stacks in the forward quarter of the ship where higher vertical accelerations would be expected. Alternatively, the cell guide system could be designed with intermediate stops to support containers above the first 7 or 8 tiers.

Deckhouse and Air Draft Considerations Affecting the Design of Large Containerships

For a conventional containership design, the height of the deckhouse and bridge is determined in some measure by the SOLAS (Safety of Life at Sea) visibility requirement. From the conning position on the bridge there should be clear visibility to the water's surface at a distance forward of the bow not farther than the lesser of two ship lengths or 500m. For ships transiting the Panama Canal, the forward visibility limitation is even more stringent. The visibility requirement reduces the number of tiers of containers that may be carried at the forward bays and is affected by draft and trim conditions.

Effective utilization of the upper-most tier on deck to transport loaded containers is related to both the stability characteristics of the ship and the on-deck securing system. In very general terms, for a Panamax ship, the fifth tier on deck is often limited to empties or very light cargo loads. For a post-panamax ship with a single level lashing bridge, the first five tiers on deck may be fully utilized and the sixth tier may be limited to light cargoes or empties. For a post-panamax ship with a double level lashing bridge, the first six tiers on deck may be fully utilized and the seventh tier may be limited to light cargoes or empties.

Navigation lights are located above the bridge consistent with regulatory requirements for their visibility. Radar and communication antennae are installed at locations above the bridge to insure that they are functional under all operating conditions. The stack and engine exhaust pipes are terminated at a height that will allow the exhaust gases and any ash

/ combustion particulate matter to be blown away in the relative air stream while the ship is underway or in a maneuvering mode under most weather conditions.

Antenna heights above the keel have been estimated for the 12,000 TEU and 18,000 TEU size ships and are based on a conventional arrangement as shown in Figures II-3 and II-4. If the arrangement was modified to locate the deck house and accommodations forward at the bow while still maintaining a machinery casing and exhaust stack at the ¾ point of the hull, the antenna height might be reduced slightly – say 1 to 2 meters. This arrangement would benefit container slot capacity as full stack heights could be accommodated all the way forward. Upper tiers that would normally be lost due to visibility restrictions would be gained.

An efficient container vessel will be designed in such a way that maximum use of the deck space is achieved, subject to stability and lashing strength limitations. This naturally leads to a certain deck house/antenna height for each given size of vessel. As indicated in Table II-7, the vertical dimension (keel to top of structures) for vessels of 8000, 12000, and 18000 TEU are approximately 63m 76m and 87m, respectively. A vessel's airdraft, which determines the required vertical clearance under bridges, is equal to these keel-to-antenna dimensions, less the (water) draft of the ship. Air draft may be slightly reduced by installing an antenna that may be tilted down or with a mechanical system to allow it to be raised and lowered.

Vessel Draft and Required Water Depth Considerations Affecting The Design of Large Containerships

The vessel characteristics presented in Table II-7 were developed without imposing restrictions on the design draft, and thus approximate the optimal vessel dimensions for ships of each capacity. As can be seen from that table, the natural design draft will exceed 14m at a vessel capacity 8000-10000 TEU. Once the design draft exceeds about 13-14m, the number of existing and planned ports that could be called is noticeably reduced, limiting the deployment flexibility and therefore utility of the vessel. In order to investigate the impact of imposing a draft constraint on large container vessels, modified designs that adhere to a maximum 14m draft were also developed.

Limiting the draft to 14m begins to affect the design of containerships at around the 10,000 TEU size. The unrestricted draft of an 18,000 TEU ship is about 18m or greater and therefore achieving a 14m design draft with proportions that fall within a reasonable range is not considered feasible. Therefore, the draft of the 18,000 TEU ship has instead been limited to 16m. The characteristics of both the draft constrained and unconstrained ships are presented in Table II-8 for comparison.

Table II-8 – Comparison of Containership Characteristics for Vessels Ranging From 10,000 to 18,000 TEU's with and without Draft Constraints

Containership Size Class	TEU's	10000	10000	12000	12000	14000	14000	18000	18000
LOA	**m**	363.8	363.8	393.3	393.3	407.9	422.8	439.4	452.2
LBP	**m**	350.0	350.0	379.5	379.5	394.1	409.0	425.6	438.4
Breadth	**m**	47.2	49.7	52.1	54.6	57.0	59.5	59.6	62.1
Depth	**m**	29.9	27.7	31.5	27.7	32.6	30.1	35.1	35.1
Design Deadweight	**tonnes**	114,900	115,200	140,600	140,200	165,800	163,900	206,700	209,300
Design Draft	**m**	15.4	**14.0**	15.7	**14.0**	16.2	**14.0**	18.0	**16.0**
Keel to Top of Antenna	**m**			76.1				86.9	
Speed	**knots**	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Main Engine - Output - MCR kW	**kW**	74,000	76,200	82,100	84,700	89,700	93,600	98,200	103,200
Tot Installed Aux. Power (w/o emerg gen)	**kW**	12,000	12,000	14,000	14,000	16,000	16,000	19,000	19,000
Fuel Consumption - at sea	**mt/day**	307	315	342	352	375	390	415	433
- maneuvering	**mt/day**	219	224	246	252	271	280	303	315
- in port	**mt/day**	24	24	28	28	32	32	38	38
Reefer Capacity	**# outlets**	800	800	960	960	1120	1120	1440	1440
ON DECK - Tiers / Stacks Across		7/19	7/20	7/21	7/22	7/23	7/24	8/24	7/25
IN HOLD - Tiers / Stacks Across		11/16	10/17	11/18	10/19	12/19	11/20	13/20	13/21

Source: Herbert Engineering Corp.

In each case, the constrained draft is achieved by increasing the beam to permit an additional stack below deck and on deck and/or by increasing the overall length to permit an additional bay of containers. The effect of this is particularly acute for the larger ships. For example, the 12000, 14000 and 18000 TEU ships increase to 23, 24 and 25 containers across, and lengths reach 393, 423 and 452m, respectively. Ships of this size may face additional navigating constraints due to their length and breadth, over and above those related to depth of water. Increasing length or breadth to accommodate a draft limitation increases hull resistance and, therefore increases the required power and fuel consumption. In these size ranges, the draft constraints as envisioned impose a fuel cost penalty of approximately 3-5%. The implications of this potential fuel penalty will be further considered in the section of this report addressing vessel economics.

Figure II-2 - 6000 TEU Post-Panamax Containership

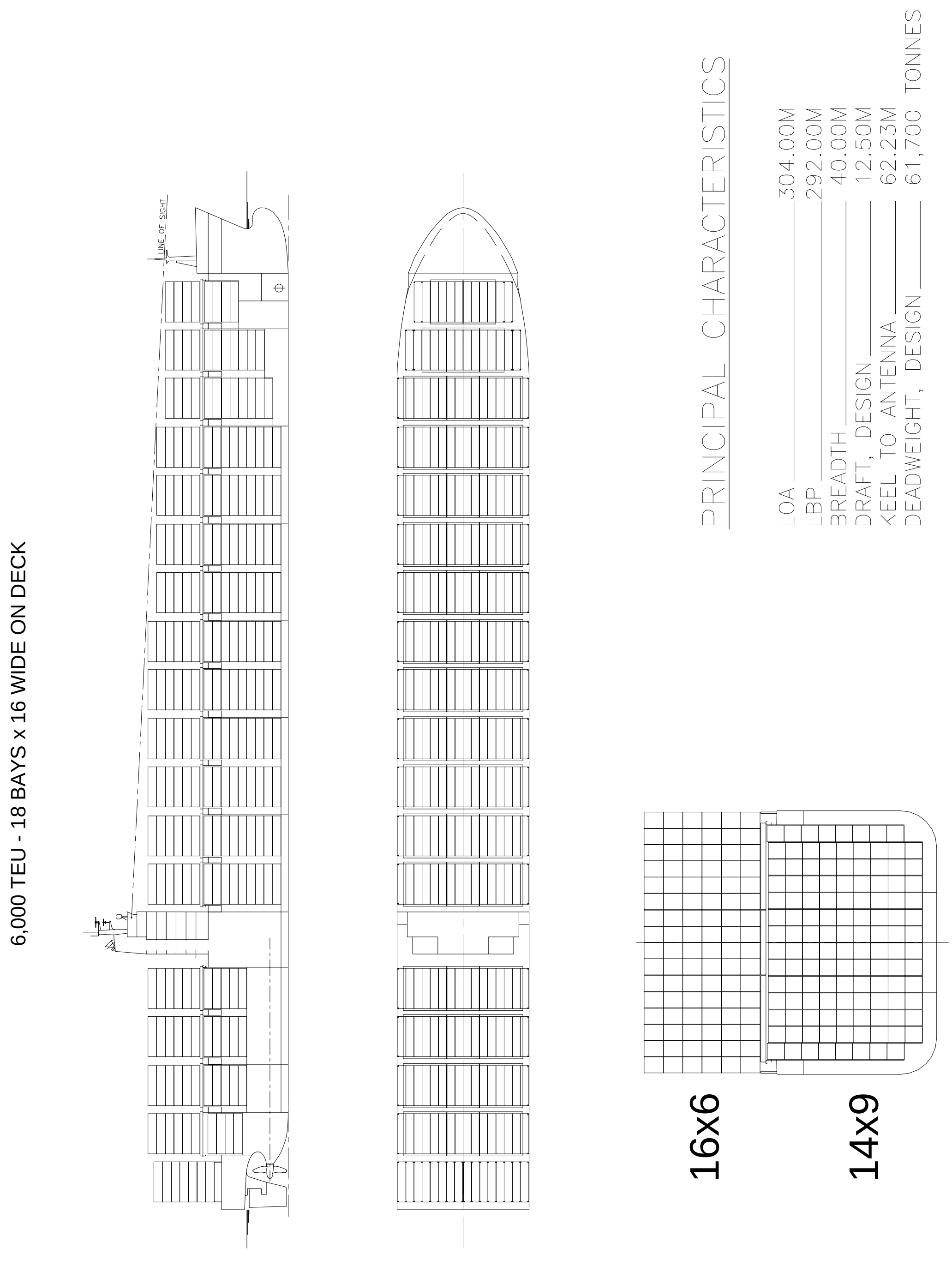


Figure II-3 - 12,000 TEU Suezmax Containership

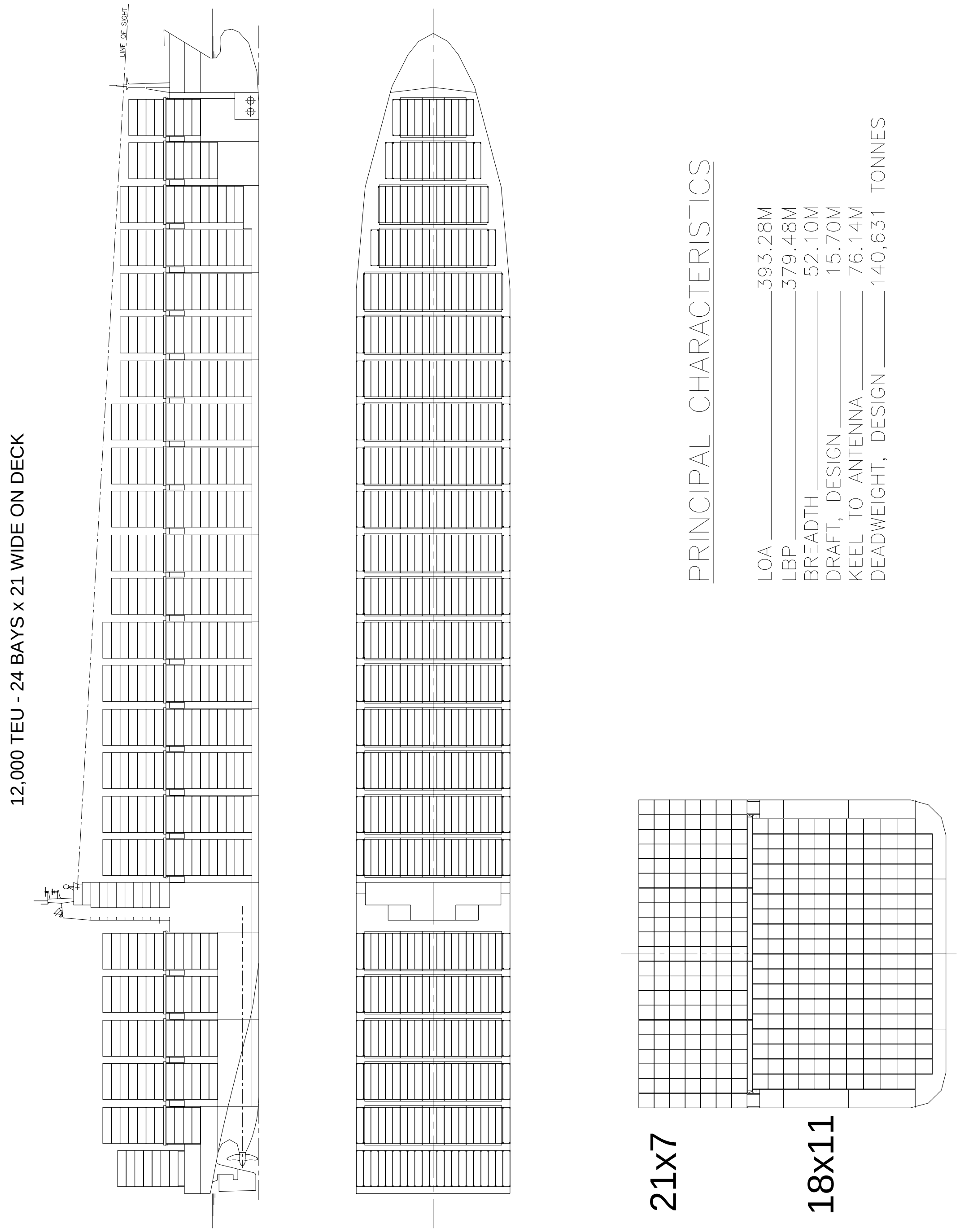
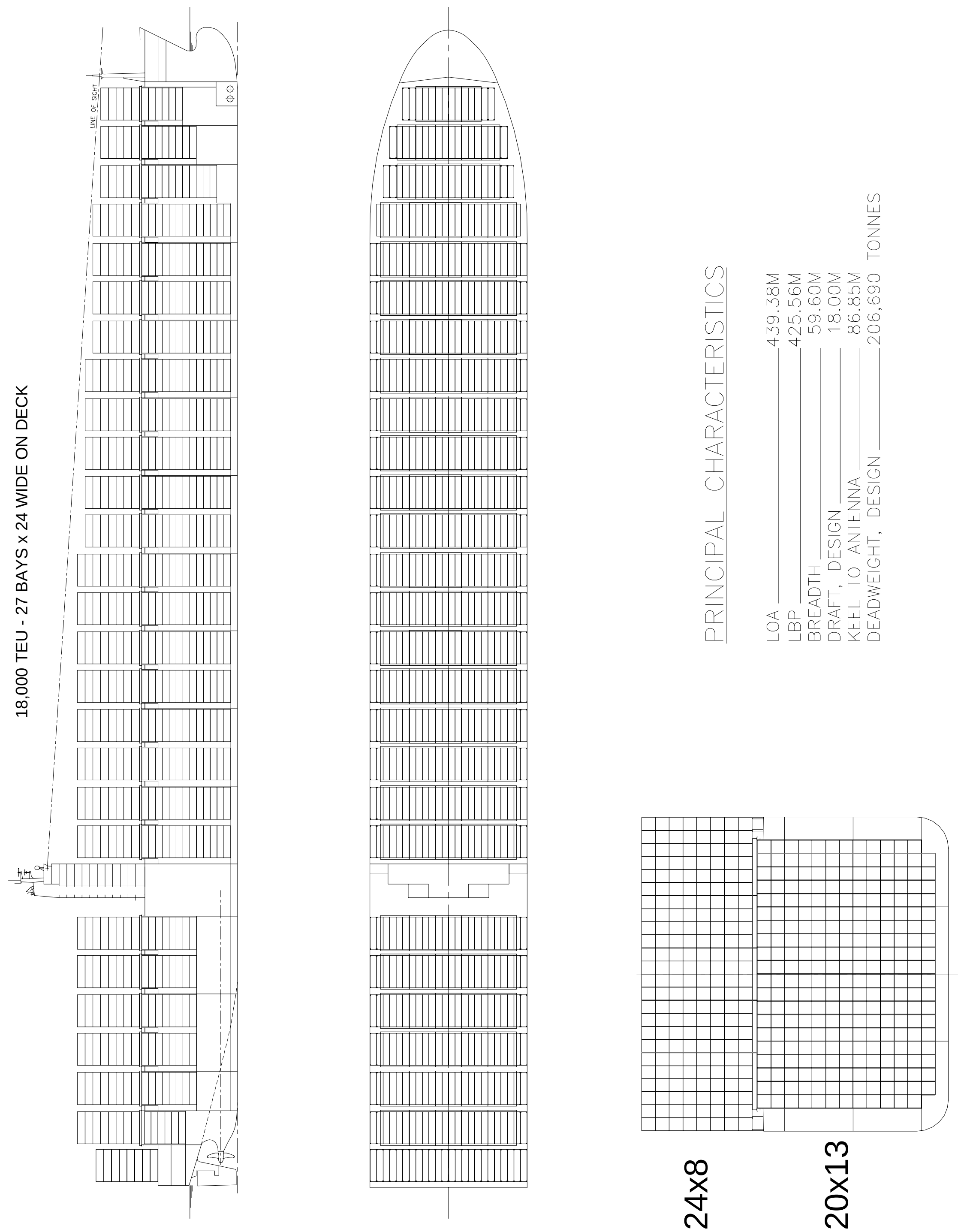


Figure II-4 - 18,000 TEU Containership



Current and Future Design Limits Imposed By The Panama & Suez Canals

Some east-west trades restrict vessel traffic to confined shipping lanes. Two of the more significant man-made restrictions are the Panama and Suez Canals. Both canals significantly reduce the all-water mileage on east-west trade routes thus reducing shipping costs. The following paragraphs identify current ship size limitations for the canals and briefly review present and proposed plans for future enhancements.

Currently, of the two canals, only the Panama Canal has limitations that have proven restrictive to containerships. Vessel breadth is limited to 32.2m and this in turn limits the maximum size containership to about 4500 TEU's. The Panama Canal Authority has been considering plans for future expansion that would permit passage containerships of approximately 12,500 TEU capacity. These plans include construction of additional locks with chamber dimensions that are 427m long, 61m wide and 18.3m deep, although it has recently been reported that the Panama Canal Authority may scale back these plans to suit ships up to about 10000 TEU. In either case, existing trades between the US East Coast and Asia and to a lesser extent between the US West Coast and Europe would benefit from the utilization of larger, more efficient ships and it is envisioned that cargo volumes on these routes would increase as a result.

Dredging has increased the depth of the Suez Canal so that it can accommodate tankers up to 200,000 tonnes DWT. For vessels in ballast, the maximum permitted beam is 74.67m, with draft of 9.75m forward and 11m aft, with no restrictions on a vessel's length. Vessels with a beam greater than 64m and similar drafts are only permitted to transit in calm conditions with a beam wind of 10 knots or less.

For loaded vessels transiting North or South, the Suez Canal Authority provides Beam / Draft Tables to determine the maximum draft permitted. For example, for a beam up to 53.04m the maximum draft is 16.05m or for a beam up to 60.96m the maximum draft is 12.72m.

The Suez Canal Authority is currently moving ahead with a 10 year project to widen and deepen the Canal so that by 2010 it can accommodate VLCC and ULCC class tankers with cargoes of up to 350,000 deadweight tonnes. Due to the ongoing improvements, the maximum size containership that can transit the Suez Canal is in essence a moving target but currently it would be in the range of 12,000 to 12,500 TEU's. It is envisioned that after the enhancements, containerships capable of transporting 18,000 TEU's could transit the canal.

The envisioned characteristics of future panamax and suezmax containerships are as follows:

Table II-9 – Prospective (Future) Maximum Vessel Characteristics
For Panama and Suez Canals

	Future Panamax	**Future Suezmax**
Capacity	12,000 TEU	18000 TEU
LOA	394.0 m	440.0 m
LBP	380.0 m	426.0 m
Beam	52.1 m	60.0 m
Depth	31.5 m	35.1 m
Draft, design	15.7 m	18.0 m
Deadweight (tonnes)	140,700t	207,000 t

Source: Herbert Engineering Corp.

Propulsion System Requirements and the Impact on Vessel Design

Twin Screw vs. Single Screw

Up to now, Owners have been able to avoid the need for twin screw propulsion, and so all large containerships in service (other than those with very unique operating requirements) feature a lower cost, more efficient, single screw arrangement. As large container ships continue to evolve and increase in size and speed, however, the required power will exceed the limits of single screw propulsion technology. A second screw will be added to share the total power demand.

If the power is to be split evenly between the two screws, a conventional open water stern with twin shafts, struts and propellers can be developed, or a more modern and efficient twin gondola stern can be utilized, similar to the new TOTE Orca Class trailer ships built at NASSCO. For fuller ships, twin gondola sterns have proven to be equivalent or slightly more efficient than single screw propulsion. Although the hull forms have a greater wetted surface area and more resistance, the improved flow into the propellers yields a higher propulsive efficiency that can offset or exceed the increase in resistance. The engines and auxiliaries used in these twin screw ships would be the same as for a single screw ships, so the emission rate per kW produced or per kg of fuel burned will not change. The potential gains for a new generation of large twin screw container ships with a twin gondola or other hull form will be determined by future research and model testing. For the purposes of the characteristics presented herein, it has been assumed that powering and consumption are comparable to single screw ships.

Propulsion System Improvements:

Diesel engine fuel consumption rates have been reduced over the last 35 years, but the most significant improvement occurred during the beginning of the period. Little change in the fuel consumption rate has taken place over the last 15 years. The primary emphasis in diesel development in recent years has been in improving emissions characteristics. Specifically, the manufacturers have been concentrating on ways to reduce the NOx emission rates.

An emerging technology that has promise to reduce fuel consumption is the use of the Contra Rotating Pod (CRP) system. In this arrangement, a single low speed diesel is directly connected to a single propeller on the ship's centerline. An azimuthing pod is placed aft of and in line with the ship's propeller and is arranged to rotate in the opposite direction. The contra rotating effect has been shown to convert more of the rotational energy imparted by the propeller into thrust and thus enhance efficiency and fuel consumption. The pod propulsion power is typically about 30 to 40 % of the low speed diesel power. There are at present only a few prototype installations of this technology on some high speed ferries.

Gas turbines have generally not been applied to commercial ships with the exception of a very limited number of applications to cruise ships. Their significantly higher fuel costs, due to higher consumption rates and higher fuel quality requirements have effectively prohibited them from being applied to containerships.

Electric drive, and podded propulsion, which is a form of electric drive, have become very popular for cruise ships where only a fraction of the installed power is for ship propulsion and fuel costs are generally a smaller portion of the overall operating cost. For most types of commercial vessels operating on long voyages, the inefficiency of the electric drive increases fuel costs in the range of 8% to 12.5% and therefore it is far less attractive than a low speed diesel directly connected to the propeller shaft.

Impact of International Regulations:

It is anticipated that future regulations will require all oil tanks on all vessels to be protected from the sea by double hulls or other means that provide equivalent protection from oil spills. This will have a major impact on container ships that have historically carried fuel oil in wing tanks and on occasion in innerbottom tanks. Future vessel designs will likely allocate fuel oil to inboard transverse bulkhead spaces as well as spaces that are currently used for cargo.

Emissions regulation brought on by international treaty – MARPOL Annex VI – will limit all ship's fuel world wide to 4.5% sulfur. This will not be a major problem since most ship's fuel is currently in the range of 2.5 to 3% sulfur. The treaty also allows for the establishment of sulfur control areas, (SECA) where the maximum sulfur content can not exceed 1.5% sulfur. The first SECA will be the Baltic Sea and parts of the North Sea and English Channel. There is activity underway to declare both coasts of North America a SECA. In addition, the European Union has proposed limits on the sulfur content of distillate oil burned while in EU ports. The measure, EU Directive 1999/32 is not yet approved, but proposes to limit sulfur to 0.2% until January 1, 2010 when the limit would be reduced to 0.1%. There have been reports by some ship owners that MDO (marine diesel oil) is not available with sulfur this low. MGO (marine gas oil) will meet this standard and is available since it has widespread use for land based applications, but it is substantially more expensive. The EU directive allows the use of HFO (Heavy Fuel Oil) with sulfur at the MARPOL limit of 4.5% or 1.5% when in a SECA. This has led some ship owners to burn HFO with higher sulfur rather than an expensive distillate.

The California Air Resource Board, CARB, has fielded a draft proposal to require all ships in California waters to burn only MGO with 0.2% sulfur by January 1, 2006 and with no more than 0.1% sulfur by January 1, 2008. They also propose that for any vessel making more than 5 calls per year on any California port the vessel must file a plan within a year of the fifth visit that is activated within the next year to reduce their NOx and Particulate Matter (PM) by 50% over what is expected from burning the cleaner low sulfur fuel. The potential impact of these proposed regulations is that tanks on existing ships will have to be modified and new piping and equipment installed to handle MGO and to keep this fuel separate from MDO and HFO. It is not clear at this point how ship owners might develop plans to reduce NOx emissions by 50% as the technology and systems to develop viable commercial components are still being developed.

Conclusions Regarding Large Containership Designs

It is considered technically feasible to develop container vessels up to the 18,000 TEU size. The ability to design and build these vessels will not be a factor that limits their introduction. Other factors that could limit the introduction of such vessels, including the suitability of ports and the commercial attractiveness of handling ultra large parcels of cargo on a single vessel, will likely come into play before issues of technical feasibility.

Task II-4: Projections of Long-term Vessel Economics

In order to evaluate vessel deployment alternatives and consider how fleet deployments may evolve over the next 20 years, a set of baseline vessel costs, by size category, is required. The development of vessel costs was done in three steps. The first step was to create a consistent set of vessel designs and define the characteristics of each, including main dimensions, power and speed characteristics, and capacity. Drawing on information found in Appendix I.2.c Table II-7, basic data for cost estimating was assembled as shown in Table II-10. Based on these vessel specifications, acquisition costs for each vessel were developed based on recent world shipbuilding prices. These estimated costs are also presented in Table II-10. Acquisition costs were also estimated for each of the four draft-constrained vessel designs (of 10000, 12000, 14000, 18000 TEUs).

Table II-10 - Estimated Containership Acquisition Costs

Size Class		**1000**	**2000**	**3000**	**4000**	**6000**	**8000**	**10000**	**12000**	**14000**	**18000**
Nominal TEU Capacity	TEUs	1100	2100	3100	4000	6300	8100	10700	13100	15300	19200
LOA	m	145.7	182.0	220.5	289.5	304.0	323.0	363.8	393.3	407.9	439.4
LBP	m	135.9	172.7	210.2	277.0	292.0	308.0	350.0	379.5	394.1	425.6
Beam	m	23.3	29.8	32.2	32.2	40.0	42.8	47.2	52.1	57.0	59.6
Depth	m	11.7	15.6	18.7	21.5	24.2	24.6	30.0	31.5	32.6	35.1
Design Draft	m	**8.8**	**10.1**	**10.5**	**12.0**	**12.0**	**13.0**	**15.4**	**15.7**	**16.2**	**18.0**
Design DWT	tonnes	13,200	23,800	32,200	54,600	61,700	82,200	114,900	140,631	165,800	206,700
Speed	knots	19.0	20.0	22.0	24.0	25.0	25.0	25.0	25.0	25.0	25.0
Installed Power (MCR)	kW	10,560	12,240	26,270	37,878	57,075	68,520	74,000	82,100	89,700	98,200
Acquisition Cost / Ship	$ millions	$24.5	$36.0	$51.7	$66.9	$86.4	$96.1	$119.1	$143.5	$158.2	$177.1
$ Cost / TEU	$	$23,300	$17,500	$16,600	$16,600	$13,800	$11,900	$11,100	$11,000	$10,300	$9,200

		With Draft Constraints			
Size Class		**10000**	**12000**	**14000**	**18000**
Nominal TEU Capacity		10700	13000	15200	19400
LOA	m	363.8	393.3	422.8	452.2
Beam	m	49.7	54.6	59.5	62.1
Depth	m	27.7	27.7	30.1	35.1
Design Draft	m	14.0	14.0	14.0	16.0
Design DWT	tonnes	115,200	140,200	163,900	209,300
Speed	knots	25.0	25.0	25.0	25.0
Installed Power (MCR)	kW	76,200	84,700	93,600	103,200
Acquisition Cost / Ship	$ millions	$118.0	$138.7	$159.1	$185.3
$ Cost / TEU	$	$11,000	$10,700	$10,500	$9,600

Source: Herbert Engineering Corp.

Vessel acquisition costs were then combined with assumptions about the cost of capital and costs for vessel operations (crew, insurance, maintenance and repair, etc.) to arrive at daily vessel costs for each size category. These figures are presented in Table II-11.

Table II-11 - Daily Vessel Operating Costs By Vessel Size
Inputs For Network Analysis and Planning

Vessel Particulars and Daily Costs Used For For Network Planning

Nominal TEU	Eff. TEU Capacity	Max DWT mt	Speed	Fuel Cons mt/day At Sea	Fuel Cons mt/day In Port	Estimated Owner's Daily Cost*	2004 Acquisition Cost ($mil)	Daily Owner's Cost $ Per TEU
Base Designs								
1,000	840	14,000	18.0	38	3	12,800	24.5	15.2
2,000	1,800	30,000	21.5	52	5	17,400	36.0	9.7
3,000	2,700	40,000	22.0	92	9	23,500	51.7	8.7
4,500	3,900	60,000	24.0	160	13	29,600	66.9	7.6
6,000	5,400	81,000	25.0	246	16	37,300	86.4	6.9
8,000	7,200	100,000	25.0	286	20	41,300	96.1	5.7
10,000	9,600	120,000	25.0	307	24	50,200	119.1	5.2
12,000	11,800	150,000	25.0	342	28	59,600	143.5	5.1
14,000	13,800	175,000	25.0	375	32	65,400	158.2	4.7
18,000	17,300	225,000	25.0	415	38	72,800	177.1	4.2
With Draft Constraints								
10,000	9,600	120,000	25.0	315	24	49,800	118.0	5.2
12,000	11,800	150,000	25.0	352	28	57,800	138.7	4.9
14,000	13,800	175,000	25.0	390	32	65,800	159.1	4.8
18,000	17,300	225,000	25.0	433	38	75,900	185.3	4.4

* Includes capital cost, basis 8% amortization over 12 years; excludes fuel

Source: Herbert Engineering Corp. / Mercator Transport Group

Task II-5: Evaluation of Key SPB Trading Ports

In developing vessel deployment plans for a particular liner trade, and in selecting optimal vessel-types for each service, carriers must consider the available port facilities and the water draft and air draft constraints at the primary ports in both continents comprising the trade. In this task, Mercator briefly reviewed the fundamental capabilities and constraints for handling very large containerships in each of the primary Far East base ports, in order to provide additional insights on future Transpacific deployment patterns relevant to the San Pedro Bay ports.

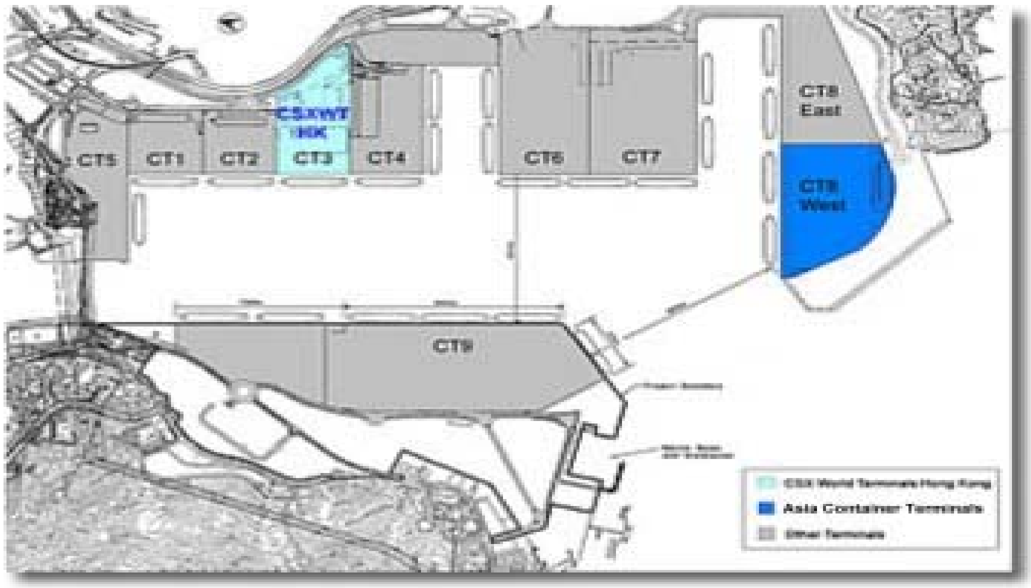
Given that over 69% of the Transpacific imports to Los Angeles and Long Beach are now originating in Greater China (including Hong Kong and Taiwan), and considering both current and anticipated deployment patterns for very large containerships, the primary Far East base ports (or port clusters) were defined as follows:

• Hong Kong	• Shanghai	• Busan/Kwangyang
• Yantian	• Ningbo	• Kobe/Osaka
• Kaohsiung	• Qingdao	• Tokyo/Yokohama

Hong Kong

Hong Kong is the world's largest container port (in terms of annual through-put), and presently has seven separately-operated marine terminals in the Kwai Chung area of its harbour, all of which are accessed by a body of water known as the Rambler Channel.

Figure II-5 – Hong Kong Container Terminals at Kwai Chung



- *CT1/CT2/CT5*, a three-berth facility operated by Modern Terminals Limited (MTL)
- *CT3*, a one-berth facility originally developed by Sea-Land Service in the 1970s, and now managed by CSX World Terminals (CSXWT)
- *CT4/CT6/CT7*, a ten-berth facility developed in multiple stages, and run by Hutchison International Terminals (HIT)
- *CT8E*, a two-berth facility that opened in 1998, and is effectively run by HIT, though as a joint venture with COSCO Pacific, and functions essentially as a set of dedicated berths for COSCO's container line
- *CT8W,* a two-berth facility also known as Asia Container Terminal (ACT), is operated by a joint venture comprised of SHK Holdings & CSXWT. CSXWT acts as the facility manager.
- *CT9N,* a two-berth facility on the southeast side of Tsing Yi Island, opened in 2004, and run by HIT
- *CT9S,* a four-berth facility also opened in 2004, and operated by MTL

None of these facilities have any significant expansion potential, bordered as they are by highways, steep hills (especially behind CT9), and densely developed urban neighbourhoods. The oldest terminals within the Kwai Chung area (CT1/CT2/CT5, CT3, and CT4) are sub-optimally configured to accommodate “super” post-Panamax ships. However, as the following table implies, CT8 and CT9 have been designed to handle such vessels.

Table II-12
Summary of Hong Kong's Terminal Characteristics

Operator	**HIT**	**HIT**	**COSCO/HIT**	**MTL**	**MTL**	**ACT**	**CSXWT**	**Total**
Terminal	CT-4,6,7	CT-9	CT-8E	CT-1,2	CT-9	CT-8W	CT-3	All
# of line-haul berths	10	2	2	3	4	2	1	24
Total Berth Length(m)	3,292	700	640	935	1,387	740	305	7,999
Depth(m)	13.3 - 14.0	15.5	15.5	13.3	15.5	15.5	14.0	N/A
# Cranes	33	4	9	26		8	4	84
Terminal Area (Hectare)	92	19	30	92		28.5	16.7	278
Design Capacity (000 TEU/year)	5,500	1,100	1,200	1,500	2,600	1,300	750	13,950
Projected 2004 Thru-put	6,300		1,600	4,200		0	800	12,900
Projected Market Share - 2004	**49%**		**12%**	**33%**		**0%**	**6%**	**100%**

Source: Various

As part of the CT9 construction project, which commenced in 1999, the Rambler Channel was dredged to a depth of 15.5 meters, consistent with the quayside depths of the berths of the new terminal. The Hong Kong Port and Maritime Board has undertaken preliminary studies on the engineering, environmental, and economic viability of further deepening the Channel, but a decision on whether or not to proceed with such a project is most likely a few years away from being made.

In the interim, the Hong Kong Special Administrative Region is also considering when or whether to proceed with the development of a new, tenth terminal, to be located either on Lantau Island (about 10 kilometers west of the Kwai Chung area) or on the southwest side of Tsing Yi Island (around the shoreline from CT9).

Yantian

South China’s leading container port has experienced explosive growth since opening in the mid-1990s, driven by its proximity to cargo and significant cost advantages over the nearby Kwai Chung terminals. Yantian handled 5.26 million TEUs in 2003, through its one terminal, Yantian International Container Terminals (YICT), operated by a subsidiary of HIT. From its inception as a 3-berth facility, YICT has implemented two successive expansion programs, the latest of which will be completed next year. With its “Phase III” expansion fully operational, YICT will have 9 line-haul berths and more than 200 hectares of terminal space, as indicated in the following table:

Table II-13 - Yantian Container Facilities

Summary of YICT's Facilities

Terminal Charcteristics	Phase			Total
	I	II	III	
Linehaul Berths	3	2	4	9
Total Berth Length(m)	1,500	850	1,400	3,750
Quayside Depth (m)	14	15	16	-
Number of Cranes	12	8	18	38
Terminal Area (Hectares)	66	52	90	208

Source: www.YICT.com.cn

The port has the ability and the intent to add more terminal capacity over time, northeast of the orange-shaded Phase III development:

Figure II-6 - Yantian Container Terminals

Access to this terminal complex is via a navigation channel through Dapeng Bay that has 14-20 meter water depths. There are no bridges that vessels must pass under to reach Yantian International Container Terminal.

Figure II-7 - Location of Yantian Port

Given its growing importance as a gateway for the eastern half of Guangdong Province, and its terminal capacity expansion potential, Yantian is clearly positioned to become an increasingly important port-of-call for Transpacific vessel services, especially to San Pedro Bay. Indeed, YICT's Phase III expansion program has been deliberately engineered to enable the terminal to receive and handle 9,000+ TEU ships:

- Quayside water depth has been constructed to a 16-meter depth, with similarly deep channels accessing these berths
- The berths are each 350 meters in length
- The gantry cranes for these berths will each have an outreach of 65 meters

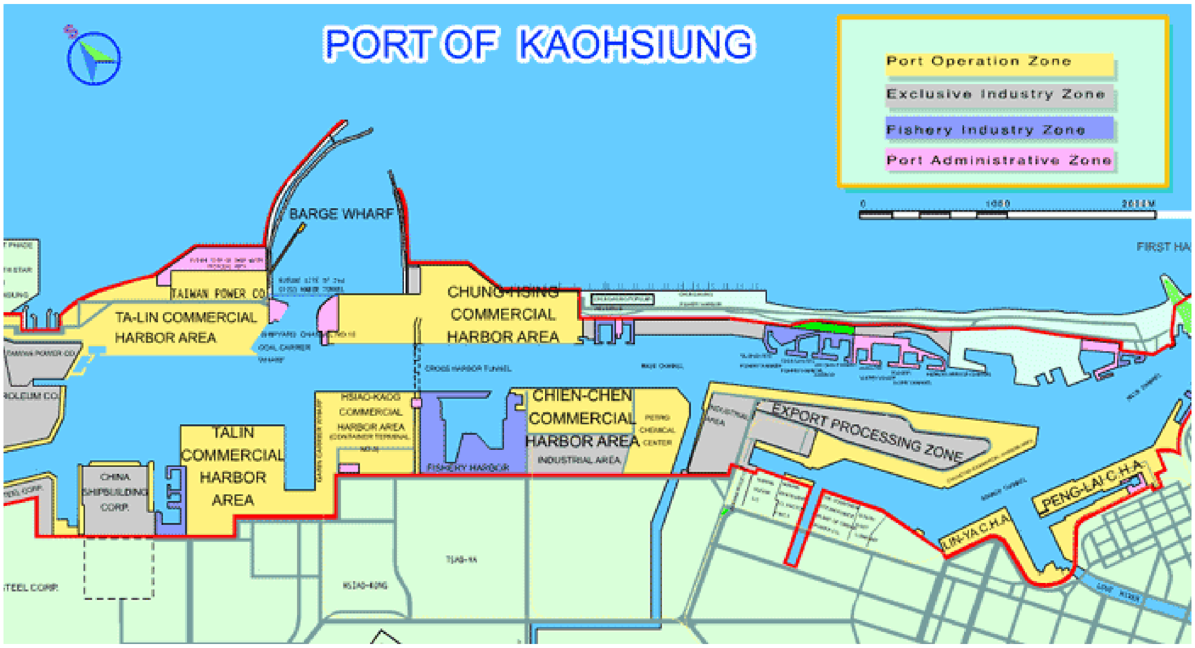
Moreover, should quayside water depths in excess of 16 meters be required in the future for maintaining the terminal's competitiveness, both the Shenzhen Municipal Port Authority and HIT would undoubtedly fund the dredging to make this happen.

Kaohsiung

Although Taiwan's leading port has experienced moderate traffic growth in the past five years, the more rapid expansion of China's liner traffic and container ports has resulted in fewer shipping lines using Kaohsiung as their primary hub port in the Far East. Nonetheless, the Port is still included in 31 of the 76 weekly vessel services in the Transpacific trade.

Kaohsiung has 22 separate container terminals, several of which are located on an island connected to the mainland via tunnel, as indicated in the following diagram.

Figure II-8 – Layout of the Port of Kaohsiung



Source: www.khb.gov.tw

The Port's main navigation channels have a MLW depth of -16 meters, with a tidal range of approximately 0.5 meters. The majority of its newer container berths have quayside depths of 14-15 meters. The Port is also planning an expansion of its container facilities, to be built further into the Formosa Strait.

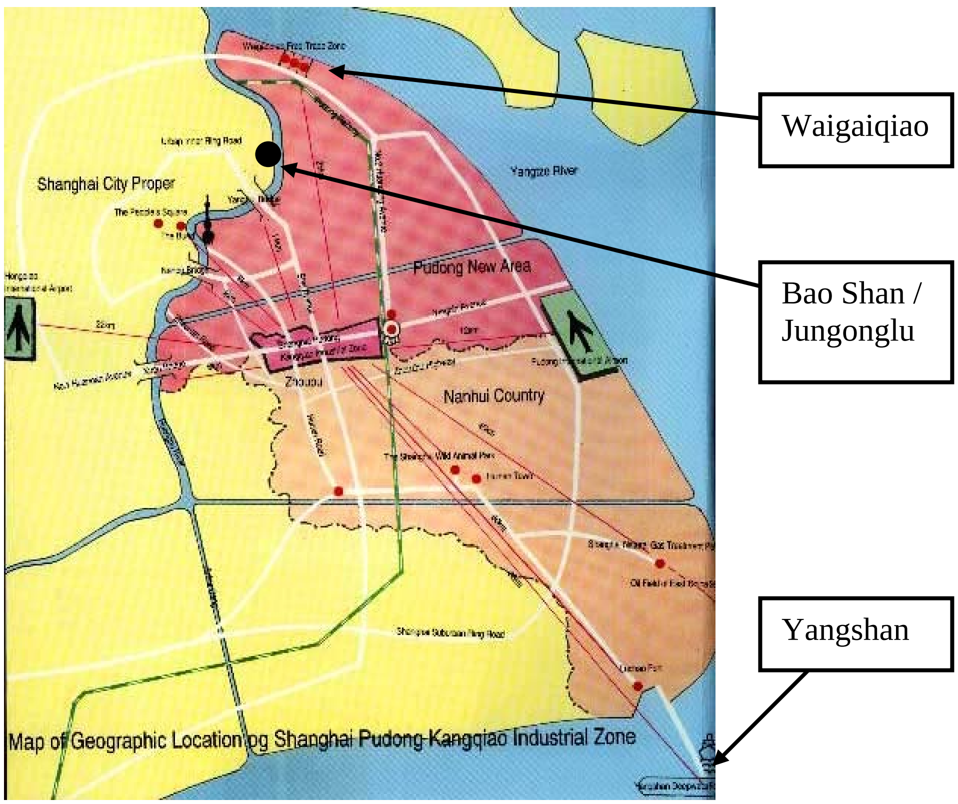
Shanghai

Shanghai is China's leading port and has benefited from its location near the mouth of the Yangtze (Chang Jiang) River. It has experienced significant growth in terms of its traffic base (now having the third largest through-put in the world), in spite of the fact that its container terminals have been significantly draft-constrained. The port's first dedicated container terminals, known as the Bao Shan and Jungonglu facilities, are located on the Huangpu River, a tributary of the Yangtze. Quayside depths at this location are only 9.5 – 10.5 meters. Shanghai's second terminal complex – known as Waigaoqiao and located along theYangtze itself, has been developed in five sequential phases and has quayside depths of 11-12 meters.

Although it might be possible to dredge the berths at Waigaiqiao to provide deeper water, there is a sandbar in the River downstream from the terminal that cannot be feasibly removed, and which limits the drafts of vessels sailing upstream to only 10.5-11.0 meters (depending on tidal conditions). Although a $300+ million dredging project is underway to deepen the navigation channel at the river mouth, its depth will still be only 12 meters after the work is completed.

Consequently, the Shanghai Special Administrative Region (SAR) and the Shanghai International Port Group decided several years ago to circumvent the draft restrictions imposed by the Yangtze River and develop a massive port complex around the Xiaoyangshan Islands, located about 30 kilometers offshore and southeast of the SAR's Nanhui district:

Figure II-9 – Shanghai Container Facilities



The first phase of this project –a five-berth terminal to be operated by SIPG – is scheduled to open in 2005. Other terminals will be developed through concessions to be tendered to international joint venture companies, with the master plan calling for the construction of another 27 berths by the year 2020. The new port complex will be linked to the mainland by a 31-kilometer long, multi-lane bridge. By using landfill to connect some of the islands within the Xiaoyangshan archipelago, and because of the area's distant offshore location, SIPG will be able to obtain natural channel and quayside MLW water depths of 15 meters for this new port.

Considering the tremendous scale of this infrastructure project and the Shanghainese backgrounds of some of the PRC Government's leaders, it is clear that the Yangshan port complex is not intended to simply provide Shanghai with additional marine terminal capacity, but instead to establish the Port as a leading transhipment hub in the Far East, by being able to accommodate the world's largest container ships. This new physical capability, coupled with the size and projected growth of Shanghai's regional cargo base and with its strategic location (relative to Japan, Korea, and northern China), is likely to result in Shanghai eventually becoming the world's largest container port.

Ningbo

Ningbo is the leading port of Zhejiang Province and China's second largest port, in terms of total tonnage. It has traditionally been focused on handling petroleum products, chemicals, and dry bulk cargoes, but has recently attracted a significant amount of container traffic, handling 2.8 million TEU of through-put in 2003. Although the center of this metropolitan area of 6 million residents is on a river, the Port's international cargo-handling facilities are located on a naturally-deep bay in the Beilun District.

The Port presently has two separate container terminals – a 4-berth public facility operated by the Port Authority and a 3-berth facility operated by HIT. The latter terminal has 900 meters of linear berth, with quayside depth of 13.5 meters and 75 hectares of yard space.

The Port also has ambitious growth plans, with a three-phase construction project underway to develop 15 more berths (each with 15 meters of quayside water depth). The first portion of this expansion will become operational in 2005.

Qingdao

Qingdao is the primary gateway of Shandong Province and is also China's third largest container port, after Shanghai and Yantian. For deepsea international liner services using latest-generation ships, there is essentially one container terminal available in this port – the Qingdao Qianwan Container Terminal (QQCT), first developed in the late 1990s in an area on the opposite side of the bay on which the city of Qingdao is situated.

Figure II-10 - Qingdao Port Location

QQCT is a joint venture between the Qingdao Port Corporation and three international maritime companies – P&O Ports, A.P. Moller Group, and COSCO Pacific – and contains 5 line-haul berths, with 15-meter quayside depths and approximately 155 hectares of back-up land. In 2005, the terminal will complete its latest expansion project, which will add three more berths and additional yard space.

The Port Corporation has reached an agreement with China Merchants Corporation to develop a five-berth facility on the west and south sides of the same slip that QQCT fronts, and is also negotiating with CSXWT and other parties to develop an additional four berths on the south side of this same slip.

All of these berths will be accessed by 15.5 meter-deep channel, and quayside berth depths for the new berths being constructed will be 16.5-17 meters. No bridges exist across either the channel through Jiazhao Bay or the Qianwan slip.

Busan

The Port of Busan presently has nine separately-operated container terminals in six different areas of the harbor:

Figure II-11 - Busan Container Terminals

Source: www.portbusan.or.kr

- *Jaeseongdae*, a five-berth facility opened in 1978, and now operated by Hutchison Busan Container Terminal Company (HBCT)

- *Sinseondae*, a four-berth facility opened in 1991, run by a unit of the Korea Container Terminal Authority (KCTA) and known as Pusan East Container Terminal (PECT)

- *Uam*, a two-berth facility opened in 1996, and managed by a subsidiary of the Korea Container Transportation Company

- *Gamchon*, another two-berth facility opened the following year, and operated by a division of Hanjin Shipping (Korea's largest ocean carrier)

- *Gamman*, a four-berth facility that opened in 1998, and was split into four one-berth terminal concessions, which were allocated to the following companies:

    - Hyundai Merchant Marine (which sold its concession to HIT in 2002)
    - Hanjin Shipping
    - Korea Express
    - Global Enterprise (a Korean company)

- *Sin-gamman*, a three-berth facility opened in 2002, which is leased to a joint venture between Evergreen Marine (a major Taiwanese ship line) and Dongbu Group (a Korean conglomerate)

Access to all of the above-listed terminal complexes, except for Gamchon, is provided by a navigation channel that varies in MLW depth between 15 and 20 meters. There are no bridges under which a vessel must pass in order to berth at any of these facilities, key physical parameters of which are provided in the following table:

Table II-14 – Existing Busan Terminal Characteristics

Terminal Charcteristics	Gamman	Jaseongdae	Singseondae	Singamma	Gamcheon	UAM	Total
Operator:	Hanjin/Korea Express/Globa/ Hutchison	Hutchison	Pusan East Container Terminal Co.	Dongbo J.V. Evergreen	Hanjin	Uam Terminal Co.	All Terminals
Number of linehaul berths	4	4	4	2	2	0	16
Number of feeder berths	0	1		1		3	5
Total Berth Length(m)	1,400	1,447	1,447	826	600	500	6,220
Depth(m)	15	14	14 - 15	15	13	11	68
Number of Cranes	14	13	13	7	4	4	55
Terminal Area (Hectare)	75	65	104	31	14	18	307
2003 Throughput	2,546,391	1,584,429	1,786,112	745,544	512,240	533,285	7,708,001
% of Busan's Total Volume	33%	21%	23%	10%	7%	7%	100%
Alternate Capacity Measures (TEUs)							
Berth Length (1,500 Per Meter)	2,100,000	2,170,500	2,170,500	1,239,000	900,000	750,000	9,330,000
Terminal Area (25,000 per Hectare)	1,875,000	1,617,500	2,597,500	770,000	355,000	460,000	7,675,000
Crane Production (160,000 per crane)	2,240,000	2,080,000	2,080,000	1,120,000	640,000	640,000	8,800,000
Minimum Operational Capacity	**1,875,000**	**1,617,500**	**2,080,000**	**770,000**	**355,000**	**460,000**	**7,157,500**
2003 Utilization @ Min.Op.Cap.	136%	98%	86%	97%	144%	116%	123%

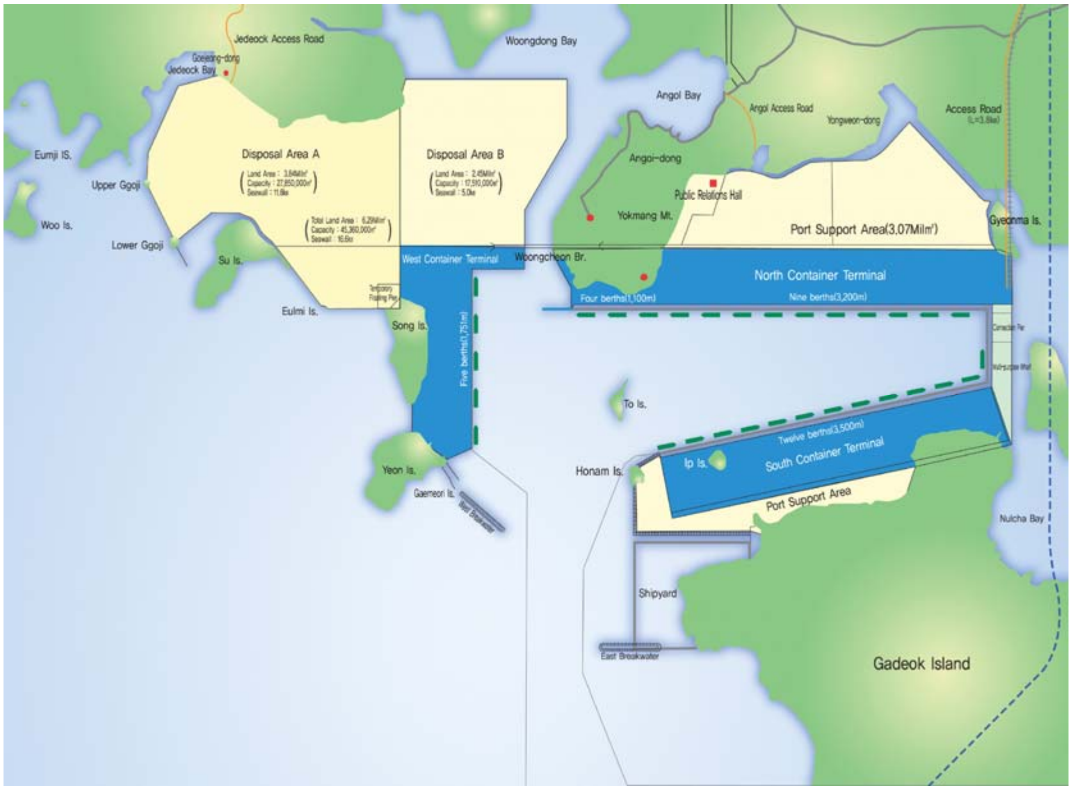
Source: compiled by MTG

As can be inferred from the preceding information, the Uam and Gamchon facilities are configured and intended for use by liner companies deploying first- and second-generation ships, of which there are several calling Busan in numerous intra-Asian services to/from Japan, China, Russia, and Southeast Asia.

All four of the remaining terminals have minimal opportunities for expanding their respective container yards or for adding berths, with the one exception of PECT, which is currently constructing a feeder-ship berth and extending its back-up land by 13 hectares. However, these facilities are all adjacent to densely-developed areas of Pusan City, and shipping lines using them have to deal with severe traffic congestion in moving containers to/from the harbour area, as there are no limited-access road-links between these terminals and metropolitan area highways.

Although the Government could physically dredge portions of the harbour to provide HBCT, PECT, Gamman, or DBCT with 15-16 meter water-depths alongside berth, it has instead focused its port infrastructure spending on a new harbour/port development project in the Gaedok-do area, about 25 kilometers west of the city. This development, known as Pusan Newport, is presently one of South Korea's largest construction projects, and will include 29 line-haul berths when fully completed. Pusan Newport will consist of four separate components, as illustrated in Figure 12.

Figure II-12 - Map of The Pusan Newport Project



As the preceding diagram indicates, there will be no air draft issues for vessels berthing at any of the Pusan Newport terminals. The first component of the Pusan Newport project is the 9-berth North Terminal, which has been concessioned to a joint venture between various Korean construction companies (led by Samsung Engineering) and CSXWT, with the latter slated as the terminal manager. The South and West Terminals, as well as a 4-berth facility immediately adjacent to and west of the North Terminal, are intended for construction in following years, although the South Korea MOMAF has yet to issue any development/management contracts for these subsequent facilities.

Nonetheless, the Pusan Newport project is clearly viewed by the Korean Government as having strategic importance to both Busan and the country, and is intended to not only serve in the future as the primary gateway for Korean container traffic but also as a major transhipment center. As the following table shows, the Pusan Newport terminals will have water depths alongside berth of 16-17 meters.

Table II-15 - Characteristics of Pusan Newport Terminals

Terminal Charcteristics	Gadeokdo Island PNC Samsung Project			PNC-North2	PNC-South			PNC-West	Total 2018
Operator:	CSXWT			KCTA	To be determined			TBD	All Terminals
Projected Completion Date	2006	2007	2009	2011	2012	2014	2016	2018	
Number of linehaul berths	3	3	3	4	3	4	4	5	29
Total Berth Length(m)	1,000	1,000	1,200	1,260	945	1,260	1,260	1,575	9,500
Depth(m)	16	16	16	15-17	15-17	15-17	15-17	15-17	-
Number of Cranes	9	9	9	N/A	N/A	N/A	N/A	N/A	N/A
Terminal Area (Hectare)	66	66	66	60	73	97	97	121	646
Hectares per berth	22	22	22	15	24	24	24	24	-

Source: compiled by MTG

In terms of water depth, berth length, yard layout, and gantry crane selection, the PNC North and South terminals are being designed and equipped to accommodate "super" post-Panamax ships.

Kwangyang

South Korea's second line-haul port is relatively new, with its first terminal opening only in 1997. Due to a fragmented berth concession process, Kwangyang now has six separate terminals, with the following key characteristics:

Table II-16

Summary of Kwangyang's Terminal Characteristics

Terminal Charcteristics	Existing Termnals HKCT	Hanjin	GKCT	KECT	DKCT	KIT
Operator	Hutchison	Hanjin	Global Ent	Korea Express	Dongbu	Hutchison
# of berths = 50,000tons	1	1	1	1	1	3
# of berths < 50,000tons						4
Total Berth Length(m)	350	350	350	350	350	1,950
Depth(m)	15	15	15	15	15	15
# Cranes	2	2	2	3	2	10
Terminal Area (Hectare)	21	21	21	21	21	88

Source: compiled by MTG

As the preceding table indicates, all of Kwangyang's container terminals have quayside depths of -15 meters. The navigation channel accessing these terminals has an MLW depth of -14 meters, but the tidal range is 3.3 meters. No bridges lie in between the port and the ocean, as indicated in the following map of the harbour area:

Figure II-13 - Map of Kwangyang Harbor Area

Like Pusan Newport, Kwangyang has been designed – and is intended by the Government – to function as a transhipment hub for Northeast Asia, being capable of accommodating 8000+ TEU super-postpanamax ships.

<u>Kobe/Osaka</u>

The two leading ports of West Japan, located on opposite sides of Osaka Bay, handle huge volumes of bulk cargoes, in addition to container ships, and consequently have had deep-water facilities for many years.

The Port of Kobe's cargo-handling facilities are located on two separate, man-made islands – Port Island and Rokko Island – layouts of which are displayed in the following two diagrams:

Figure II-14 - Kobe - Port Island

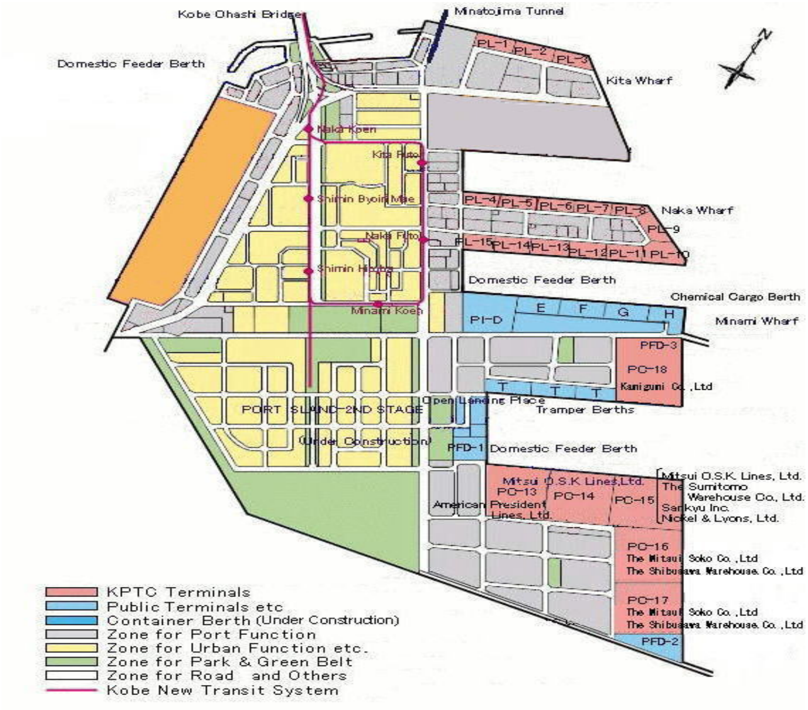
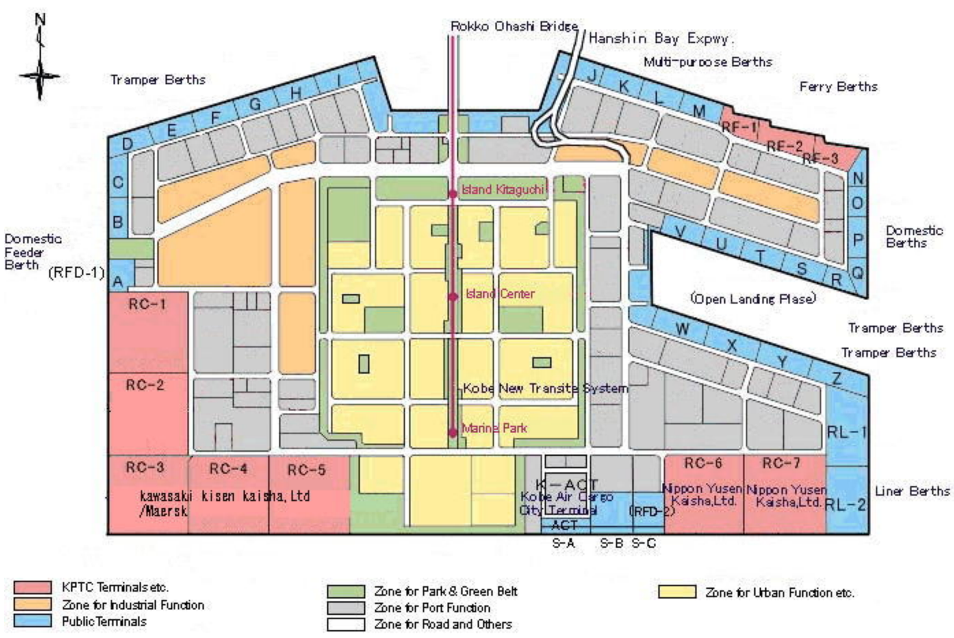


Figure II-15 - Kobe - Rocco Island



There are seven berths on each island dedicated to container-handling operations. The key dimensions of these berths are outlined in the following table:

Table II-17 - Port of Kobe Container Facilities

Port of Kobe - Dedicated Container Berths

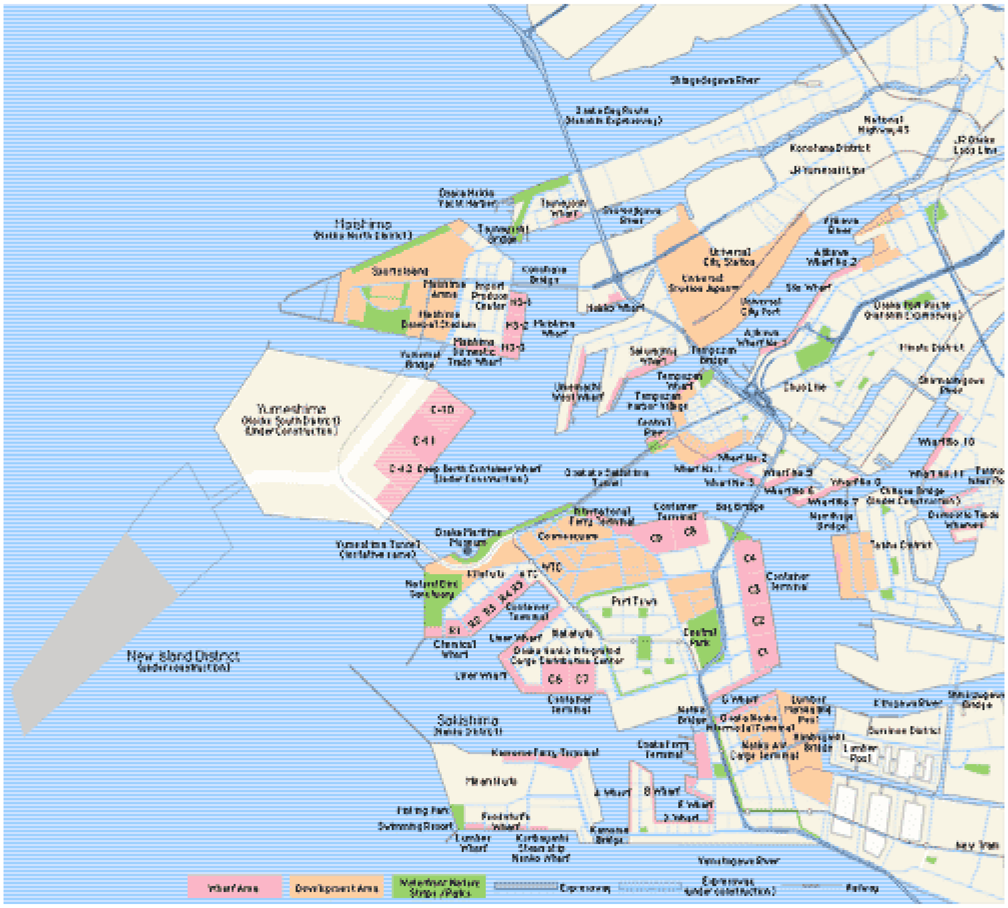
Island	Berth #	Length (M)	Water Depth (M)	Terminal Area (M2)
Port	PC13	350	-15	117,000
Port	PC14	350	-15	122,500
Port	PC15	700	-15	128,600
Port	PC16	350	-15	128,600
Port	PC17	350	-15	122,500
Port	PC18	350	-15	134,300
Rokko	PC1	350	-14	122,100
Rokko	PC2	350	-14	122,100
Rokko	PC3	350	-14	122,900
Rokko	PC4	350	-14	122,100
Rokko	PC5	350	-14	122,500
Rokko	PC6	350	-14	122,500
Rokko	PC7	350	-14	122,500

Source: compiled by MTG

Access to these terminals is provided by navigation channels with average depths of 14.6 meters, and a tidal range of 1.5 meters. Further deepening of either the channels or the berths is considered to be cost-prohibitive. There are no air draft restrictions on vessels calling at these terminals, as there are no bridges that ships have to sail under in order to reach these facilities.

The Port of Osaka's cargo-handling facilities are also located primarily on two man-made islands – Sakishima and Yumeishima – as depicted in the following map:

Figure II-16 - Port of Osaka



Most of the Port's dedicated container berths are on Sakishima Island (on its south, east, and north sides), but a new terminal complex with deeper quayside depths is being developed on the east side of Yumeishima Island. Key parameters of these berths are summarized in the following table:

Table II-18 - Port of Osaka Container Facilities

Port of Osaka - Dedicated Container Berths

Island	Berth #	Length (M)	Water Depth (M)	Terminal Area (M2)
Sakishima	C-1	350	-13.5	104,000
Sakishima	C-2	350	-13.5	105,000
Sakishima	C-3	350	-13.5	105,000
Sakishima	C-4	350	-13.5	120,000
Sakishima	C-6	300	-12.0	60,000
Sakishima	C-7	300	-12.0	60,000
Sakishima	C-8	350	-14.0	126,000
Sakishima	C-9	350	-13.0	113,000
Yumeishima	C-10	350	-15	122,900
Yumeishima	C-11	350	-15	122,100

Source: compiled by MTG

Access to Osaka terminals is provided by navigation channels with average depths of 13.0 meters, and a tidal range of 1.6 meters. Further deepening of the berths on Sakishima Island is considered to be cost-prohibitive, but any additional berths developed on Yumeishima Island will feature quayside depths of 15 meters, similar to C-10 and C-11. No programs are currently planned for dredging the Port's navigation channels to a greater depth, especially since they are bisected by two tunnels.

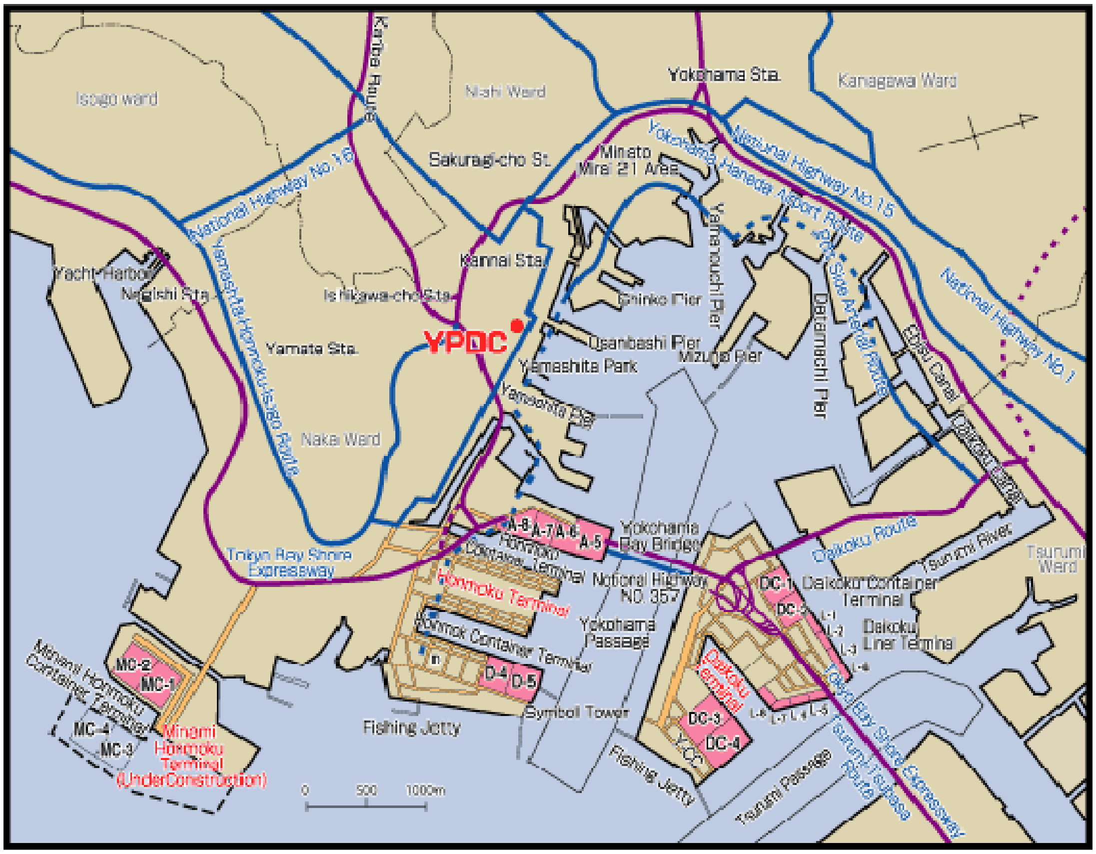
As the preceding diagram indicates, ships have to sail under a bridge linking Sakishima Island with Osaka City, in order to access the C-1 through C-4 berths of the Port. This bridge has a vertical clearance of 49 meters.

Tokyo/Yokohama

The ports serving Japan's largest metropolitan area, like their counterparts in West Japan, handle a wide array of cargoes, but both have multiple container terminals.

Within the Port of Yokohama, dedicated container terminals are located in three separate areas -- specifically, Daikoku (a man-made island in the middle of the harbour), Honmoku (the oldest part of the port), and Minami Honmoku (a new land-fill section). These areas are indicated in the following map of the harbor:

Figure II-17 - Yokohama Harbor



Key characteristics of the container terminals within the Port are provided in the following table:

Table II-19 - Port of Yokohama Container Facilities

Port of Yokohama - Dedicated Line-haul Container Berths

Area	Berth #	Length (M)	Water Depth (M)	Terminal Area (M2)	Line/ Operator
Honmoku	A-5	300	-12.0	125,000	various
Honmoku	D-4	300	-14.0	105,000	APL
Honmoku	D-5	300	-15.0	105,000	MOL
Daikoku	C-3	350	-15.0	175,000	NYK
Daikoku	C-4	350	-15.0	153,000	NYK
Minami	MC-1	350	-16.0	175,000	Maersk
Minami	MC-2	350	-16.0	175,000	Maersk

Source: compiled by MTG

In addition to the facilities listed above, the Port Corporation is developing two additional line-haul berths within the Minami Honmoku terminal area, with berth lengths, quayside depths, and back-up acreage comparable to the MC-1 and MC-2 berths currently there.

The navigation channel connecting Tokyo Bay with Yokohama's dedicated container terminals has depths in the range of 16-19 meters, and tidal variations at the Port's terminals are less than 1 meter. Although the Yokohama Bay Bridge (with a clearance of 55 meters) bi-sects the harbour area, all of the Port's container berths lie on the Bay side of the bridge.

The Port of Tokyo has only three dedicated container terminals, all located within the same general vicinity, as shown in the following diagram:

Figure II-18 - Port of Tokyo

The Shinagawa Terminal is the oldest of the three, having been developed in the late 1960s, but has less than 600 meters of berth and only -10 meters of quayside depth. The Oi Terminal was built in stages in the following decade, and has over 2300 meters of berth (and 934,000 square meters of yard area), with berth depths ranging from -13 to -15 meters. This facility is currently being renovated and modified, after which it will comprise seven berths, each with -15 meters of quayside depth, and with berth lengths of 330-350 meters.

The newest of the Port's terminals, Aomi, has three 290-meter berths and two 350-meter berths, with 478,000 square meters of yard area and quayside berth depths ranging from -12 to -15 meters.

The navigation channel linking Tokyo Bay with these three terminals has a maximum depth of -13 meters, and a tidal range of 2.2 meters. This channel is also bisected by the Rinkai tunnel, at the entrance to the harbour, which limits further deepening of it.

Conclusions With Respect To Asian Terminals

A handful of major Far East container port authorities have already positioned their container facilities to accommodate, or will soon be physically prepared to accommodate, "super" post-Panamax ships, with navigation channels and quayside water depths of at least 16 meters, and without any bridge clearance restrictions. This select group is comprised of the following ports:

- Pusan (Newport)
- Qingdao (Qianwan)
- Singapore (Pasir Panjang)
- Yantian (Phase III)
- Yokohama (Minami)
- Tanjung Pelepas

A few other ports have (or will shortly have) comparable capabilities --- in terms of the absence of air draft restrictions and tide-enhanced channel and quayside depths:

- Shanghai (Yangshan)
- Ningbo (Daxie)
- Kwangyang
- Kaohsiung

In Mercator's view, this represents "critical mass" in terms of the number of ports that should be able to accommodate ships of up to 12000-14000 TEU capacity, making it feasible, at least from the perspective of Asian port facilities, to continue increasing, up to that level, the maximum size of containerships deployed.

Task II-6: Evaluation of Key SPB Competitor-Ports

In this task, Mercator briefly analyzed the existing and potential physical capabilities of other North American ports that could potentially compete with Los Angeles and Long Beach for that portion of the Asia – North America eastbound trade destined to locations east of the Rocky Mountains (i.e. to cities with multiple routing options). The rationale for this review was to assess the extent to which very large containerships could be accommodated at gateways besides San Pedro Bay.

This examination has been structured by port-range, with the following groupings:

- Pacific Northwest/British Columbia
- Other California
- Pacific Mexico
- South Atlantic
- North Atlantic

Pacific Northwest/British Columbia

Several, natural deep-water harbours with existing and/or planned terminal facilities and rail connections are situated within the Pacific Northwest region of North America – specifically, in Tacoma, Seattle, Vancouver (both in Burrard Inlet and at Deltaport), and Prince Rupert. These ports could conceivably capture more Transpacific containers from the SPB ports should the latter's terminals not be able to accommodate the largest class containerships being operated by the carriers in the future, and/or not have sufficient yard/rail system capacity to efficiently handle all of the vessel services that the carriers will be running in the years ahead.

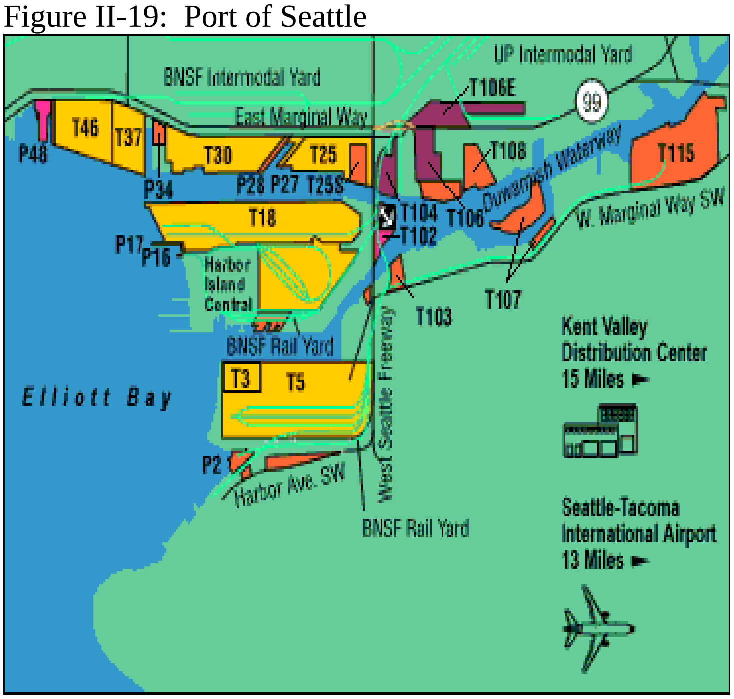
However, as the following paragraphs will indicate, several of these PNW ports have certain landside infrastructure issues that could restrict the deployment of 8000+ TEU ships in to the region, on a first-inbound call basis.

Seattle

The Port of Seattle has three container terminals in its Eliot Bay harbour area that each have at least one line-haul berth with 50' of MLW depth alongside:

- Total Terminals/Hanjin (T46)
- SSA (T18)
- Eagle Marine/APL (T5)

Figure II-19: Port of Seattle



The naturally-created navigation channel accessing these berths through the Puget Sound has a minimum depth of 75' and there are no air clearance restrictions for container ships entering Eliot Bay.

Nonetheless, any of Seattle's three terminals would be challenged to efficiently handle vessel services employing 8000+ TEU ships making first-inbound calls at the Port --- especially if the carriers deploying them planned for 75% or more of the import containers to be discharged on that call --- because the rail infrastructure accessing these terminals is not configured to efficiently handle such high-volume ship/train exchanges.

- The APL terminal has an on-dock intermodal rail-yard with 6 working tracks and room to hold 54 double-stack cars (equivalent to about 2 unit trains) simultaneously. Rail access to the terminal is via a single-track branch line that traverses an industrial waterway on a drawbridge. The nearest rail classification yard, at which cuts of rail-cars can be assembled into long unit trains, is about 2 miles away.

- The SSA terminal also has an on-dock intermodal rail-yard with approximately the same rail-car holding capacity as T-5. Access to it is via the same single-track branch line that links the Eagle Marine facility with the UP's Argo Yard or with the BNSF .

- The TTI/Hanjin terminal does not have an on-dock intermodal rail-yard, so boxes must be drayed about 1.5 miles through crowded city streets to either a satellite yard of the BNSF or the UP's Argo Yard

- Because of the layout and configuration of the respective track networks of the UP and BNSF in the area south and east of the Port, neither railroad has efficient rail access between its main-line and either the APL or SSA intermodal rail yards. Moreover, there are several interlockings and junction points in this area, but no neutral switching railroad (such as Pacific Harbor Line in San Pedro Bay), which increases the frequency of train meets and delays.

- In order for unit trains from T-5, T-18, or the BNSF rail yard in Seattle to reach the east-west transcontinental main lines of the BNSF, they must first run either north to Everett or south to Auburn, on tracks that are used by numerous daily Amtrak, commuter, and general freight trains, as well as by unit container trains to/from the Port of Tacoma.

- In order for unit trains from the Port of Seattle to reach the east-west transcontinental main line of the UP, they must first run south through Tacoma to Portland, using trackage rights on the BNSF from Tacoma.

Tacoma

The Port of Tacoma, located on Commencement Bay, entered the container-handling market in the mid-80s, when Sea-Land Service relocated its Pacific Northwest gateway operation from Seattle, and now has five carrier-run terminals dedicated to containerships (along with a separate Ro-Ro facility operated by and for the Alaska-trade niche carrier, TOTE).

Figure II-20: Port of Tacoma Container Terminals

All five of these terminals have 50' MLW depth alongside berth, and a naturally-deep navigation channel through the Puget Sound to these berths. However, Tacoma has rail access problems somewhat similar to Seattle's:

- Because of the layout and configuration of the respective track networks of the UP and BNSF in the areas west and southeast of the Port, neither railroad has efficient rail access between its main-line and the intermodal rail yards supporting the marine terminals.
    - Moreover, there are several interlockings and junction points between the UP, BNSF, and Tacoma Port Railroad lines that sharply limit the number of daily unit trains that can be moved to/from the Port's near-dock and on-dock intermodal terminals.
- Neither Class I railroad has adequate rail-car storage and switching support tracks for intermodal traffic close to the Port area, and the Tacoma Railroad's yard is heavily utilized by non-intermodal rail traffic

- The existing intermodal rail yards have lower capacities than several of the on-dock yards in San Pedro Bay – Tacoma's South Intermodal Yard can hold only 67 double-stack cars simultaneously, and the Hyundai Intermodal Yard holds only 22 double-stacks

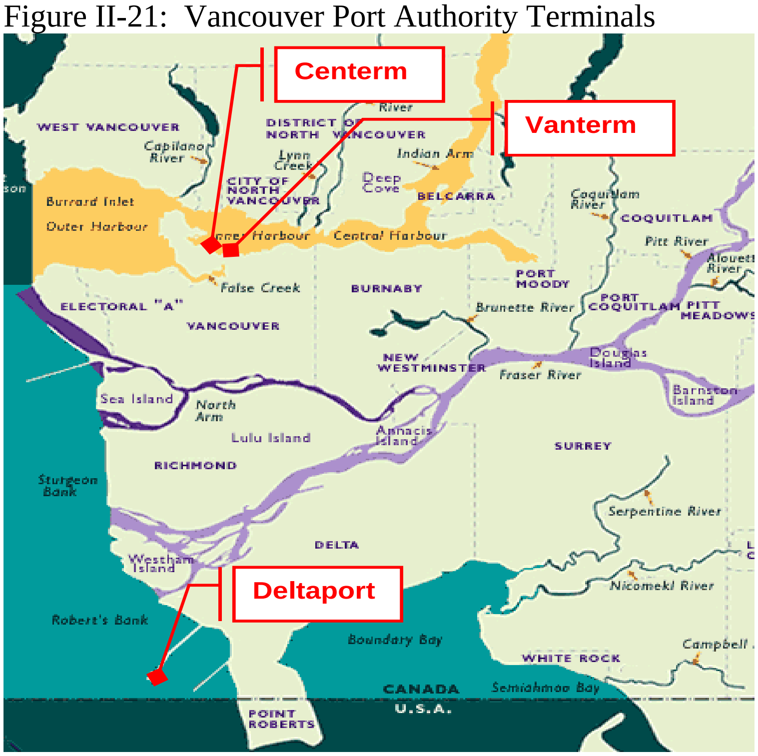
- Tacoma's access to the east-west transcontinental main-lines of the BNSF and the UP requires trains to utilize the same north-south tracks (primarily of the BNSF) as the trains to/from the Port of Seattle

Vancouver

There are presently four container terminals in the Vancouver metropolitan area, three of which belong to the Vancouver Port Authority, while the fourth is part of the Fraser River Port Authority. The latter entity's Surrey Docks facility has inherent water depth limitations – specifically, a sandbar at the mouth of the River and the roof of the tunnel through which Highway 99 (the main artery between the US border and the city of Vancouver) runs underneath it. The Fraser River also has extensive silting and floating log debris on an annual basis. Consequently, it is highly unlikely that Surrey Docks will ever be able to accommodate 6000+ TEU ships.

Of Vancouver Port Authority's three terminals, two are located on the Burrard Inlet, adjacent to the central city, while one is located south of the Fraser River (on a landfill peninsula), as shown in the following map.

Figure II-21: Vancouver Port Authority Terminals



Although Vanterm and Centerm both have deep water (15.5 meters MLW) alongside berth and on-dock intermodal rail tracks, they are relatively small facilities (76 acres and 73 acres, respectively) with almost no ability to expand their respective marshalling areas or berths. On-dock rail-car holding capacity is also inadequate for high-volume transfer operations, and there are no nearby rail yards with adequate space to provide storage and switching support for the marine terminals. In addition, access between the main lines of the CP and CN and these two terminals is inefficient.

The Deltaport terminal was developed adjacent to an export coal bulk loading pier at Roberts Bank (approximately 20 miles south of the city), and accordingly has 15.9 meters of alongside water depth, with no air clearance restrictions on ships approaching the facility. It has an on-dock intermodal rail facility, with capacity to hold 88 double-stack cars on eight 3500' tracks , but also has a support yard immediately adjacent to the intermodal area, where another four unit trains can be assembled or held, as it runs the length of the peninsula on which the marine terminal is built.

Figure II-22: Aerial View of Deltaport, BC

The preceding aerial photograph also indicates one of Deltaport's strategic advantages, in terms of rail access, but also it's primary challenge for accommodating future volume growth. With regard to rail access, the double-track branch line that links Deltaport with the transcontinental main lines of the CN and CP traverses through uncongested rural lands (with only a few grade crossings).

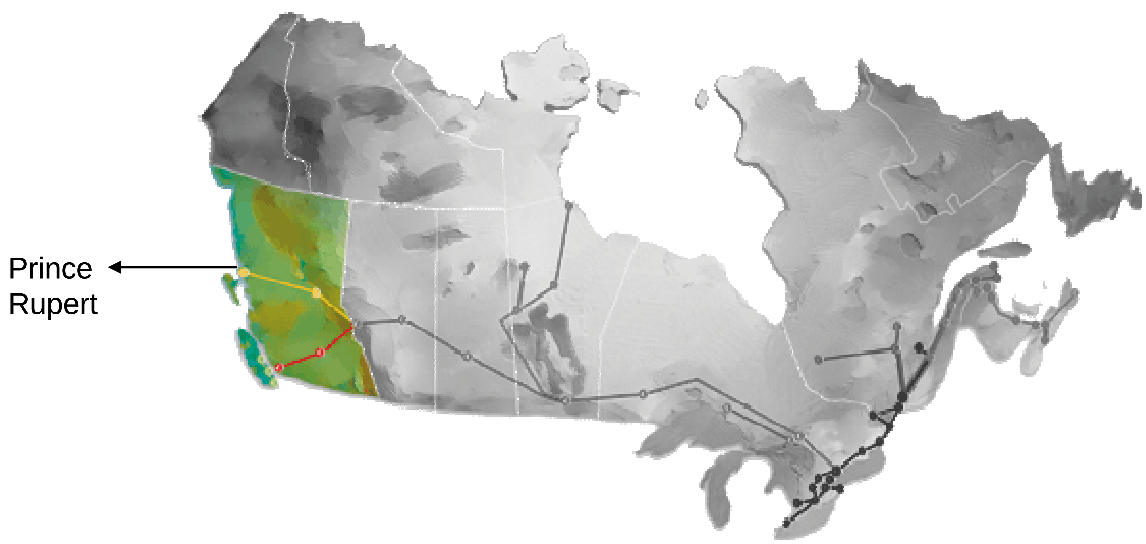
However, the container terminal has only 670 meters of berth and 160 acres of yard space. The Port Authority has plans to extend the berth and yard (in the direction back towards the mainland), but there is strong opposition from environmental groups in British Columbia to these plans. If the facility expansion is allowed to proceed, it would make Deltaport a more viable alternative to San Pedro Bay, for handling the first inbound calls of 8000+ ships.

Prince Rupert

In the summer of 2004, the Port Authority of Prince Rupert, in northern British Columbia, announced that it would be modifying and expanding its multi-purpose Fairview Terminal, in partnership with Maher Terminals (based in New Jersey), into a container-handling facility. The first phase of development appears to feature a dedicated single-berth operation with three gantry cranes, to be later enlarged into a three-berth facility with 150 acres of yard space. The existing terminal has only 13.7 meters of MLW depth alongside berth, but the Port has relatively high tidal variation and a navigation channel with 35-meter depths.

The Port is linked to central and eastern Canada by the Canadian National Railway, via a single-track main line through the British Columbia Coast Mountains and the Rocky Mountains to Edmonton.

Figure II-23: Canadian National Railway Transcontinental Rail Routes



Given that the town of Prince Rupert (with a population of only 17,000) has no local containerized market and that the Port has not previously handled any containerships on a regularly scheduled basis, it is uncertain at this time whether the new terminal will be able to attract any major carriers and services, especially utilizing very large vessels, for at least several key reasons:

- Although the Port is one day closer by ship to Far East base ports than Vancouver or Seattle, any carrier opting to deploy a string of ships with a first inbound call at Prince Rupert will be completely dependent on the bi-directional rates offered and service levels provided by the Canadian National Railway.

- Moreover, rail car fleet logistics would suggest that the ocean carrier would need to load back an equivalent number of westbound containers to the amount it plans to discharge at Prince Rupert, since there is no domestic intermodal traffic from eastern Canada to Prince Rupert and no cost-efficient means of repositioning empty rail-cars from the Vancouver area to the northern port.

- Commercial considerations also suggest that a vessel service making a first inbound call at Prince Rupert would have a limited rationale for having any other West Coast port calls – after the ship spends 2+ days unloading and re-loading at Prince Rupert, and then one more day sailing to Vancouver or Seattle (or 2+ days sailing to Oakland), the service would not have competitive transits into any of those markets with other lines' deployments making first inbound calls therein.

- With essentially 100% of a ship's capacity discharging and re-loading at Prince Rupert, the Port will need a sufficiently large intermodal yard to assemble and/or receive five or more unit trains per day in each direction.

Consequently, the comparative system economics of a ship deployment between selected Far East ports and Prince Rupert, versus a string of ships calling the same Asian ports and California, is questionable, even without addressing what the capacity constraints are on the Canadian National's main line between the Port and Edmonton.

<u>Other California</u>

Aside from the two San Pedro Bay ports, the state of California has five other ports (or port clusters) that have been periodically utilized or considered as alternative gateways for container traffic:

- Oakland
- Other San Francisco Bay ports
- Eureka
- Port Hueneme
- San Diego

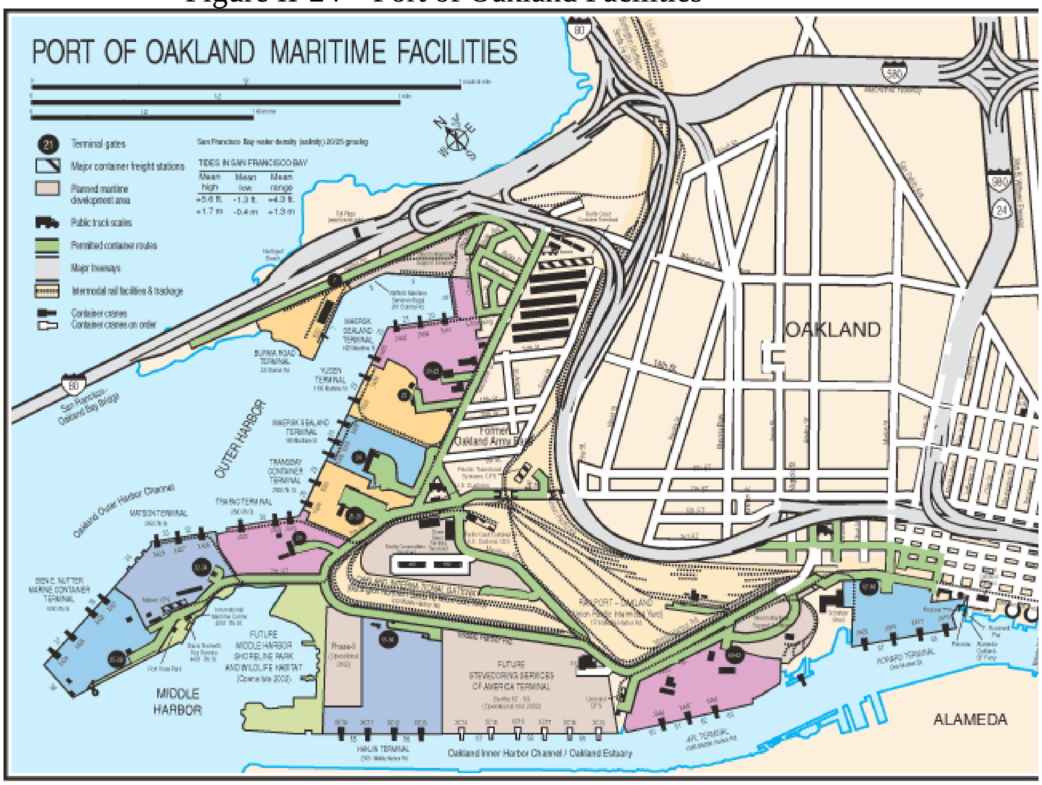
Of these, only Oakland has established itself as a significant container port, and the others are highly unlikely to become viable alternatives to Los Angeles and Long Beach for multiple reasons, including:

- Poor rail access (especially for Eureka, San Francisco, Redwood City, and San Diego)
- Opposition from community groups and/or environmental organizations to port expansion
- Limited water depth, and opposition to dredging
- Small local markets (especially for Eureka and Port Hueneme)

- Insufficient land for container yard and/or intermodal operations.

Although Oakland's through-put has recently surpassed 2 million TEUs/year, making it the country's fourth largest container port, it's ability to serve as the first inbound port of call for deployments utilizing 6000+ TEU ships is uncertain. With the exception of the relatively newer SSA and Hanjin facilities, the Port's marine terminals are relatively small in acreage, compared to those in San Pedro Bay, and have limited room for expansion.

Figure II-24 – Port of Oakland Facilities



None of Oakland's terminals have on-dock rail facilities, and even though the BNSF and UP each have an intermodal yard proximate to most of the marine terminals, they are both capacity-constrained, with limited expansion capabilities. Water depth is also an issue for Oakland – with the exception of the SSA and Hanjin facilities (which have 15.2 meters of MLW depth), the other terminals have only 12.8 meters of alongside depth.

Main line rail access is also becoming more of an issue for Oakland, even though the UP north-south main line runs adjacent to the Port, as the number of Amtrak and commuter trains operating on the line each day increases.

Pacific Mexico

There are two existing ports along the West Coast of Mexico with theoretical potential to handle intermodal Transpacific container flows now routed through San Pedro Bay: Manzanillo (in the state of Colima) and Lazaro Cardenas (in the state of Michoacan). Both ports have rail lines that could provide train service linkages with the central and eastern USA, via border gateways at Laredo and Eagle Pass, both in Texas.

The Port of Lazaro Cardenas was originally developed for liquid and dry bulk cargoes, and has a 16.5-meter deep entrance channel, without any bridges across it and with a tidal range of 0.5 meters. Although its existing container terminal has a quayside depth of only 12 meters and has less than 300 meters of linear berth, there are two bulk facilities in the Port with 16 meters of water.

Figure II-25 - Port of Lazaro Cardenas

Thus, the Port has the ability to construct new container berths with 16 meters of quayside depth on a portion of the extensive amount of undeveloped waterfront land within its property line, and in fact, has a plan to do so. Private sector funding will be required to implement this objective, and the Port's recent concession agreement with Hutchison Ports de Mexico to operate the existing terminal (with an option to develop a new, enlarged facility) essentially represents a step in this direction.

However, it is uncertain when or whether the rail line infrastructure and train operations between Lazaro Cardenas, San Luis Potosi, and Laredo can be cost-effectively enhanced so that point-to-point intermodal service from – for example – Hong Kong to Houston is reasonably transit-competitive and cost efficient, considering that the expense savings of using Mexican stevedores (versus ILWU labor) would be partially offset by higher vessel operating costs associated with the extra sailing days to Lazaro.

The dedicated container terminal in Manzanillo, developed by SSA Marine in the 1990s, has now become Mexico's second largest trade gateway, after Veracruz, with a through-put of over 700,000 TEU in 2003 (more than double the figure of 1999). A recently completed expansion project there has enabled SSA Marine to provide 500 meters of linear berth, with 14 meter quayside depths. Access to this berth is furnished by an unobstructed, 16-meter deep navigation channel and turning basin, with a tidal range of 0.6 meters. As the harbor bottom is sandy, the terminal's quayside berths could feasibly be dredged to -16 meters, should the Port Authority and SSA deem it desirable to do so.

However, this terminal – as well as the general cargo terminal on the other side of the harbour – has limited ability to add more back-up land. In addition, the same uncertainties regarding rail infrastructure and train operations for Lazaro Cardenas exist for Manzanillo, in terms of obtaining competitive intermodal service to Texas.

A new Mexican port is being considered for development at a green-field site south of Ensenada, in the state of Baja California del Norte. Referred to as Punta Colonet by its project sponsor, Hutchison Ports de Mexico, the new port would be linked with the US railway system via a new main line to be built between the site and Yuma/Mexicali, where connections would be made with the Union Pacific. Hutchison envisions that the terminal would be constructed in three sequential phases, each with about three berths, so that a total through-put of 5 million TEUs per year could be efficiently handled there.

It is Mercator's understanding that if this project is implemented, the access channel and quayside water depths would be in the 16-17 meter range, as HPM clearly intends for the terminal to be capable of accommodating very large container ships in the Transpacific trades.

<u>Conclusions on West Coast Ports</u>

There are several ports on the North American West Coast with existing terminals that have sufficient channel/berth water depths and air clearances to accommodate "super" post-Panamax ships – specifically, Vancouver, Seattle, and Tacoma. In addition, the terminal currently being developed at Prince Rupert, as well as facilities planned at Punta Colonet and Lazaro Cardenas in Mexico, will have the physical ability to receive 10,000+ TEU vessels --- and with dredging, so will Manzanillo.

However, with the exception of Vancouver's Deltaport (and potentially the new terminals in Prince Rupert and Punta Colonet), these deep-water gateways lack sufficient amounts of near-dock or on-dock intermodal yard capacity and rail track capacity to support the unit train volumes that would be generated by these very large ships. In addition, the transcontinental railway lines that access the PNW ports (including Prince Rupert) have more train capacity constraints than the lines linking California ports with eastern North America, while the lines connecting the Mexican West Coast ports with Texas need substantial upgrades in order to become competitive landbridge service corridors.

Consequently, it is uncertain whether other West Coast ports, besides Los Angeles and Long Beach, could become "first-inbound" ports of call for Transpacific deployments that utilize "super" post-Panamax ships.

South Atlantic

There are presently no ports in this group that could physically accommodate a fully-laden 8000+ TEU container ship with a draft of approximately 14.0 meters. The following table summarizes the current water depths for the primary South Atlantic ports:

Table II-20 - Water Depths For US South Atlantic Container Ports

Port	MLW Channel Depth (m)	Quayside Depth (m)	Tidal Range (m)
Wilmington	11.6	11.6	1.1-1.2
Charleston	12.8	12.2	1.5-1.8
Savannah	12.8	12.8	2.1-2.7
Jacksonville	12.8	11.6	
Port Everglades	13.4	13.5	0.8-0.9
Miami	12.8	12.8	0.8-0.9

Source: compiled by MTG

The first four of these ports are located on river estuaries, with distances to the ocean that range from approximately 8 to 30 kilometres. Consequently, significant dredging expenses would be required to deepen their access channels beyond current levels, even without including the time-related and procedural costs of obtaining environmental permits for such projects. Any proposals to further dredge in either of the South Florida ports (beyond maintenance levels) would encounter stiff opposition from local community groups and environmental organizations.

In addition to these water depth issues, Charleston and Savannah also have bridges bisecting their entrance channels, with air clearances of 46.5 meters and 56.5 meters, respectively. Reconstruction of either of these bridges within the next ten years is viewed to be highly unlikely.

Aside from the Jasper County, South Carolina project associated with SSA, there are no new deep-water ports being planned for this particular coastal range. This project, if developed, would result in the construction of a 3-berth terminal (as the initial phase) at the mouth of the Savannah River. However, the state port authorities of Georgia and South Carolina are actively attempting to legally block SSA from being able to proceed.

North Atlantic

The major container ports of the north-eastern United States and eastern Canada have, on average, deeper access channels than their counterpart ports south of Virginia, as the following table demonstrates:

Table II-21 - Water Depths For North Atlantic Container Ports

Port	MLW Channel Depth (m)	Maximum Quayside Depth (m)	Tidal Range (m)
Halifax	21.0	16.5	1.4-2.0
Boston	12.1	13.6	2.7-2.9
New York	13.5	14.2	1.4-1.5
Philadelphia	12.1	12.2	1.6-1.7
Baltimore	15.2	12.8	0.4-0.5
Hampton Roads	15.2	12.5	0.7-0.8

Source: compiled by MTG

The Halifax Port Authority is fortunate to have one of the continent's deepest natural harbors, although one of its two container terminals (Fairview Cove) is accessed by a channel that is crossed by two bridges, the older of which has an air clearance of only 49.5 meters. Nonetheless, its other terminal is clearly capable (from the perspectives of water depth and air draft) of accommodating the world's largest container ships, if deployed on all-water services from South China, Southeast Asia, and the Indian Subcontinent via the Suez Canal.

Given Boston Harbor's relatively high tidal variation, the Massachusetts Port Authority's Conley Marine Terminal has the quayside water depth at one of its berths to receive a large post-Panamax vessel. However, this facility lacks sufficient back-up land or an on-dock rail connection to function as a high-volume intermodal gateway. These deficiencies are unlikely to be remedied, as the nearest rail terminal is 4 miles from Conley, and given the land-use patterns and property values of the densely developed urban areas surrounding this part of the Port.

The Port Authority of New York/New Jersey has been working with the Army Corps of Engineers (USACE) for many years to deepen the Kill Van Kull Channel that links New York Harbor with the Port's four primary container terminals, which include Port Newark Container Terminal, Elizabeth Marine Terminal (Maher Terminal & APM Terminal), and

Howland Hook Container Terminal. The Port launched a program in 1998 to dredge the Channel from 12.1 to 13.6 meters, and is scheduled to complete this work in early 2005. The Port received USACE approval in 2002 to further deepen the Kill van Kull to 15.2 meters.

Figure II-26 - Terminals Within the Port of New York / New Jersey

Because the bottom of this Channel is rocky, deepening involves extensive drilling, blasting, and disposal of rock materials, and is accordingly very expensive, with an estimated total cost of over $1 billion and a completion time of at least six years. Given the scale and cost of this undertaking, it is unlikely that the Port could obtain federal funds for an additional dredging program to get below 15.2 meters.

Another constraint for the Port's main container terminals in accommodating very large container ships is the mid-span clearance of the Bayonne Bridge, which crosses the Kill van Kull and is only 45.4 meters above the water level. Neither the Port Authority or the states of New York or New Jersey have any concrete plans for replacing this bridge.

The Port of Philadelphia has been unable for several years to obtain funding for a dredging program to deepen a 30-mile section of the Delaware River to 13.6 meters, despite having received USACE approval for this project in 1992. Considering the Port's declining container traffic levels (correlated with its drawback of being too close to New York), it seems unlikely that either of its terminals will ever be suitable gateways for large post-Panamax ships.

Similarly, although the Maryland Port Authority could conceivably dredge some of the berths at its Seagirt or Dundalk Terminals deeper than the current 12.8 meters, the Port's traffic growth over the past five years has been relatively modest, and its location – more than 110 miles from the ocean, with approximately 10 hours of pilotage in each direction – suggests that ocean carriers would be highly unlikely to deploy "super" post-Panamax ships calling this Maryland trade gateway. Baltimore's Outer Harbor Crossing Bridge also limits the size of ships calling at either terminal, with its 54.5-meter mid-span clearance.

Of all the US East Coast ports, Hampton Roads is the one best positioned to physically accommodate very large container ships, although further dredging at the berths of Virginia Port Authority's Norfolk International Terminal would be necessary. However, the new APM Terminals facility being constructed in the Portsmouth area of the harbour (essentially opposite NIT) will feature multiple berths with quayside depths of 15 meters, but will not be operational until 2008.

Conclusions on East Coast Ports

It now appears that once current plans for port deepening and construction are completed, the Port of New York/New Jersey and ports within Hampton Roads will be able to accommodate ships operating at a draft of 14 meters. This would make it feasible for carriers to deploy ships of 10000-12000 TEU on Asia-USEC routes, either via Panama or via Suez. The fact that the South Atlantic ports will probably be unable to accommodate such vessels when fully laden suggests, however, that carriers will need to retain in their East Coast fleets a certain portion of ships at the current size.

Task II-7: Analysis of Canal Expansion Impacts

The Panama Canal is in the process of developing and evaluating plans to expand the capacity of the Canal. A part of the canal expansion plan under consideration is to add a new set of locks that would allow vessels up to approximately 12,000 TEU to transit when fully loaded. Such an increase in the size of vessels that could be deployed on the Asia-USEC route would increase the existing cost advantage of the all-water route for serving the east cost.

To quantify the likely extent of the cost differential, Mercator developed voyage cost models for services between a set of key Asian ports and the USWC and USEC. The analysis was done for ship sizes spanning the range of 4500 TEU to 18000 TEU. The output of the analysis, presented in terms of voyage cost per TEU of capacity, is summarized in Tables II-25 and II-26.

Table II-25 - Slot Costs For 5-Vessel Asia-USWC Services

Asia - USWC Slot Costs

TEU Class		4500	6000	8000	10000	12000	14000	18000
	Voyage Cost Per (Effective) TEU							
Vessel		381	347	288	262	254	238	211
Fuel		155	157	154	132	125	118	105
Port Charges		44	41	40	36	36	34	31
Canal Costs								
Total		$581	$546	$482	$430	$415	$391	$347
	Change In Cost Versus 4500 TEU Panamax							
Vessel			-8.9%	-24.5%	-31.2%	-33.5%	-37.6%	-44.6%
Fuel			1.4%	-0.8%	-15.2%	-19.1%	-23.8%	-32.3%
Port Charges			-6.5%	-10.7%	-19.2%	-18.0%	-22.2%	-29.7%
Canal Costs								
Total	Base		-6.0%	-17.1%	-26.0%	-28.5%	-32.7%	-40.2%

Source: MTG

Table II-26 - Slot Costs For 8-Vessel Asia-USEC Services (Via Panama)

Asia-USEC Via Panama

TEU Class*		4500	6000	8000	10000	12000
Est Eff TEU		3900	5100	7200	9600	11800
	Voyage Cost Per (Effective) TEU					
Vessel		610	556	461	420	406
Fuel		294	292	256	219	199
Port Charges		70	66	63	57	58
Canal Costs		85	81	81	76	75
		$1,059	$995	$861	$772	$737
	Change In Cost Versus 4500 TEU Panamax					
Vessel			-8.9%	-24.5%	-31.2%	-33.5%
Fuel			-0.6%	-12.8%	-25.6%	-32.4%
Port Charges			-6.1%	-10.6%	-18.8%	-17.6%
Canal Costs			-3.7%	-3.8%	-9.6%	-11.9%
Total	Base		-6.0%	-18.7%	-27.1%	-30.4%

Source: MTG

Sample vessel proforma model output is attached as part of Appendix II.7a.

A key assumption underlying the unit cost analysis is that the effective cost per TEU for the Canal transits by ships over 4500 TEU will not be lower than for current Panamax vessels. Although under the current tariff the cost per TEU declines as ship sizes increase, it is assumed here that newer, larger ships (the drivers behind any canal expansion), will pay comparable canal fees of a costs per container basis. Proposed increases in canal tolls above the 2004 level have not been included. These could amount to $40 per TEU or more per roundtrip.

The cost analysis confirms that the larger vessels will deliver a cost advantage, although an advantage that is perhaps not as large as might have been expected. With costs as presently calculated and / or estimated, each 2000 TEU increment in vessel capacity yields a reduction in unit slot costs of about 10% (although in the range between 10000 and 12000 TEU, the unit cost reduction appears to be only about 3%). Unit cost reductions are somewhat greater for the 8-ship Asia-USEC segments, which is attributed to the fact that these services spend more time at sea compared to time in port, and thus better take advantage of the economy of the larger vessels.

Evaluating Vessel Schedules

This subject will be more fully explored within Task III, however a few preliminary observations are offered here to facilitate the assessment of Panama Canal impacts.

In addition to considering unit costs of alternative vessel deployments, planners must consider a wide range of other factors, including:

- The number and location of ports that can efficiently served
- The competitiveness of transit times and departure days provided,
- The sizes of the markets served
- The expected share capture and vessel utilization that can be expected
- The schedule reliability that can be maintained

One indicator of expected reliability is the ratio of max possible lifts that could be completed within the available port time divided by the number of lifts required per voyage when the vessel is fully loaded. This ratio should at least be equal to one, and would ideally be approximately 1.25 to 1.5 in order to provide adequate flexibility to accommodate varying cargo patterns and to recover from schedule disruptions. In the following table, this ratio is calculated for each of the Asia-USWC and Asia-USEC schedules.

Table II-27 - Summary Of Proforma Voyage Schedules

Asia-USWC	Voyage Statistics						
Size Class	4500	6000	8000	10000	12000	14000	18000
Est Eff TEU	3900	5100	7200	9600	11800	13800	17300
Lifts Req'd.	9,635	13,341	17,788	23,718	31,929	37,341	42,741
Max Lifts Avail	14,696	18,436	23,561	25,390	31,596	36,536	42,688
Lift Ratio	1.53	1.38	1.32	1.07	0.99	0.98	1.00
Port Hrs	202	217	243	254	264	268	264
Avg # Cranes	3.4	4.0	4.6	4.7	5.7	6.3	8.0
Avg Speed, kn	22.0	22.5	23.5	24.0	24.5	24.5	24.5

Asia-USEC	Voyage Statistics				
Size Class	4500	6000	8000	10000	12000
Est Eff TEU	3900	5100	7200	9600	11800
Lifts Req'd.	10,094	13,976	18,635	24,847	30,541
Max Lifts Avail	17,200	21,150	24,800	28,575	31,900
Lift Ratio	1.70	1.51	1.33	1.15	1.04
Port Hrs	217	236	238	254	254
Avg # Cranes	3.2	3.5	4.2	4.5	5.0
Avg Speed, kn	22.7	23.0	23.0	23.5	23.5

Source: MTG

This analysis demonstrates that as ship sizes increase, the degree of schedule reliability is likely to decline, due to the increased amount of time required to complete stevedoring activity. For the Asia-USWC deployments, the lift ratio drops to less than 1.0 when capacity reaches 12000 TEU, even as the average number of cranes deployed exceeds 5.5, and the average operating speed is increased above 24 knots. This suggests that the proforma should be shortened (i.e. call fewer ports and steam fewer miles) in or order to make more time available for cargo handling.

Reducing port calls is a normal and accepted approach to making a schedule feasible for the particular vessel types being deployed, however there may be a problem achieving adequate utilization if too few ports are called. This can in particular be the case when ship sizes increase, if it unduly increases the market share that must be captured at each port being called.

The Panama-USEC schedules appear better able to accommodate the larger vessels, showing less strain as vessel sizes increase. Fewer cranes and lower operating speeds are required for these schedules. Part of this is because USEC ports are able to provide sufficient labor to operate more hours per day, and partly it is a result of the increased sea time relative to port time. This, and the increased cost benefit obtained by deploying larger vessels on that route, suggests that carriers would seek to deploy “super-post panamax” vessels on the Panama-USEC rate, subject to the availability of suitable USEC port facilities.

To serve the Southeast markets, where deep water is not available, carriers will find the economics of large vessels less attractive if they must operate at less than full capacity. In this case, we would expect carriers to retain their current tonnage until improved port facilities are developed.

Based on these observations, we would expect each alliance group to deploy at least one string of 8000-10000 TEU ships calling the USEC via Panama when and if the Canal is expanded. These ships would either be purpose-built for that route, or re-deployed from another transpacific string. To the extent that 6000-10000 TEU vessels are "swapped" out of the Asia-USWC route in exchange for 4000-5000 TEU vessels, SPB ports could benefit in terms of greater vessel call frequency with fewer peak arrival days. This would be a good outcome for SPB port operations if it creates a more level demand for port services across the week.

Although the lower costs obtained with larger tonnage on the Panama route will likely lead to the re-routing of some cargos, Mercator does not foresee a sudden or radical shift in port shares. First, the Panama route already enjoys a significant cost advantage versus land-bridge service to points on the USEC, as well as for many eastern points not actually on the coast. The savings in intermodal costs of $1500 -2000/ per roundtrip container already far outweigh the incremental vessel slot costs for the Panama route (which amount to about $1000 per 40' load). In addition, port and stevedoring costs are lower on the USEC, creating an additional benefit on the order of $200 per round-trip container. Much of the cargo for which the landbridge is a feasible and acceptable routing will likely already be moving via that route.

Vessel tonnage for the launching of new Panama strings has been in short supply and limited the introduction of new services in the past year. This, however, is not a permanent condition, as carriers will order the ships they need to satisfy demand. For the time being, the Panama Canal itself does not appear to be a constraint. It still has the capacity to accommodate more container vessel transits, and if container vessel transit fees are increased above those paid by other vessels, which appears to be the strategy being pursued by the Panama Canal Authority, then capacity should continue to be available.

More likely is a continuation of the ongoing shift of eastern US cargos away from land-bridge routings and onto all-water routings. This shift, driven by capacity constraints and service limitations of the US railroads as well as the greater reliability and more attractive costs available with all-water service will continue until a new equilibrium is reached. The introduction of larger and lower-cost Panama tonnage will simply shift the equilibrium by an incremental amount, but is not likely to cause a major dislocation to the system.

Task II-8: Impacts of Structural Changes

In this task, Mercator examined how potential changes in the liner industry's structure through mergers and/or acquisitions could impact Transpacific deployments, and in particular, the frequency and average capacities of the vessel services calling at the San Pedro Bay (SPB) ports.

During the past ten years, the industry has experienced considerable consolidation. Mergers and acquisitions have been utilized by an array of carriers to achieve increased presence in particular markets, marketing synergies, and network efficiencies, as well as to expand vessel fleets less expensively than by ordering new ships. Given that several transactions since the mid-1990s (such as NOL's purchase of APL, the P&OCL/Nedlloyd merger, and Maersk's absorption of Sea-Land's international business) were partially the cause of increased service competition, especially in the east-west arterial trades, it seemed relevant to evaluate the prospects for further merger/acquisition transactions with ramifications for Transpacific service networks.

Overview of Transpacific Services Structure

In examining the potential industry structure changes that would impact Transpacific service competition, Mercator first considered the current composition of fully-cellular liner services in the Transpacific, with a focus on service network density.

As of Q4 2004, there were 75 distinct weekly deployments of fully-cellular ships providing bi-directional liner service to companies shipping containers between the Far East and North America. Of these, 17 are East Coast all-water deployments via the Panama Canal, 1 is an all-water service to the East Coast via the Suez Canal, and the balance are shuttles and/or pendulum deployments turning around on the West Coast.

Only 2 of the all-water services make eastbound calls in SPB, while 40 of the 57 West Coast-turnaround services call inbound-first in Los Angeles or Long Beach. It is these 42 services, along with the one service calling Oakland inbound-first that carry the preponderance of SPB's Transpacific imports and which are the focal point of carrier managements in designing their Asia – North America networks.

Five vessel operating groups operate about 70% of these 43 California-focused deployments, and are considered here as the "first tier" of Transpacific service providers:

Tier One Carriers (Groups):	
Grand Alliance	(carriers PONL, OOCL, NYK, Hapag-Lloyd)
New World Alliance	(carriers APL, MOL, Hyundai)
CHKY Alliance	(carriers Cosco, Hanjin, K-Line, Yang Ming)
Maersk Sealand	
Evergreen	

Each ship line within this first tier offers its customers eight or more weekly sailings between Asia and North America, and also participates in most of the world's major liner trades (i.e. each first tier line is also a "global" carrier). The competition between these five vessel operating groups, in terms of transit times and sailing frequencies for multiple eastbound market segments (and in terms of network operating costs) clearly is the primary driving factor underlying the growth over the past ten years in the number and size of vessels calling in California ports.

"Tier 2" in the Transpacific is comprised of six individual lines. These six global lines are expanding rapidly and, although considered here to constitute a "second tier" of Transpacific capacity suppliers, the vessel fleets that they respectively operate rank among the top twenty in the world:

Tier Two Carriers:

Mediterranean Shipping	CMA-CGM
China Shipping Container Line (CSCL)	Zim Container Service
CP Ships,	CSAV/Norasia

Each of these carriers presently has a relatively smaller presence in the Transpacific trade, with the six lines collecting operating just 17 Pacific services in total, 7 of which call first-inbound at one of the SPB ports.

A desire to compete more effectively in terms of service frequencies with the Tier 1 operating groups has led each of the Tier 2 lines to enter into vessel sharing agreements. The Tier 2 vessel sharing agreements typically apply to individual services (as opposed to broader alliances covering one or more entire trades), and have primarily been made between Tier 2 lines. Competition and a desire to grow has also impelled several of them – particularly MSC, CMA-CGM, and CSCL – to commit to fairly aggressive vessel newbuilding programs. These latter three lines collectively will take delivery of 128 new ships with capacity of 4000 TEU or more during the next three years. Although many of those new ships are likely to be deployed in other trades, the sheer number implies that each of these three lines aspires to become "first-tier" operators in the Transpacific.

Finally, there are several lines operating only one weekly Transpacific string (generally with relatively small ships) and/or run services that carry Asia – North America containers but are primarily designed to serve other trades. These "third tier" carriers are listed in the following table.

Table II-28 - Tier 3 Carriers / Services

Carrier(s)	Service	Avg. Vessel TEU Capacity
Great Western	GWX	2031
Sinotrans	CAS	2521
US Lines	USL	1522
Wan Hai	TPS	2695 (also has a service with CMA CGM)
PIL	Sprint2	3958 (in partnership with CP Ships)
Maruba, CCNI, HSDG	AMPAC	2167
PM&O		714

Given the nature of their deployments, and since these third-tier carriers collectively carry less than 5% of the Transpacific trade, Mercator concluded that the acquisition of any one of them by either a Transpacific first-tier or second-tier line would not have any material impact on the competitive dynamics (with respect to vessel service frequencies or average capacities) between the Tier 1 & Tier 2 carriers and operating groups. Similarly, the acquisition of one of these third-tier lines by a carrier not presently serving the Transpacific (such as United Arab Shipping or Shipping Company of India) would have minimal, if any, effect on the number or size of vessel services deployed by the Tier 1/2 carriers and operating groups. As a result, Mercator subsequently focused its examination of structural industry changes on the larger Transpacific players.

Near-Term Outlook For Merger / Acquisition Activity Among Carriers

Having noted and segmented the relative positions of the shipping lines currently serving the Transpacific trade, in terms of the comparative scope and frequency of their respective vessel networks, Mercator then addressed the following questions:

- What merger/acquisition transactions could potentially transpire that would result in a reduction in the number of Tier1 or Tier 2 carriers during the forecast period (to 2020)?
    - As a corollary, how might this reduction in the number of Tier 1 or Tier 2 carriers lead to the formation of new vessel sharing alliances and/or change the number of Tier 1 vessel operating groups?
- How would a change in the number of major vessel operating groups impact the frequencies and average capacities of the vessel services calling regularly at Los Angeles/Long Beach?

For at least the next five years, there are several Transpacific Tier 1 or Tier 2 lines that are unlikely to be acquired or to ***merge*** -- within the framework of a cross-border transaction -- due to a clear and long-standing commitment to these businesses by their respective owners (some of which are agencies or ministries of foreign governments). This sub-set would undoubtedly include:

Family-Controlled	Conglomerate-Controlled	Government-Controlled
• Maersk Sealand	• NYK	• APL
• Evergreen	• MOL	• COSCO
• Hanjin		• CSCL
• Zim		• Yang Ming

This is an admittedly subjective list, and it could be argued that some other lines (such as the family-controlled MSC, CMA-CGM, and CSAV) ought to be included on it. Nonetheless, of the ten carriers listed above, six have pursued expansion strategies in which organic, internal growth has been occasionally supplemented with the acquisition of another line:

- ✓ Maersk Sealand – acquiring Safmarine and Sea-Land Service
- ✓ Evergreen – purchasing Lloyd Triestino

- ✓ Hanjin – absorbing DSR/Senator
- ✓ APL – being acquired by NOL, with the latter discontinuing its brand name
- ✓ NYK and MOL – through consolidation/acquisition of YS Line, Japan Line, and Showa Line

Conversely, there are a handful of global carriers that have owners whose respective long-term commitments to the liner shipping business are, based on public statements by their board directors, occasional rumours of their availability for sale, and/or the inherent nature of their corporate structures, are unclear or tenuous. This sub-set includes:

- ✓ CP Ships (publicly traded on three Anglo-American stock exchanges)
- ✓ Hapag-Lloyd (subsidiary of a publicly-traded German industrial conglomerate)
- ✓ P&O Nedlloyd (subsidiary of a publicly-traded Dutch corporation)
- ✓ OOCL (has been a divestiture candidate in at least one previous industry downturn)

The acquisition of CP Ships by another carrier (whether the latter was a global carrier or regional specialist) would have a relatively minor impact on the competitive dynamics of the Transpacific trade, as this line participates in just three weekly services (only one of which it operates exclusively). However, if Hapag-Lloyd, P&O Nedlloyd, or OOCL were to be acquired by another leading global carrier (other than another Grand Alliance member – i.e. NYK), it could catalyze one or more other consolidation transactions and/or result in the re-structuring of one or more vessel sharing alliances.

For example, if APL was to purchase P&O Nedlloyd (as it has attempted to do at least once since 2000), the Grand Alliance, in order to maintain its sailing frequency competitiveness with the other Tier 1 operating groups, would need to find a carrier capable of replacing a majority of the P&O Nedlloyd contributed vessel assets. The remaining members (NYK, OOCL, and Hapag-Lloyd) could attempt to persuade one of the CHKY carriers (or possibly Hyundai, a member of the New World Alliance) to switch camp. Another option would be to invite either Evergreen or Maersk Sealand (both of which would likely decline) or one of the Transpacific Tier 2 lines (such as MSC, CMA-CGM, or Zim) into the agreement.

Since all of these Tier 2 lines have different vessel sharing agreements for individual services, the latter scenario would also have cascading impacts. Moreover, an APL acquisition of P&O Nedlloyd would undoubtedly catalyze one or more further transactions – just as NOL's purchase of APL in 1997 partially stimulated A.P. Moller/Maersk to buy the international operations of Sea-Land Service in 1999. Three such transactions that several industry insiders have speculated could likely transpire as a result of a first move by APL/NOL would be 1) the purchase of Hapag-Lloyd's container line by A.P. Moller/Maersk, 2) the acquisition of OOCL by COSCO or CSCL, and 3) a consolidation of the three Japanese carriers into two.

While impossible to accurately predict what specific merger/acquisition transactions will occur within the industry, the pressures for further consolidation are apparent:

- Compared to some other global industries, the liner business is still highly fragmented in terms of the number of separate commercial entities competing for container traffic in each major trade. By most measures, there is plenty of opportunity for further concentration of market share.

- As the cost reduction impacts of increasing ship size diminish with each new size class, and with most major carriers involved in vessel sharing agreements to some extent, corporate consolidations represent one of the few remaining "big-bang" initiatives that carriers can turn to for large-scale expense savings.

- The amount of capital investment (including mid-term and long-term leasing) to maintain competitiveness keeps increasing for the largest carriers, and the gap between the very largest global lines and the smallest is also widening. As an example, by 2007 Maersk Sealand is projected to be operating a fleet of nearly 300 ships, with more than 1 million TEUs of capacity, which will be more than four times the size of number 9 ranked APL/NOL, despite the latter's acquisition of 11x 5000+ TEU ships between 2004 and 2007. Considering the industry's historically poor return on capital, some of the parent corporations of the smaller global lines (especially those that are publicly-traded) are likely to re-assess staying in the business.

- The cyclical nature of the industry virtually guarantees that there will be at least one multi-year period of depressed rates and corporate losses during the next 5-7 years. Given the scale of the current orderbook of new container ships, this next downturn is likely to be greater in magnitude than the late 2001-early 2003 depression, causing some owners to divest.

It is also apparent that the Singapore Government wants APL/NOL to become one of the industry's top 5 or 6 operators, and furthermore recognized that Maersk Sealand's owners are fully committed to keeping their ship line at the head of the pack. These two companies – along with CMA-CGM, which has itself periodically made strategic acquisitions to support its expansion, are likely to be the primary catalysts of the next round of consolidation within the industry's top tier. Given their histories and corporate cultures, most of the major Asian carriers (besides APL/NOL) are more likely to concentrate on internal growth strategies and to pursue acquisition options mainly on a defensive basis.

The combination of aggressive expansion strategies for a handful of global carriers, coupled with an expected downturn in industry profitability in 2007-2008 (or beyond) and the tenuous commitment of some current owners of liner companies, should result in a reduction in the number of Tier 1 and Tier 2 ***carriers*** in the Transpacific.

Outlook for The Number of Transpacific Vessel Sharing Alliances

Based on the preceding categorizations of the first- and second-tier carriers with regard to potential merger/acquisition activity, Mercator assessed the prospects for a change in the number of first-tier operating groups.

The three largest global vessel sharing alliances – the Grand Alliance, the New World Alliance, and the CHKY Alliance – have had membership stability for at least the past five years. It could be argued that as these operations encompass increasing numbers of ships and services, the costs for an individual member to withdraw and reposition its ships are becoming a force for continued stability. However, as indicated in the preceding paragraphs, one of these alliances (the Grand) has more than one member whose corporate ownership has an uncertain long-term commitment to the liner business. A contraction or re-constitution of this alliance is therefore a distinct possibility within the next 5-7 years.

Mercator considered the current vessel newbuild orders and existing service-specific vessel sharing agreements of the second tier Transpacific carriers to determine potential movement across tiers. We saw from this analysis that CSCL has the clear potential to become a Tier 1 operator. It is expected to be operating the following fleet of Panamax and Post-Panamax ships by 2007:

- 33 x 4000+ TEU
- 23 x 5000+ TEU
- 9 x 8000+ TEU
- 8 x 9000+ TEU

While Mercator expects CSCL to deploy its 8000-TEU and 9000-TEU ships in the Far East – North Europe trade (along with 12-13 x 5000 TEU ships in a North Europe – Far East – West Coast North America pendulum), it would nonetheless still have sufficient vessels to be able to operate at least 7 other competitive Transpacific services – an increase from the 4 strings it contributes ships to presently. With 8 weekly Transpacific services (including the pendulum), CSCL would be able to provide highly competitive frequencies in most of the critical eastbound market segments, even without participating in any vessel sharing agreements. If participating in a vessel sharing alliance covering the entire trade, with a carrier such as CMA-CGM (with whom it has two service-specific agreements today), it would certainly become another Tier 1 carrier, along with its partner(s).

After similar analysis of the projected fleets of Mediterranean Shipping Company, CMA-CGM, and the other Tier 2 lines, as well as the current Tier 1 carriers, Mercator developed two alternative scenarios regarding the number of first-tier operating groups in existence by or before the middle of the next decade. In the first scenario, it was assumed there would be a relatively high degree of consolidation within the top ranks of the industry, with the following transactions speculated:

Table II-29: Prospective Transactions Impacting Transpacific Operating Groups Under High Consolidation Scenario

Purchaser	Acquired Line
NOL/APL	P&O Nedlloyd
A.P. Moller/Maersk	Hapag-Lloyd
CMA-CGM	CSAV/Norasia
NYK	K-Line
COSCO	OOCL
Evergreen	Yang Ming

With these assumptions, and given surviving carriers' respective future fleets, Mercator concluded that there would be an increase in the number of first-tier vessel operating groups from 5 to 6, including:

1. New World Alliance (with APL/NOL, MOL, and HMM)
2. CHN Alliance (with COSCO, Hanjin, and NYK)
3. New Alliance (with CMA-CGM, CSCL, and Zim)
4. Maersk Sealand
5. Mediterranean Shipping
6. Evergreen

In the second scenario, it was assumed that there would be only two merger/acquisition transactions during this period – an NOL/APL purchase of one of the current Grand Alliance members (other than NYK), and the purchase of CP Ships by either CMA-CGM or CSAV. Under those assumptions, Mercator would expect the number of first-tier vessel operating groups to increase to 8:

1. New World Alliance (with APL/NOL, MOL, and HMM)
2. CHKY Alliance (with COSCO, Hanjin, K-Line, and Yang Ming)
3. Grand Alliance (with NYK and two among OOCL, Hapag-Lloyd, and P&O Nedlloyd)
4. New Alliance #1 (with CSCL and CMA-CGM)
5. New Alliance #2 (with Zim, CSAV/Norasia, and potentially PIL)
6. Maersk Sealand
7. Mediterranean Shipping

8. Evergreen

This analysis led Mercator to conclude that the number of first-tier operating groups, each of which would be capable of providing ten or more weekly Transpacific services by or before 2010, will likely increase from the current five to a number between six and eight. In addition, it suggests that the existing Tier 2 service providers will face increasing competitive pressure to broaden their service-specific agreements into trade-encompassing alliances.

Impacts of a Change in Number of First-Tier Operating Groups

The potential consolidation transactions and formation of new vessel sharing alliances discussed above, along with the organic expansions of the surviving lines, imply that the aggregate Transpacific vessel fleet capacity controlled by each operating group will increase significantly. This higher degree of fleet concentration should lead to both an increase in average service frequency in key market segments (such as Hong Kong/South China – SPB, or Shanghai – SPB) and in average ship capacities.

In this competitive environment, Mercator would expect the Transpacific networks of a typical first-tier operating group to include a package of services similar to the following:

- Four weekly strings from Hong Kong/Yantian to SPB
  - Spaced on Wednesday, Friday, Saturday, and Monday sailings from Yantian (using 4000-TEU, 5000-TEU, 8,000-TEU and 6000-TEU ships respectively)
  - Sailing directly to Los Angeles/Long Beach with prior calls in Taiwan or Southeast Asia, or calling subsequently at Shanghai/Ningbo or in Japan/Korea

- Three weekly strings from the Yangtze River basin to SPB
  - Sailings from Shanghai and or Ningbo on Tuesday, Thursday, Saturday
  - With one or two sailing directly to Los Angeles/Long Beach, with prior calls in S. PRC, Taiwan or Southeast Asia
  - With at least one sailing via Qingdao or Busan

- Two additional strings from Japan / Korea to SPB
  - Spaced at even intervals across the week
  - With one sailing from Tianjin/Dalian before Korea
  - With one sailing from Qingdao before Japan / Korea

- Two-to-three strings from Far East base ports to the PNW

- Two-to-three (or more) strings from Far East base ports to US East Coast

Of course, each carrier or alliance will have a unique fleet of vessels, as well its own particular market segment priorities, so the preceding list of service elements is but one of many potential network outlines. Nonetheless, with 6-8 first-tier operating groups each deploying a dozen or more separate Transpacific strings, cost and service frequency competition in the most critical market segments will undoubtedly intensify. The implications on frequency and ship size over the long-term are discussed in greater detail in the next phase of this report.

Section III: CONTAINERSHIP CALLS AT SAN PEDRO BAY PORTS

In previous sections of this report, the characteristics and the deployment of the current containership fleet serving San Pedro Bay ports has been described, along with a forecast of the market and competitive dynamics that will likely shape future service patterns. In this section, Mercator identifies and evaluates the factors that will influence the further development of the containership fleet and develops a forecast of vessel calls that can be expected at San Pedro Bay Ports.

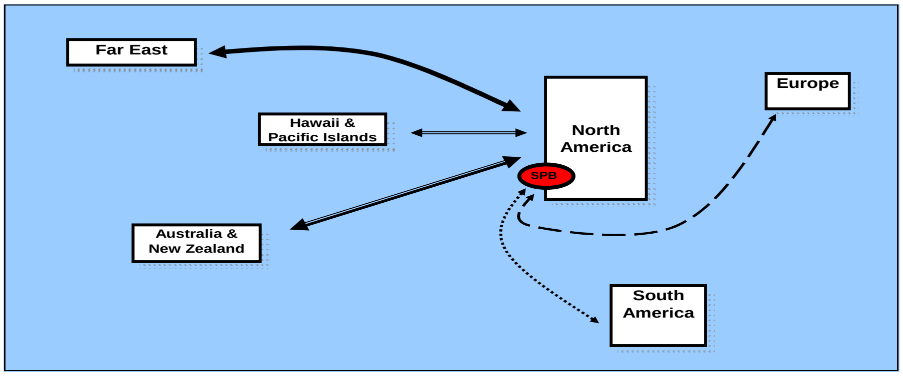
Notwithstanding the important role played by shippers in the shaping of carrier networks, it is the carriers that will determine the size and frequency of ship calls to be made at the port. Consequently, the approach taken by Mercator in constructing the containership forecast for San Pedro Bay has been to consider the Transpacific capacity and service requirements from the perspective of carriers overall, and specifically the perspective of a large carrier or carrier operating group. The large carrier groups will be the ones setting the marketplace parameters for ship size, transit time and service frequency, and so are the most important in terms of this analysis.

Task III-1: Tradelane Structures and Service Patterns

Geographic Tradelanes Involving San Pedro Bay Ports

The forecasting of future container shipping activity in San Pedro Bay is best viewed within the framework of the specific geographically-defined tradelanes that are involved, because it is only at the tradelane level that the underlying trends and factors that influence past and future events can be identified. For San Pedro Bay ports, container traffic is carried by ships operating in one of the following 5 tradelanes:

Figure III-1 - Diagram of Tradelanes Involving San Pedro Bay Ports



Source: MTG

The distribution of port calls by tradelane is highly uneven. As shown in Table III-1, the vast majority of ship calls are generated by vessels that primarily serve the Asia-North America market.

Table III-1 - Distribution of 2004 SPB Ship Calls By Primary Tradelane

Primary Trade Served	Calls/Wk
Trans Pacific - Asia	53
Hawaii Domestic	3
S. America	3
Australia / New Zealand	2
Europe	1
Total SPB Calls	62

Source: MTG

The foregoing table and the fact that Asia-North America trade is growing faster than other trades make it clear that the Asia-North America trade is by far the most important and will be the primary trade driving future SPB port calls. Further analysis of this trade will be presented, but prior to that we examine the secondary trades to forecast their expected behaviour and quantify their expected contribution to SPB port calls.

Vessel Routing Framework For The Forecast Model

In addition to the geographic tradelane structure described above, a further breakdown defined according to vessel operational routes is necessary to describe the patterns of vessel services and port calls. The operational route framework developed by Mercator for making the actual port call forecasts is presented below.

All SPB port calls are assigned to a unique service/port call category, with categories defined so that any port call fits in one category. The second column describes the geographic trades served. The third column lists the number of such calls per week as of Q3 2004.

Table III-2 - Operational Route Framework For SPB Port Call Forecasting

Cat Num	Category Description	Principal Geographic Trades	Calls/ Week 2004
1	T-P / WCNA – 1st Call SPB	Asia-N. Amr; (E/B & W/B)	40
2	T-P / WCNA – NOT 1st Call SPB	Asia-N. Amr (E/B & W/B)	5
3	T-P / USEC, E/B via Panama	Asia- N.Amr-C.Amr, Carib,Eur (E/B)	2
4	Panama W/B services	Eur, Carib, C. Amr - N. Amr - Asia; (W/B)	7
5	N/S, west coast of Americas[5]	N. Amr - C. Amr - WCSA	3
6	Aus / NZ	N. Amr - Austalia & New Zealand	2
7	HI Domestic	N. Amr - Hawaii	3

Definition of Route Framework / Port Call Categories”

Category 1: Transpacific services making a first inbound call at a SPB port, and then returning to Asia, possibly with an additional call in North America.

Category 2: Transpacific services that make a first call at some port other than in SPB, but then call SPB before returning to Asia.

Category 3: Transpacific services that call a SPB port prior to transiting the Panama Canal

Category 4: Services that call in SPB after transiting the Panama Canal in the westbouind direction (having come from Europe, the USEC, Carib, Central America)

Category 5: Services operating on the n/s axis along the west coast of North America and South Anerica

Category 6: Direct services between North America and australia / New Zealand

Category 7: Domestic services between the US Mainland and Hawaii, which do not continue to Asia

Category 1 comprises the majority of port calls, and is the one most clearly connected to the dominant flow of cargo through the ports, the flow of imports from Asia. Category 2 port

[5] For Asia-WCNA-WCSA services, the eastbound call is included category 1, the w/b call in category 5.

calls also bring Asian imports, but the drivers for these calls are more often associated with westbound exports to Asia.

Although the vessels making Category 3-7 port calls may be deployed in services that cross the pacific, the number of such port calls is not driven by the primary eastbound Asian trade flow. These calls serve secondary trade flows, as described below.

Port calls were segregated into these categories so that all similar port calls, i.e. those that serve the same markets and which would be expected to grow at similar same rates, could be forecast together.

Secondary Tradelanes Contributing to SPB Port Calls

Before addressing in some detail the Category 1 and 2 port calls, we will examine the characteristics of the secondary trades that contribute to SPB port calls. The characteristics of those trades and their current and future service patterns are presented below.

- **Europe/Mediterranean – North American West Coast (Category 3 & 4 calls)**
    - Market size is relatively small with just 1 dedicated service using ships <2600 TEU
        - Cargo is primarily carried by services to/from Asia that stop in SPB en-route to/from the USEC / Europe
        - Northbound boxes are carried by WCSA – Asia services and by relay at Panama to westbound ships from US East Coast to US West Coast
    - The trade's size/growth and sailing corridor imply that coverage will continue to be provided primarily by Asia – USWC – USEC deployments extended across the Atlantic Ocean; These services will also carry via transshipment the limited USWC-Carib/ECSA trade
    - Category 3 & 4 port calls also serve the Caribean and the East Coast of South America markets

- **West Coast of South & Central America – North American West Coast (Category 5 calls)**
    - Trade volume is very small, with just 1 dedicated weekly service
        - Southbound boxes are primarily carried by services originating in Asia that stop en-route in SPB
        - Northbound boxes are carried by WCSA – Asia services and by relay at Panama to westbound ships from US East Coast to US West Coast
    - Long-term trade outlook indicates modest growth
    - Limited trade size/growth, coupled with geographic factors and the development of additional transshipment capability in Panama, imply a continuation of current service patterns, with a gradual increase in average ship size and potentially two additional sailings per week

- **Australia/New Zealand – North American West Coast (Category 6 calls)**

- Head-haul market size of about 4000 TEU/week
- Currently just 2 direct weekly services, plus relay services via Far East, but latter are not very competitive, especially for northbound shipments
- Both direct services operated by the same 4-carrier alliance, with <2000 TEU ships
- Long-term outlook indicates modest growth, with capacity requirements satisfied through gradual increases in ship size and the introduction of 1 additional service

- **Mainland USA – Hawaiian Islands (Category 7 calls)**
  - Head-haul market size of about 9000 TEU/week (<5% of Transpacific E/B trade)
  - Currently has 3 weekly services ex SPB, with <2800 TEU ships
  - Long-term trade outlook indicates 2-4% average annual growth
  - Limited number of competitors (compared to international trades), due to cabotage requirements
  - Slow market growth, limited size, competitive frequency requirements, and high domestic shipyard costs will limit the deployment of new, large ships to this trade.
  - By 2020, we expect frequency to increase to 4 sailings per week, with slightly larger vessels

Current Service Patterns For the Primary Transpacific Trade

The current capacity deployed in the Asia-SPB eastbound market includes 45 TP-WCNA "loop" services, 40 of which make Category 1 calls (with a first inbound call at a POLB or POLA terminal), with 5 making Category 2 calls (calling SPB after first 1 or more other west coast ports). In addition 2 services call SPB en route to the US East Coast and Europe (making category 3 calls). The capacity of the 40 1st-call services that serve the Southern California ports amounts to about 166,000 TEU/week (8.6 million TEU/yr). Including the 5 services making secondary E/B calls at SPB ports increases the capacity deployed on Transpacific loops to about 9.4 million TEUs per year[6]. These services, along with the non-SPB-calling services that are also part of the Pacific trade, are summarized in Table III-3.

[6] References in this report to vessel capacity are based on the so-called nominal capacity at which ships are listed in industry publications and references. Actual effective container carrying capacity is normally 85-90% of the nominal capacity. Although there is some variability among owners and carriers with respect to the calculation of vessel capacity figures, the nominal figures as published represent the only available data. The impact of this variability is limited to the extent possible by consistently applying a common approach to the interpretation of these figures.

Future cargo volume and corresponding capacity growth are highly important in terms of effect on carrier deployment design and choice of vessel size. For the sake of the ship call forecast, Mercator considered a range of import growth rates, as discussed in Section II of this report. Low, medium and high import growth rates of 5%, 7% and 9% per annum were selected to bracket the expected rates of import cargo growth. For each scenario, the required capacity was projected for each of the transpacific service sectors included in the foregoing tables. Weekly capacity that would be deployed in year 2020 under each of these growth scenarios is presented in Table III-3.

Table III-3 - Estimated Future Transpacific Capacity Required By Service Sector (TEUs/wk)

Asia-North America Capacity Required Under Alternative Import Growth Scenarios

	Current Capacity Mid-Year 2004			**Required 2020- Capacity TEU/wk Under Alternative Growth Scenarios**		
				Low 5.0%	**Expected 7.0%**	**High 9.0%**
Service Type	Count	Avg TEU	TEU/wk	2020	2020	2020
TP-WCNA -SPB 1st Call	40	4160	166,400	363,230	491,240	660,659
TP-WCNA -SPB 2nd+ Call	5	3025	15,125	33,016	44,651	60,051
TP-WCNA -PNW/North Calif Without any SPB calls	12	3360	40,320	88,014	119,031	160,083
Asia-USEC No en-route SPB Call	17	3774	64,158	140,049	189,405	254,727
Asia-USEC With en-route SPB call	2	4333	8,665	18,915	25,580	34,403
Total Asia-North America	76	3,877	294,668	643,223	869,908	1,169,922

Source: MTG analysis of MDST Containership Databank

In this table, we assumed a continuation of the current market shares for each port range. This is a reasonable assumption as long as SPB ports do not reach capacity saturation, which, according to the Ports' analysis of capacity potential, will not to occur until SPB port volumes reach approximately 45 million TEUs. This level of activity would only be reached in the high growth scenario, in approximately year 2018-2019. Under the low and medium growth scenarios this level of activity is not reached before 2020. In any event, the SPB fleet and port call forecasts are considered valid within each SPB volume/capacity scenario, irrespective of the growth experienced by other ports.

As shown in this table, capacity of TP-WCNA services making a first inbound call at SPB ports would, in the medium growth scenario, reach about 500,000 TEUs/week (about 26 million TEUs per year) by 2020. Under this scenario, a "typical" operating group (one of the seven that are, taken together, assumed to be providing 95% of the capacity) would thus be seeking to deploy about 67,000 TEUs per week, or about 3.5 million TEUs per year.

Task III-2: Structure of Future Transpacific Service Providers

As discussed in Section II of this report, the Transpacific market can be broken into 3 tiers of participants. The first tier is presently comprised of five large carriers/carrier groups (CHKY, MSL, NWA, EMC, Grand) that together operate about 77% of market capacity. The second tier includes six global carriers (MSC, CMA CGM, CSCL, Zim, CP Ships, CSAV), each of which operates independently or in a variety of vessel sharing agreements, but without a consistent set of partners. The Second Tier collectively operates slightly more than 20% of current capacity. The Third Tier includes small operators without a global presence, operating small vessels and with relatively small market shares.

Between 2005 and 2020, it is expected that through corporate mergers and acquisitions and through further alliance consolidation, the market will evolve to approximately seven major operating groups in the Pacific market, and that these seven groups will operate approximately 95% of market capacity. The development of the fleet will thus be assessed considering the needs and likely behaviours of these large vessel operating groups.

The distribution of capacity across carrier groups and the corresponding scale of each group is a factor influencing each group's choice of ship sizes and deployments. Current Transpacific services and service capacity, distributed according to carrier tier are presented in Table III-4.

Table III-4 - Current Transpacific Service Count and Capacity Deployed - By Carrier Tier

Count of Services Offered in 2004, By Carrier Tier - Per Week

	MSL	Evergreen	Grand Alliance	New World Alliance	CHKY Alliance	Tier 1 Subtotal	Tier 1 Average	Tier 2	Tier 3	Grand Total
TP-WCNA -SPB 1st Call	4	2	5	7	9	27	5.4	8	5	40
TP-WCNA -SPB 2nd+ Call	1	1	0	1	0	3	0.6	0	2	5
TP-WCNA -PNW/North Calif Without any SPB calls	1	2	1	1	3	8	1.6	4	0	12
Asia-USEC (w/out SPB E/B)	2	2	3	2	3	12	2.4	5	0	17
Asia-USEC (with SPB E/B)		1	1	0	0	2	0.4	0	0	2
Total	8	8	10	11	15	52	10.4	17	7	76

Source: MTG analysis of MDST Containership Databank

Capacity of Services Offered in 2004, By Carrier Tier - TEUs per week

	MSL	Evergreen	Grand Alliance	New World Alliance	CHKY Alliance	Tier 1 Subtotal	Tier 1 Average	Tier 2	Tier 3	Grand Total
TP-WCNA -SPB 1st Call	16,545	10,349	27,210	32,323	41,907	128,334	25,667	27,963	10,103	166,400
TP-WCNA -SPB 2nd+ Call	4,223	3,396		4,625	0	12,244	2,449	0	2,881	15,125
TP-WCNA -PNW/North Calif Without any SPB calls	2,273	8,044	5,427	4,411	10,637	30,792	6,158	9,528	0	40,320
Asia-USEC (without SPB)	8,392	7,018	10,317	8,445	11,616	45,788	9,158	18,370	0	64,158
Asia-USEC (with SPB)	0	3,927	4,738	0	0	8,665	1,733	0	0	8,665
Total	31,433	32,734	47,692	49,804	64,160	225,823	45,165	55,861	12,984	294,668

Source: MTG analysis of MDST Containership Databank

Mercator has forecast that consolidation of carrier ownership and the formation of new carrier alliances will result in 7 “Tier 1” carrier operating groups controlling 95% of the Transpacific market, up from the current five Tier 1 groups that control 77% of the market. Under the medium growth rate scenario, a typical such group would deploy capacity of about 120,000 TEU per week by 2020, as shown in Table III-5.

Table III-5 - Typical Capacity Requirement For A Tier 1 Carrier Group – 2020

Estimated 2020 Capacity Requirement
For An Average "Tier One" Operating Group

Assumptions:	
Number of Tier 1 operating groups	7
Growth - CAGR	7.0%
Share of market served by Tier 1 groups	95%
Service Type	**2020**
Capacity By Service Type:	
TP-WCNA -SPB 1st Call	66,668
TP-WCNA -PNW/OAK 1st	22,214
Asia-USEC	29,177
Total Asia-North America	118,059

The Tier 1 operating groups presently deploy an average of about 10 weekly services between Asia and North America. Based on the ages of the current Pacific fleet and the likelihood of redeploying smaller tonnage to other markets, each of the expected seven major groups will, in 2020, likely be operating approximately 20 strings of ships, with weekly capacity of about 120,000 TEU. The ships for only about half of these strings are already in operation or on order, equating to weekly capacity of about 50,000 TEU per group. This means that each group would need to order new tonnage providing capacity of almost 70,000 TEU per week. By evaluating the issues that will influence what additional new tonnage carriers will prefer, we will develop a proforma mix of vessel sizes and likely deployments for one of the seven major operating groups that are expected to be serving the Transpacific market in 2020.

Task III-3: Analysis of Factors Influencing Selection of Ship Size

When expanding its fleet or replacing existing vessels, a carrier typically considers a variety of factors before selecting the capacity for new ships to be built. These factors fall into three main categories:

- Operating Economy – typically measured as the average ownership plus operating cost, for a round trip voyage, on a per-slot basis
- Operational performance and characteristics of the ports to be called
  - Available crane size, berth length and water depth
  - Port productivity, including the ability of the terminals to process containers at the required rate
- Commercial attractiveness and suitability for the markets to be serviced, specifically -
  - Whether the market is sufficiently large to support high utilization
  - Whether transit time and service frequency will be competitive
  - How the new tonnage would impact alliance arrangements

In all of these areas, carriers will typically evaluate and compare their own alternatives, and compare their alternatives with the current and future services offered by the competition. Consequently, what other carriers are doing, and the desire not to be too far from the mainstream in terms of service plans and asset designs, often are important factors. Carriers will evaluate these many factors and seek a solution that provides a comfortable balance between cost, reliability, and service attractiveness.

Because ships will remain in service for a considerable period (20-30 years), these factors must be considered not only in terms of the then-current environment, but also in terms of uncertain future environments.

In this task, each of the key evaluation and decision factors is discussed in greater depth to identify how it will influence future fleet selection.

<u>Operating Feasibility and Economy</u>

To evaluate the deployment feasibility and operating economy of various ship sizes, Mercator created proforma vessel schedules and calculated the voyage costs and effective cost per slot for ship size classes ranging from 4500 to 18000 TEUs. The basic deployment involved 5 ships on a 35 day voyage, calling 1 or more Japan ports westbound, along with 3 main loading ports eastbound (Hong Kong, Yantian & Shanghai).

Because of the initial construction cost and the continuing high fuel cost for ships operating above 24-25 knots, a 25 knot speed was adopted as the upper limit for the analysis. As ships increase in size, therefore, the required container load and discharge rate per hour in port increases significantly. For the 4500 TEU Class ship, handling rates of about 80 moves per operating hour are sufficient, however, for the 12000 and 18000 TEU Class ships, the handling rate must increase to 150 - 200 containers per hour. It is not clear that ports can achieve these levels on a regular basis, which creates some concern with respect to the ability of the very large ships to maintain a weekly Transpacific schedule using 5 ships. Nonetheless, for the sake of comparing slot economy, it was assumed that such a schedule, with consistent use of 6 to 8 cranes on these very large ships for the entire duration of their port times, was feasible.

The results of the Mercator schedule and slot cost analysis are summarized below. Additional supporting schedules may be found in Appendix II.7a.

Table III-5 - Asia-USWC Slot Cost, According to Ship Capacity

Asia - USWC Slot Costs

TEU Class	4500	6000	8000	10000	12000	14000	18000
Est Eff TEU	3,900	5,100	7,200	9,600	11,800	13,800	17,300
Voyage Cost Per (Effective) TEU							
Vessel - Capital	318	296	247	230	225	212	190
Vessel - Operating	64	51	41	33	28	26	22
Fuel	155	157	154	132	125	118	105
Port Charges	44	41	40	36	36	34	31
Canal Costs							
Total	$581	$546	$482	$430	$415	$391	$347
$/TEU Reduction For each 1000 TEU Increase in Ship Size							
		$29	$31	$22	$7	$12	$12

Source: MTG

Notes:
Figures include vessel ownership, crew & operating expenses, fuel, port charges.
Costs for 10000+ TEU vessels do not include the fuel penalty associated with possible draft limits.
Fuel costs for 10000 TEU class would increase by 3% if limited to 14m draft.
Cargo handling costs, including transshipment & feeder costs are excluded.
Loading of vessel to its estimated max effective operational capacity is assumed.

As illustrated in Table III-5, Mercator's analysis confirms that cost savings are generated across the full range of increased ship sizes, from 4500 TEU to 18000 TEU. The magnitude of cost reductions, however, is not consistent across that range, with significantly smaller reductions when size is increased to above the 10000 TEU class. Specifically, we calculate meaningful cost reductions as ship size increases up to the 10000 TEU level (a $20-30 per

TEU reduction with each 1000 TEU increase in ship size), but a much smaller reduction (about $7/TEU) when adding capacity at the 12000 TEU size class.

The lack of material cost reduction benefits derived from an increase in ship size from the 10000 TEU class to the 12000 TEU class, particularly when combined with all of the operational and commercial challenges associated with larger vessels, makes the 12000 TEU class unattractive.

The discontinuity in cost reduction potential with the 12000 TEU class is driven by a change in vessel construction and operating cost associated with the need to install twin screw propulsion on ships larger than about 11000 TEU. The result is that the effective cost per slot for the 12000 TEU class ship is not significantly lower than for the 10000 TEU size.

The figures above indicate that the largest reduction in unit costs is achieved by increasing vessel size from 6000 TEU to 8000 TEU, with smaller cost reduction benefits generated by each size increase above that level. This cost / size behaviour lowers the probability that a carrier would choose to build a ship in the 12000 TEU size class or greater. Given the limited difference in slot economics between the 10000 and 12000 TEU classes, we conclude that 12000 TEU class vessels would not be built.

In addition to the diminishing unit cost benefit at and above the 10000 TEU class capacity level, other factors also point to limited benefits to be achieved by pushing vessel capacity above the 10000 TEU level. These issues are discussed in the following sections.

Port Turnaround Time and The Ability To Maintain Schedule

Based on the Section II-5 analysis of the infrastructure available at major Asian container ports, it appears that ships with a draft up to 15m could be accommodated, either now or within several years, at 10 of the top ports that trade with the ports in San Pedro Bay. This creates the opportunity for carriers to deploy ships of up to 12000 TEU, or even 14000 TEU, provided that container terminal infrastructure and operating processes are sufficient to support the vessels.

The challenge for carriers and terminal operators will be to achieve and efficiently maintain the high rates of container loading and discharge that are required in order for the large container vessels to maintain a 35 day, fixed-day-of-the-week schedule. Mercator has calculated that terminals handling 10000 TEU vessels would need to be able to maintain handling rates of at least 125 moves per berth hour at all ports in Asia, and 125 moves per operating hour on the USWC[7]. These rates are achievable at most ports. As size increases, however, the required handling rates also increase, to 150/hour with 12000 TEU vessels, 175/hour for 14000 TEU ships, and 200/hour for an 18000 TEU ship. Even at these high handling rates, which are at or beyond what is reasonably feasible with current systems, and

[7] Required container handling rates are based on the pro-forma vessel schedules that are included in Appendix II.7a.

with ships always sailing at the upper limit of vessel speed capabilities, the number of lifts that can be accomplished over the course of the voyage is barely enough to load and discharge a full vessel, with little or no time reserved for schedule contingencies.

Operating expensive vessel assets in a complex transportation system with extremely small allowances for schedule disruptions would be very risky. Most carriers would choose not to deploy ships in such a precarious schedule, which lowers the likelihood of ships above the 10000 TEU class being deployed in a Transpacific loop service. The option of increasing the number of vessels deployed in a given string to ensure service reliability is clearly not attractive, given that the cost savings would be immediately wiped out by the cost of the extra vessel, and that transit times would at the same time be increased. New terminal handling and vessel loading and discharge technology that would cost efficiently increase handling rates to the 200-300 containers per hour range (such as 2-sided operations with an "indented berth") would largely eliminate, the schedule reliability problems of the large vessels, however no carriers or terminal operators have experience with such systems at this time.

Efficient operation of port terminals and efforts to maximize throughput through limited facilities benefit from a balanced distribution of services across the week. A distributed schedule with multiple sailings helps to avoid peak activity surges that limit the performance of the terminal and reduce the level of service that can be maintained. In order to distribute volume across the week, it will be better to have more moderately-sized services than to concentrate volume on a few ultra-large services. It is likely that the intermodal rail system supporting each SPB terminal would benefit from having vessel arrivals distributed more evenly throughout the week, considering the logistical challenges and infrastructure constraints associated with moving and marshalling fleets of trains before and after each port call of an ultra-large ship. These factors support a limitation in the maximum size of vessels to be deployed in the trade.

Commercial Attractiveness of The Vessel Service

Increasing the size of ships naturally increases the time required to discharge and load those ships. For example, if discharged at the same 125 container per hour rate, a 10000 TEU ship would require 38 working hours to discharge its roughly 4800 containers, compared to just 17 hours for a 4500 TEU ship to discharge its 2100 containers, a difference of 21 hours. Due to a shortage of stacking areas, however, most terminals are unable to discharge a vessel without simultaneously loading containers back to the vessel (in order to make room for the continuing stream of containers being discharged). This means that before finishing the discharge of a large vessel, the terminal operator will likely have handled half again as many containers as were discharged. This extends the time to complete the discharge of the 10000 TEU vessel to about 57 hours, compared to about 26 hours for the 4500 TEU vessel.

Under this scenario, an additional 30 working hours would be required in order for all cargo from the 10000 TEU ship to be available. With the possibility of staffing challenges associated with obtaining sufficient hoot gang stevedores in SPB terminals (especially during peak seasons and holiday periods) and the reluctance to utilize hoot gangs due to their higher costs, this 30-hour differential could in practice translate into an additional two days of port dwell time. The use of more cranes on the larger vessels can reduce the time differential, but in any event, the effective transit time extension for the last cargo discharged is on the order of 1-2 days. A similar impact could be foreseen at the origin terminals, created by a need to receive cargo further in advance of a sailing in order to avoid excessive peak demands on the terminal.

The extended transit time for “incremental cargo” that is added through an increase in the size of ships makes the incremental capacity less attractive commercially. Under such an operating plan, the carrier would increasingly need to segment and manage customers and their freight according to the transit time that was sold/promised in order to avoid a damaging general decline in service levels offered. Although not an impossible problem to solve, the operational challenges of doing so are significant, and would be made doubly difficult in an environment of constrained terminal capacity such as can be expected in the future in Southern California.

Transshipment Requirements and Related Costs

If larger ships making fewer port calls are to be filled through an increased use of transshipment, the unit cost advantages of the larger ships will be partially offset by increased transshipment costs. The table below illustrates the issue.

In this example, it is assumed that larger ship sizes are increasingly dependent upon the use of transshipment to collect cargo from a range of Asian ports, with the percentage of transshipped containers assumed to increase by 5% for each 2000 TEU increase in ship capacity. With the inclusion of estimated transshipment costs, which total about $234 per TEU transshipped (feeder cost plus handling cost per round-trip cycle), system cost reduction from the deployment of larger vessels ranges from 4% to 20%, compared to the 6% to 35% reductions achieved if no increase in overall transshipment is required by the deployment of larger tonnage.

Table III-6 - Impact of Increasing Transshipment Rates On Large Vessel Economics

Estimated Impact of Transshipment on Large Vessel Slot Costs

Ship TEU Class	Average Cost/TEU				
	$/TEU if 100% Direct Load	% Reduct. Vs. 4500 TEU Class	% Trans-shiped	Avg. Cost Per TEU (Incl T/S Cost)	% Reduct. Vs. 4500 TEU
4,500	581		10%	$604	
6,000	546	6.0%	15%	$581	3.8%
8,000	482	17.1%	20%	$528	12.6%
10,000	430	26.0%	25%	$488	19.2%
12,000	415	28.5%	30%	$486	19.6%
14,000	391	32.7%	35%	$473	21.8%
18,000	347	40.2%	45%	$453	25.1%

Source: MTG

Operational Benefit of Limiting Peak Activity Levels

Another factor limiting the introduction of ever-larger ships will be an expected operational need to balance activity across the week at origin and destination terminals so as to more efficiently make use of limited terminal capacity. This operational desire, coupled with a commercial desire to offer increased service frequency, could lead to increased popularity of services with 4000-5000 TEU vessels making fewer port calls, and possibly being operated by 4 ships instead of the more traditional 5 ships per string.

Task III-4: Matching Vessel Capacity and Service Frequency To Market Size

As discussed previously in this report (in Section II-9 and at the beginning of this section), Mercator envisions a scenario for 2020 that includes 6 to 8 large Tier 1 carrier operating groups, that together handle about 95% of the market. In order to maintain competitive service frequency across major ports, each carrier group would typically need to deploy about 70,000 TEU directly to SPB, distributed across 9 or 10 vessel strings, with the size of vessels in each string properly matched to the market being served.

To assess the size of vessels that a typical carrier group would likely deploy in the future, we have constructed a pro-forma deployment plan that follows the outlines of the plan first introduced in Section II.

The Asia export market has been subdivided into 8 sub-regions, 4 of which (including HKG) are within PRC, as shown on the map below. The current and projected weekly exports to North America are tabulated in Table III-7.

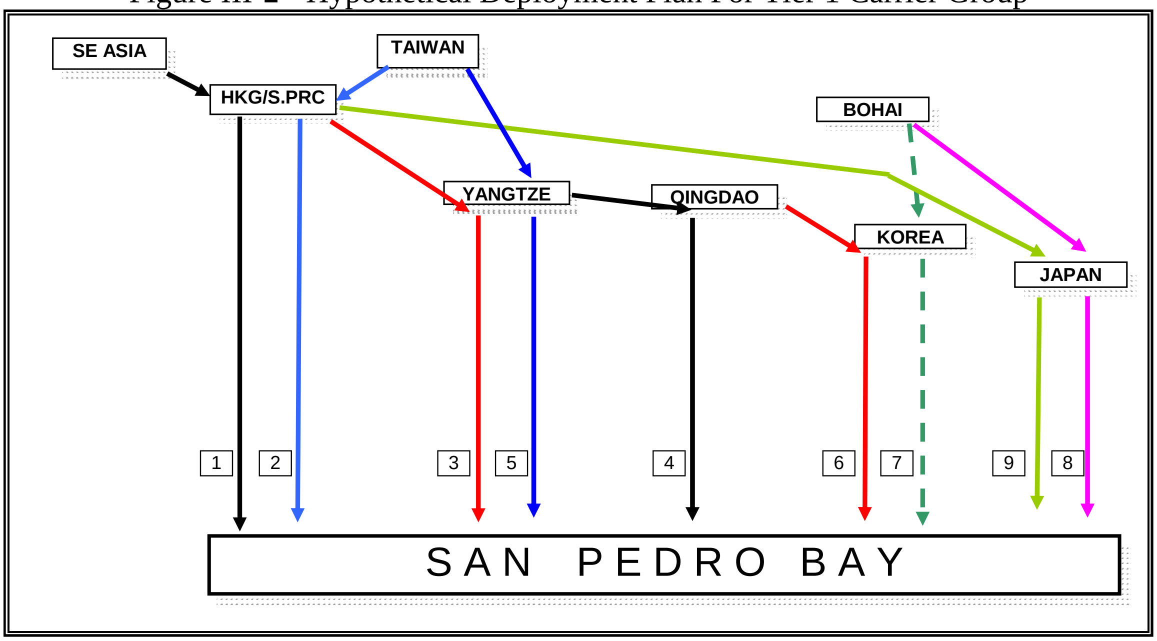
Table III-7 – Geographic Distribution of Asian Exports To US
By Asian Origin – TEU/yr (000s) - 2004 and 2020

Share of Exports To The US				
Origin Region	2004		2020 Fcst.	
	TEUs	Share	TEUs	Share
HKG / S. PRC	4,193	37%	10,720	32%
Yangtze	2,472	22%	8,040	24%
Qingdao	532	5%	4,020	12%
Bohai	618	5%	4,020	12%
PRC & HKG subtotal	7,823	70%	26,800	81%
S.E.A.	1,285	11%	2,406	7%
Japan	857	8%	1,606	5%
Taiwan	678	6%	1,269	4%
Korea	598	5%	1,121	3%
Total	11,241	100%	33,202	100%

Sources: 2004 trade data by country from JOC/Piers; 2004 regional breakdown within PRC developed by MTG based on PRC port handling statistics from Containerization International; 2020 volumes developed by MTG based on estimated differential growth rates for sub-regions

Due an expected higher growth rate, the share of the market moving from within China is expected to grow, with the northern regions of China, which are now less developed than the south or Yangtze regions, making the major increases in share.
To assess the likely ships that would be required to serve the Asia-SPB market, hypothetical itineraries were created fro a typical "Tier 1" carrier group. One potential vessel deployment plan for providing competitive service between these markets and SPB is indicated in the Figure III-2.

Figure III-2 - Hypothetical Deployment Plan For Tier 1 Carrier Group



Source: MTG

By overlaying the estimated volume coming out of each of the sub-regions upon the expected voyage plan from Figure III-2, it is possible to develop a distribution of vessels/sizes for a typical Tier 1 carrier group. The results of this analysis are shown below in Table III-8.

Table III-8 - Volume Per Sailing and Required Ship Sizes For
Hypothetical Tier 1 Asia-SPB Service Plan – Yr 2020, With 7% CAGR

		HKG/ SPRC	Yangtze	QGD	Bohai	Korea	Japan	Taiwan	S.E.A	Average Per Voy	Req'd Nom Vsl TEU Cap
Total SPB TEU / Week		123,693	92,769	46,385	46,385	12,932	18,530	14,643	27,760	383,096	
											Assume 1.25 x
Sailings/wk per Tier 1 Grp		4.0	3.0	2.0	2.0	2.0	2.0	2.0	1.0	18.0	Average TEUs
Avg. TEU/Sailing		4200	4200	3150	3150	880	1260	990	3770	2890	
String ID	1	4,200							3,770	7,970	9,960
Ref Fig. III-2	2	4,200						990		5,190	6,490
	3	4,200	4,200							8,400	10,500
	4		4,200	3,150						7,350	9,190
	5		4,200					990		5,190	6,490
	6			3,150		880				4,030	5,040
	7				3,150	880				4,030	5,040
	8				3,150		1,260			4,410	5,510
	9	4,200					1,260			5,460	6,830
Total 2020, "Avg. Tier 1"		16,800	12,600	6,300	6,300	1,760	2,520	1,980	3,770	52,030	65,050
Sailings Per Region		4	3	2	2	2	2	2	1	18	9
								Average per Tier 1 String			7,200
								Total Tier 1 (7 groups)			455,350
								Total Trade			479,000

Source: MTG

Operating with this service plan, a Tier 1 carrier with a typical share (i.e. a 1/7th share of 95% of the market), would deploy the following mix of vessel strings[8] as shown in Table III-9.

Table III-9 - Mix of Ships For Hypothetical Tier 1 Service Plan
Medium (7%) Growth Scenario

TEU Class	String #s Ref Fig III-2	Count of Strings	Cum % of Strings	Capacity TEU/wk	Cum % of Capacity
4-5000			0%	0	0%
5-6000	6, 7, 8	3	33%	15,590	24%
6-7000	2, 5, 9	3	67%	19,810	54%
7-8000			67%	0	54%
8-10000	1, 4	2	89%	19,150	84%
10-12000	3	1	100%	10,500	100%
14-18000+			100%	0	100%
Total		9		65,050	

Source: MTG

[8] Nominal capacity exceeds the actual container lift by a factor of 1.25 to account for a) differences in actual capacity versus nominal (actual = about 90% of nominal) and b) seasonality of cargo flows (average utilization of effective capacity is typically about 90%) . Effective average loading is thus about 80% of nominal (i.e. nominal is about 1.25 x average loading),

This distribution of vessels is by no means definitive and should not be expected to apply universally, as each Tier 1 group will have a somewhat different share of each market, and will have its own bias with respect to how to serve each market. In practice, each hypothetical string could be operated with ships falling within a range of sizes, and carriers would of course adjust their own service plans depending on their particular fleet. Nonetheless, some important conclusions can be derived from this analysis:

- Deployment of 12000 and 14000 TEU ships would generally not be expected, at least under the “expected” 7% growth scenario.
- Based on the market sizes and frequency expectations, deployment options for ships over 10,000 TEU are limited. A 10,000 + TEU vessel would need to call both of the two largest markets, and lift a significant share of each. A particular carrier group would be unlikely to operate more than 1 such service, and some groups would likely avoid that size altogether.
- There are requirements for ships within each size class across the full range ranges of sizes from 4000/5000 to 10000.
- There is no obvious role for ships under 4000 TEU in the 2020 Transpacific-SPB network of a Tier 1 carrier group, and so most of those vessels will be re-deployed to other markets by that time.

Carrier Vessel Service Plan Under Alternate Scenarios - High Growth

A similar analysis was undertaken for the high growth and low growth forecast scenarios. For the high growth scenario, the prospective fleet composition is presented in Tables III-10 and III-11

Table III-10 - Volume Per Sailing and Required Ship Sizes – High Growth
Hypothetical Tier 1 Asia-SPB Service Plan – Yr 2020, With 9% CAGR

		Load Port / Volume Lifted (TEU/Sailing)									
		HKG/ SPRC	Yangtze	QGD	Bohai	Korea	Japan	Taiwan	S.E.A	Average Per Voy	Req'd Nom Vsl TEU Cap
Total SPB TEU/Wk		165,900	124,425	62,212	62,212	17,539	25,132	19,861	37,651	514,934	
											1.25 x Average
Sailings/wk per Tier 1 Grp		4.0	3.0	2.0	2.0	2.0	2.0	2.0	1.0	18.0	TEUs
Avg. TEU/Sailing		5630	5630	4220	4220	1190	1710	1350	5110	3880	
										TEU Lift	
String ID	1	5,629							5,110	10,739	13,420
Ref Fig III-2	2	5,629						1,348		6,976	8,720
	3	5,629	5,629							11,257	14,070
	4		5,629	4,222						9,850	12,310
	5		5,629					1,348		6,976	8,720
	6			4,222		1,190				5,412	6,760
	7				4,222	1,190				5,412	6,760
	8				4,222		1,705			5,927	7,410
	9	5,629					1,705			7,334	9,170
Total 2020, "Avg. Tier 1"											87,340
Sailings By Region		4	3	2	2	2	2	2	1	18	9
								Average per Tier 1 String			9,700
								Total Tier 1 (7 groups)			611,380
								Total Trade			644,000

Source: MTG

Under this service plan, and for a Tier 1 carrier with a typical share (i.e. a 1/7th share of 95% of the market), the following mix of vessels would be required:

Table III-11 - Mix of Ships For Hypothetical Tier 1 Service Plan
High (9%) Growth Scenario

TEU Class	String ID Fig III-2	Count of Strings	Cum % of Strings	Capacity TEU/wk	Cum % of Capacity
4-5000			0%	0	0%
5-6000			0%	0	0%
6-7000	6, 7	2	22%	13,500	15%
7-8000	8	1	33%	7,400	24%
8-10000	2, 5, 9	3	67%	26,600	54%
10-12000	1, 4	2	89%	25,700	84%
14-18000+	3	1	100%	14,100	100%
Total		9		87,300	

Source: MTG

From this analysis of carrier deployments and ship sizes under the high growth scenario, some different insights can be derived;

- Deployment of 14000 TEU ships would likely be undertaken by at least some of the larger Tier 1 groups. Given the sizes of the markets, 8000 and 10000 TEU strings seem not to be overly large. Subject to port facilities being sufficiently expanded, carrier groups could each be operating multiple strings of 10000 TEU and 8000 TEU ships.
- Unless carriers decide to further increase frequency beyond the level assumed in this analysis, virtually all strings would be operated with vessels of 6000 TEU or greater. This would require that a most currently deployed vessels be re-deployed to another trade, to make room for the upgraded vessels. This is considered unlikely, and therefore we would expect an increase in service frequency related to the continued deployment of certain vessels in the 4000-6000 TEU classes.

Ships under 4000 TEU would likely not play a role in the Transpacific-SPB networks of Tier 1 carriers, who should have little difficulty re-deploying those vessels by that time. Even though "on paper" they don't fit a particular deployment requirement, a limited number of ships of the 4000 and 5000 TEU classes would nonetheless likely continue to be deployed because they are flexible and already exist in carrier's fleets,

Low Growth Scenario

Prospective fleet composition for a typical Tier 1 carrier under the low growth scenario is presented in Tables III-12 and III-13.

Table III-12 - Volume Per Sailing and Required Ship Sizes – Low Growth Hypothetical Tier 1 Asia-SPB Service Plan – Yr 2020, With 5% CAGR

		Load Port / Volume Lifted (TEU/Sailing)							**Low Growth Scenario**			
		HKG/ SPRC	Yangtze	QGD	Bohai	PRC & HKG	Korea	Japan	Taiwan	S.E.A	Average Per Voy	Req'd Nom Vsl TEU Cap
Total SPB TEU/Yr (000s)		90,344	67,758	33,879	33,879	225,860	10,249	14,687	11,606	22,002	221,319	
												1.25 x
Sailings/wk per Tier 1 Grp		4.0	3.0	2.0	2.0	0.0	2.0	2.0	2.0	1.0	7.0	Average
Avg. TEU/Sailing		3070	3070	2300	2300	#DIV/0!	700	1000	790	2990	4290	TEUs Lifted
String ID	1	3,070								2,990	6,060	7580
Ref Fig III-2	2	3,070							790		3,860	4830
	3	3,070	3,070								6,140	7680
	4		3,070	2,300							5,370	6710
	5		3,070						790		3,860	4830
	6			2,300			700				3,000	3750
	7				2,300		700				3,000	3750
	8				2,300			1,000			3,300	4130
	9	3,070						1,000			4,070	5090
Total 2020, "Avg. Tier 1"												48350
Sailings By Region		4	3	2	2	0	2	2	2	1	18	9
											Average per Tier 1 String	5,400
											Total Tier 1 (7 groups)	338,450
											Total Trade	356,000

Source: MTG

Under this service plan, and for a Tier 1 carrier with a typical share (i.e. a 1/7th share of 95% of the market), the following mix of vessels would be operated:

Table III-13 - Mix of Ships For Hypothetical Tier 1 Service Plan
Low (5%) Growth Scenario

TEU Class	String #s Ref Fig III-2	Count of Strings	Cum % of Strings	Capacity TEU/wk	Cum % of Capacity
3-4000	6, 7	2	22%	7,500	16%
4-5000	2, 5, 8	3	56%	13,790	44%
5-6000	9	1	67%	5,090	55%
6-7000	4	1	78%	6,710	68%
7-8000	1, 3	2	100%	15,260	100%
8-10000		0	100%	0	100%
10-12000		0	100%	0	100%
14-18000+		0	100%	0	100%
Total		9		48,350	

Source: MTG

From this analysis of carrier deployments and ship sizes under the high growth scenario, some different insights can be derived;

- Few carriers would operate ships of 10000 TEU and above. Without continued high growth, the trend to larger vessels would likely lose momentum after the introduction of the current crop of 8000-10000 TEU vessels
- Carriers would be forced to make a choice between achieving lower operating costs with larger vessels and meeting the increased frequency expected in the market. Different solutions to this challenge would emerge, with some carriers continuing to favor 5000-7000 TEU vessels, and others continuing to pursue larger vessels

Panama Canal Expansion As An Influence On Vessels Calling SPB Ports

An increase in the limiting dimensions of the Panama Canal would lead to some redeployment of the 4000-5000 TEU vessels that will be operating in the Asia-USEC tradelane, along with the concurrent deployment of existing and new 6000-10000 TEU vessels to the East Coast route. Because the slot cost benefits of larger ships are greatest in deployments to trades with the longest sailing distances (and highest percentage of time spent at sea) and with at least one or two intermediate ports that function as transshipment hubs to collect and distribute containers to/from additional trade lanes, the Asia-USEC route would be well suited to an increase in ship size. [This principle of vessel economics is a key reason why the Far East – North Europe trade is the lane in which the industry's largest ships are generally first deployed.]

If ships between 8,000 and 10,000 TEU in size are able to transit the Panama Canal by or before 2015, then at least a few of the carrier groups that by then would be operating four (or more) Asia – US East Coast all-water services (each with 8-9 x 4000+ TEU ships) will likely replace two strings of 4000 TEU ships with one string of 8,000-10,000 TEU vessels, with an eastbound deployment probably beginning in Hong Kong, then to Shanghai (and potentially Qingdao), and Busan, before traversing the Pacific to an expanded Balboa (for discharging and loading containers to/from Central America and the West Coast of South America), and then to Freeport or Kingston (for discharging and loading containers to/from Florida, Caribbean Islands, the North and East Coasts of South America, and the Gulf Coast), before calling at two or three major US East Coast ports.

By implementing such a deployment, a carrier or operating group would make at least 16 Panamax ships available for re-assignment into four x 4-ship strings, which could provide twice per week shuttles between Shanghai/Ningbo and SPB, and simultaneously between Qingdao/Busan and SPB (as examples of potential loops with operationally feasibly and commercially attractive 28-day voyage loops).

Task III-5: Port Call Forecast Results and Conclusions

Because the World Fleet, the Trans Pacific Fleet and the San Pedro Bay Fleet are so very closely inter-related, and because the San Pedro Bay port call forecast is so strongly dependent on the composition and deployment of the vessel fleet, a common forecast tool has been developed that addresses these elements together.

The forecast as developed by Mercator involves a systematic expansion of the number of services and the introduction of progressively larger vessels in each trade. The hypothetical carrier service plans as developed in the prior section provide a guide as to how the service networks will evolve and how they will likely be structured as of 2020. In addition, checks are made at each forecast time point to confirm that -

- the capacity for the overall trade and sub-segments of the trade are in line with expectations for growth
- the number of overall services is consistent with expectations for industry structure and satisfies service frequency requirements
- the vessel size mix is consistent with pre-existing fleets and expectations derived from our deployment feasibility and unit cost assessments
- the rate of vessel retirements or “cascading” of smaller vessels into secondary services does not appear to exceed the level that those services can accommodate.

Based on the analysis of carrier deployment planning issues, and after developing a range of fleet expansion and deployment scenarios, it is Mercator’s view that carriers, following the delivery and integration into service of the considerable quantity of vessels now on order, will eventually introduce single screw ships in the 10000-11000 TEU size category to the Transpacific. 12000 TEU class ships, which we believe would need to be of a higher cost twin-screw design, will prove to be unattractive because their increased operational and commercial challenges are not offset by meaningful cost reductions.

The next size increment beyond the 10000 TEU class will thus be the 14000 TEU class vessel, which we believe will not be deployed into the Transpacific under either the low or medium growth scenarios. Only under the high growth scenario would we expect any of these vessels to be deployed, and then only in limited numbers.

Forecast results for each of the six scenarios (low, medium and high growth, each without and with a change to the panama canal dimensions) are contained in Appendix III-5a. A brief recap of each is provided below.

Forecast Scenario #1: **Base Case**
Medium Import Growth
No Expansion of Panama Canal Dimensions

After the current backlog of ships on order is delivered and deployed (by 2007 / 2008), the pace of capacity additions will slow as the industry absorbs the new assets. Between 2010 and 2020, the pace of capacity additions would again pick up, more or less in step with demand increases.

Table III-14 - Base Case - Medium Growth and No Change To Panama Canal Dimensions
Forecast of Container Vessel Fleet Composition

Base Case: **Medium Growth** and **NO CHANGE** To Panama Canal Dimensions

	Asia-Europe Tradelane					Asia-North America Tradelane					Combined AE & TP Trades				
TEU Class	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	0	0	0	0	0	5	5	5	0	0	5	5	5	0	0
1000 - 2000	7	14	7	0	0	20	15	10	0	0	27	29	17	0	0
2000 - 3000	71	42	35	21	0	89	46	38	25	20	160	88	73	46	20
3000 - 4000	37	29	28	35	35	117	71	51	41	51	154	100	79	76	86
4000 - 5000	67	88	88	72	58	127	196	188	240	270	194	284	276	312	328
5000 - 6000	93	93	99	96	95	55	73	124	184	243	148	166	223	280	338
6000 - 7000	78	92	106	120	127	20	45	74	89	113	98	137	180	209	240
7000 - 8000	8	16	16	45	53	5	25	39	64	98	13	41	55	109	151
8000 - 10000	0	88	104	103	166	0	35	40	50	75	0	123	144	153	241
10000 - 12000	0	0	8	56	104	0	0	0	20	55	0	0	8	76	159
12000 - 14000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14000 - 18000	0	0	0	16	40	0	0	0	0	0	0	0	0	16	40
18000 +	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	361	462	491	564	678	438	511	569	713	925	799	973	1,060	1,277	1,603

Table III-15 - Base Case - Medium Growth and No Change To Panama Canal Dimensions
Forecast of SPB Container Vessel Calls, By Trade

SPB Container Vessel Calls and Deployed Capacity
By Deployment Route Type

Base Case: **Medium Growth** and **NO CHANGE** To Panama Canal Dimensions

	SPB Port Calls - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
Tradelane	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
TransPac - WCNA - 1st call at SPB	40	46	50	58	73	8,507	12,990	14,628	18,678	25,256
TransPac - WCNA Other SPB	5	5	6	6	8	819	819	1,011	1,118	1,825
TransPac, to USEC (e/b calls)	2	2	3	3	4	447	447	671	671	894
Hawaii	3	4	5	4	4	317	458	598	614	614
Transpac from USEC (w/b calls)	7	7	9	10	12	1,420	1,451	1,950	2,205	2,652
Australia / New Zealand	2	2	2	2	2	177	229	281	333	416
West Coast Services (n/s)	3	3	3	4	5	296	296	359	499	692
Total Port Calls	62	69	78	87	108	11,983	16,689	19,497	24,118	32,349

Table III-16 - Base Case - Medium Growth and No Change To Panama Canal Dimensions
Forecasted Container Vessel Calls At San Pedro Bay Ports

SPB Container Vessel Calls and Deployed Capacity

By Vessel TEU Capacity

Base Case: **Medium Growth** and **NO CHANGE** To Panama Canal Dimensions

TEU Class	SPB Port Call Count - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	1	1	1			39	39	39		
1000 - 2000	9	7	4	2	1	744	577	333	156	78
2000 - 3000	12	9	11	11	9	1,685	1,264	1,544	1,544	1,264
3000 - 4000	11	5	7	6	10	2,116	962	1,347	1,154	1,924
4000 - 5000	15	17	20	21	23	3,354	3,801	4,472	4,696	5,143
5000 - 6000	9	10	11	13	16	2,340	2,600	2,860	3,380	4,160
6000 - 7000	4	8	10	12	15	1,331	2,662	3,328	3,994	4,992
7000 - 8000	1	5	6	9	12	374	1,872	2,246	3,370	4,493
8000 - 10000		7	8	9	11		2,912	3,328	3,744	4,576
10000 - 12000				4	11				2,080	5,720
12000 - 14000										
14000 - 18000										
18000 +										
	62	69	78	87	108	11,983	16,689	19,497	24,118	32,349

Forecast Scenario #2: **Alternate Case – Panama Canal Expansion**
Medium Import Growth
With Expansion of Panama Canal Dimensions Before 2015

In this scenario, it is assumed the maximum dimensions of vessels passing through the Panama Canal increase in about 2012 (sometime between 2010 and 2015), and that 8000-10000 TEU vessels are shifted to this route. Some of the 4000-5000 TEU vessels previously on the Panama route are then deployed in Transpacific-WCNA loop services.

Table III-17 - Alternate Case - Medium Growth, INCREASED Panama Canal Dimensions
Forecast of Container Vessel Fleet Composition
For Asia-Europe and Asia-North America Trades

Asia-Europe and Asia-North America: Linehaul Fleet Count By Capacity Class

Medium Growth and EXPANDED Panama Canal Dimensions

	Asia-Europe Tradelane					Asia-North America Tradelane					Combined AE & TP Trades				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	0	0	0	0	0	5	5	5	0	0	5	5	5	0	0
1-2000	7	14	7	0	0	20	15	5	0	0	27	29	12	0	0
2-3000	71	42	35	21	0	89	46	43	30	15	160	88	78	51	15
3-4000	37	29	28	35	35	117	71	61	46	46	154	100	89	81	81
4-5000	67	88	88	72	58	127	196	193	229	228	194	284	281	301	286
5-6000	93	93	99	96	95	55	73	124	148	149	148	166	223	244	244
6-7000	78	92	106	120	127	20	45	64	74	88	98	137	170	194	215
7-8000	8	16	16	45	53	5	25	39	83	118	13	41	55	128	171
8-10000	0	88	104	103	166	0	35	45	90	142	0	123	149	193	308
10-12000	0	0	8	56	104	0	0	5	30	71	0	0	13	86	175
12-14000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-18000	0	0	0	16	40	0	0	0	0	0	0	0	0	16	40
18000 +	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	361	462	491	564	678	438	511	584	730	857	799	973	1,075	1,294	1,535

Table III-18 - Alternate Case - Medium Growth, INCREASED Panama Canal Dimensions
Forecast of Container Vessel Calls, By Trade

SPB Container Vessel Calls and Deployed Capacity
By Deployment Route Type

Medium Growth and EXPANDED Panama Canal Dimensions

	SPB Port Calls - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
Tradelane	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
TransPac - WCNA - 1st call at SPB	40	46	53	66	76	8,507	12,990	15,569	20,576	24,965
TransPac - WCNA Other SPB	5	5	6	6	8	819	819	1,011	1,342	1,825
TransPac, to USEC (e/b calls)	2	2	3	3	4	447	447	671	671	894
Hawaii	3	4	5	4	4	317	458	598	614	614
Transpac from USEC (w/b calls)	7	8	9	10	10	1,420	1,674	1,950	2,356	2,766
Australia / New Zealand	2	2	2	2	2	177	229	281	333	416
West Coast Services (n/s)	3	3	3	4	5	296	296	359	499	692
Total Port Calls	62	70	81	95	109	11,983	16,913	20,439	26,390	32,172

Table III-19 - Alternate Case - Medium Growth, INCREASED Panama Canal Dimensions
Forecasted Container Vessel Calls At San Pedro Bay Ports

SPB Container Vessel Calls and Deployed Capacity

By Vessel TEU Capacity

Medium Growth and EXPANDED Panama Canal Dimensions

TEU Class	SPB Port Call Count - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	1	1	1			39	39	39		
1000 - 2000	9	7	3	1	1	744	577	255	78	78
2000 - 3000	12	9	12	12	9	1,685	1,264	1,685	1,685	1,264
3000 - 4000	11	5	9	8	9	2,116	962	1,732	1,539	1,732
4000 - 5000	15	18	21	24	28	3,354	4,025	4,696	5,366	6,261
5000 - 6000	9	10	11	16	18	2,340	2,600	2,860	4,160	4,680
6000 - 7000	4	8	8	10	10	1,331	2,662	2,662	3,328	3,328
7000 - 8000	1	5	6	9	11	374	1,872	2,246	3,370	4,118
8000 - 10000		7	9	9	12		2,912	3,744	3,744	4,992
10000 - 12000			1	6	11			520	3,120	5,720
12000 - 14000										
14000 - 18000										
18000 +										
	62	70	81	95	109	11,983	16,913	20,439	26,390	32,172

The effect of the Panama Canal expansion is an increase in the number of TP-WCNA loop services, due to the redeployment of some of the 4000 TEU vessels previously serving the Asia-USEC route.

Forecast Scenario #3: Alternate Case
High Import Growth
No Expansion of Panama Canal Dimensions

After the current backlog of ships on order is delivered and deployed (by 2007 / 2008), the pace of capacity additions will slow only slightly as growth continues at high levels.

Table III-20 - High Growth and No Change To Panama Canal Dimensions
Forecast of Container Vessel Fleet Composition

Asia-Europe and Asia-North America: Linehaul Fleet Count By Capacity Class

High Growth Case with **NO CHANGE** To Panama Canal Dimensions

	Asia-Europe Tradelane					Asia-North America Tradelane					Combined AE & TP Trades				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	0	0	0	0	0	5	5	5	0	0	5	5	5	0	0
1-2000	7	14	7	0	0	20	15	5	0	0	27	29	12	0	0
2-3000	71	42	35	21	0	89	46	43	30	15	160	88	78	51	15
3-4000	37	29	28	35	35	117	71	61	46	41	154	100	89	81	76
4-5000	67	88	88	72	58	127	196	193	233	356	194	284	281	305	414
5-6000	93	93	99	96	95	55	73	140	168	202	148	166	239	264	297
6-7000	78	92	106	120	127	20	45	64	84	113	98	137	170	204	240
7-8000	8	16	16	45	53	5	25	49	79	98	13	41	65	124	151
8-10000	0	88	104	103	166	0	35	45	90	125	0	123	149	193	291
10-12000	0	0	8	56	104	0	0	5	50	105	0	0	13	106	209
12-14000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-18000	0	0	0	16	40	0	0	0	5	50	0	0	0	21	90
18000 +	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	361	462	491	564	678	438	511	610	785	1,105	799	973	1,101	1,349	1,783

Table III-21 - High Growth and No Change To Panama Canal Dimensions
Forecast of SPB Container Vessel Calls, By Trade

SPB Container Vessel Calls and Deployed Capacity
By Deployment Route Type

High Growth Case with **NO CHANGE** To Panama Canal Dimensions

Tradelane	SPB Port Calls - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
TransPac - WCNA - 1st call at SPB	40	46	53	63	83	8,507	12,990	15,683	22,225	34,315
TransPac - WCNA Other SPB	5	5	5	6	8	819	819	819	1,118	1,825
TransPac, to USEC (e/b calls)	2	2	3	4	5	447	447	671	894	1,118
Hawaii	3	4	5	4	4	317	458	598	614	614
Transpac from USEC (w/b calls)	7	8	10	11	14	1,420	1,674	2,174	2,428	3,099
Australia / New Zealand	2	2	2	3	3	177	229	281	421	504
West Coast Services (n/s)	3	3	3	4	5	296	296	359	499	806
Total Port Calls	62	70	81	95	122	11,983	16,913	20,584	28,200	42,281

Table III-22 - High Growth and No Change To Panama Canal Dimensions
Forecasted Container Vessel Calls At San Pedro Bay Ports

SPB Container Vessel Calls and Deployed Capacity

By Vessel TEU Capacity

High Growth Case with **NO CHANGE** To Panama Canal Dimensions

TEU Class	SPB Port Call Count - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	1	1	1			39	39	39		
1000 - 2000	9	7	3	3	1	567	400	78	244	88
2000 - 3000	12	9	12	12	10	1,721	1,160	1,440	1,264	983
3000 - 4000	11	5	8	7	10	2,257	1,243	1,960	1,576	2,153
4000 - 5000	15	18	22	21	26	3,354	4,025	4,919	4,888	6,006
5000 - 6000	9	10	10	9	8	2,340	2,600	2,600	2,340	2,080
6000 - 7000	4	8	8	10	14	1,331	2,662	2,662	3,328	4,659
7000 - 8000	1	5	7	10	10	374	1,872	2,621	3,744	3,744
8000 - 10000		7	9	13	18		2,912	3,744	5,408	7,488
10000 - 12000			1	9	15			520	4,680	7,800
12000 - 14000										
14000 - 18000				1	10				728	7,280
18000 +										
	62	70	81	95	122	11,983	16,913	20,584	28,200	42,281

Forecast Scenario #4: Alternate Case – Panama Canal Expansion
High Import Growth
With Expansion of Panama Canal Dimensions Before 2015

In this scenario, it is assumed the maximum dimensions of vessels passing through the Panama Canal increase in about 2012 (sometime between 2010 and 2015).

Table III-23 - Alternate Case - High Growth, INCREASED Panama Canal Dimensions
Forecast of Container Vessel Fleet Composition

Asia-Europe and Asia-North America: Linehaul Fleet Count By Capacity Class

High Growth Case with EXPANDED Panama Canal Dimensions

	Asia-Europe Tradelane					Asia-North America Tradelane					Combined AE & TP Trades				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	0	0	0	0	0	5	5	5	0	0	5	5	5	0	0
1-2000	7	14	7	0	0	20	15	5	0	0	27	29	12	0	0
2-3000	71	42	35	21	0	89	46	43	30	15	160	88	78	51	15
3-4000	37	29	28	35	35	117	71	61	46	41	154	100	89	81	76
4-5000	67	88	88	72	58	127	196	193	202	171	194	284	281	274	229
5-6000	93	93	99	96	95	55	73	145	140	128	148	166	244	236	223
6-7000	78	92	106	120	127	20	45	64	79	108	98	137	170	199	235
7-8000	8	16	16	45	53	5	25	44	119	202	13	41	60	164	255
8-10000	0	88	104	103	166	0	35	50	119	195	0	123	154	222	361
10-12000	0	0	8	56	104	0	0	5	40	95	0	0	13	96	199
12-14000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-18000	0	0	0	16	40	0	0	0	5	45	0	0	0	21	85
18000 +	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	361	462	491	564	678	438	511	615	780	1,000	799	973	1,106	1,344	1,678

Table III-24 - Alternate Case - High Growth, INCREASED Panama Canal Dimensions
Forecast of Container Vessel Calls, By Trade

SPB Container Vessel Calls and Deployed Capacity
By Deployment Route Type

High Growth Case with EXPANDED Panama Canal Dimensions

Tradelane	SPB Port Calls - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
TransPac - WCNA - 1st call at SPB	40	46	54	68	85	8,507	12,990	15,985	22,942	33,982
TransPac - WCNA Other SPB	5	5	5	6	8	819	819	819	1,118	1,825
TransPac, to USEC (e/b calls)	2	2	3	4	5	447	447	671	894	1,118
Hawaii	3	4	5	4	4	317	458	598	614	614
Transpac from USEC (w/b calls)	7	8	9	10	11	1,420	1,674	1,950	2,356	3,000
Australia / New Zealand	2	2	2	3	3	177	229	281	421	504
West Coast Services (n/s)	3	3	3	4	5	296	296	359	499	806
Total Port Calls	62	70	81	99	121	11,983	16,913	20,662	28,844	41,850

Table III-25 - Alternate Case - High Growth, INCREASED Panama Canal Dimensions
Forecasted Container Vessel Calls At San Pedro Bay Ports

SPB Container Vessel Calls and Deployed Capacity

By Vessel TEU Capacity

High Growth Case with EXPANDED Panama Canal Dimensions

TEU Class	SPB Port Call Count - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	1	1	1			39	39	39		
1000 - 2000	9	7	3	3	1	567	400	78	244	88
2000 - 3000	12	9	12	12	10	1,721	1,160	1,440	1,264	983
3000 - 4000	11	5	8	7	10	2,257	1,243	1,960	1,576	2,153
4000 - 5000	15	18	21	23	21	3,354	4,025	4,696	5,335	4,888
5000 - 6000	9	10	11	12	12	2,340	2,600	2,860	3,120	3,120
6000 - 7000	4	8	8	9	14	1,331	2,662	2,662	2,995	4,659
7000 - 8000	1	5	6	11	11	374	1,872	2,246	4,118	4,118
8000 - 10000		7	10	14	18		2,912	4,160	5,824	7,488
10000 - 12000			1	7	15			520	3,640	7,800
12000 - 14000										
14000 - 18000				1	9				728	6,552
18000 +										
	62	70	81	99	121	11,983	16,913	20,662	28,844	41,850

The effect of the Panama Canal expansion is a small increase in the number of TP-WCNA loop services, due to the redeployment of some of the 4000 TEU vessels previously serving the Asia-USEC route.

Forecast Scenario #5: Alternate Case
Low Import Growth
No Expansion of Panama Canal Dimensions

After the current backlog of ships on order is delivered and deployed (by 2007 / 2008), the pace of capacity additions will remain low as growth remains slow.

Table III-26 - Low Growth and No Change To Panama Canal Dimensions
Forecast of Container Vessel Fleet Composition

Asia-Europe and Asia-North America: Linehaul Fleet Count By Capacity Class

Low Growth with NO CHANGE to Panama Canal Dimensions

	Asia-Europe Tradelane					Asia-North America Tradelane					Combined AE & TP Trades				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	0	0	0	0	0	5	5	5	0	0	5	5	5	0	0
1-2000	7	14	7	0	0	20	15	5	0	0	27	29	12	0	0
2-3000	71	42	35	21	0	89	46	38	30	30	160	88	73	51	30
3-4000	37	29	28	35	35	117	71	61	51	56	154	100	89	86	91
4-5000	67	88	88	72	58	127	196	201	209	248	194	284	289	281	306
5-6000	93	93	99	96	95	55	73	116	158	219	148	166	215	254	314
6-7000	78	92	106	120	127	20	45	45	74	99	98	137	151	194	226
7-8000	8	16	16	45	53	5	25	30	40	45	13	41	46	85	98
8-10000	0	88	104	103	166	0	35	35	35	40	0	123	139	138	206
10-12000	0	0	8	56	104	0	0	0	0	0	0	0	8	56	104
12-14000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-18000	0	0	0	16	40	0	0	0	0	0	0	0	0	16	40
18000 +	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	361	462	491	564	678	438	511	536	597	737	799	973	1,027	1,161	1,415

Table III-27 - Low Growth and No Change To Panama Canal Dimensions
Forecast of SPB Container Vessel Calls, By Trade

SPB Container Vessel Calls and Deployed Capacity
By Deployment Route Type

Low Growth with NO CHANGE to Panama Canal Dimensions

Tradelane	SPB Port Calls - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
TransPac - WCNA - 1st call at SPB	40	46	49	52	64	8,507	12,990	14,076	15,324	18,569
TransPac - WCNA Other SPB	5	5	5	6	8	819	819	819	1,118	1,773
TransPac, to USEC (e/b calls)	2	2	3	3	4	447	447	671	671	894
Transpac from USEC (w/b calls)	7	7	8	9	11	1,420	1,451	1,758	1,981	2,428
Australia / New Zealand	2	2	2	2	2	177	229	281	333	333
West Coast Services (n/s)	3	3	4	4	4	296	296	437	437	499
Total Port Calls	59	65	71	76	93	11,666	16,232	18,041	19,864	24,497

Table III-28 - Low Growth and No Change To Panama Canal Dimensions
Forecasted Container Vessel Calls At San Pedro Bay Ports

SPB Container Vessel Calls and Deployed Capacity

By Vessel TEU Capacity

Low Growth with NO CHANGE to Panama Canal Dimensions

TEU Class	SPB Port Call Count - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	1	1	1			39	39	39		
1000 - 2000	9	7	4	3	1	744	577	333	234	78
2000 - 3000	12	9	11	10	12	1,685	1,264	1,544	1,404	1,685
3000 - 4000	11	5	7	7	8	2,116	962	1,347	1,347	1,539
4000 - 5000	15	17	21	22	30	3,354	3,801	4,696	4,919	6,708
5000 - 6000	9	10	11	13	16	2,340	2,600	2,860	3,380	4,160
6000 - 7000	4	8	8	11	15	1,331	2,662	2,662	3,661	4,992
7000 - 8000	1	5	6	7	7	374	1,872	2,246	2,621	2,621
8000 - 10000		7	7	7	8		2,912	2,912	2,912	3,328
10000 - 12000										
12000 - 14000										
14000 - 18000										
18000 +										
	62	69	76	80	97	11,983	16,689	18,639	20,478	25,111

Forecast Scenario #6: Alternate Case – Panama Canal Expansion
Low Import Growth
With Expansion of Panama Canal Dimensions Before 2015

In this scenario, it is assumed the maximum dimensions of vessels passing through the Panama Canal increase in about 2012 (sometime between 2010 and 2015).

Table III-29 - Alternate Case - Low Growth, INCREASED Panama Canal Dimensions
Forecast of Container Vessel Fleet Composition

Asia-Europe and Asia-North America: Linehaul Fleet Count By Capacity Class

Alternate Case: **Low Growth** and **INCREASED** Panama Canal Dimensions

	Asia-Europe Tradelane					Asia-North America Tradelane					Combined AE & TP Trades				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	0	0	0	0	0	5	5	5	0	0	5	5	5	0	0
1-2000	7	14	7	0	0	20	15	5	0	0	27	29	12	0	0
2-3000	71	42	35	21	0	89	46	43	30	30	160	88	78	51	30
3-4000	37	29	28	35	35	117	71	61	51	56	154	100	89	86	91
4-5000	67	88	88	72	58	127	196	201	200	191	194	284	289	272	249
5-6000	93	93	99	96	95	55	73	116	129	163	148	166	215	225	258
6-7000	78	92	106	120	127	20	45	45	69	99	98	137	151	189	226
7-8000	8	16	16	45	53	5	25	30	51	77	13	41	46	96	130
8-10000	0	88	104	103	166	0	35	35	51	72	0	123	139	154	238
10-12000	0	0	8	56	104	0	0	0	0	0	0	0	8	56	104
12-14000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-18000	0	0	0	16	40	0	0	0	0	0	0	0	0	16	40
18000 +	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	361	462	491	564	678	438	511	541	581	688	799	973	1,032	1,145	1,366

Table III-30 - Alternate Case - Low Growth, INCREASED Panama Canal Dimensions
Forecast of Container Vessel Calls, By Trade

SPB Container Vessel Calls and Deployed Capacity
By Deployment Route Type

Alternate Case: **Low Growth** and **INCREASED** Panama Canal Dimensions

Tradelane	SPB Port Calls - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
TransPac - WCNA - 1st call at SPB	40	46	50	52	64	8,507	12,990	14,217	15,028	18,569
TransPac - WCNA Other SPB	5	5	5	6	8	819	819	819	1,118	1,784
TransPac, to USEC (e/b calls)	2	2	3	3	4	447	447	671	671	894
Transpac from USEC (w/b calls)	7	8	9	10	10	1,420	1,674	1,950	2,356	2,610
Australia / New Zealand	2	2	2	2	2	177	229	281	333	333
West Coast Services (n/s)	3	3	4	4	4	296	296	437	437	499
Total Port Calls	59	66	73	77	92	11,666	16,455	18,374	19,942	24,690

Table III-31 - Alternate Case - Low Growth, INCREASED Panama Canal Dimensions
Forecasted Container Vessel Calls At San Pedro Bay Ports

SPB Container Vessel Calls and Deployed Capacity

By Vessel TEU Capacity

Alternate Case: **Low Growth** and **INCREASED** Panama Canal Dimensions

TEU Class	SPB Port Call Count - Per Week					SPB "Vessel Call Capacity" Per Yr (000s)				
	2004	2007	2010	2015	2020	2004	2007	2010	2015	2020
<1000	1	1	1			39	39	39		
1000 - 2000	9	7	4	3	1	744	577	333	234	78
2000 - 3000	12	9	12	10	11	1,685	1,264	1,685	1,404	1,544
3000 - 4000	11	5	8	7	7	2,116	962	1,539	1,347	1,347
4000 - 5000	15	18	21	25	27	3,354	4,025	4,696	5,590	6,037
5000 - 6000	9	10	11	12	19	2,340	2,600	2,860	3,120	4,940
6000 - 7000	4	8	8	10	14	1,331	2,662	2,662	3,328	4,659
7000 - 8000	1	5	6	7	9	374	1,872	2,246	2,621	3,370
8000 - 10000		7	7	7	8		2,912	2,912	2,912	3,328
10000 - 12000										
12000 - 14000										
14000 - 18000										
18000 +										
	62	70	78	81	96	11,983	16,913	18,972	20,556	25,303

The effect of the Panama Canal expansion is a small increase in the number of TP-WCNA loop services, due to the redeployment of some of the 4000 TEU vessels previously serving the Asia-USEC route.

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I.2b	Container Fleet Characteristics - August 2004
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