



DFR: ANNEX 1 SHIPPING COSTS ANALYSIS THE NORTH PACIFIC RIM TRADE CORRIDOR STUDY

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1 INTRODUCTION

The purpose of this Annex is to examine and quantify the potential for the shipping lines on transpacific routes to achieve savings in ship operating costs and transit times by using the Port of Anchorage. The focus is on container traffic potentially using the intermodal ACRL to serve inland markets centred on Ontario and Chicago.

The analysis here is on the shipping side of the cost equation only.

2 EXISTING SERVICES

The main features of the existing transpacific services with which Anchorage would have to compete are as follows:

- There are about 50 services on the direct route to between North American west coast ports and Far East ports - with only Maersk-Sealand/PONL handling over 10% of the total. The other main shipping groups are the CHKY alliance, the New World Alliance, and the Grand Alliance.
- The average number of port calls per service is about 8.
- The most frequent round voyage time is 5 weeks, i.e. 35 days. There are, however, three 28 day round voyage *shuttle services* – two run by CHKY from Shanghai and Busan, and one by Evergreen from Hong Kong.
- The shortest time between the last port of call in Asia and the first in North America is 7-8 days. The main “last ports” in the Far East are Busan and Tokyo with Hong Kong and Yokohama next - Table 1.
- Ship capacities generally range from about 3500 TEU to 8000 TEU
- Ship speed is about 24-25 knots.
- The transit times between the last Asian ports and the first North American ports range from 7 to 14 days - Table 1.

The transpacific traffic is dominated by the Ports of LA and Long Beach, which account for 63% of the total traffic at the main ports in 2005 - Table 2.

Table 1 Shipping Services: Transit Time Comparisons

Shipping Line/Alliance	Last Asian Port	First US Port	Transit Time (days) Last Asian port to 1 st US
CHKY	Busan	LB	9
Maersk	Busan	LA	11
NWA	Busan	LB	8
NWA	Busan	LA	10
Grand Alliance	Busan	LB	9
CSCS	Busan	Vancouver	8
CSCS	Busan	Vancouver	8
Zim	Busan	LA	11
CCNI	Busan	Vancouver	9
CHKY	HK	LB	11
Grand Alliance	HK	LB	11
Grand Alliance	HK	LA	11
Evergreen	HK	LA	12
Maersk	Kaohsiung	Tacoma	10
Grand Alliance	Kaohsiung	LA	11
Evergreen	Kaohsiung	LA	11
CHKY	Keeling	LA	10
Maersk	Kobe	LA	10
Evergreen	Nagoya	Tacoma	10
CHKY	Ningbo	LA	12
Evergreen	Ningbo	Oakland	13
Grand Alliance	Sendai	LA	8
CHKY	Shanghai	LB	12
Evergreen	Shimizu	LA	8
NWA	Tokyo	LA	8
CHKY	Tokyo	Tacoma	7
CHKY	Tokyo	Seattle	8
CHKY	Tokyo	LB	8
NWA	Tokyo	Tacoma	7
Grand Alliance	Tokyo	Seattle	
Evergreen	Tokyo	Tacoma	7
CSCS	Tokyo	LB	14
CHKY	Xiamen	LB	10
NWA	Yantian	LA	12
CMA CGM	Yantian	LB	11
CCNI/Hamburg Sud	Yantian	LB	11
Maersk	Yokohama	Oakland	8
Maersk	Yokohama	LA	8
NWA	Yokohama	LA	8
CHKY	Yokohama	Seattle	9

Source: *Containerisation International*

Table 2 The port of Anchorage's Main Competitors' Traffic Volumes, 2005

NORTH WEST COAST PORTS	
Tacoma	2,066
Seattle	2,088
Vancouver	1,767
Total north west	5,921
SOUTH WEST COAST PORTS	
Los Angeles	7,485
Long Beach	6,710
Oakland	2,273
Total south west	16,468
Total, 6 main West Coast ports	22,389

3 ASSESSING COMPETITIVENESS: POA'S ADVANTAGES

The sea distances between North American West Coast ports, including Anchorage, and the main Far East ports are shown in Table 3. Anchorage's distance advantages relative to other North American ports are shown in Table 4. As shown, Anchorage's advantage over the dominant ports of LA/LB is about 1500 nautical miles. The sea voyage times between North America west coast ports and the main Far East ports are given in Table 5. They assume a vessel speed of 24.5 knots. Anchorage's sea voyage time advantages relative to other North American ports are given in Table 6.

Anchorage's advantage over the dominant ports of LA/LB is about 2.6 days.

Table 3 Sea Distances (N miles)

From:	Yokohama	Kobe	Shanghai	HK
To:				
Anchorage	3,320	3,596	4,173	4,830
LA/LB	4,842	5,137	5,708	6,363
Prince Rupert	3,825	4,101	4,678	5,355
Vancouver	4,284	4,554	5,114	5,760
New York	10,587	10,867	11,471	11,587

Table 4 Anchorage's Distance Advantages (N Miles)

From:	Yokohama	Kobe	Shanghai	HK
To:				
Anchorage
LA/LB	1,522	1,541	1,535	1,533
Prince Rupert	505	505	505	525
Vancouver	964	958	941	930
New York	7,267	7,271	7,298	6,757

Table 5 Sea Voyage Times (days, one direction)

From:	Yokohama	Kobe	Shanghai	HK
To:				
Anchorage	5.6	6.1	7.1	8.2
LA/LB	8.2	8.7	9.7	10.8
Prince Rupert	6.5	7.0	8.0	9.1
Vancouver	7.3	7.7	8.7	9.8
New York	18.0	18.5	19.5	19.7

Table 6 Anchorage's Sea Voyage Time Advantages (days, one direction)

From:	Yokohama	Kobe	Shanghai	HK
To:				
Anchorage
<i>LALB</i>	2.59	2.62	2.61	2.61
Prince Rupert	0.86	0.86	0.86	0.89
Vancouver	1.64	1.63	1.60	1.58
New York	12.36	12.37	12.41	11.49

4 SHIPPING COSTS

The costs of serving Far-East/US West Coast routes via Anchorage and competing ports are calculated in detail in Appendix I and summarised in Table 7.¹

Table 7 Shipping Costs, \$/TEU, in One Direction (\$ per TEU)

		2000 TEU	4000 TEU	6000 TEU	8000 TEU
Anchorage					
	Kobe	622	550	584	579
	Yokohama	617*	546	532	497
	Hong Kong	605	592	563	547
	Shanghai	563	490	523	499
Prince Rupert					
	Kobe	649	576	609	585
	Yokohama	644	571	605	582
	Hong Kong	821	808	764	740
	Shanghai	572	572	530	506
Vancouver					
	Kobe	736	736	694	670
	Yokohama	731	657	690	666
	Hong Kong	903	814	850	819
	Shanghai	659	657	614	590
LA/LB					
	Kobe	747	745	702	678
	Yokohama	742	740	698	674
	Hong Kong	915	814	835	804
	Shanghai	765	667	688	659
New York					
	Kobe	851	779	731	725
	Yokohama	846	775	745	704
	Hong Kong	1,068	934	877	847
	Shanghai	1,183	1,007	927	882

* This could be reduced to \$520 if ship speed were raised to 25.5 knots instead of the 24.5 knots assumed for all other routes. See Appendix I for details. The costs in the table above include:

- (a) ship operating costs at sea and in port;
- (b) the cost of the containers;
- (c) terminal handling charges; and
- (d) port charges

¹ The assumptions are listed in the tables in Appendix I, and at the end of the Appendix.

5 CONCLUSIONS AND SIGNPOSTS

The main conclusions to be drawn from Table 7 are summarised below.

First, ***the maximum cost advantage of Anchorage over their main competitors, LA/LB, is, for any given ship size, around \$200 per TEU.*** In most cases, however, Anchorage's advantage is lower, because the services calling at competing North America West Coast (NAWC) ports, especially LA/LB, would generally use larger ships than those likely to call at Anchorage, giving the other ports economies of scale. For example, the 2000-4000 TEU likely to be used at Anchorage would not be competing with 2000-4000 TEU ships, but 6000-8000 TEU ships at LA/LB. Taking this into account, Anchorage's advantage is reduced.

Second, there is not a smooth and consistent pattern behind the cost comparisons. The main reasons for the apparently uneven pattern are that:

- The benefits of ship time resulting from shorter sea distances cannot always be "used". This is because services are almost always scheduled to take a certain number of *weeks* - typically 4, 5 or 6 weeks. For example, on route 3 in Appendix I, the 2000TEU vessel would have only 1.4 days of surplus time while the 4000 TEU ship would have 5.2 days. However, the 4000 TEU ship would not be able to exploit this spare time, as the saving is insufficient to introduce a 21 day, rather than a 28 day, round trip (see Note 2 at the end of this section).^{2, 3}
- Terminal handling charges vary widely between ports (see assumptions at the end of Appendix I)

Third, Anchorage can save 1.6-2.6 days transit time, relative to LA/LB and Vancouver.

Strategic Issue

Neither the cost nor the transit time savings are likely to be sufficient to offset the additional rail costs and transit time – there are major service cost and time challenges facing the ACRL port – rail offer.

² It is to be noted that the savings associated with "freeing up" ships is already incorporated in the ship cost shown in Table 7. Where a shorter route results in the voyage time being cut by, say 25%, then the benefits show up in the lower cost of ship time at sea. The cost shown there already reflects the reduction of the vessels required to serve a route. The "release" of ships is not a separate benefit. It should not be double counted.

³ It would be possible to carry out comparisons based on the assumption that all ship time saved, i.e. all days surplus to the time needed to serve the route, could be "used" elsewhere. But it would not be realistic. Almost all services are weekly, and a surplus of half a week cannot in practice be exploited.

APPENDIX 1

SHIPPING LINE COSTS (16 routes)

ROUTE:	1	Kobe-Anchorage-Kobe			
Total number of ports on route		4-8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		3,596	3,596	3,596	3,596
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		12.2	12.2	12.2	12.2
Additional sea time for other ports		5.6	2.4	6.2	6.3
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	21	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		509,253	778,762	1,002,897	1,214,399
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		241,975	349,009	791,122	938,337
Ship costs per voyage (both legs)		751,228	1,127,772	1,794,020	2,152,736
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	324,895	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		46,000	92,000	138,000	368,000
TOTAL Ship and Container costs p.a		959,676	1,544,667	2,581,810	3,387,124
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		369	297	331	326
Handling costs (\$/TEU)					
THC Anchorage		121	121	121	121
THC Kobe		132	132	132	132
TOTAL COST, \$ PER TEU		622	550	584	579
Transit time to USWC (days)		8	9	11	11

Assumptions on next page and note at end of this Appendix.

	ASSUMPTIONS (i)					
1	SHIP OPERATING COSTS					
	Ship Capacity (TEU)	2000	4000	6000	8,000	
	Construction Cost (\$ mn)	35.0	58.3	78.2	96.0	
	<i>Annual Operating Costs (\$000)</i>					
	Capital costs p.a. (a) (b)	4,833	8,056	10,793	13,257	
	Insurance	700	1,167	1,563	1,920	
	Maintenance and repair	875	1,458	1,954	2,400	
	Crew	1,250	1,250	1,250	1,250	
	Others	2,000	2,000	2,000	2,000	
	Total p.a.	9,658	13,931	17,560	20,827	
	Daily cost in port	27,595	39,802	50,170	59,506	
	Fuel cost per day at sea	14,040	23,868	31,824	39,780	
	Daily cost at sea	41,635	63,670	81,994	99,286	
2	CONTAINER COSTS					
	Ship Capacity (TEU)	2000	4000	6000	8000	
	No of sets of containers	3	3	3	3	
	Containers per ship	6,000	12,000	18,000	24,000	
	Container purchase price (\$ per TEU)	2000	2000	2000	2000	
	Cost of containers	12,000,000	24,000,000	36,000,000	48,000,000	
	Capital Costs p.a.	2,167,461	4,334,923	6,502,384	8,669,846	
	Insurance p.a	240,000	480,000	720,000	960,000	
	M&R p.a	300,000	600,000	900,000	1,200,000	
	Container cost p.a.	2,707,461	5,414,923	8,122,384	10,829,846	
	Container costs \$ per day	7,736	15,471	23,207	30,942	

3	OTHER ASSUMPTIONS					
	Ship length(metres)	200	250	300	350	
	Handling speeds(TEU/day)					
		2448	3060	3672	4,284	
		2142	2142	2142	2,356	

	No of port calls per voyage	4	4	4	8	
	Port Charges(port dues, tugs, pilots) \$ per GT	0.5	0.5	0.5	0.5	
	Canal charges	n.a	n.a	n.a	n.a	
	Assumptions for Ship Operating Costs:					
	Interest (%)	12.5 %	12.5%	12.5%	12.5%	
	Life (years)	20	20	20	20	
	Annual capital cost factor	0.1381	0.1381	0.1381	0.1381	
	Insurance, % of ship building cost	2.0%	2.0%	2.0%	2.0%	
	M&R, % of ship construction cost	2.5%	2.5%	2.5%	2.5%	
	Crew (\$ mn) (Philippine, Indian)	1.25	1.25	1.25	1.25	
	Fuel price (\$/tonne)	150	150	150	150	
	BHP	30,000	51,000	68,000	85,000	
	Fuel consumption, kg/BHP/hour	0.13	0.13	0.13	0.13	
	Daily fuel consumption (tonnes)	94	159	212	265	
	Daly fuel cost at sea	14,040	23,868	31,824	39,780	
	Assumptions for Container Costs:					
	Interest (%)	12.5 %	12.5%	12.5%	12.5%	
	Life of containers (years)	10	10	10	10	
	Annual capital costs factor	0.1806	0.1806	0.1806	0.1806	
	Insurance	2.0%	2.0%	2.0%	2.0%	
	M&R	2.5%	2.5%	2.5%	2.5%	

ROUTE:	2	Yokohama-Anchorage-Yokohama			
Total number of ports on route		4-8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		3,320	3,320	3,320	3,320
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		11.3	11.3	11.3	11.3
Additional sea time for other ports		6.5	3.4	0.2	0.2
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	21	21	21
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		470,167	718,991	925,923	1,121,192
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		267,881	386,374	487,028	577,656
Ship costs per voyage (both legs)		738,048	1,105,365	1,412,951	1,698,848
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	324,895	487,343	649,791
Canal transit charges		0	0	0	0
Port entry dues		46,000	92,000	276,000	184,000
TOTAL Ship and Container costs p.a		946,496	1,522,260	2,176,294	2,532,638
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		364	293	279	244
Handling costs (\$/TEU)					
THC Anchorage		121	121	121	121
THC Yokohama		132	132	132	132
TOTAL COST, \$ PER TEU		617	546	532	497
Transit time to USWC (days)		7	9	10	10

For assumptions see notes to Route 1

ROUTE:	3	Hong Kong-Anchorage-Hong Kong			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		4,830	4,830	4,830	4,830
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		16.4	16.4	16.4	16.4
Additional sea time for other ports		1.4	5.2	2.0	2.1
Transit time for Canal		0	0	0	0
Time in port (days)		1.3	2.6	3.9	3.4
		1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	28	28	28
Ship cost per day in port		13,886	16,952	19,557	21,903
Ship cost per day at sea		27,926	40,820	51,381	61,683
Cost of ship time at sea		458,780	670,621	844,122	1,013,361
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		63,478	196,163	226,307	253,447
Ship costs per voyage (both legs)		522,257	866,784	1,070,429	1,266,809
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	433,194	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		776,705	1,483,978	1,996,220	2,501,196
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		299	285	256	240
Handling costs (\$/TEU)					
THC Anchorage		121	121	121	121
THC Shanghai		45	45	45	45
TOTAL COST, \$ PER TEU		563	490	523	499
Transit time to USWC (days)		10	11	13	13

For assumptions see notes to Route 1

ROUTE:	4	Shanghai-Anchorage-Shanghai			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		4,173	4,173	4,173	4,173
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		14.2	14.2	14.2	14.2
Additional sea time for other ports		3.6	0.5	4.3	4.3
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	21	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		590,966	903,719	1,163,818	1,409,257
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		187,817	270,895	692,659	821,551
Ship costs per voyage (both legs)		778,783	1,174,615	1,856,477	2,230,808
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	324,895	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,033,231	1,683,510	2,782,268	3,465,195
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		397	324	357	333
Handling costs (\$/TEU)					
THC Anchorage		121	121	121	121
THC Shanghai		45	45	45	45
TOTAL COST, \$ PER TEU		563	490	523	499
Transit time to USWC (days)		9	10	12	12

For assumptions see notes to Route 1

ROUTE:	5	Kobe- Prince Rupert- Kobe			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		4,101	4,101	4,101	4,101
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		13.9	13.9	13.9	13.9
Additional sea time for other ports		3.9	0.7	4.5	4.6
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	21	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		580,770	888,127	1,143,738	1,384,942
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		194,575	280,642	704,945	836,124
Ship costs per voyage (both legs)		775,345	1,168,769	1,848,683	2,221,066
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	324,895	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,029,792	1,677,665	2,774,474	3,455,453
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		396	323	356	332
Handling costs (\$/TEU)					
THC Kobe		132	132	132	132
THC Prince Rupert		121	121	121	121
TOTAL COST, \$ PER TEU		649	576	609	585
Transit time to USWC (days)		9	10	12	12

For assumptions see notes to Route 1

ROUTE:	6	Yokohama- Prince Rupert- Yokohama			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		3,825	3,825	3,825	3,825
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		13.0	13.0	13.0	13.0
Additional sea time for other ports		4.8	1.6	5.5	5.5
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	21	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		541,684	828,355	1,066,764	1,291,734
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		220,481	318,007	752,044	891,987
Ship costs per voyage (both legs)		762,164	1,146,363	1,818,808	2,183,721
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	324,895	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,016,612	1,655,258	2,744,598	3,418,109
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		391	318	352	329
Handling costs (\$/TEU)					
THC Yokohama		132	132	132	132
THC Prince Rupert		121	121	121	121
TOTAL COST, \$ PER TEU		644	571	605	582
Transit time to USWC (days)		8	10	11	11

For assumptions see notes to Route 1

ROUTE:	7	HK- Prince Rupert- HK			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		5,355	5,355	5,355	5,355
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		18.2	18.2	18.2	18.2
Additional sea time for other ports		6.6	3.4	0.3	0.3
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		28	28	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		758,357	1,159,698	1,493,469	1,808,428
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		270,040	389,488	490,953	582,311
Ship costs per voyage (both legs)		1,028,397	1,549,185	1,984,422	2,390,740
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		216,597	433,194	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,336,994	2,166,379	2,910,213	3,625,127
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		514	417	373	349
Handling costs (\$/TEU)					
THC Hong Kong		185	185	185	185
THC Prince Rupert		121	206	206	206
TOTAL COST, \$ PER TEU		821	808	764	740

For assumptions see notes to Route 1

ROUTE:	8	Shanghai-Prince Rupert-Shanghai			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		4,678	4,678	4,678	4,678
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		15.9	15.9	15.9	15.9
Additional sea time for other ports		1.9	5.7	2.6	2.6
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destination	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	28	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		662,483	1,013,084	1,304,659	1,579,800
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		140,417	481,140	606,481	719,338
Ship costs per voyage (both legs)		802,899	1,494,224	1,911,140	2,299,137
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	433,194	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,057,347	2,111,418	2,836,931	3,533,525
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		407	406	364	340
Handling costs (\$/TEU)					
THC Shanghai		45	45	45	45
THC Prince Rupert		121	121	121	121
TOTAL COST, \$ PER TEU		572	572	530	506

For assumptions see notes to Route 1

ROUTE:	9	Kobe- Vancouver- Kobe			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		4,554	4,554	4,554	4,554
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		15.5	15.5	15.5	15.5
Additional sea time for other ports		2.3	6.2	3.0	3.0
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	28	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		644,922	986,230	1,270,076	1,537,924
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		152,056	497,927	627,642	744,435
Ship costs per voyage (both legs)		796,978	1,484,157	1,897,718	2,282,359
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	433,194	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,051,425	2,101,351	2,823,509	3,516,747
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		404	404	362	338
Handling costs (\$/TEU)					
THC Kobe		132	132	132	132
THC Vancouver		200	200	200	200
TOTAL COST, \$ PER TEU		736	736	694	670
Transit time to USWC (days)		9	11	13	12

For assumptions see notes to Route 1

ROUTE:	10	Yokohama-Vancouver- Yokohama			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		4,264	4,264	4,264	4,264
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		14.5	14.5	14.5	14.5
Additional sea time for other ports		3.3	0.1	4.0	4.0
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	21	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		603,853	923,427	1,189,198	1,439,988
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		179,276	258,575	677,130	803,132
Ship costs per voyage (both legs)		783,129	1,182,002	1,866,327	2,243,121
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	324,895	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,037,576	1,690,898	2,792,118	3,477,508
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		399	325	358	334
Handling costs (\$/TEU)					
THC Yokohama=		132	132	132	132
THC Vancouver		200	200	200	200
TOTAL COST, \$ PER TEU		731	657	690	666

For assumptions see notes to Route 1

ROUTE:	11	Hong Kong-Vancouver- Hong Kong			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		5,760	5,760	5,760	5,760
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		19.6	19.6	19.6	19.6
Additional sea time for other ports		5.2	2.1	5.9	5.9
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destination	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		28	28	35	35
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		815,712	1,378,499	2,088,905	2,534,492
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		232,026	252,709	477,813	563,696
Ship costs per voyage (both legs)		1,047,737	1,631,208	2,566,718	3,098,188
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		216,597	433,194	812,238	1,082,985
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,356,334	2,248,402	3,654,956	4,549,172
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		522	432	469	437
Handling costs (\$/TEU)					
THC Hong Kong		182	182	182	182
THC Vancouver		200	200	200	200
TOTAL COST, \$ PER TEU		903	814	850	819
Transit time to USWC (days)		11	13	15	15

For assumptions see notes to Route 1

ROUTE:	12	Shanghai-Vancouver-Shanghai			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		5,114	5,114	5,114	5,114
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		17.4	17.4	17.4	17.4
Additional sea time for other ports		0.4	4.3	1.1	1.1
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	28	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		724,227	1,107,506	1,426,256	1,727,041
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		99,493	422,114	532,079	631,090
Ship costs per voyage (both legs)		823,721	1,529,620	1,958,335	2,358,131
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	433,194	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,078,168	2,146,814	2,884,126	3,592,518
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		415	413	370	345
Handling costs (\$/TEU)					
THC Shanghai		45	45	45	45
THC Vancouver		200	200	200	200
TOTAL COST, \$ PER TEU		659	657	614	590
Transit time to USWC (days)		10	12	13	13

For assumptions see notes to Route 1

ROUTE:	13	Kobe-LA/LB- Kobe			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		5,137	5,137	5,137	5,137
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		17.5	17.5	17.5	17.5
Additional sea time for other ports		0.4	4.2	1.0	1.1
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	28	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		727,485	1,112,487	1,432,671	1,734,808
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		97,334	419,001	528,154	626,435
Ship costs per voyage (both legs)		824,819	1,531,487	1,960,825	2,361,243
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	433,194	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,079,267	2,148,681	2,886,616	3,595,630
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		415	413	370	346
Handling costs (\$/TEU)					
THC Kobe		132	132	132	132
THC Long Beach		200	200	200	200
TOTAL COST, \$ PER TEU		747	745	702	678
Transit time to USWC (days)		10	12	13	13

For assumptions see notes to Route 1

ROUTE:	14	Yokohama-LA/LB- Yokohama			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		4,842	4,842	4,842	4,842
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		16.5	16.5	16.5	16.5
Additional sea time for other ports		1.4	5.2	2.0	2.1
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		21	28	28	28
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		685,708	1,048,600	1,350,397	1,635,184
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		125,024	458,938	578,495	686,144
Ship costs per voyage (both legs)		810,731	1,507,538	1,928,893	2,321,327
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		162,448	433,194	649,791	866,388
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,065,179	2,124,732	2,854,683	3,555,715
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		410	409	366	342
Handling costs (\$/TEU)					
THC Yokohama		132	132	132	132
THC Long Beach		200	200	200	200
TOTAL COST, \$ PER TEU		742	740	698	674
Transit time to USWC (days)		10	11	13	13

For assumptions see notes to Route 1

ROUTE:	15	Hong Kong-LA/LB- Hong Kong			
Total number of ports on route		8			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		6,363	6,363	6,363	6,363
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		21.6	21.6	21.6	21.6
Additional sea time for other ports		3.2	0.0	3.8	3.9
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		28	28	35	35
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		901,107	1,377,994	1,774,593	2,148,838
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		175,427	253,025	670,133	794,834
Ship costs per voyage (both legs)		1,076,534	1,631,018	2,444,726	2,943,672
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		216,597	433,194	812,238	1,082,985
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,385,131	2,248,212	3,532,964	4,394,656
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		533	432	453	423
Handling costs (\$/TEU)					
THC Hong Kong		182	182	182	182
THC Long Beach		200	200	200	200
TOTAL COST, \$ PER TEU		915	814	835	804
Transit time to USWC (days)		12	14	16	16

For assumptions see notes to Route 1

ROUTE:	16	Shanghai-LA/LB- Shanghai			
To					
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		5,708	5,708	5,708	5,708
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		19.4	19.4	19.4	19.4
Additional sea time for other ports		5.4	2.2	6.1	6.1
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		28	28	35	35
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		808,348	1,236,144	1,591,918	1,927,639
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		236,906	341,699	781,907	927,407
Ship costs per voyage (both legs)		1,045,254	1,577,843	2,373,825	2,855,046
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		216,597	433,194	812,238	1,082,985
Canal transit charges		0	0	0	0
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,353,851	2,195,037	3,462,064	4,306,031
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		521	422	444	414
Handling costs (\$/TEU)					
THC Shanghai		45	45	45	45
THC Long Beach		200	200	200	200
TOTAL COST, \$ PER TEU		765	667	688	659
Transit time to USWC (days)		11	13	14	14

For assumptions see notes to Route 1

ROUTE:	17	Kobe-New York-Kobe			
Total number of ports on route		4-8			
Via (canal)		Panama			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		10,867	10,867	10,867	10,867
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		37.0	37.0	37.0	37.0
Additional sea time for other ports		1.9	5.7	2.5	2.6
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destina tion	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		42	49	49	49
Ship cost per day in port		9,286	9,286	9,286	9,286
Ship cost per day at sea		23,326	33,154	41,110	49,066
Cost of ship time at sea		862,179	1,225,447	1,519,521	1,813,596
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		46,776	111,776	111,776	111,776
Ship costs per voyage (both legs)		908,955	1,337,223	1,631,297	1,925,372
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voygae		324,895	758,089	1,137,134	1,516,178
Canal transit charges		200,000	400,000	600,000	800,000
Port entry dues		46,000	92,000	138,000	368,000
TOTAL Ship and Container costs p.a		1,479,850	2,587,312	3,506,431	4,609,550
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		569	498	450	443
Handling costs (\$/TEU)					
THC New York		150	150	150	150
THC Kobe		132	132	132	132
TOTAL COST, \$ PER TEU		851	779	731	725
Transit time to USWC (days)		20	22	23	23

SHIPPING LINE COSTS					
ROUTE:	18	Yokohama-New York-Yokohama			
Total number of ports on route		4-8			
Via (canal)		Panama			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		10,587	10,587	10,587	10,587
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		36.0	36.0	36.0	36.0
Additional sea time for other ports		2.8	6.6	3.5	3.5
Transit time for Canal		0	0	0	0
Time in port (days)	Orign	1.3	2.6	3.9	3.4
	Destinati on	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		42	49	49	49
Ship cost per day in port		9,286	9,286	9,286	9,286
Ship cost per day at sea		23,326	33,154	41,110	49,066
Cost of ship time at sea		839,964	1,193,872	1,480,369	1,766,866
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		55,620	120,620	120,620	120,620
Ship costs per voyage (both legs)		895,583	1,314,492	1,600,989	1,887,486
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voygae		324,895	758,089	1,137,134	1,516,178
Canal transit charges		200,000	400,000	600,000	800,000
Port entry dues		46,000	92,000	276,000	184,000
TOTAL Ship and Container costs p.a		1,466,479	2,564,581	3,614,123	4,387,664
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		564	493	463	422
Handling costs (\$/TEU)					
THC N York		150	150	150	150
THC Yokohama		132	132	132	132
TOTAL COST, \$ PER TEU		846	775	745	704
Transit time to USWC (days)		20	21	23	23

ROUTE:	19	Hong Kong-New York-Hong Kong			
Total number of ports on route		8			
Via (canal)		Pamama			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		11,587	11,587	11,587	11,587
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		39.4	39.4	39.4	39.4
Additional sea time for other ports		6.4	3.2	0.1	0.1
Transit time for Canal		0	0	0	0
Time in port (days)		1.3	2.6	3.9	3.4
		1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		49	49	49	49
Ship cost per day in port		13,886	16,952	19,557	21,903
Ship cost per day at sea		27,926	40,820	51,381	61,683
Cost of ship time at sea		1,100,596	1,608,795	2,025,020	2,431,018
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		133,142	162,547	187,525	210,014
Ship costs per voyage (both legs)		1,233,738	1,771,342	2,212,544	2,641,032
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		379,045	758,089	1,137,134	1,516,178
Canal transit charges		200,000	400,000	600,000	800,000
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		1,904,783	3,113,431	4,225,678	5,325,210
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		733	599	542	512
Handling costs (\$/TEU)					
THC New York		150	150	150	150
THC Hong Kong		185	185	185	185
TOTAL COST, \$ PER TEU		1,068	934	877	847
Transit time to USWC (days)		21	23	24	24

ROUTE:	20	Shanghai-New York-Shanghai			
Total number of ports on route		8			
Via (canal)		Panama			
Ship Capacity (TEU)		2000	4000	6000	8,000
GRT		23,000	46,000	69,000	92,000
Route Distance (n miles)		11,471	11,471	11,471	11,471
Ship speed (knots)		24.5	24.5	24.5	24.5
Sea Time to link main ports (days)		39.0	39.0	39.0	39.0
Additional sea time for other ports		6.8	3.6	0.5	0.5
Transit time for Canal		0	0	0	0
Time in port (days)	Origin	1.3	2.6	3.9	3.4
	Destination	1.9	3.7	5.6	6.1
Total round voyage time (days) (a)		49	49	49	49
Ship cost per day in port		27,595	39,802	50,170	59,506
Ship cost per day at sea		41,635	63,670	81,994	99,286
Cost of ship time at sea		1,624,484	2,484,200	3,199,176	3,873,853
Cost of transit time for Canal		0	0	0	0
Cost of ship time in port		275,484	397,340	500,851	594,051
Ship costs per voyage (both legs)		1,899,968	2,881,540	3,700,026	4,467,903
Container cost per ship day		7,736	15,471	23,207	30,942
Container costs per voyage		379,045	758,089	1,137,134	1,516,178
Canal transit charges		200,000	400,000	600,000	800,000
Port entry dues		92,000	184,000	276,000	368,000
TOTAL Ship and Container costs p.a		2,571,012	4,223,629	5,713,160	7,152,082
Load Factor (including both directions)		65%	65%	65%	65%
SHIPPING COSTS, \$ per TEU		989	812	732	688
Handling costs (\$/TEU)					
THC New York		150	150	150	150
THC Shanghai		45	45	45	45
TOTAL COST, \$ PER TEU		1,183	1,007	927	882
Transit time to USWC (days)		21	23	24	24

Additional Assumptions for Shipping Costs

- Container costs. As a working rule ships have three sets of containers - one on the ship and one set on land at each end of the route.
- Terminal handling charges vary widely. Current THCs are as follows:

(\$/TEU, based on half of the charge per FEU)

LA/LB	200
Vancouver	200
Kobe	132
Yokohama	132
Shanghai	45
Hong Kong	185
Anchorage	121 (assumed 60% of LA/LB)
Prince Rupert	121 (assumed 60% of LA/LB)

- Fuel consumption is at 0.13 kg. per brake horsepower per hour. The BHP required for a given speed has to increase by 60% of an increase in vessel size. (To increase speed, however, the engine size has to increase by the square of the speed increase: e.g. a increase of 20% in speed requires an increase in brake horse power of 1.44 (1.2 x 1.2).
- Vessel handling speeds are dependent on ship length, as more cranes are normally deployed on a longer ship.