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**Panama Canal Impact on the Liner
Container Shipping Industry and the
Transshipment Activity in the
Republic of Panama**

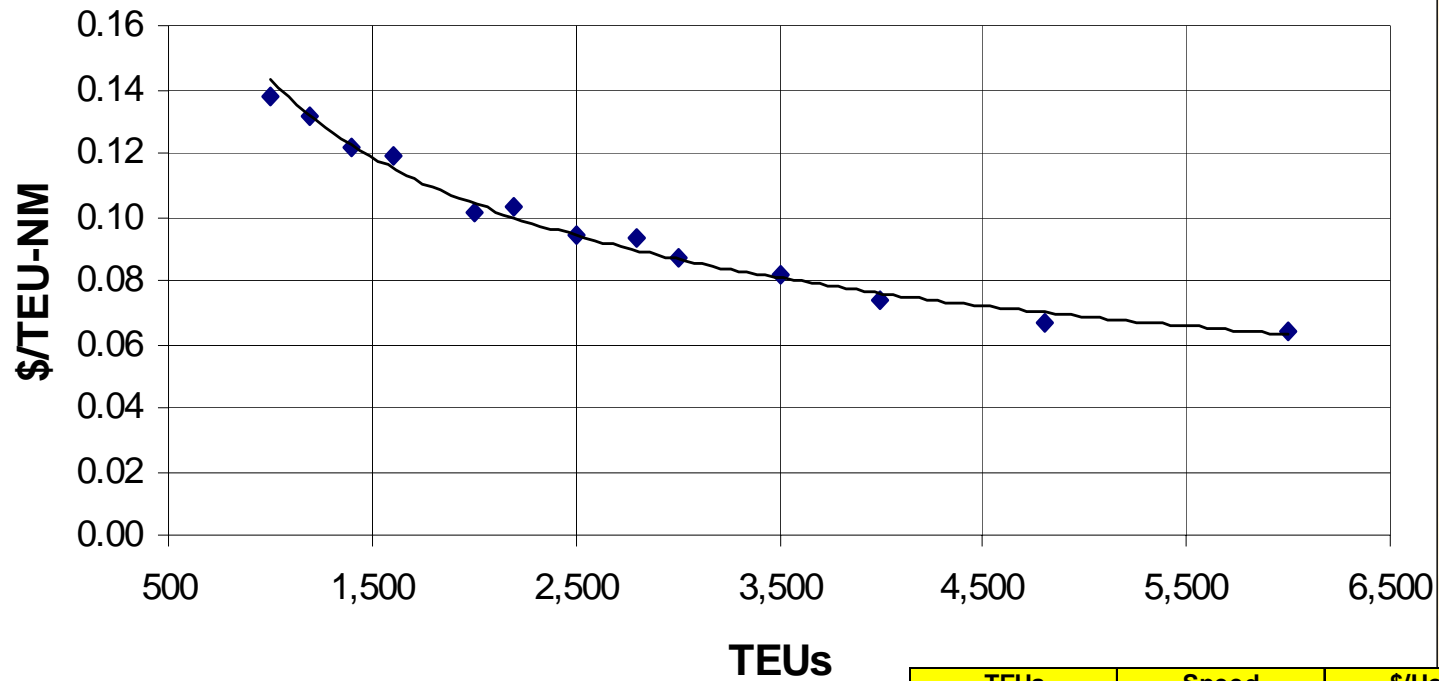
Dr. Anatoly Hochstein
National Ports & Waterways Institute
University of New Orleans

March 2005

Containership Dimensions & Arrangements

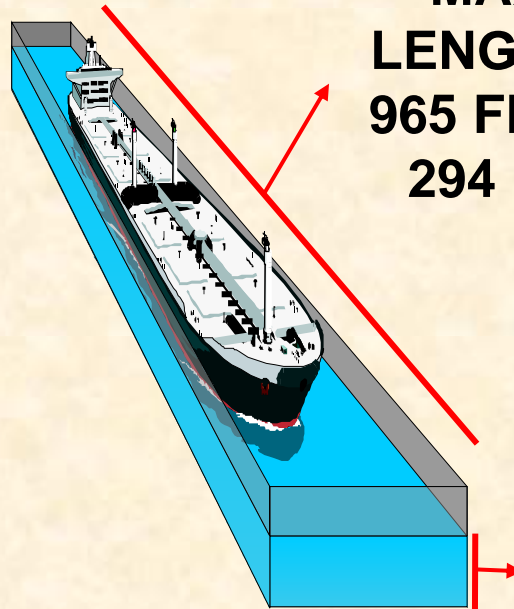
Design	Capacity (TEUs)	Length x Beam x Draft (m)	Arrangement (rows) Under - Above - Across
Panamax	4,500	295 x 32.3 x 12	8 - 5 - 13
MSL S-Class	7,500	347 x 42.8 x 14.5	9 - 6 - 17
Samsung	9,200	340 x 45.6 x 14.5	10 - 6 - 18
MSL "Rumor"	10,500	404 x 51 x 14.5	10 - 6 - 20
Malacca-Max	18,000	396 x 60 x 21	13 - 8 - 23
New-Panamax (NPX)	12 - 15,000	385 x 55.2 x 14.5	9/10 - 6 - 22

Scale Economies of Containerships



TEUs	Speed	\$/Hour	\$/TEU-NM
1,000	18	597	0.14
1,200	18	684	0.13
1,400	19	775	0.12
1,600	19	866	0.12
2,000	20	977	0.10
2,200	20	1,093	0.10
2,500	21	1,189	0.09
2,800	21	1,317	0.09
3,000	22	1,376	0.09
3,500	22	1,515	0.08
4,000	23	1,621	0.07
4,800	24	1,832	0.07
6,000	25	2,318	0.06

PANAMAX

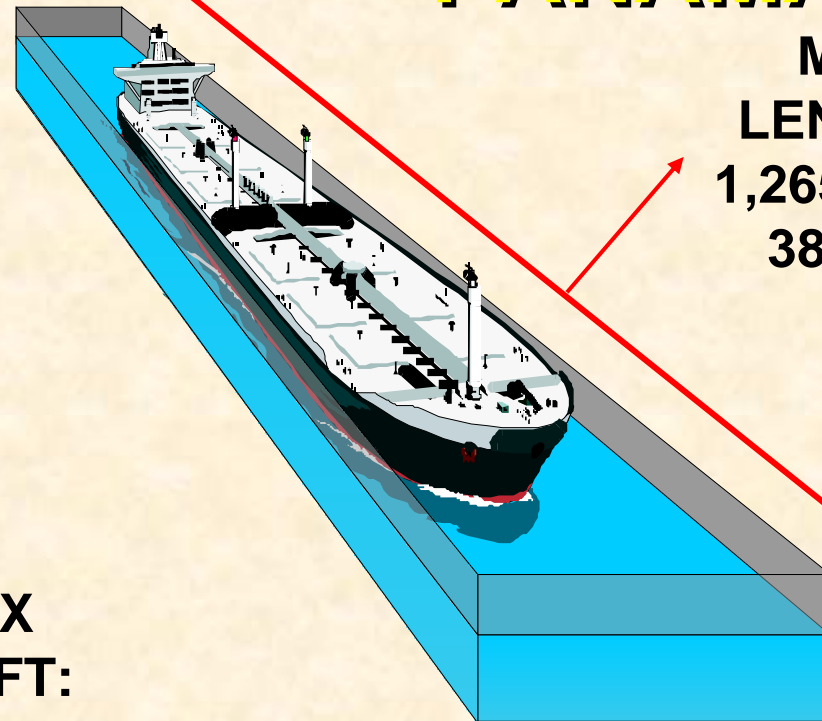


**MAX
LENGTH:
965 FEET
294 M.**

**MAX
DRAFT:
39.5 FEET
12 M.**

**MAX BEAM:
106 FEET
32.5 M.**

POST- PANAMAX



**MAX
LENGTH:
1,265 FEET
385.6M**

**MAX DRAFT:
50 FEET
15.2M**

**MAX BEAM:
180 FEET
53.9M**

Objectives, Framework & Methodology

- Relevant Trade Flows (12)
- Economic Scenarios (3)
- Operational Scenarios (3)
- Service Patterns (9)
- Containership Sizes (9)
- Allocation of Trades to Patterns
- Constraints (USWC ports, Intermodal, USEC ports)
- Diversion (Asian imports to the USA)

Relevant Trade Flows

<i>From</i>	<i>To</i>	USA Regions	Divertability
Northeast Asia	USA	East & Gulf Coasts	Divertible
Southeast Asia	USA	East & Gulf Coasts	Divertible
USA	Oceania	East & Gulf Coasts	Captive
USA	S America East & North Coasts	West Coast	Captive
South America West Coast	USA	East & Gulf Coasts	Divertible
Europe & Mediterranean	USA	West Coast	Captive
South America West Coast	Caribbean		Captive
Northeast Asia	South America East Coast		Divertible
Europe & Mediterranean	South America West Coast		Captive
S America East & North Coasts	South America West Coast		Captive
Asia	South America North Coast		Captive
Asia	South America West Coast		Divertible

Scenario Definition

S. Pattern	No Change	Moderate Change	Radical Change
TPD	7,500 TEUs	7,500 TEUs	12,500 TEUs
AWX-D	4,500 TEUs	7,500 TEUs	7,500 TEUs
AWX-Trs	Not Existing	Not Existing	12,500 TEUs
SuezX	7,500 TEUs	7,500 TEUs	7,500 TEUs
PendSuezEC	7,500 TEUs	7,500 TEUs	7,500 TEUs
AW	4,500 TEUs	7,500 TEUs	7,500 TEUs
PendPanEur	4,500 TEUs	7,500 TEUs	7,500 TEUs

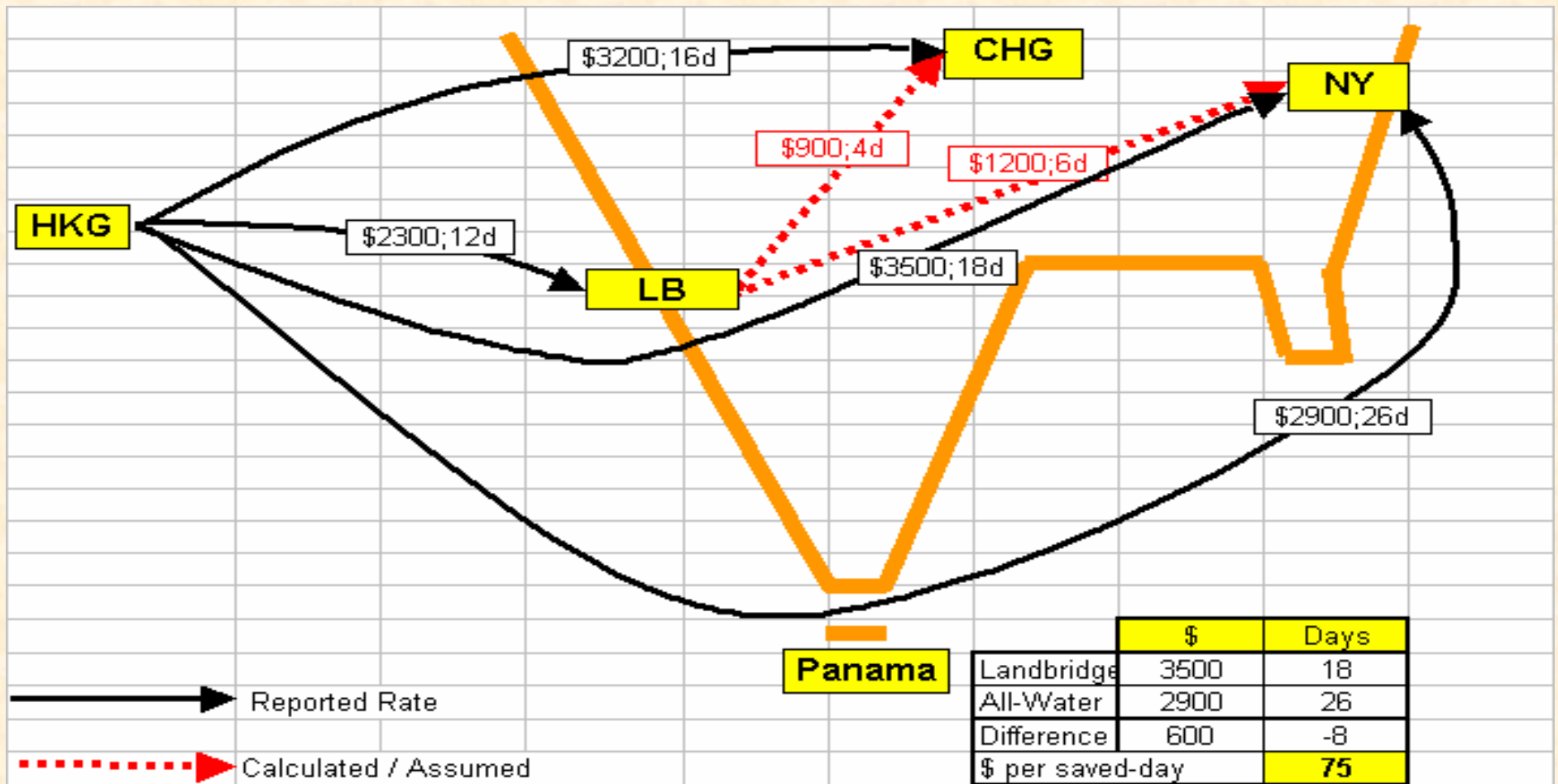
Factors Defining Scenarios

Factor	No Change	Moderate Change	Radical Change
Dominant Ship Size	7,500 TEUs	7,500 TEUs	12,500 TEUs
Transshipment Ports	Remain essentially unchanged	Minor changes	Substantially higher productivity and lower cost
Shipping Line Market	Alliances	"Super"alliances	Consolidated shipping / logistic groups
USEC Ports	Mainly 45 - 48 ft	Most 45 - 48 ft; some to 50ft	Most 45 - 48 ft; some to 50ft
Service Patterns	No change; same multi-port direct patterns	Minor changes	Extensive conversion to hub & spoke

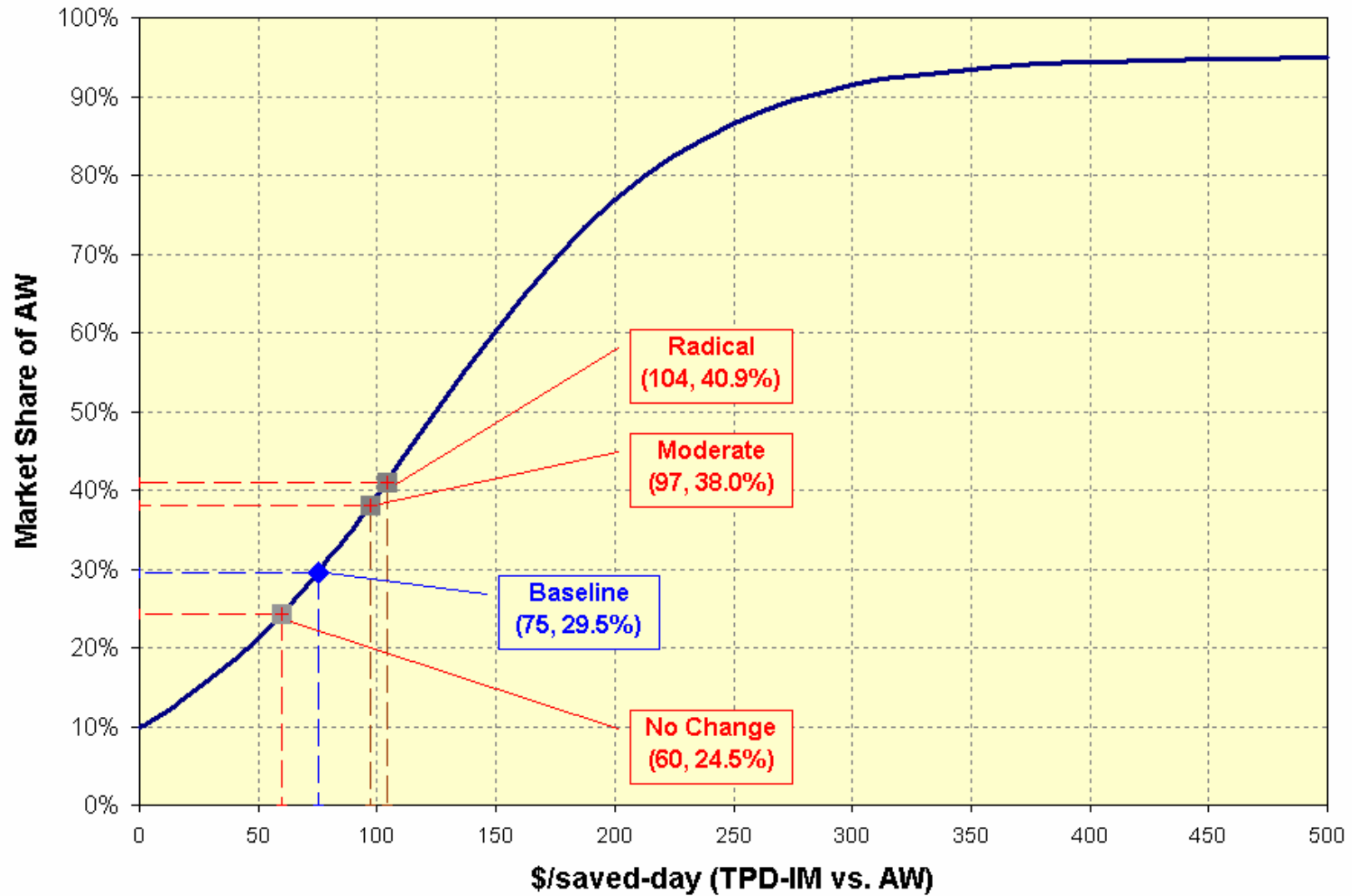
Diversions Criterion

- Inventory Cost:
 - Carrying Cost – Capital, Storage, Maintenance
 - Opportunity Cost – Lost Sales, Delayed Sale at Lower Price
- Service Premium:
 - Freight Rates Differential
 - Transit Time Differential
- Diversions:
 - Premium > Inventory Cost

Present Freight Rates and Times



Diversion of TPD-IM to AWX



US East Coast Diversions

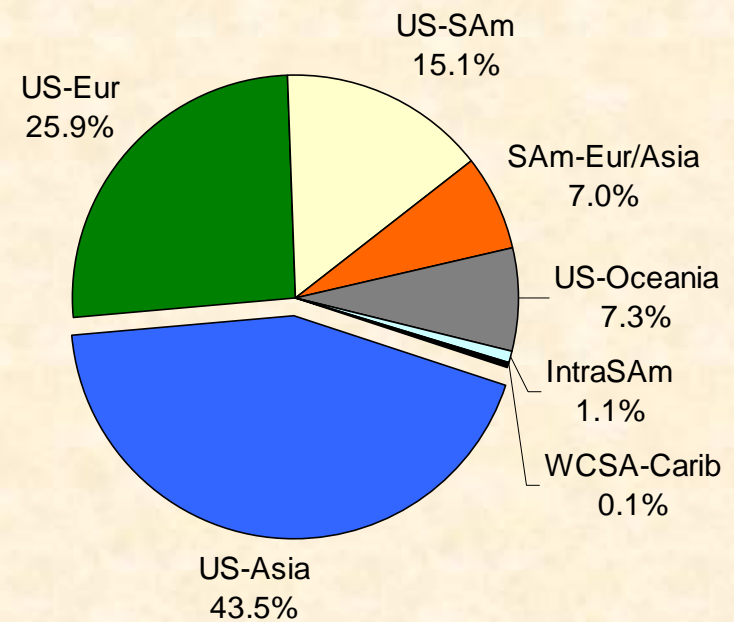
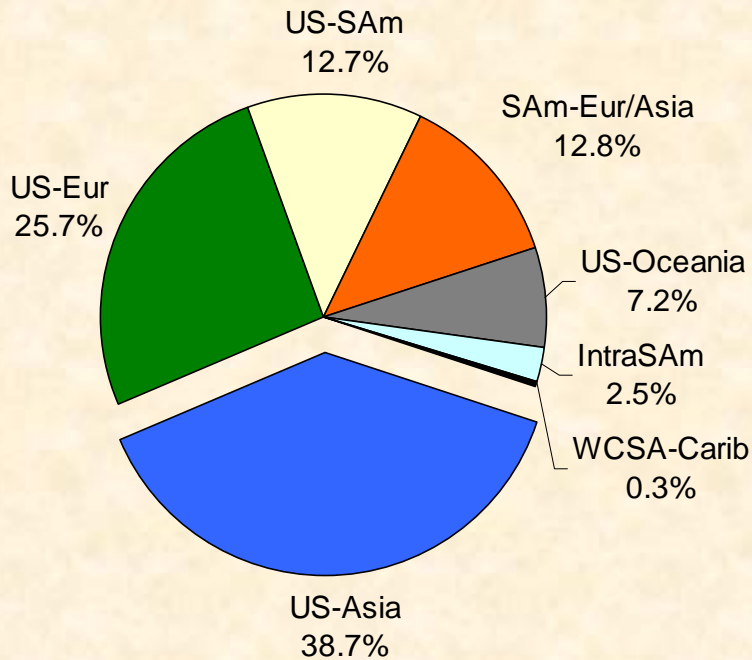
Scenario	Intermodal		All Water		IM-AW Differentials			Market	
	Pattern	Pattern	Pattern	Pattern	\$/FEU	Days	\$/FEU-Day	Share	
Present	TPD - IM	4,500	AWX-D	4,500	600	-8.0	75	29.7%	
No Change	TPD - IM	7,500	AWX-D	4,500	554	-9.2	60	24.4%	-0.18
Moderate	TPD - IM	7,500	AWX-D	7,500	640	-6.6	97	38.4%	0.29
Radical	TPD - IM	12,500	AWX - Trs	12,500	684	-6.6	104	41.1%	0.39

US Gulf Coast Diversion

	Intermodal		All Water		IM-AW Differentials			Market	
Scenario	Pattern	Pattern	Pattern	Pattern	\$/FEU	Days	\$/FEU-Day	Share	
Present	TPD - IM	4,500	AWX-D	4,500	300	-10.0	30	16.0%	
Radical	TPD - IM	12,500	AWX - Trs	12,500	384	-8.6	45	19.8%	0.24

Trade Allocation Summary by Trade Fronts (TEUs)

Economic Scenario	2001		2025									
	Total Trade	CrossPan	No Change		Mod Change		Rad Change					
			Total Trade	CrossPan	Total Trade	CrossPan	Total Trade	CrossPan				
Base	21,498,010	3,703,826	17.2%	71,978,163	11,534,130	16.0%	72,016,060	14,196,250	19.7%	72,053,957	16,394,124	22.8%
Pesimistic				60,754,115	9,715,929	16.0%	60,790,692	11,961,564	19.7%	60,827,269	13,820,277	22.7%
Optimistic				103,010,112	16,239,193	15.8%	103,050,528	20,080,753	19.5%	103,090,945	23,241,743	22.5%

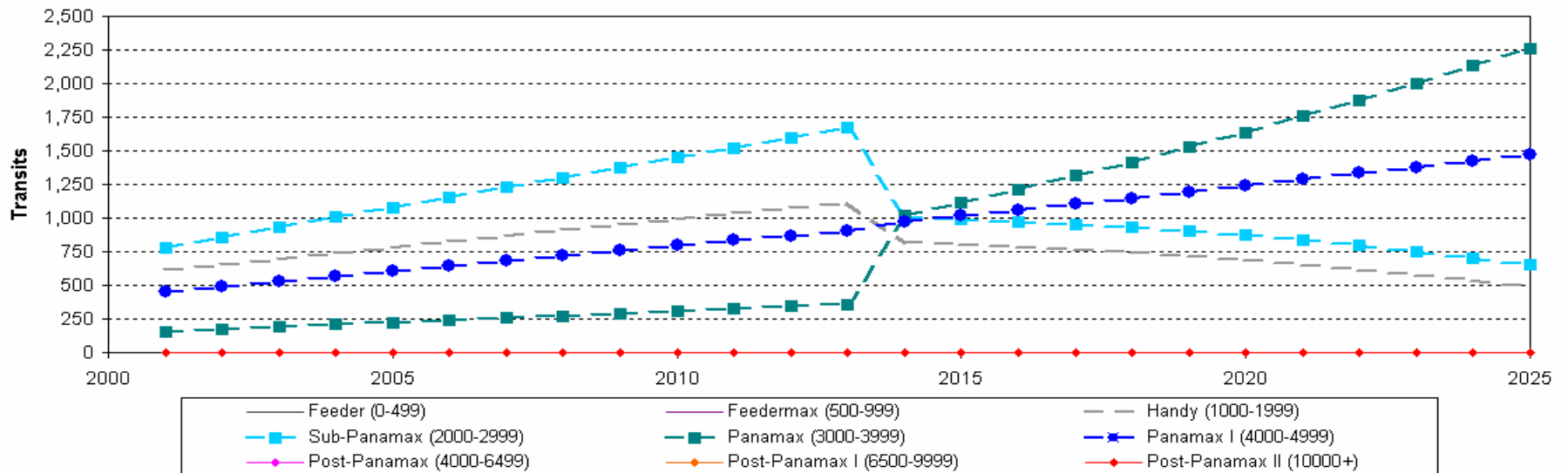


User Interface

Planned Expansion	2014
Economic Scenario	Baseline
Operational Scenario	No Change
Tolls Level - Jul 2003	No Change

Year	TEUs	Transits	PCUMS	Tolls
2010	6,640,190	3,545	99,306,909	288,443,354
2015	8,271,503	3,923	123,053,402	356,773,623
2020	9,902,816	4,441	147,060,783	426,052,798
2025	11,534,130	4,875	170,956,269	494,901,377

Ship Size	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020	2025
Feeder (0-499)	0	0	0	0	0	0	0	0	0	0	0	0	0
Feedermax (500-999)	0	0	0	0	0	0	0	0	0	0	0	0	0
Handy (1000-1999)	606,227	648,122	690,017	731,912	773,808	815,703	857,598	899,493	941,389	983,284	797,214	683,191	481,326
Sub-Panamax (2000-2999)	1,356,713	1,485,191	1,613,668	1,742,145	1,870,623	1,999,100	2,127,577	2,256,055	2,384,532	2,513,009	1,714,001	1,510,920	1,132,253
Panamax (3000-3999)	375,886	416,739	457,591	498,444	539,296	580,149	621,001	661,854	702,706	743,559	2,691,740	3,960,435	5,467,476
Panamax I (4000-4999)	1,364,999	1,480,037	1,595,074	1,710,112	1,825,150	1,940,187	2,055,225	2,170,262	2,285,300	2,400,337	3,068,548	3,748,271	4,453,074
Post-Panamax (4000-6499)	0	0	0	0	0	0	0	0	0	0	0	0	0
Post-Panamax I (6500-9999)	0	0	0	0	0	0	0	0	0	0	0	0	0
Post-Panamax II (10000+)	0	0	0	0	0	0	0	0	0	0	0	0	0



Sensitivity to Tolls Increase

Baseline Forecast, Mod Change, Tolls Jul 2003

Year	TEUs	Transits	PCUMS	Tolls
2010	6,640,190	3,545	99,306,909	288,443,354
2015	8,715,190	3,448	129,426,830	374,296,779
2020	11,455,720	3,980	169,927,462	490,571,208
2025	14,196,250	4,213	210,638,507	606,996,763

Baseline Forecast, Mod Change, Tolls Jul 2003 + 50%

Year	TEUs	Transits	PCUMS	Tolls
2010	6,541,141	3,502	97,834,018	426,265,223
2015	8,581,558	3,401	127,466,748	552,953,019
2020	11,260,072	3,920	167,065,920	723,479,720
2025	13,938,585	4,145	206,759,141	893,747,658

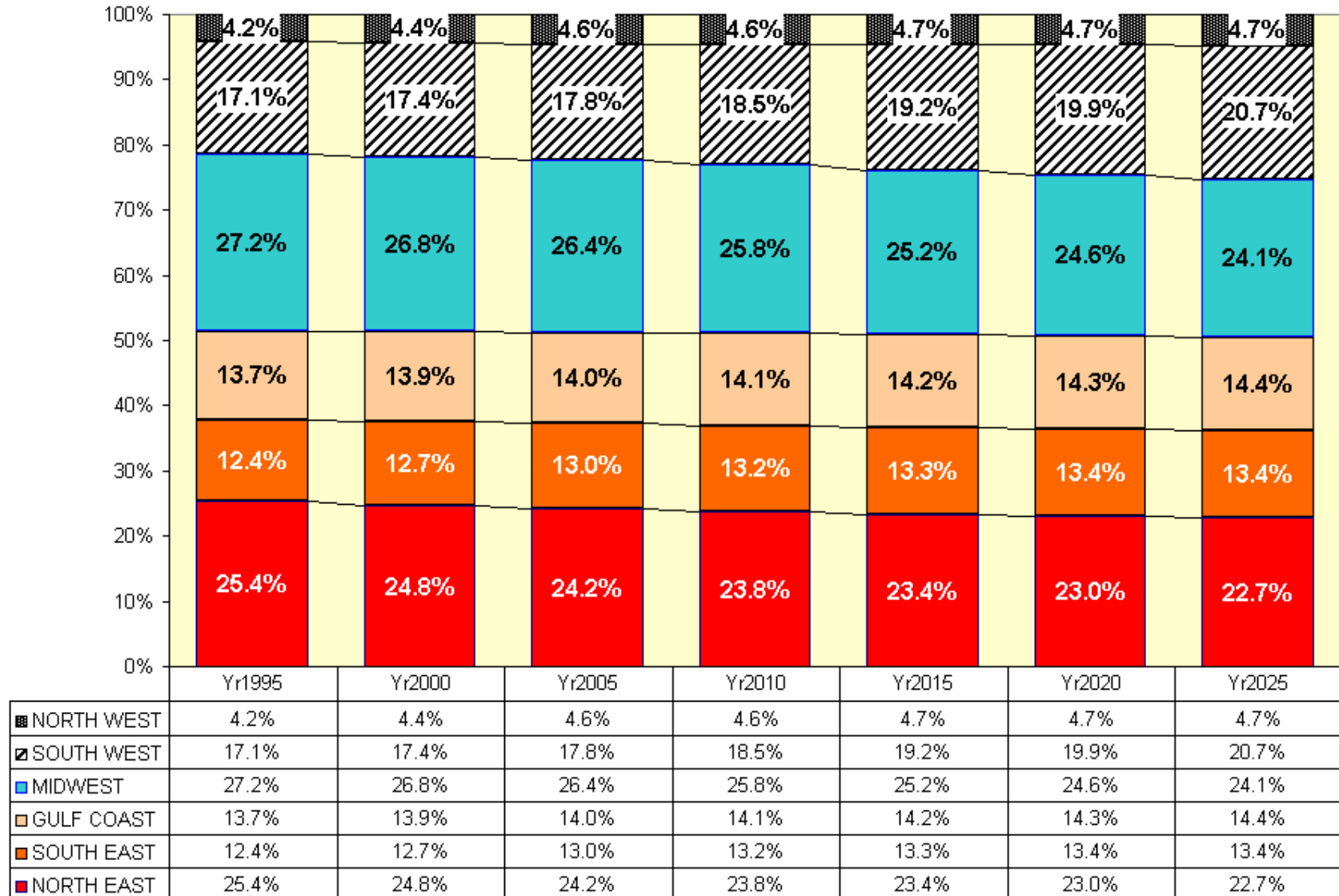
Baseline Forecast, Mod Change, Tolls Jul 2003 + 100%

Year	TEUs	Transits	PCUMS	Tolls
2010	6,455,301	3,464	96,535,405	560,829,935
2015	8,447,669	3,352	125,413,647	725,411,216
2020	11,035,118	3,851	163,735,521	945,435,552
2025	13,622,567	4,064	202,103,497	1,164,867,172

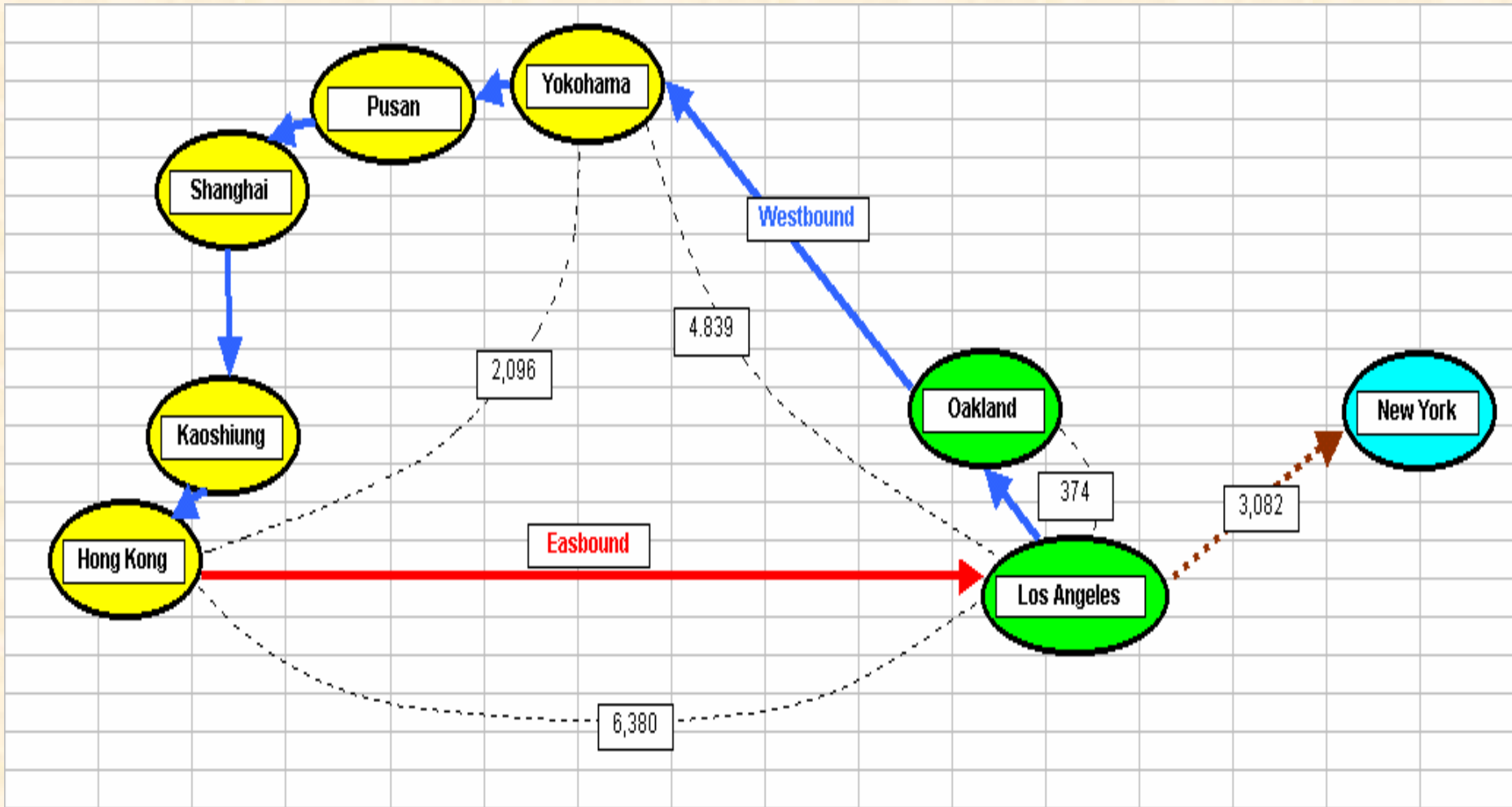
**Panama Canal Impact on the Liner
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-- Thank You --

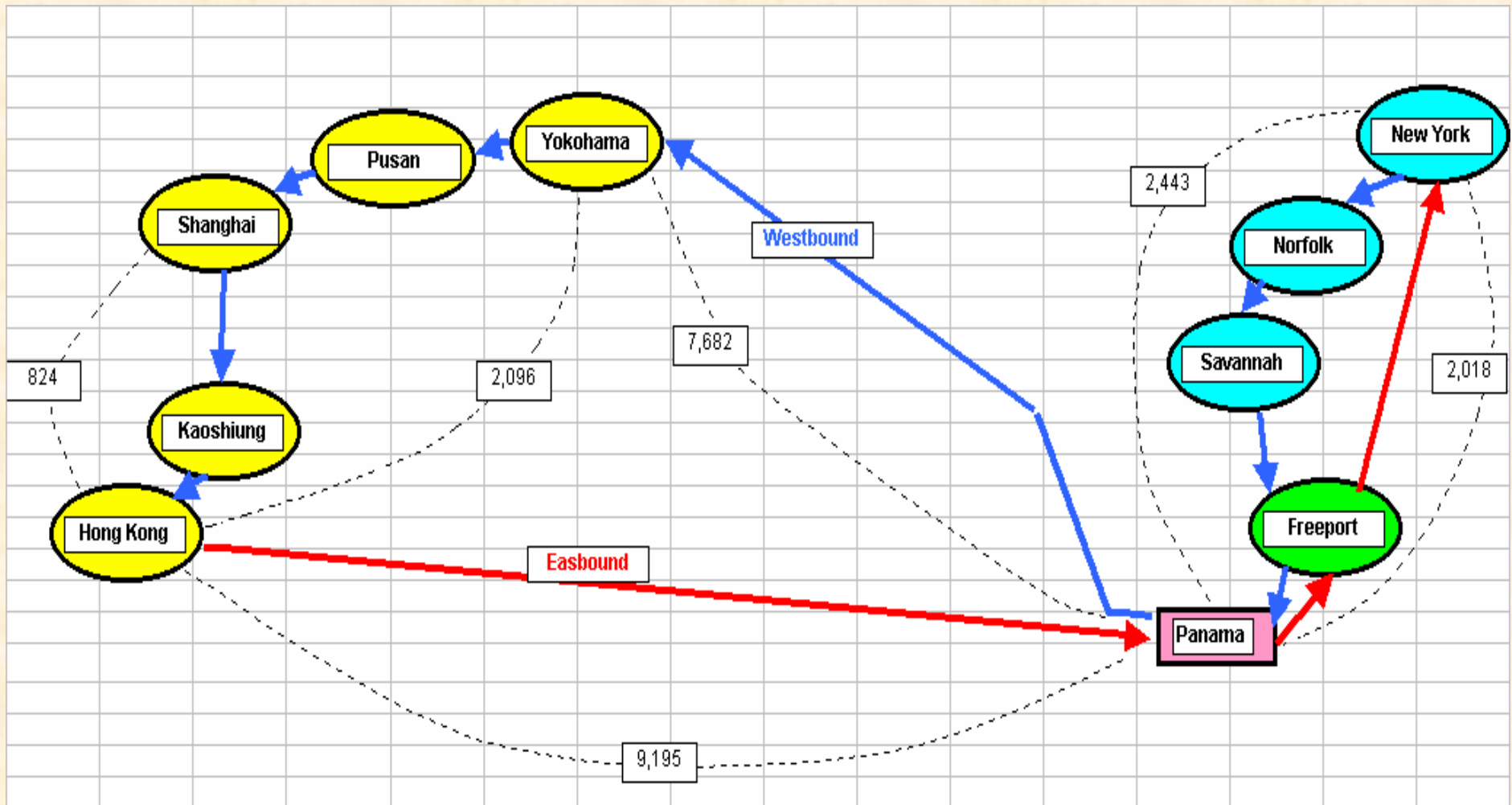
US Population Growth



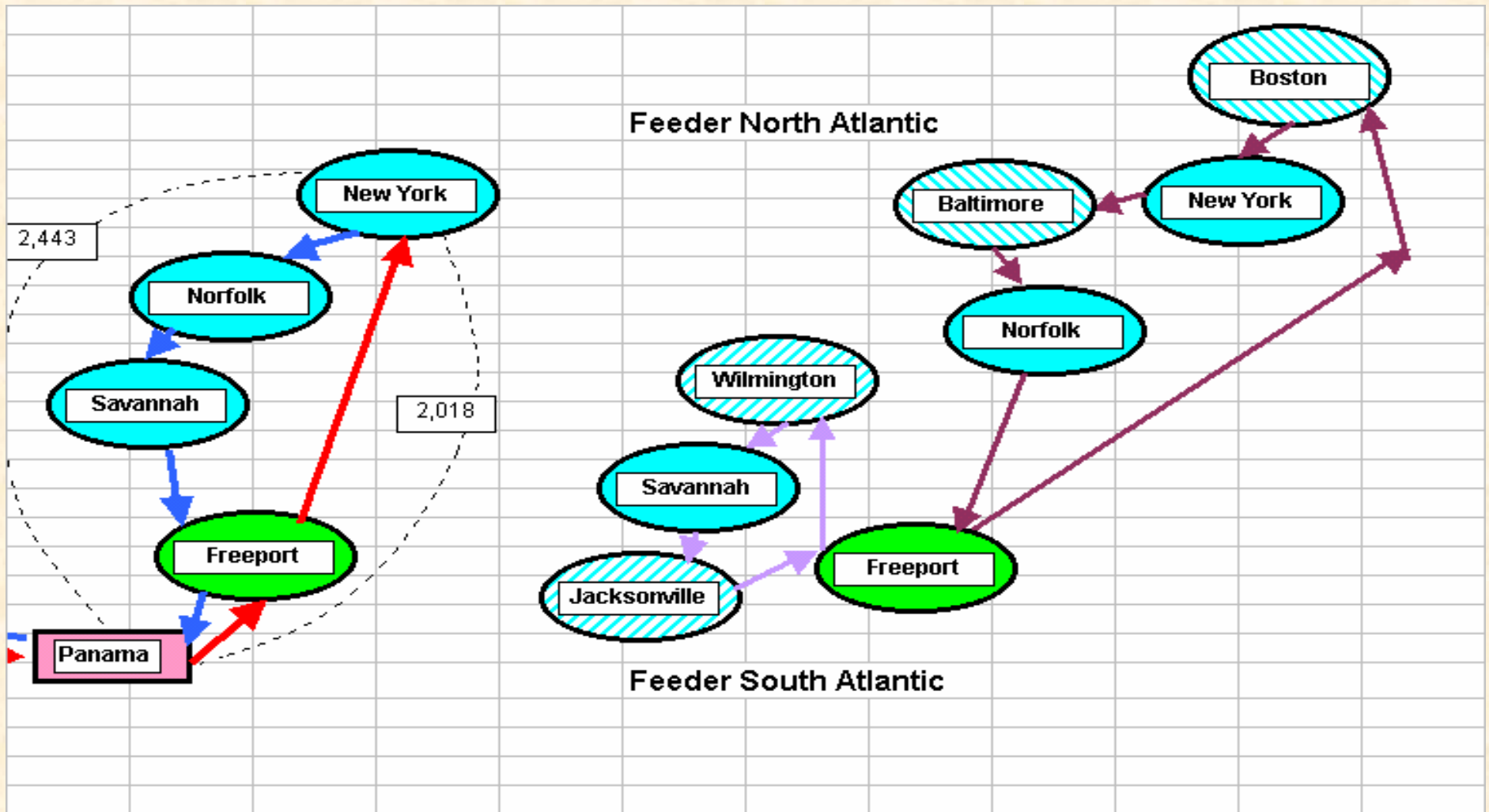
TPD + Intermodal



AWX Rotation



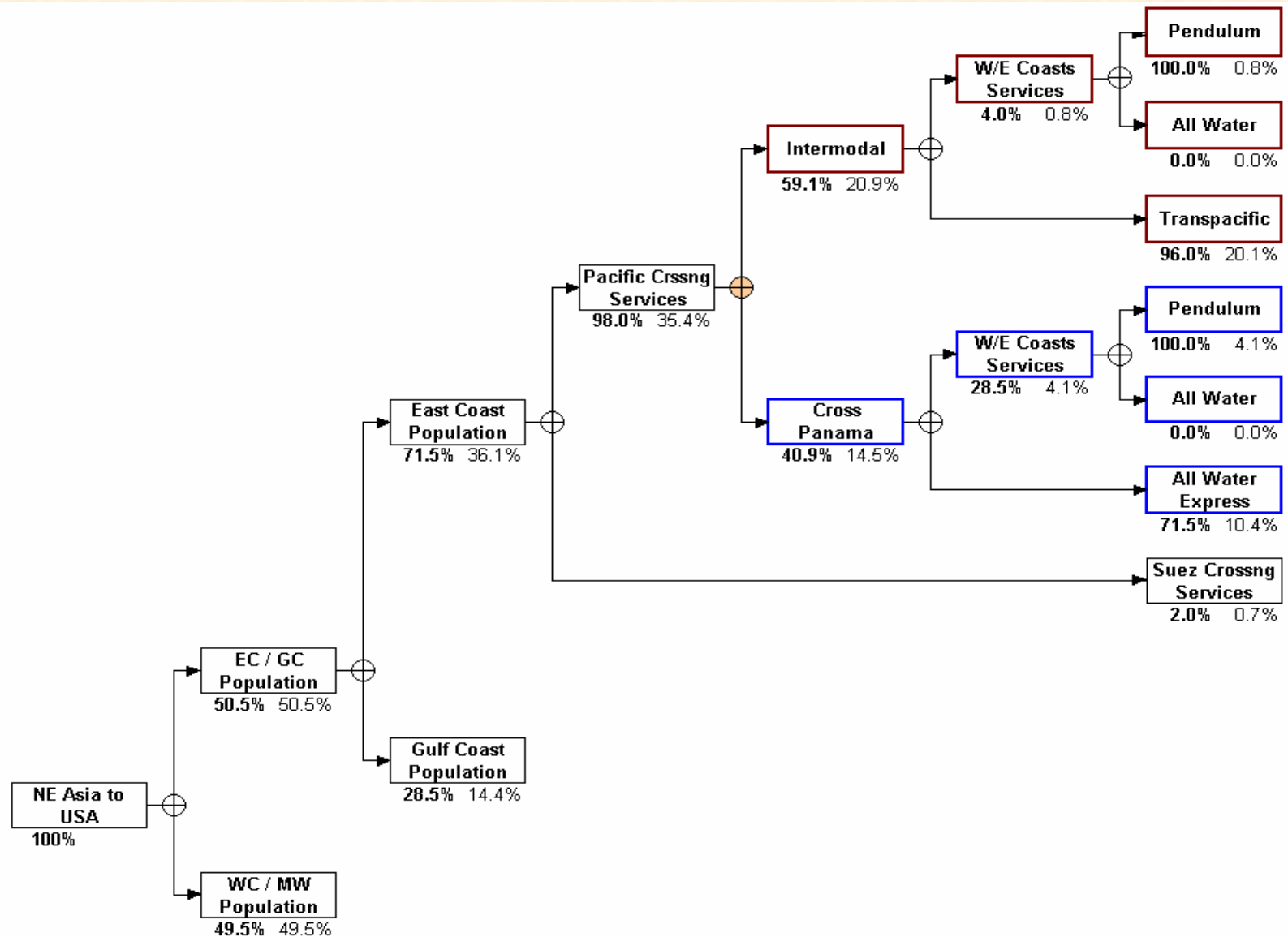
AWX – Transshipment Rotation



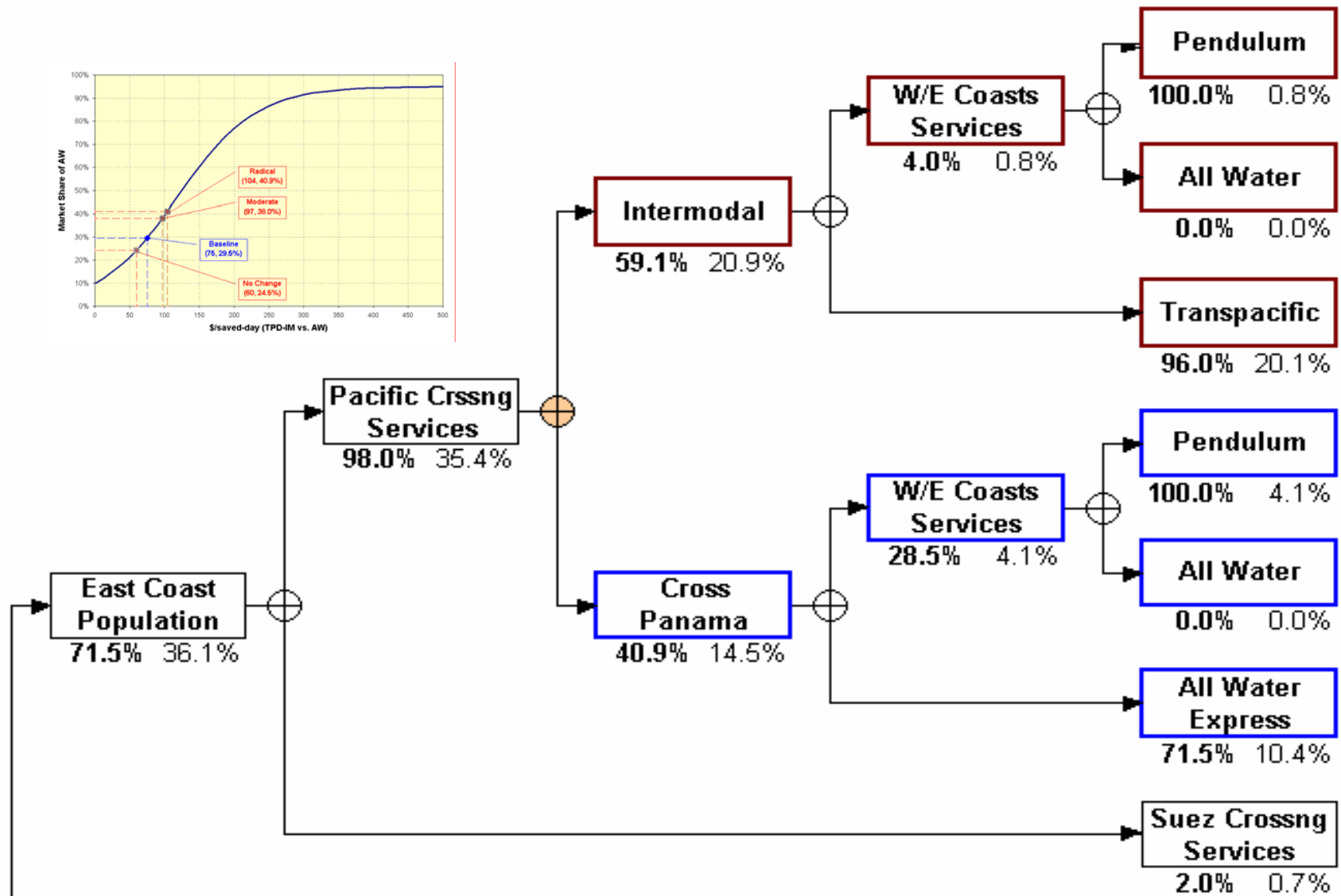
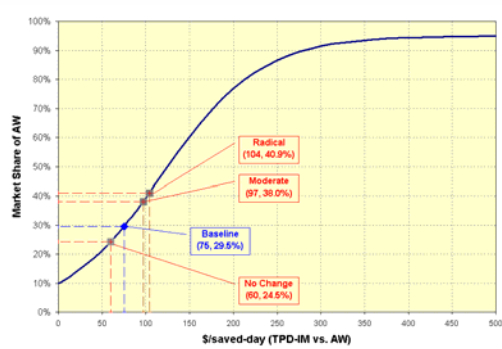
Present Services by Pattern

Alliance / Line	Pacific						Atlantic	Total
	Non-Panam		Cross-Panama					
	TPD	TPD+Eur	AW	AWX	Pend-Pan	Pend-Med	SZX	
United	6			1	1			8
CKY	4			1				5
Grand	6			2	1		1	10
MSL	3		1		1			5
New World	8	1		2	1			12
Evergreen	4	1		1	1			7
Zim		1				1		2
CMA / China Shipping	1	1		1				3
MSC			1					1
Others	4							4
Total	36	4	2	8	5	1	1	57
Grand Total	40		16				1	

Trade Allocation Tree - NE Asia to USA Trade



Trade Allocation Tree - NE Asia to USA Trade, East Coast Detail



Trade Allocation Summary by Trade Fronts (TEUs, one way)

Economic Scenario	Trade Flow		2001			2025			2001			2025		
			Total		CrossPan	No Change		CrossPan	Mod Change		CrossPan	Rad Change		CrossPan
	Destination	Origin				Total	CrossPan	Total	CrossPan	Total	CrossPan	Total	CrossPan	
Base	USA	NE Asia	5,932,441	643,927	11%	20,442,533	1,760,626	9%	20,442,533	2,752,150	13%	20,442,533	3,532,226	17%
	USA	SE Asia	1,085,644	72,107	7%	3,294,107	115,775	4%	3,294,107	271,464	8%	3,294,107	406,477	12%
	USA	Europe	2,266,124	475,886	21%	6,924,118	1,800,271	26%	6,924,118	1,800,271	26%	6,924,118	1,800,271	26%
	USA	WCSA	243,541	192,397	79%	1,052,413	778,786	74%	1,052,413	778,786	74%	1,052,413	778,786	74%
	Oceania	USA	169,817	134,155	79%	684,637	506,631	74%	684,637	506,631	74%	684,637	506,631	74%
	NC/ECSA	USA	412,632	43,326	11%	2,058,660	267,626	13%	2,058,660	267,626	13%	2,058,660	267,626	13%
	ECSA	NE Asia	144,131	0	0%	583,802	0	0%	583,802	145,951	25%	583,802	291,901	50%
	NCSA	Asia	41,611	41,611	100%	78,667	78,667	100%	78,667	78,667	100%	78,667	78,667	100%
	WCSA	Asia	184,509	26,701	14%	392,820	56,846	14%	411,768	94,743	23%	430,717	132,640	31%
	WCSA	Europe	169,052	169,052	100%	316,011	316,011	100%	316,011	316,011	100%	316,011	316,011	100%
	WCSA	NC/ECSA	93,507	46,754	50%	150,975	75,487	50%	150,975	75,487	50%	150,975	75,487	50%
	Carib	WCSA	5,997	5,997	100%	10,339	10,339	100%	10,339	10,339	100%	10,339	10,339	100%
			10,749,005	1,851,913	17%	35,989,081	5,767,065	16%	36,008,030	7,098,125	20%	36,026,979	8,197,062	23%
Pesimistic	USA	NE Asia	5,932,441	643,927	11%	16,744,031	1,442,090	9%	16,744,031	2,254,226	13%	16,744,031	2,893,169	17%
	USA	SE Asia	1,085,644	72,107	7%	3,229,299	113,498	4%	3,229,299	266,123	8%	3,229,299	398,480	12%
	USA	Europe	2,266,124	475,886	21%	5,738,341	1,491,969	26%	5,738,341	1,491,969	26%	5,738,341	1,491,969	26%
	USA	WCSA	243,541	192,397	79%	878,289	649,934	74%	878,289	649,934	74%	878,289	649,934	74%
	Oceania	USA	169,817	134,155	79%	584,185	432,297	74%	584,185	432,297	74%	584,185	432,297	74%
	NC/ECSA	USA	412,632	43,326	11%	1,828,523	237,708	13%	1,828,523	237,708	13%	1,828,523	237,708	13%
	ECSA	NE Asia	144,131	0	0%	485,918	0	0%	485,918	121,480	25%	485,918	242,959	50%
	NCSA	Asia	41,611	41,611	100%	71,779	71,779	100%	71,779	71,779	100%	71,779	71,779	100%
	WCSA	Asia	184,509	26,701	14%	379,135	54,866	14%	397,423	91,443	23%	415,712	128,020	31%
	WCSA	Europe	169,052	169,052	100%	279,750	279,750	100%	279,750	279,750	100%	279,750	279,750	100%
	WCSA	NC/ECSA	93,507	46,754	50%	147,468	73,734	50%	147,468	73,734	50%	147,468	73,734	50%
	Carib	WCSA	5,997	5,997	100%	10,341	10,341	100%	10,341	10,341	100%	10,341	10,341	100%
			10,749,005	1,851,913	17%	30,377,058	4,857,964	16%	30,395,346	5,980,782	20%	30,413,635	6,910,139	23%
Optimistic	USA	NE Asia	5,932,441	643,927	11%	29,765,726	2,563,592	9%	29,765,726	4,007,319	13%	29,765,726	5,143,163	17%
	USA	SE Asia	1,085,644	72,107	7%	5,162,418	181,439	4%	5,162,418	425,430	8%	5,162,418	637,017	12%
	USA	Europe	2,266,124	475,886	21%	9,186,843	2,388,579	26%	9,186,843	2,388,579	26%	9,186,843	2,388,579	26%
	USA	WCSA	243,541	192,397	79%	1,767,722	1,308,114	74%	1,767,722	1,308,114	74%	1,767,722	1,308,114	74%
	Oceania	USA	169,817	134,155	79%	895,892	662,960	74%	895,892	662,960	74%	895,892	662,960	74%
	NC/ECSA	USA	412,632	43,326	11%	2,869,900	373,087	13%	2,869,900	373,087	13%	2,869,900	373,087	13%
	ECSA	NE Asia	144,131	0	0%	770,586	0	0%	770,586	192,647	25%	770,586	385,293	50%
	NCSA	Asia	41,611	41,611	100%	84,012	84,012	100%	84,012	84,012	100%	84,012	84,012	100%
	WCSA	Asia	184,509	26,701	14%	418,933	60,625	14%	439,141	101,041	23%	459,350	141,458	31%
	WCSA	Europe	169,052	169,052	100%	397,333	397,333	100%	397,333	397,333	100%	397,333	397,333	100%
	WCSA	NC/ECSA	93,507	46,754	50%	171,672	85,836	50%	171,672	85,836	50%	171,672	85,836	50%
	Carib	WCSA	5,997	5,997	100%	14,018	14,018	100%	14,018	14,018	100%	14,018	14,018	100%
			10,749,005	1,851,913	17%	51,505,056	8,119,597	16%	51,525,264	10,040,377	19%	51,545,472	11,620,871	23%

Intermodal Bridges

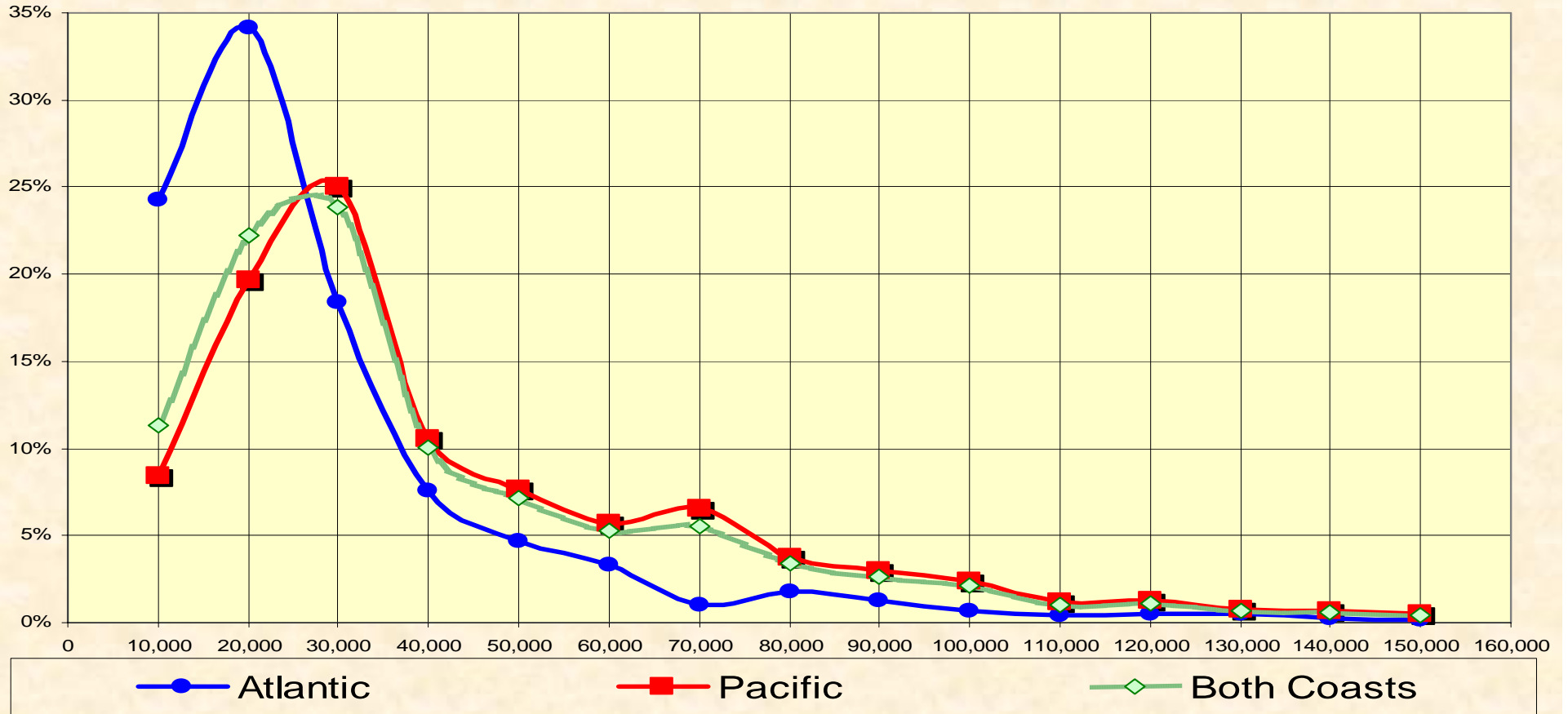
East Coast Round Trip Scenarios

Round Trip Scenario	Low	High	Share
West Coast/East Coast with Export Return	\$ 2,000	\$ 2,350	50%
West Coast/East Coast with Empty Return	\$ 1,700	\$ 2,050	25%
West Coast/East Coast with Domestic Return*	\$ 1,600	\$ 1,850	25%
Blended Average West Coast/East Coast Round Trip	\$ 1,825	\$ 2,150	

* \$200-250 WB via rail to Chicago, \$300 for IMC to USWC

- Minilandbridge rail rates have been relatively stable in recent years
- The North American rail network as a whole has reserve capacity in major corridors to handle foreseeable growth in mini-landbridge traffic.
- Southern California may face near-term congestion and prioritization, but has some ability to increase long-term capacity
- Northern California, the Pacific Northwest, and Canada all have substantial reserve rail capacity
- The potential growth in intermodal MLB traffic should justify the continued investment in line-haul capacity, equipment, and terminals

Asian Import Value (\$/TEU)



Trade Allocation Summary by Service Pattern (TEUs, one way)

Economic Scenario	Service Pattern	2001		2025					
				No Change		Mod Change		Rad Change	
		TEUs	Share	TEUs	Share	TEUs	Share	TEUs	Share
Base	AllWater	55,203	3.0%	0	0.0%	0	0.0%	0	0.0%
	AllWaterX	438,984	23.7%	1,117,548	19.4%	2,525,204	35.6%	3,689,649	45.0%
	PanamaP	783,096	42.3%	2,825,723	49.0%	2,936,954	41.4%	3,059,272	37.3%
	WCSA-USEC	147,296	8.0%	589,259	10.2%	393,270	5.5%	197,281	2.4%
	NC/ECSA-USWC	43,326	2.3%	267,626	4.6%	133,813	1.9%	0	0.0%
	WCSA-Eur	129,787	7.0%	242,177	4.2%	161,882	2.3%	81,587	1.0%
	ECSA-Asia	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	USEC-Oceania	107,324	5.8%	405,305	7.0%	329,310	4.6%	253,316	3.1%
	Reg Feeder	146,896	7.9%	319,427	5.5%	617,692	8.7%	915,956	11.2%
Base Total		1,851,913	100.0%	5,767,065	100.0%	7,098,125	100.0%	8,197,062	100.0%
Worst	AllWater	55,203	3.0%	0	0.0%	0	0.0%	0	0.0%
	AllWaterX	438,984	23.7%	943,151	19.4%	2,129,076	35.6%	3,112,459	45.0%
	PanamaP	783,096	42.3%	2,334,508	48.1%	2,432,854	40.7%	2,540,282	36.8%
	WCSA-USEC	147,296	8.0%	492,621	10.1%	328,845	5.5%	165,069	2.4%
	NC/ECSA-USWC	43,326	2.3%	237,708	4.9%	118,854	2.0%	0	0.0%
	WCSA-Eur	129,787	7.0%	214,983	4.4%	143,753	2.4%	72,523	1.0%
	ECSA-Asia	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	USEC-Oceania	107,324	5.8%	345,838	7.1%	280,993	4.7%	216,148	3.1%
	Reg Feeder	146,896	7.9%	289,156	6.0%	546,407	9.1%	803,658	11.6%
Worst Total		1,851,913	100.0%	4,857,964	100.0%	5,980,782	100.0%	6,910,139	100.0%
Best	AllWater	55,203	3.0%	0	0.0%	0	0.0%	0	0.0%
	AllWaterX	438,984	23.7%	1,635,839	20.1%	3,696,022	36.8%	5,399,777	46.5%
	PanamaP	783,096	42.3%	3,873,857	47.7%	4,023,819	40.1%	4,189,924	36.1%
	WCSA-USEC	147,296	8.0%	988,095	12.2%	659,314	6.6%	330,533	2.8%
	NC/ECSA-USWC	43,326	2.3%	373,087	4.6%	186,544	1.9%	0	0.0%
	WCSA-Eur	129,787	7.0%	305,009	3.8%	203,923	2.0%	102,838	0.9%
	ECSA-Asia	0	0.0%	0	0.0%	0	0.0%	0	0.0%
	USEC-Oceania	107,324	5.8%	530,368	6.5%	430,924	4.3%	331,480	2.9%
	Reg Feeder	146,896	7.9%	413,342	5.1%	839,830	8.4%	1,266,319	10.9%
Best Total		1,851,913	100.0%	8,119,597	100.0%	10,040,377	100.0%	11,620,871	100.0%

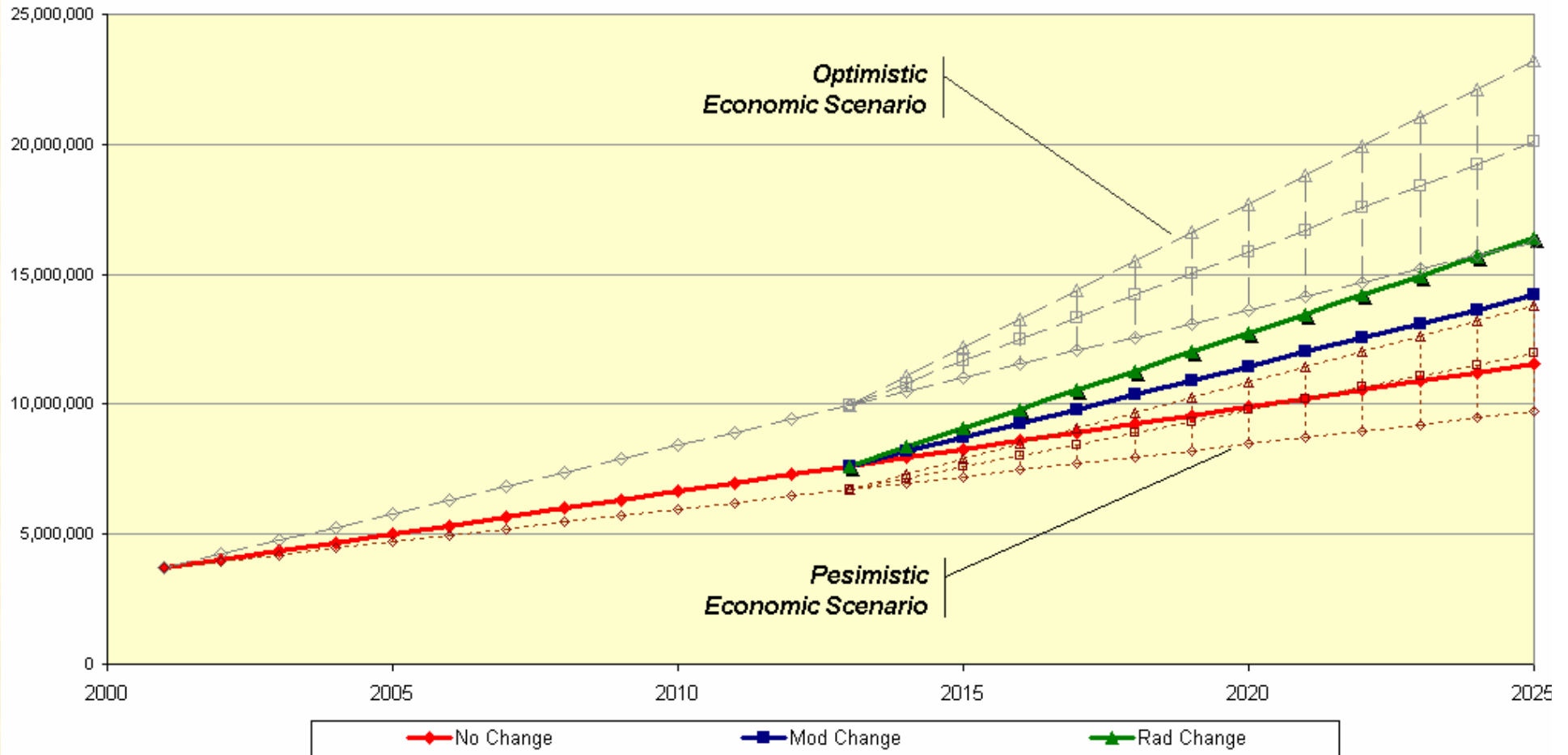
Economic Forecasts

TradeDest	TradeOrig	2001	2025					
		Base	Base			Worst		Best
USA	NE Asia	5,932,441	20,442,533	5.3%	16,744,031	4.4%	29,765,726	7.0%
	Europe	2,266,124	6,924,118	4.8%	5,738,341	3.9%	9,186,843	6.0%
	SE Asia	1,085,644	3,294,107	4.7%	3,229,299	4.6%	5,162,418	6.7%
	WCSA	243,541	1,052,413	6.3%	878,289	5.5%	1,767,722	8.6%
USA Imports	>>>	9,527,749	31,713,171	5.1%	26,589,959	4.4%	45,882,708	6.8%
NC/ECSA	USA	412,632	2,058,660	6.9%	1,828,523	6.4%	2,869,900	8.4%
Oceania	USA	169,817	684,637	6.0%	584,185	5.3%	895,892	7.2%
USA EXPORTS	>>>	582,449	2,743,297	6.7%	2,412,708	6.1%	3,765,793	8.1%
ECSA	NE Asia	144,131	583,802	6.0%	485,918	5.2%	770,586	7.2%
WCSA	Asia	171,159	364,397	3.2%	351,702	3.0%	388,621	3.5%
	Europe	169,052	316,011	2.6%	279,750	2.1%	397,333	3.6%
	NC/ECSA	93,507	150,975	2.0%	147,468	1.9%	171,672	2.6%
NCSA	Asia	41,611	78,667	2.7%	71,779	2.3%	84,012	3.0%
Carib	WCSA	5,997	10,339	2.3%	10,341	2.3%	14,018	3.6%

Containerized Trade		Annual Average Growth			
Total Trade	Scenario	2001-05	2005-2010	2010-25	2000-25
US-ASIA	Most Probable	5.1%	5.6%	5.3%	5.2%
US-ASIA	Best	5.7%	6.5%	6.4%	6.1%
US-ASIA	Worst	3.8%	4.5%	4.3%	4.1%
US-CHINA	Most Probable	7.4%	7.6%	6.9%	7.0%
US-CHINA	Best	8.0%	8.7%	8.0%	8.0%
US-CHINA	Worst	6.1%	6.6%	5.9%	6.0%
US-HONG KONG	Most Probable	5.4%	5.6%	4.8%	4.9%
US-HONG KONG	Best	5.9%	6.4%	5.8%	5.7%
US-HONG KONG	Worst	3.9%	4.2%	3.5%	3.6%
US-JAPAN	Most Probable	3.7%	4.1%	3.7%	3.7%
US-JAPAN	Best	4.2%	5.0%	4.7%	4.6%
US-JAPAN	Worst	2.4%	3.0%	2.6%	2.6%

Source: DRI-WEFA

Containerized Cargo Forecast by Economic and Operational Scenarios (TEUs)



Diversion Criterion

- Inventory Cost:
 - Carrying Cost – Capital, Storage, Maintenance
 - Opportunity Cost – Lost Sales, Delayed Sale at Lower Price
- Service Premium:
 - Freight Rates Differential
 - Transit Time Differential
- Diversion:
 - Premium > Inventory Cost

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Qualitative Factors

- Large Retailers (WalMart, Home Depot):
 - Import Center – Regional Distribution Center – Stores
 - Already AW
- Large Importer (Sony, Mattel, Nike):
 - National Distribution Center at WC/MW
 - Mostly IM
- Diversion IM to AW:
 - Growth of Large Retailer At Expense of Large Importers and Small Retailers (+)
 - Time Event Products (-)
 - Cargo Value Decrease (+)
 - JIT Increase (-)

Present US Distribution

