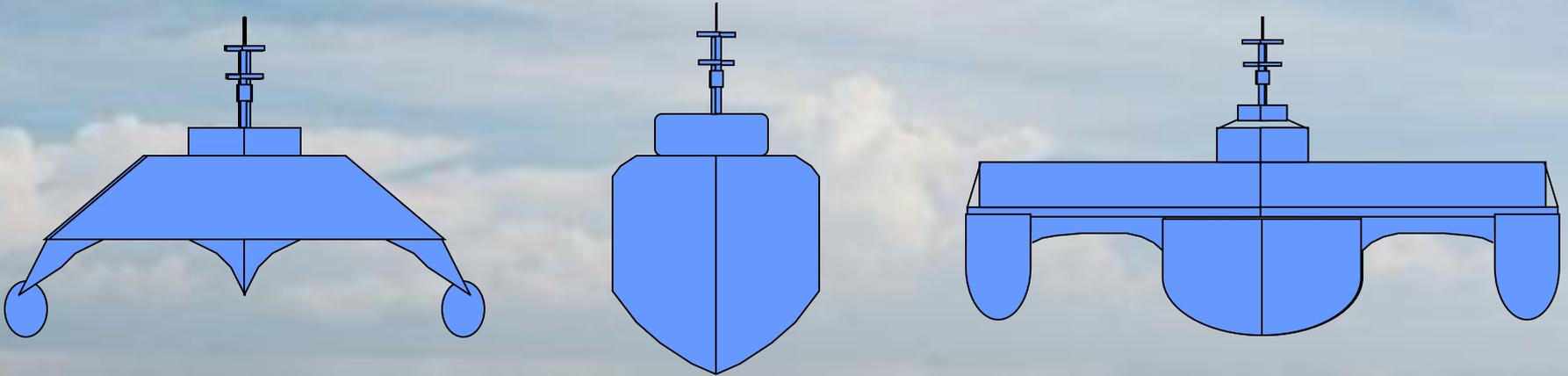


SPAR's Estimating Cost Models



April 2017



PERCEPTION ESTI-MATE is a powerful database-oriented estimating system within which the user can store a wide range of cost data (cost estimating relationships, or CERs) to generate estimates at any level of detail.

Typically, these CERs reflect the user's own cost experience and the way it does business.

Options are available to purchase a comprehensive set of generic CERs for either new construction or ship repair or both.



The SPAR Cost Models are pre-developed cost models of specific hull forms and are organized with generic CERs already installed and ready to use. These cost models can be run outside ESTI-MATE or fully integrated within ESTI-MATE.



The *SPAR* Cost Models are used to estimate concept and preliminary ship designs.

The cost models permit quick assessments of costs, risk, and design/mission trade-off and build strategy alternatives.



The models provide a range of structural and powering selections to predict costs and various performance characteristics.



Separate models are available for different hull types (Mono-Hulls, Catamarans and Trimarans).

Special variant mono-hull cost models include:

- *Tankers & Product Carriers*
- *Ro/PAX/Container Carrier Ships*
- *Patrol Boats, Cutters & Frigates*
- *Research & Hydrographic Vessels*
- *Replacement Fore Bodies: Tankers & Bulk Carriers*
- *Ice Breaking Ships*



The cost models substitute default ship design parameters developed from statistical data analyses until actual design data can be determined.

In this way, the cost estimate can follow the design evolution and can produce quickly cost changes due to design trade off alternatives.



Costs are generated at relatively low levels of detail and summed according to an abbreviated Ships Work Breakdown Structure (SWBS).

Reports are available in various levels of detail, both tabular and graphical.



Cost Item Value Report by SWBS Groups(CI14)

Detail Cost Estimate Reports

Cost Item	Description	Labor Hours	Labor Cost	Material Cost	SubCon Cost	Equipment Cost	Direct Cost	Taxes	Indirect Cost	Total Cost	Profit	Total Price
Project BASE Baseline JHSV Wave Piercing Catamaran												
Group 4 - Electronics & Navigation												
Center SY - Shipyard Production Departments												
75	Electronic Navigation Aides (Lights and	0	0	18,357	0	0	18,357	0	0	18,357	1,836	20,192
76	Electronics Installation Labor Hours	4,000	85,920	0	0	0	85,920	0	128,880	214,800	21,480	236,280
77	Degaussing System	0	0	10,609	0	0	10,609	0	0	10,609	1,061	11,670
Group: 4 Totals		4,000	85,920	1,325,649	0	0	1,411,569	0	128,880	1,540,449	154,045	1,694,494
Group 5 - Auxiliary Systems												
Center SY - Shipyard Production Departments												
78	General Ship Ventilation	3,199	68,716	106,781	0	0	175,498	0	103,074	278,572	27,857	306,429
81	Ceiling Mounted Heat Pumps for Pass	10,259	220,367	542,171	0	0	762,538	0	330,550	1,093,088	109,309	1,202,397
82	Engine Room Ventilation	1,864	40,039	651,636	0	0	691,674	0	60,058	751,733	75,173	826,906
83	Diesel Fuel System	373	8,008	33,276	0	0	41,284	0	12,012	53,295	5,330	58,625
84	Lube Oil System	186	4,004	16,176	0	0	20,180	0	6,006	26,185	2,619	28,804
85	Seawater System	215	4,625	9,984	0	0	14,609	0	6,937	21,546	2,155	23,701
86	Bilge System	3,934	84,501	544,037	0	0	628,538	0	126,751	755,289	75,529	830,818
87	Ballast System	3,427	73,622	43,671	0	0	117,293	0	110,432	227,725	22,773	250,498
88	Air Intake & Exhaust System	12,310	264,416	188,096	0	0	452,512	0	396,624	849,136	84,914	934,049
89	Pipe Hangers	3,983	85,558	182,143	0	0	267,701	0	128,337	396,038	39,604	435,642
90	Pumps	492	10,563	117,355	0	0	127,917	0	15,844	143,761	14,376	158,137
91	Engine Room Pumps - CUNO	569	12,224	94,586	0	0	106,810	0	18,336	125,146	12,515	137,660
92	Fire Main - Machinery Space by volum	212	4,555	7,620	0	0	12,175	0	6,833	19,008	1,901	20,909
93	Fire Main - Deck House by volume (Inc	42	899	1,504	0	0	2,404	0	1,349	3,753	375	4,128
94	Fire Main - Deck Area Weather & Belo	3,245	69,700	116,581	0	0	186,281	0	104,550	290,831	29,083	319,914
95	Fire Suppression CO2 System with Pi	711	15,270	74,104	0	0	89,374	0	22,906	112,280	11,228	123,508
96	Fire Suppression Foam System with P	444	9,534	44,189	0	0	53,723	0	14,301	68,024	6,802	74,826
97	Distiller (drinking water) Equipment	161	3,462	122,803	0	0	126,264	0	5,192	131,456	13,146	144,602
103	Fresh Water, Plumbing & Sewerage pi	13,505	290,093	439,365	0	0	729,458	0	435,140	1,164,598	116,460	1,281,058
104	Sewage Treatment System	258	5,536	49,860	0	0	55,397	0	8,305	63,701	6,370	70,072
105	Garbage Disposal System	258	5,536	8,432	0	0	13,968	0	8,305	22,273	2,227	24,500
109	Winches & Warping Gear	508	10,919	57,536	0	0	68,454	0	16,378	84,832	8,483	93,316
110	Anchor Gear	101	2,176	40,640	0	0	42,815	0	3,264	46,079	4,608	50,687
111	Auxiliary Machinery	160	3,442	59,819	0	0	63,261	0	5,163	68,424	6,842	75,266
112	Tools & Instruments	925	19,859	75,848	0	0	95,707	0	29,789	125,496	12,550	138,046

Company Confidential Information

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(Date format: MM/DD/YYYY)

SPAR Associates, Inc.
SWBS Group Summary Report (SUM02)

Page 1 of 1

Project Range: 0 to ZZZZZZZZ Group Range: 0 to ZZZZZZZZ

Group	Description	Labor Hours	Labor Cost	Material Cost	SubCon Cost	Equipment Cost	Direct Cost	Taxes	Indirect Cost	Total Cost	Profit	Total Price
1	Hull	605,107	12,997,709	7,476,490	0	0	20,474,199	0	19,496,563	39,970,762	3,997,076	43,967,839
2	Propulsion	54,000	1,159,920	22,760,525	0	0	23,920,445	0	1,739,880	25,660,325	2,566,032	28,226,357
3	Electrical	5,623	120,779	1,262,610	0	0	1,383,389	0	181,169	1,564,558	156,456	1,721,013
4	Electronics & Navigation	4,000	85,920	1,325,649	0	0	1,411,569	0	128,880	1,540,449	154,045	1,694,494
5	Auxiliary Systems	62,417	1,340,724	4,392,630	0	0	5,733,355	0	2,011,086	7,744,441	774,444	8,518,885
6	Outfit & Furnishings	50,747	1,090,038	3,395,619	0	0	4,485,657	0	1,635,057	6,120,714	612,071	6,732,785
7	Armament								0	0	0	0
8	Technical Support								3,999,876	6,696,251	669,625	7,665,876
9	Shipyards Services	117,307	2,519,763	1,102,067	0	0	3,621,829	0	3,779,644	7,401,473	740,147	8,141,620
10	Fees & Insurance	0	0	16,177,063	0	0	16,177,063	0	0	16,177,063	1,617,706	17,794,769
	Construction Totals	977,470	21,981,437	57,922,443	0	0	79,903,880	0	32,972,156	112,876,036	11,287,604	124,163,639
21	Preliminary Design	1,136	161,335	0	0	0	161,335	0	0	161,335	16,133	177,468
22	Functional Design	20,457	2,026,305	0	0	0	2,026,305	0	0	2,026,305	202,631	2,228,935
23	Transition & Detail Design	109,102	10,531,594	0	0	0	10,531,594	0	0	10,531,594	1,053,159	11,584,753
24	Production Planning & Scheduling	34,094	3,291,124	0	0	0	3,291,124	0	0	3,291,124	329,112	3,620,236
25	Purchase Specs & Support	4,546	438,817	0	0	0	438,817	0	0	438,817	43,882	482,698
26	ILS	2,273	219,408	0	0	0	219,408	0	0	219,408	21,941	241,349
29	Contract Engineering Management	23,866	2,417,163	2,967,607	0	0	5,384,770	0	0	5,384,770	538,477	5,923,247
	Non-Recurring Totals	195,474	19,085,745	2,967,607	0	0	22,053,351	0	0	22,053,351	2,205,335	24,258,686
	Non-Recurring & Construction Totals	1,172,944	41,067,182	60,890,049	0	0	101,957,231	0	32,972,156	134,929,387	13,492,939	148,422,326

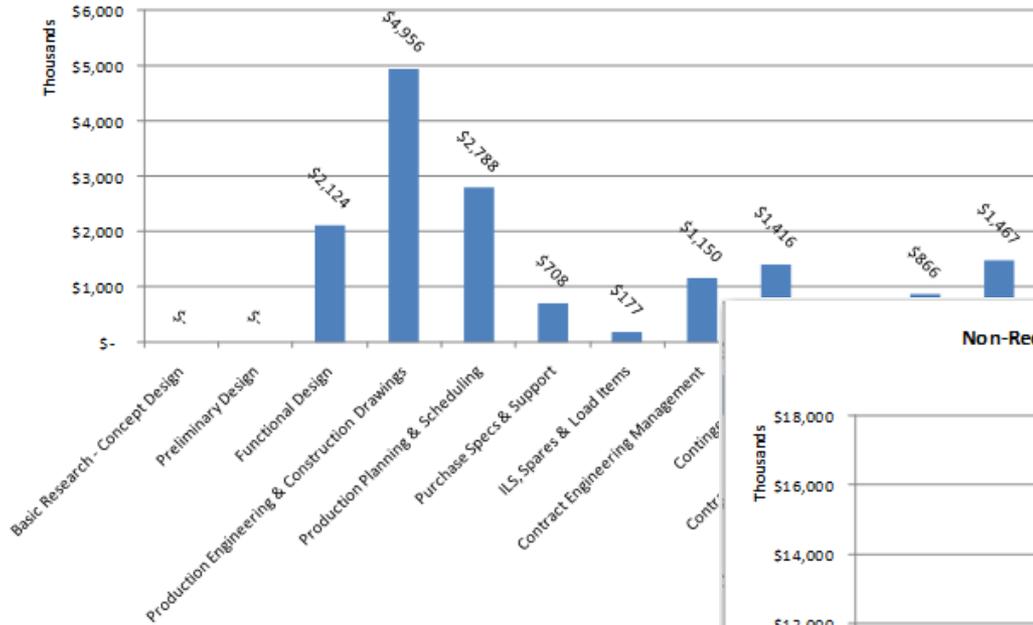
Summary Cost Estimate Reports



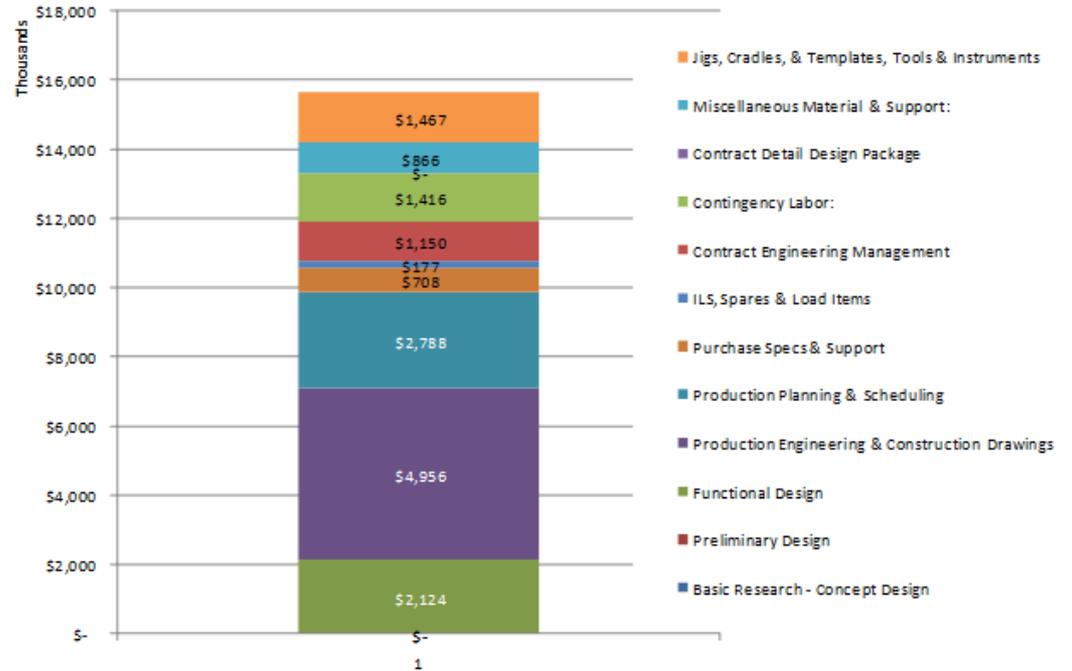
**The models estimate both
recurring and non-
recurring costs**



Non-Recurring Costs (Does Not Include Overall Management Fee, If Applicable)
2012US\$

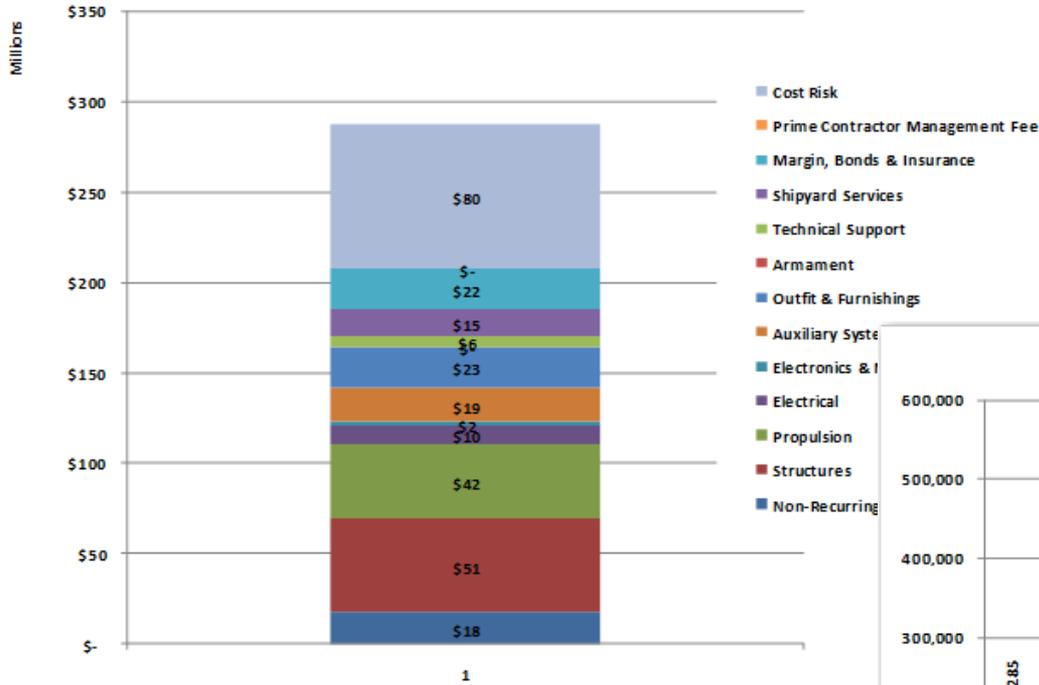


Non-Recurring Costs (Does Not Include Overall Management Fee, If Applicable) 2012US\$

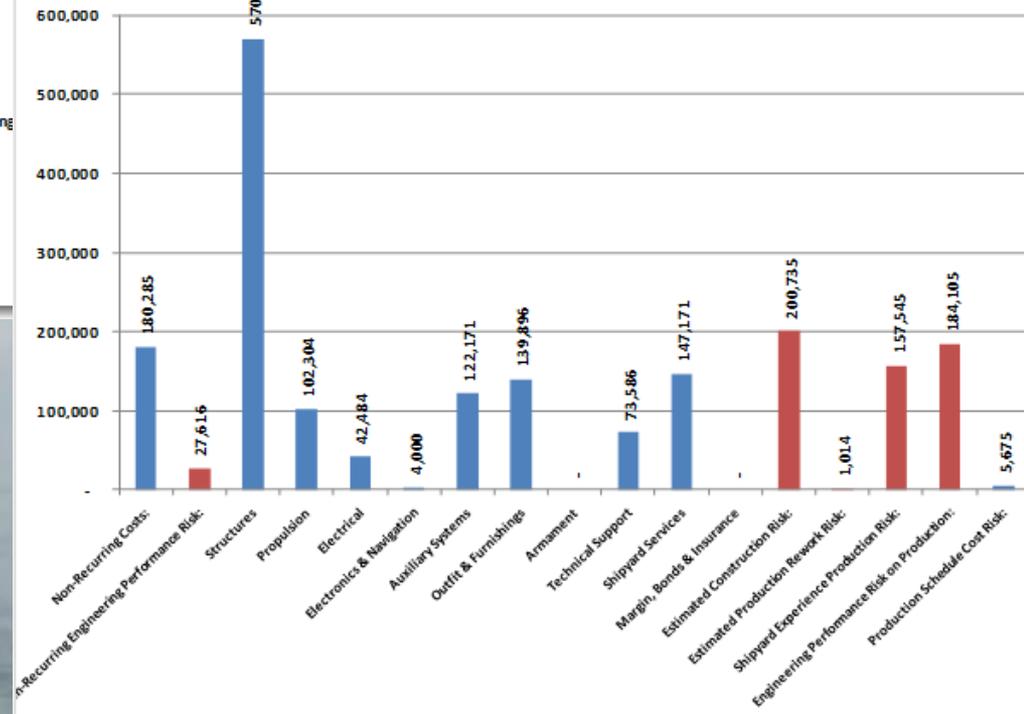


Non-Recurring Cost Estimate

Price Breakdown - Lead Ship 2012US\$

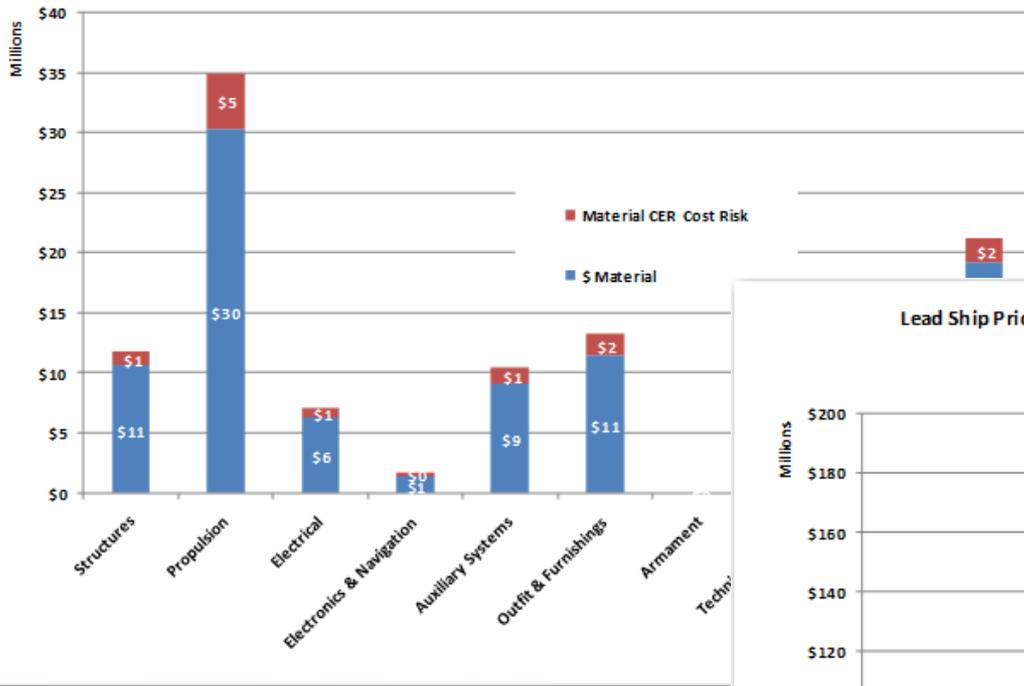


Lead Ship Labor Hours

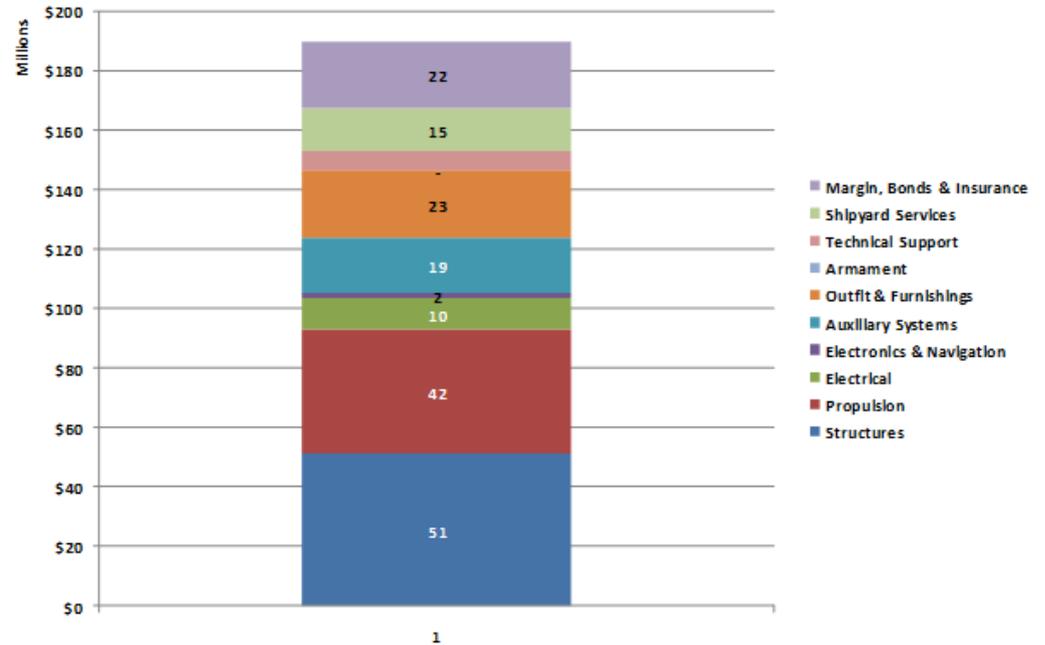


Lead Ship Cost Estimate

Material Cost - Lead Ship 2012US\$



Lead Ship Price Breakdown - Not Including Non-Recurring 2012US\$



Lead Ship Material Cost Estimate

Summary Non-Recurring & Lead Ship Cost Estimate

Mono Hull RO/CON/PAX Cost Model (Model Version March 2009)										NON-RECURRING COSTS																																																																																																																																																																																																																																																																																																	
% Margin	-	%	Ship Type:	HEC RORO-CONTAINER CARRIER - Large US Yard	Version:	A	SPAR ASSOCIATES, INC.			Basic Research - Concept Design	\$	-																																																																																																																																																																																																																																																																																															
% Mark-Up	-	%	Date:	18-Nov-10						Preliminary Design	\$	-																																																																																																																																																																																																																																																																																															
% Change Orders	2.60	%										Functional Design	\$	2,123,904																																																																																																																																																																																																																																																																																													
% Program Costs	-	%										Production Engineering & Constr	\$	4,966,776																																																																																																																																																																																																																																																																																													
% Design Contingencies	6.00	%										Production Planning & Scheduling	\$	2,757,923																																																																																																																																																																																																																																																																																													
Pricing:										Procure Specs & Support	\$	707,968																																																																																																																																																																																																																																																																																															
Shipbuilder Economic Mark-Up/Down:	0.0%											IL & Spares & Load Items	\$	178,992																																																																																																																																																																																																																																																																																													
Technical Wage \$/M hr:	\$ 32.83	\$ 73.88	w/overhead	Non-Recurring Engineering & Production Planning					Contract Engineering Management	\$	1,160,448																																																																																																																																																																																																																																																																																																
Production Wage \$/M hr:	\$ 27.36	\$ 61.68	w/overhead	Standard Work Week:	40.00	hours/week						Contingency Labor:	\$	1,416,938																																																																																																																																																																																																																																																																																													
% Overhead:	126.00	%	120%	Labor Rates:							Contract Detail Design Package	\$	-																																																																																																																																																																																																																																																																																														
% G&A Labor:	-	%	120%	Senior Professional/Manager		\$ 73.83	per hour						Miscellaneous Material & Support	\$	88,644																																																																																																																																																																																																																																																																																												
% G&A Material:	2.00	%	120%	Engineer		\$ 73.83	per hour						Jigs, Cradles, & Templates, Tools	\$	1,488,892																																																																																																																																																																																																																																																																																												
% Profit:	12.00	%	120%	Designer/Draftsperson/Planner		\$ 73.83	per hour						TOTAL NON-RECURRING COST \$:	\$	16,851,481																																																																																																																																																																																																																																																																																												
			120%	Clerical		\$ 73.83	per hour						Profit not include																																																																																																																																																																																																																																																																																														
			120%	Contingency (weighted average)		\$ 73.83	per hour																																																																																																																																																																																																																																																																																																				
Navy C4ISR	No																																																																																																																																																																																																																																																																																																										
Jones Act Premium Material Factor:	Yes	1.16	Shipyard		Fab/Assy Modules																																																																																																																																																																																																																																																																																																						
Current Year:	2012	Shipyard Tech Support Labor Factor:		1.0000	No Ext. Modules		Estimated Schedules																																																																																																																																																																																																																																																																																																				
Additional Material Escalation:	1.00	1.000 = none	Steel Productivity Factor:	1.0000	1.0000	Est. Detail Engineering Time:		12.00	Months																																																																																																																																																																																																																																																																																																		
Shipyard Material Cost Factor:	1.00	MIL SPEC Prem. =1.21	Outfit Productivity Factor:	1.0000	1.0000	Est. Construction Time:		18.00	Months																																																																																																																																																																																																																																																																																																		
Combined Material Cost Factor:	1.00	On-Block Paint Factor:		0.9600	40% Hours On Block		Overlap:	3.00	Months	18.7%																																																																																																																																																																																																																																																																																																	
										RM \$ Men/Month:	246	0.08	Months	0.6%																																																																																																																																																																																																																																																																																													
<table border="1"> <thead> <tr> <th>SWBS Group</th><th>Weight M Tons</th><th>M-Hrs Per Mton</th><th>Modular M-Hrs</th><th>Production M-Hrs</th><th>\$ Labor</th><th>\$ Overhead</th><th>\$ G&A Labor Only</th><th>2012 \$ Material</th><th>\$ G&A Material Only</th><th>\$ Profit Labor + Material</th><th>Total</th><th>Cum. Total</th></tr> </thead> <tbody> <tr><td>Structures</td><td>1</td><td>11,145.1</td><td>51.16</td><td>-</td><td>570,206</td><td>16,603,304</td><td>19,504,766</td><td>-</td><td>10,669,162</td><td>213,103</td><td>5,517,709</td><td>51,498,614</td></tr> <tr><td>Propulsion</td><td>2</td><td>662.0</td><td>102.04</td><td>-</td><td>102,304</td><td>2,799,109</td><td>3,498,901</td><td>-</td><td>30,299,906</td><td>606,935</td><td>4,464,117</td><td>41,665,090</td></tr> <tr><td>Electrical</td><td>3</td><td>1,444.0</td><td>29.42</td><td>-</td><td>42,454</td><td>1,153,411</td><td>1,463,014</td><td>-</td><td>6,347,156</td><td>126,944</td><td>1,090,747</td><td>10,180,301</td></tr> <tr><td>Electronics & Navigation</td><td>4</td><td>12.7</td><td>316.21</td><td>-</td><td>4,000</td><td>109,448</td><td>136,507</td><td>-</td><td>1,407,061</td><td>25,141</td><td>201,775</td><td>1,883,229</td></tr> <tr><td>Auxiliary Systems</td><td>6</td><td>468.0</td><td>261.06</td><td>-</td><td>122,171</td><td>3,342,766</td><td>4,176,467</td><td>-</td><td>9,099,004</td><td>181,950</td><td>2,016,265</td><td>18,813,470</td></tr> <tr><td>Outfit & Furnishings</td><td>6</td><td>742.0</td><td>188.64</td><td>-</td><td>139,596</td><td>3,027,746</td><td>4,754,653</td><td>-</td><td>11,466,214</td><td>229,324</td><td>2,436,956</td><td>22,744,923</td></tr> <tr><td>Armament</td><td>7</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr> <tr><td>Technical Support</td><td>8</td><td>7.6%</td><td>6.12</td><td>-</td><td>73,656</td><td>2,416,051</td><td>3,020,101</td><td>-</td><td>26,000</td><td>600</td><td>655,402</td><td>6,117,083</td></tr> <tr><td>Shipyard Services</td><td>9</td><td>16.0%</td><td>10.24</td><td>-</td><td>147,171</td><td>4,026,001</td><td>6,033,602</td><td>-</td><td>4,162,616</td><td>83,660</td><td>1,599,176</td><td>14,925,645</td></tr> <tr><td>Margin, Bonds & Insurance</td><td>10</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>19,226,766</td><td>354,636</td><td>2,353,356</td><td>21,964,645</td></tr> <tr><td>Lead Ship Total:</td><td>14,375</td><td>83.61</td><td>-</td><td>1,201,898</td><td>\$ 33,288,223</td><td>\$ 41,610,279</td><td>\$ -</td><td>\$ 92,709,802</td><td>\$ 1,854,196</td><td>20,336,600</td><td>\$ 189,798,000</td><td>\$ 189,798,000</td></tr> <tr><td>Non-Recurring Costs:</td><td>% Total Lead Ship G 1-7 Man-Hours:</td><td>16%</td><td>180,285</td><td>\$ 13,318,645</td><td>\$ -</td><td>\$ -</td><td>\$ -</td><td>\$ 2,332,836</td><td>\$ -</td><td>1,878,178</td><td>\$ 17,628,869</td><td>\$ 207,327,659</td></tr> <tr><td colspan="10"></td><td colspan="3">Estimated Cost for Prime Contractor Management Team: \$ -</td></tr> <tr><td colspan="10"></td><td colspan="3">Over-All Program Management Fee: 0.0% \$ -</td></tr> <tr><td colspan="10"></td><td colspan="3">Total Price with Prime Contractor Management: \$ 207,327,659</td></tr> <tr><td colspan="10"></td><td colspan="3">Est. Construction/Technology Risk: \$ 22,419,676 w/o Profit</td></tr> <tr><td colspan="10"></td><td colspan="3">Estimated Overlap Rework Risk: \$ 160,092 w/o Profit</td></tr> <tr><td colspan="10"></td><td colspan="3">Est. Shipyard Experience Risk: \$ 24,872,764 w/o Profit</td></tr> <tr><td colspan="10"></td><td colspan="3">Engineering Performance Risk: \$ 31,763,173 w/o Profit</td></tr> <tr><td colspan="10"></td><td colspan="3">Production Schedule Cost Risk: \$ 898,184 w/o Profit</td></tr> <tr><td colspan="10"></td><td colspan="3">Total Price with 100% Risk: \$ 287,440,538 w/o Profit</td></tr> </tbody> </table>														SWBS Group	Weight M Tons	M-Hrs Per Mton	Modular M-Hrs	Production M-Hrs	\$ Labor	\$ Overhead	\$ G&A Labor Only	2012 \$ Material	\$ G&A Material Only	\$ Profit Labor + Material	Total	Cum. Total	Structures	1	11,145.1	51.16	-	570,206	16,603,304	19,504,766	-	10,669,162	213,103	5,517,709	51,498,614	Propulsion	2	662.0	102.04	-	102,304	2,799,109	3,498,901	-	30,299,906	606,935	4,464,117	41,665,090	Electrical	3	1,444.0	29.42	-	42,454	1,153,411	1,463,014	-	6,347,156	126,944	1,090,747	10,180,301	Electronics & Navigation	4	12.7	316.21	-	4,000	109,448	136,507	-	1,407,061	25,141	201,775	1,883,229	Auxiliary Systems	6	468.0	261.06	-	122,171	3,342,766	4,176,467	-	9,099,004	181,950	2,016,265	18,813,470	Outfit & Furnishings	6	742.0	188.64	-	139,596	3,027,746	4,754,653	-	11,466,214	229,324	2,436,956	22,744,923	Armament	7	-	-	-	-	-	-	-	-	-	-	-	Technical Support	8	7.6%	6.12	-	73,656	2,416,051	3,020,101	-	26,000	600	655,402	6,117,083	Shipyard Services	9	16.0%	10.24	-	147,171	4,026,001	6,033,602	-	4,162,616	83,660	1,599,176	14,925,645	Margin, Bonds & Insurance	10	-	-	-	-	-	-	-	19,226,766	354,636	2,353,356	21,964,645	Lead Ship Total:	14,375	83.61	-	1,201,898	\$ 33,288,223	\$ 41,610,279	\$ -	\$ 92,709,802	\$ 1,854,196	20,336,600	\$ 189,798,000	\$ 189,798,000	Non-Recurring Costs:	% Total Lead Ship G 1-7 Man-Hours:	16%	180,285	\$ 13,318,645	\$ -	\$ -	\$ -	\$ 2,332,836	\$ -	1,878,178	\$ 17,628,869	\$ 207,327,659											Estimated Cost for Prime Contractor Management Team: \$ -													Over-All Program Management Fee: 0.0% \$ -													Total Price with Prime Contractor Management: \$ 207,327,659													Est. Construction/Technology Risk: \$ 22,419,676 w/o Profit													Estimated Overlap Rework Risk: \$ 160,092 w/o Profit													Est. Shipyard Experience Risk: \$ 24,872,764 w/o Profit													Engineering Performance Risk: \$ 31,763,173 w/o Profit													Production Schedule Cost Risk: \$ 898,184 w/o Profit													Total Price with 100% Risk: \$ 287,440,538 w/o Profit		
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Propulsion	2	662.0	102.04	-	102,304	2,799,109	3,498,901	-	30,299,906	606,935	4,464,117	41,665,090																																																																																																																																																																																																																																																																																															
Electrical	3	1,444.0	29.42	-	42,454	1,153,411	1,463,014	-	6,347,156	126,944	1,090,747	10,180,301																																																																																																																																																																																																																																																																																															
Electronics & Navigation	4	12.7	316.21	-	4,000	109,448	136,507	-	1,407,061	25,141	201,775	1,883,229																																																																																																																																																																																																																																																																																															
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Outfit & Furnishings	6	742.0	188.64	-	139,596	3,027,746	4,754,653	-	11,466,214	229,324	2,436,956	22,744,923																																																																																																																																																																																																																																																																																															
Armament	7	-	-	-	-	-	-	-	-	-	-	-																																																																																																																																																																																																																																																																																															
Technical Support	8	7.6%	6.12	-	73,656	2,416,051	3,020,101	-	26,000	600	655,402	6,117,083																																																																																																																																																																																																																																																																																															
Shipyard Services	9	16.0%	10.24	-	147,171	4,026,001	6,033,602	-	4,162,616	83,660	1,599,176	14,925,645																																																																																																																																																																																																																																																																																															
Margin, Bonds & Insurance	10	-	-	-	-	-	-	-	19,226,766	354,636	2,353,356	21,964,645																																																																																																																																																																																																																																																																																															
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Production Hrs./L SW:	83.61	Production Costs (1-7):		\$ 146,790,627	77.3%	GR 1-10																																																																																																																																																																																																																																																																																																					

Instructions: Fill in light gray data fields indicated with red characters. The model will provide the remaining information. References in blue refer to additional information available on indicated worksheets.

Tanker & Product Carrier Cost Model

(Model Version March 2007)

Ship Type:

35,000 DWT Product Carrier

Version: A

Date: 25-May-07



Summary Non-Recurring Costs

NON-RECURRING COSTS

Basic Research - Concept Design	\$	-
Contract Design Validation	\$	39,071
Functional Design	\$	533,964
Production Engineering & Construction	\$	4,961,958
Production Planning & Scheduling	\$	384,601
Purchase Specs & Support	\$	97,676
ILS, Spares & Load Items	\$	48,838
Contract Engineering Management	\$	175,003
Contingency Labor	\$	233,054
Contract Detail Design Package	\$	-
Miscellaneous Material & Support:	\$	1,483,729
Jigs, Cradles, & Templates, Tools & I	\$	832,151
TOTAL NON-RECURRING COSTS:	\$	8,796,232

Pricing:

Technical Wage \$/Mhr: \$24.42 \$ 54.95 w/ overhead

Production Wage \$/Mhr: \$20.28 \$ 45.63 w/ overhead

% Overhead:

% G&A Labor:

% G&A Material:

% Profit:

% Contingency Margin

Rates & Escalation

Non-Recurring Engineering & Production Planning

Standard Work Week: 40.00 hours/week

Labor Rates:

Manager \$ 120.00 per hour

Production Planner \$ 75.00 per hour

Clerical \$ 50.00 per hour

Contingency (weighted average) \$ 89.47 per hour

Jones Act Premium Material Factor: No 1.00

Current Year: 2007

Additional Material Escalation: 1.0000 1.000 = none

Shipyards Material Cost Factor: 1.0000 MILSPEC Prem=1

Combined Material Cost Factor: 1.0000

Shipyards Tech Support Labor Factor: 1.0000 See Shipyards

Productivity Factors

Est. Det. Engineering Time: 4.0000 Months

Es. Construction Time: 8.0000 Months

Overlap: 2.0000 Months

566 Months 25.0% 0.0%

Estimated Schedules

	SWBS		M-Hrs	Labor	Production	\$			2007		\$		Cum.Total
	Group	Weight				Overhead	Labor Only	\$ G&A	\$ G&A	\$ Profit	Total	\$	
Structures	1	6,775	45.48	1.00	308,146	6,249,202	7,811,503	-	6,769,178	676,918	2,150,680	23,657,480	
Propulsion	2	389	26.31	1.00	10,228	207,433	259,291	-	5,587,300	558,730	661,275	7,274,029	
Electrical	3	189	105.23	1.00	19,921	403,999	504,998	-	2,812,174	281,217	400,239	4,402,627	
Electronics & Navigation	4	11	359.89	1.00	4,000	81,120	101,400	-	1,194,694	119,469	149,668	1,646,351	
Auxiliary Systems	5	762	236.75	1.00	180,316	3,656,812	-	-	-	-	-	430	
Outfit & Furnishings	6	834	82.30	1.00	68,629	1,391,799	-	-	-	-	-	483	
Armament	7	-	-	1.00	-	-	-	-	-	-	-	-	
Technical Support	8	-	4.95	7.5%	44,343	1,082,858	-	-	-	-	-	323	
Shipyards Services	9	-	9.90	15.0%	88,686	1,798,555	2,248,193	-	1,759,737	175,974	598,246	6,580,705	
Margin, Bonds & Insurance	10	-	-	-	-	-	-	-	10,139,580	1,013,958	1,115,354	12,268,892	
Lead Ship Totals:	8,960	80.83			724,270	\$ 14,871,778	\$ 18,589,722	\$ -	\$ 41,598,901	\$ 4,159,890	7,922,029	\$ 87,142,320	\$ 87,142,320
Non-Recurring Costs:													

SWBS Summary Costs

Technical Support:	4.13%	Production \$ Costs
Shipyards Services:	10.03%	Production \$ Costs
Fees & Insurance:	18.71%	Production \$ Costs
Non-Recurring Costs:	14.75%	Production \$ Costs

Estimated Cost for Prime Contractor Management Team:	\$	-
Over-All Program Management Fee:	0%	\$ -
Total Price with Prime Contractor Management:	\$	96,818,175

Summary Cost Risk

Estimated Construction Risk:	\$	6,924,314	w/o Profit
Estimated Rework Risk:	\$	964,930	w/o Profit
Est. Experience Rating (0-1):	0.80	\$ 11,633,942	w/o Profit
Engineering Performance (0-1):	0.75	\$ 17,474,560	w/o Profit
Production Schedule Cost Risk:	\$	2,142,676	w/o Profit

	Learning & Multi-Ship Savings		Construction Cost										Non-Recurring
	0.850	0.950											
Lead Ship	1	100.00%	0%	724,270	\$ 14,871,778	\$ 18,589,722	\$ -	\$ 41,598,901	\$ 4,159,890	\$ 7,922,029	\$ 87,142,320	\$ 9,675,855	
#2 Follow Ship:	2	85.00%	5%	615,630	\$ 12,641,011	\$ 15,801,264	\$ -	\$ 39,518,956	\$ 3,951,896	\$ 7,191,313	\$ 79,104,439	\$ -	
#3 Follow Ship:	3	77.29%	8%	559,799	\$ 11,494,618	\$ 14,368,272	\$ -	\$ 38,350,816	\$ 3,835,082	\$ 6,804,879	\$ 74,853,666	\$ -	
#4 Follow Ship:	4	72.25%	10%	523,285	\$ 10,744,859	\$ 13,431,074	\$ -	\$ 37,543,009	\$ 3,754,301	\$ 6,547,324	\$ 72,020,567	\$ -	
#5 Follow Ship:	5	68.57%	11%	496,611	\$ 10,197,148	\$ 12,746,434	\$ -	\$ 36,928,161	\$ 3,692,816	\$ 6,356,456	\$ 69,921,014	\$ -	
#6 Follow Ship:	6	65.70%	12%	475,829	\$ 9,770,425	\$ 12,213,031	\$ -	\$ 36,433,275	\$ 3,643,328	\$ 6,206,006	\$ 68,266,065	\$ -	
#7 Follow Ship:	7	63.37%	13%	458,938	\$ 9,423,598	\$ 11,779,498	\$ -	\$ 36,020,034	\$ 3,602,003	\$ 6,082,513	\$ 66,907,646	\$ -	

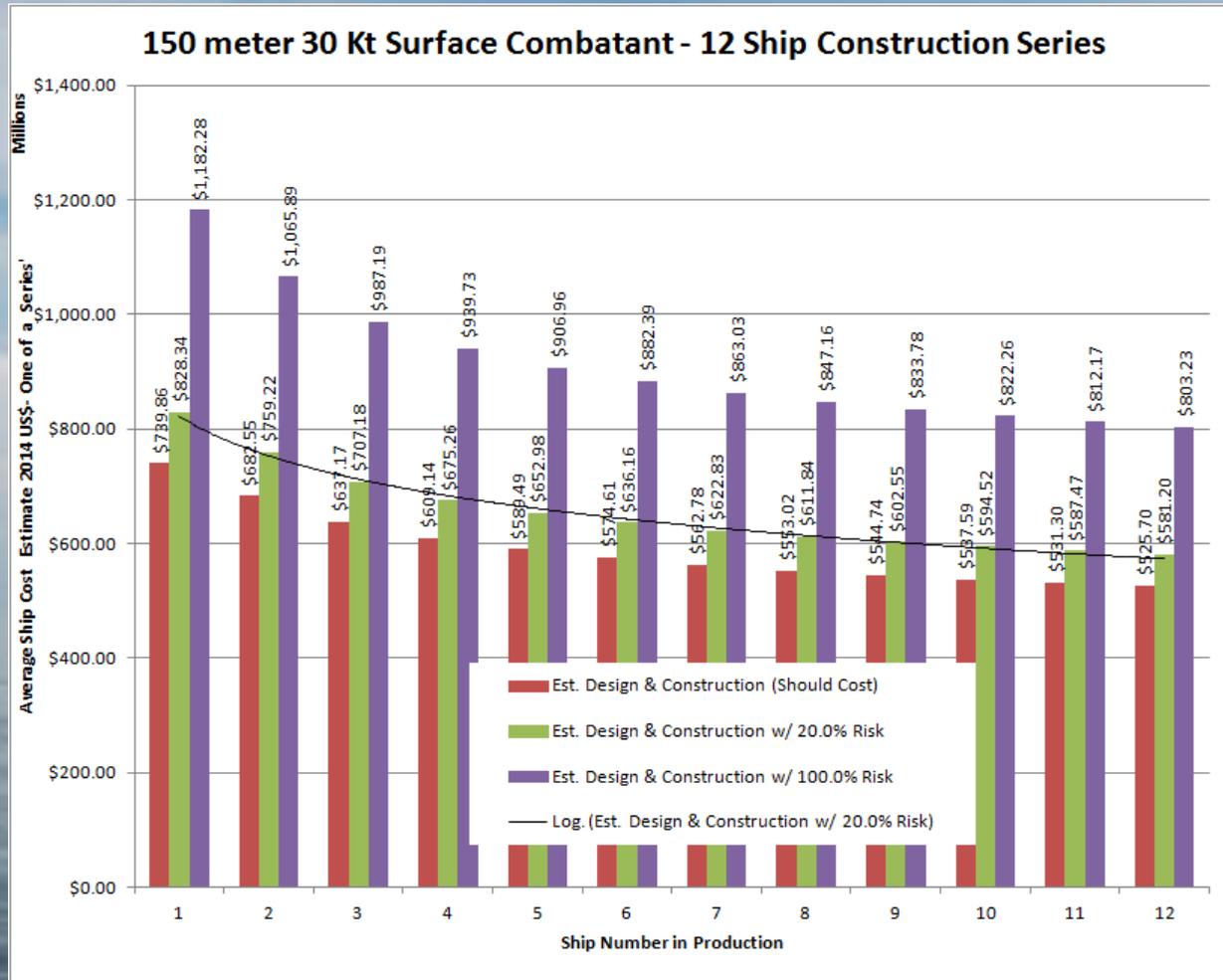
Estimated Multi-Ship Costs (Includes Learning & Allocated Non-Recurring Costs)



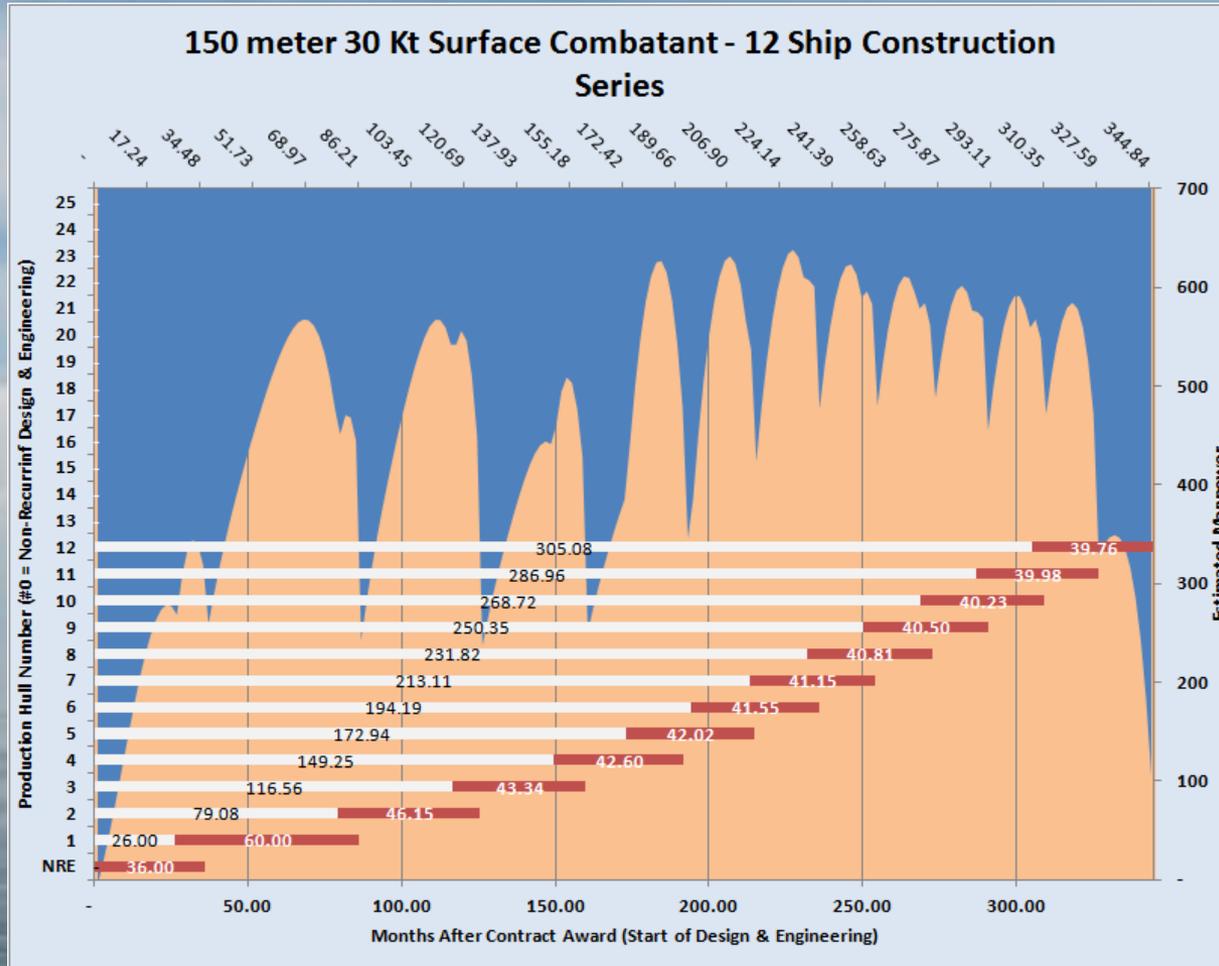
**The models generate average
ship costs for multiple-ship
construction programs.**



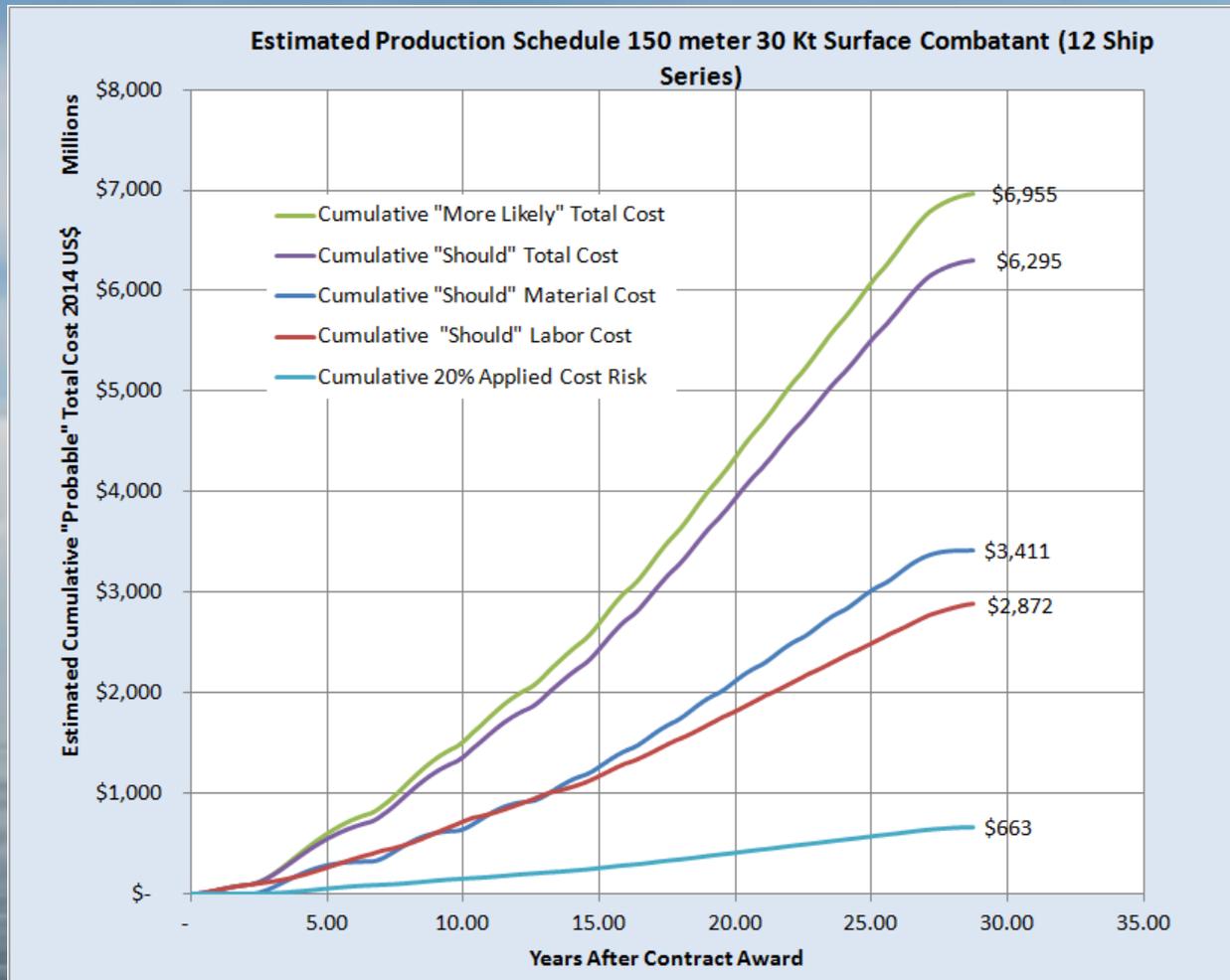
Estimating Costs for a Multi-Ship Construction Program with Learning Curves & Apportioned Non-Recurring Costs



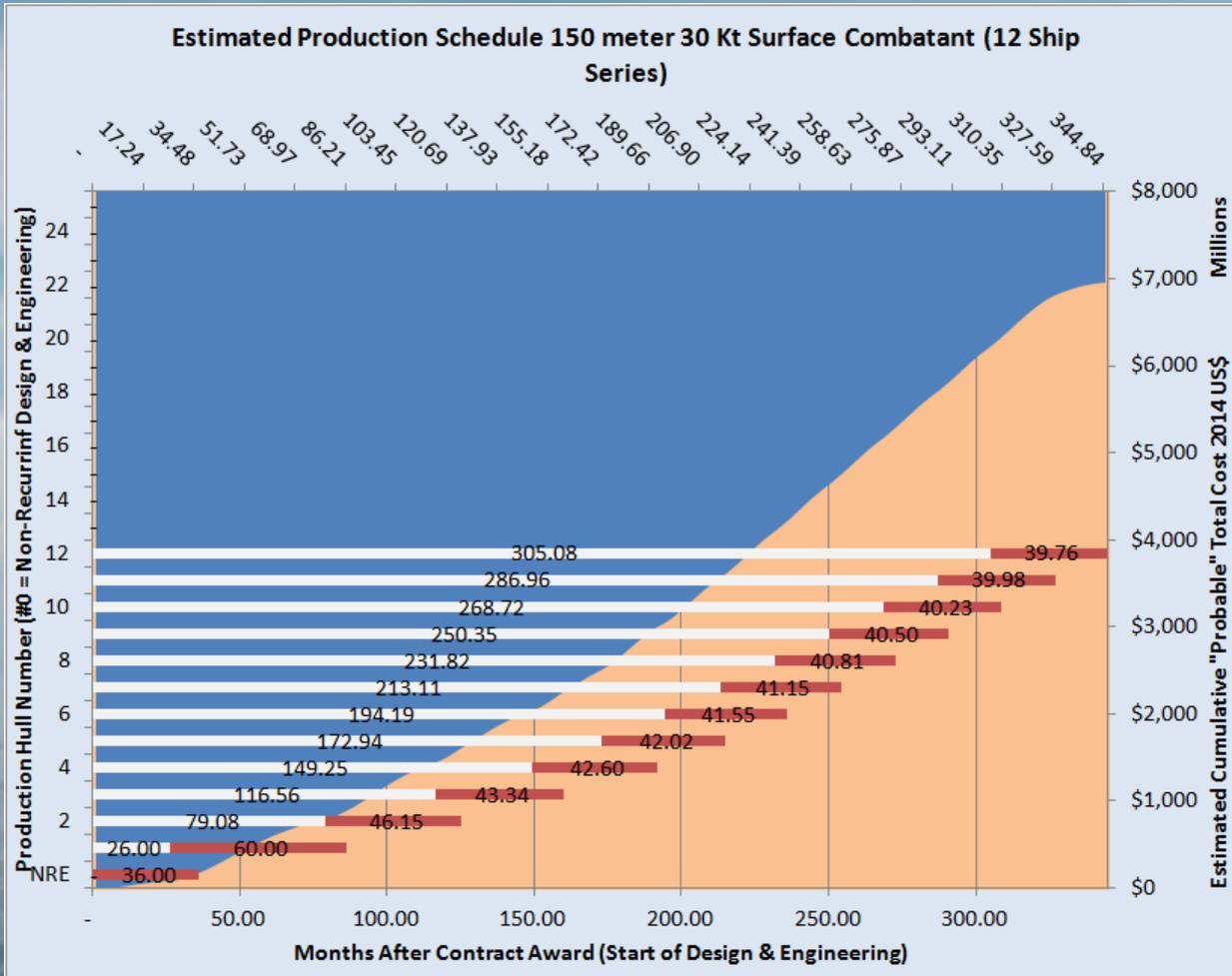
Estimating Multi-Ship Production Schedule & Manpower Requirements Quickly & Easily



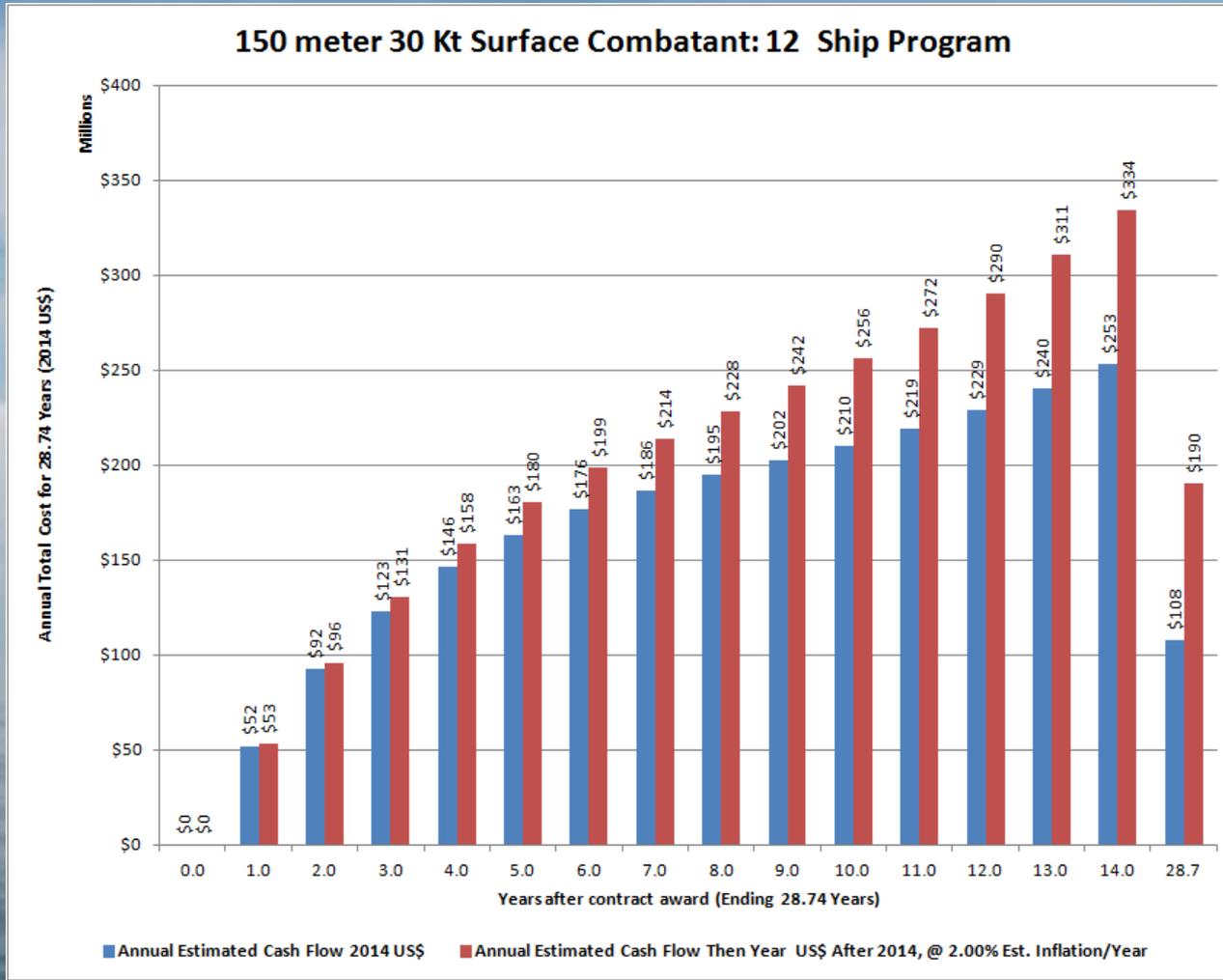
Estimating Multi-Ship Costs Quickly & Easily



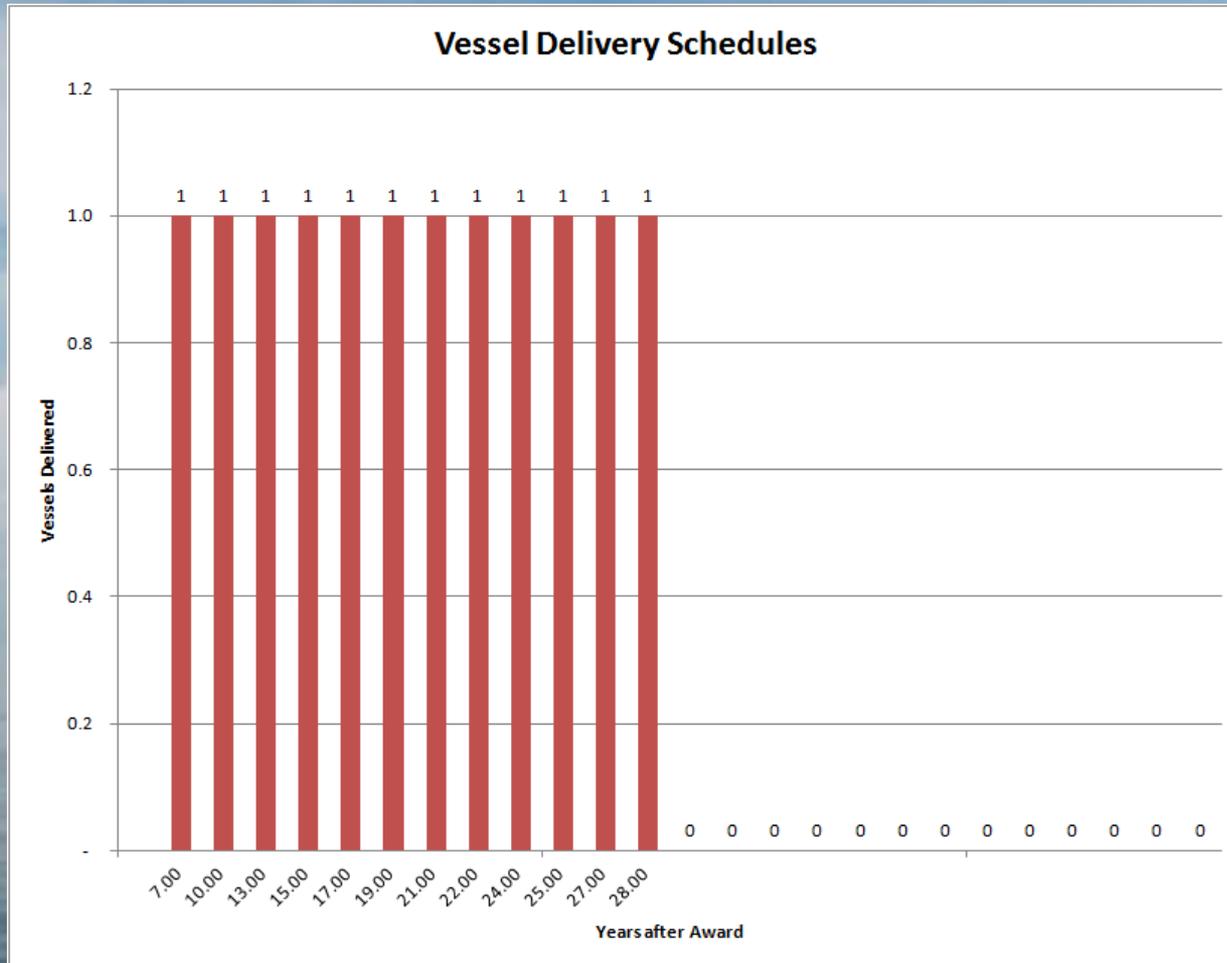
Estimating Multi-Ship Costs Quickly & Easily



Estimating Multi-Ship Annual Cash Flow Quickly & Easily



Estimating Multi-Ship Delivery Schedule Quickly & Easily



Defining Ship Characteristics

Basic design information (ship characteristics) is required as input into the model. This includes dimensional and structural data, powering specifications, and details of special equipment and functional areas of the ship.



The models also can generate some information not provided by the user from sets of default assumptions and functional relationships.

NOTE: Any default values used by the model should not be regarded as having been validated by any formal naval architectural or engineering review process.



Ship Characteristics Data Entry Worksheet

Tankers & Product Carriers				"Computed" purple fields indicate that if no entry has been provided, the model will use default values. WARNING: these default values are based only on statistical data, not on a properly engineered determination for the given ship design being estimated.				Model Default Values
35,000 DWT Product Carrier		Enter Ship Name		Metric Units	Computed			
Hull:								
LOA, Length Overall	165.00	M	165.00	94% LOA			155.88	M
LWL, Length Waterline	-	M	155.88	17% LOA			28.31	M
Beam, Molded	-	M	28.31	9% LOA	53% Beam		14.88	M
Depth, Molded	-	M	14.88	6% LOA			9.80	M
Draft, Design Full Load, Molded	-	M	9.80					
Cubic Number (LWL x Beam x Depth)	-	CUNO(M)	65,658					
SVI, Ship Volume Indicator (LWL x Beam x Draft)	-	CUM	43,247					
Cb, Block Coefficient	-	COEF	0.800				0.80	
SDI, Ship Displacement Indicator (Cb x SVI)	-	CUM	34,598					
Length of Machinery Space	-	M	19.30	Optional if volume of machinery space is given			19.30	M
Height of Machinery Space	-	M	14.88	Optional if volume of machinery space is given			14.88	M
Volume of Machinery Space	-	CUM	7,030				7,030	CUM
SuperStructure Deck Area	-	SGM	1,092				1,092	SGM
Volume of SuperStructure	-	CUM	3,081				3,081	CUM
Number Decks Below Weather Deck	-	-	-				-	
Total Areas of Cargo Decks OMS	-	SGM	-				-	SGM
Volume Cargo Decks OMS	-	CUM	-				-	CUM
Average Deck Heights	-	M	3.50				3.50	M
Max Beam Overall at Deck:	-	M	28.31	100% Beam				
Transport Factor=[DWT x Speed] HP/550 239.46 UJIR "Viability Large HS Displ Vessels"								
Displacement:								
Total Displacement at Full Load Draft	-	MTON	35,470				35,470.12	MTON
Total Displacement at Full Load Draft	-	CUM	34,598					
Light Ship Weight	-	MTON	8,778	24.7% Total FL Displ			8,129.86	MTON
Light Ship Weight	-	CUM	8,562					
Fuel & Load Items	-	MTON	(133)	-0.4% Total FL Displ			(133.21)	MTON
Fuel & Load Items	-	CUM	(130)					
Total Payload Displacement	-	MTON	26,626	76% Total FL Displ			26,090.00	MTON
Total Payload Displacement	-	CUM	26,166					
Displacements in balance within		0.00%						
CARGO CAPACITY								
Designed Deckspace per MTON Cargo	-	SOFTMTON	40.00	Default 40 SOFTMTON			40	SOFTMTON
Designed Deckspace per MTON Cargo	-	SGMMTON	3.72					
Required Cargo Deck Space	-	SGM	99,684	4269% Estimated Available			99,684	SGM
Number of TEUs	-	TEU	-				-	TEU
Number of Vehicles at Capacity	-	NO.	1,341				1,341.00	NO.
Average Weight per Vehicle	-	MTONEA	20.00				20.00	MTONEA
Average Deck Space per Vehicle	-	SGM	74					
Liquid Cargo Capacity	-	CUM	31,390				31,389.93	CUM
	-	BBL	211,901				211,901.14	BBL
ACCOMMODATIONS								
Accommodations Areas (Berthing, Sanitary, & Mess Areas)								
Ship's Crew Number (MSC)	-	CREW	20	200	SGM	10.00	SGMPERS	100.00%
Commissioned Officers	-	PAX	-	-	SGM	-	SGMPERS	0.00%
Non-Commissioned Officers	-	PAX	-	-	SGM	-	SGMPERS	0.00%
Enlisted	-	PAX	-	-	SGM	-	SGMPERS	0.00%
Troop Force	-	PAX	-	-	SGM	-	SGMPERS	0.00%
Overnight Passengers	-	PAX	-	-	SGM	-	SGMPERS	0.00%
PAX Daytrippers	-	PAX	-	-	SGM	-	SGMPERS	0.00%
	-	Total	20	Total	200	SGM	10.00	SGMPERS 100.00%



Defining Structural Components with Material Codes

Structure Weight:	Metric Units	Computed	Mat'l Code No.	Wt Fac.	HR Factor	Material \$/MTON	Total Str. % Displ.	% Compd Curvature
Specific Structural Components		Enter -1 to zero item						
Flight Deck - Composite	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Flight Deck - AH-36	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Flight Deck Sponsons	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
2nd Deck + 3rd Crossover Deck AH-36	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
4th Decks in Wing & Center Hull	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Double Bottoms - Center Hull	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Double Bottoms - Side Hulls	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Shell Plate - Center Hull AH-36	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Shell Plate - Side Hulls AH-36	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	10.0%
Transverse Bhds - Center Hull	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Transverse Bhds - Wings	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Center Hull Skeg	- MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Aviation Support - Hangers	(1.00) MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
General Structures Not Specific								
Hull - Plating	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Main Deck	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Lower Decks	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Transverse Frames	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Longitudinal Frames	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Transverse Bulkheads	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Longitudinal Bulkheads	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Trunks and Enclosures	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Sponsons	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Inner Bottoms	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Platforms/Plats	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Castings	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Sea Chest	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Stanchions	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Bilge Keels & Skegs	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Sonar Dome	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Bulbous Bow	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Rudder & Horn	MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Deckhouse/Superstructure/Bridge	MTON	252.95	1	1.00	1.00	\$ 1,052	3.7%	0.0%
Default Total Ship - Not Specific	- MTON	6,389.66	1	1.00	1.00	\$ 1,052	94.0%	2.5%
Miscellaneous		Enter -1 to zero item						
Stacks and Macks	- MTON	10.62	1	1.00	1.00	\$ 1,052	0.2%	0.0%
Foundations - Machinery	- MTON	44.72	1	1.00	1.00	\$ 1,052	0.7%	0.0%
Foundations - Hull	- MTON	15.63	1	1.00	1.00	\$ 1,052	0.2%	0.0%
Deck Platforms & Cross-Overs	- MTON	41.09	1	1.00	1.00	\$ 1,052	0.6%	0.0%
Bulwarks	- MTON	25.30	1	1.00	1.00	\$ 1,052	0.4%	0.0%
Masts & Spars	- MTON	15.53	1	1.00	1.00	\$ 1,052	0.2%	0.0%
Ramps	(1.00) MTON	-	1	1.00	1.00	\$ 1,052	0.0%	0.0%
Total Structure:	MTON	6,775.50						
							% Displ.	
Jigs, Cradles, & Templates:	- MTON	260.86	1	1.00	1.00	\$ 1,052	0.7%	

NOTE: The weights of jigs, cradles & templates are not included in the lightship weight of the vessel. Their costs are determined in "Non-Recurring Costs."

Structural Properties & Costs From "Structural Materials" worksheet
Select Material Code



Wide Selection of Type Structural Materials to Assign to Structural Components

Structural Material Selections:	Mat'l Code	Structural Material Selections:	Mat'l Code
Mild Steel (A, B, C, CS, D, E)	1	Composite - VARTM/SCRIMP FRP Cored Panel	16
HTS (AH)	2	Composite - VARTM/SCRIMP FRP Stiffened Panel	17
HY-80	3	Composite - VARTM/SCRIMP FRP Stiffened Hull Section	18
HSLA-80	4	Composite - UV VARTM FRP Composite Cored Panel	19
HY-100	5	Composite - UV VARTM FRP Composite Stiffened Panel	20
HSLA-100	6	Composite - UV VARTM FRP Composite Hull Section	21
HY-130	7	Composite - UV Pre-Preg FRP Composite Cored Panel	22
Titanium (CP Ti 50A & Ti 130)	8	Composite - UV Pre-Preg FRP Composite Stiffened Panel	23
Aluminum (5xxx)	9	Composite - UV Pre-Preg FRP Composite Hull Section	24
Aluminum (2xxx & 7xxx)	10	Composite - Low Temp Cured Pre-Preg FRP Composite Cored Panel	25
Stainless Steel 304	11	Composite - Low Temp Cured Pre-Preg FRP Composite Stiffened Panel	26
Stainless Steel 316	12	DeckHouse-50% Composite; 38% Mild Steel; and 12% HTS	27
Composite - Average FRP Cored Panel	13	1/4 HTS & 3/4 Mild Steel	28
Composite - Average FRP Stiffened Panel	14	1/3 HTS & 2/3 Mild Steel	29
Composite - Average FRP Stiffened Hull Section	15		
Details for each material provided in Structural Materials Worksheet.			



Wide Selection of Ship Systems & Support Services from which to Choose:

Electric Systems:

- Electrical Generation
- Cable & Hangers
- Appliances & Electrical Components
- Lighting

Electronics:

- Exterior & Interior Communications
- Navigation Systems
- Miscellaneous Electronics



Auxiliary Systems:

- HVAC
- Engine Room Piping (fuel, Lube, Cooling, Exhaust)
- Bilge & Ballast Systems
- Habitation Piping (Potable & Sanitary)
- Fire Protection Systems
- Cargo Piping Systems

Outfit Systems:

- Exterior & Interior Coating
- General Hull Outfit (Rails, Stanchions, Davits, Insulation, etc.)
- Rescue & Life Saving Systems
- Cranes, Lifts & Elevators
- Machinery Space Outfit
- Superstructure Outfit
- Accommodation Outfit
- Fire Fighting & Pollution Control Systems
- Hydrographic Research Equipment



Technical Support:

- Planning & Program Management
- Production Engineering Support
- Tests & Inspections
- Contract Administration

Production Support:

- Material Control
- Quality Control
- Supervision
- Production Services

**All CERs can be modified, added or deleted
by the user.**



Cost Estimating Relationships

The cost estimating relationships (CERs) used in the cost models apply to a generic mid-size commercial U.S. shipyard having reasonably productive manufacturing and assembly facilities, and technical and management competence.

The CERs are based upon a comprehensive analysis of U.S. shipbuilding costs gathered from SPAR's working experience with a variety of shipyards, large and small, commercial and naval contractors.



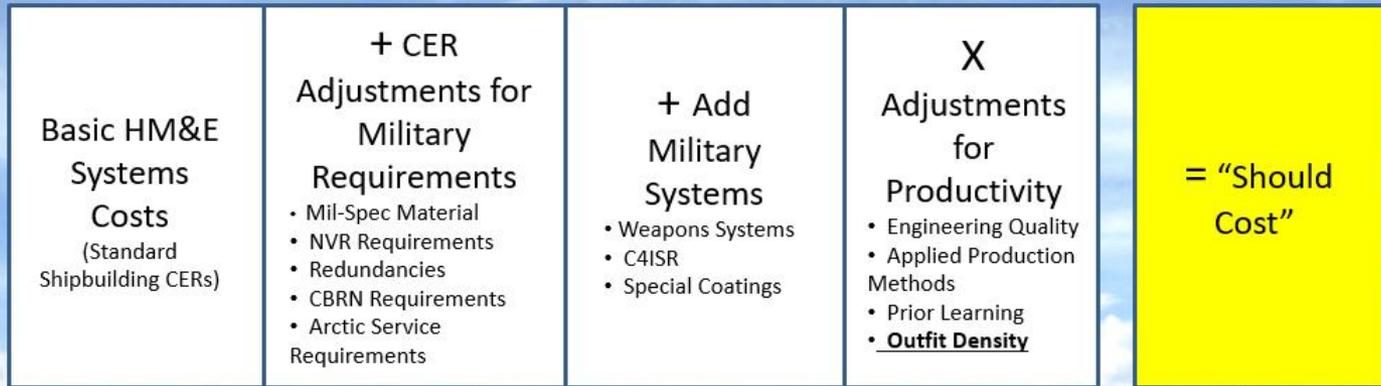
The generic CERS are based upon a notional modern mid-size U.S. commercial shipbuilding facility having the following general operating characteristics:

- a) Current technology CAD and resource planning and management systems**
- b) Moderate levels of pre-outfitted hull block and module construction**
- c) N/C plasma plate cutting**
- d) Automated panel line**
- e) Large hull block assembly hall**
- f) Automated shot blast and painting facilities**
- g) Steel manufacturing capacity of approximately 20,000 MTONs (steel or equivalent) per annum.**



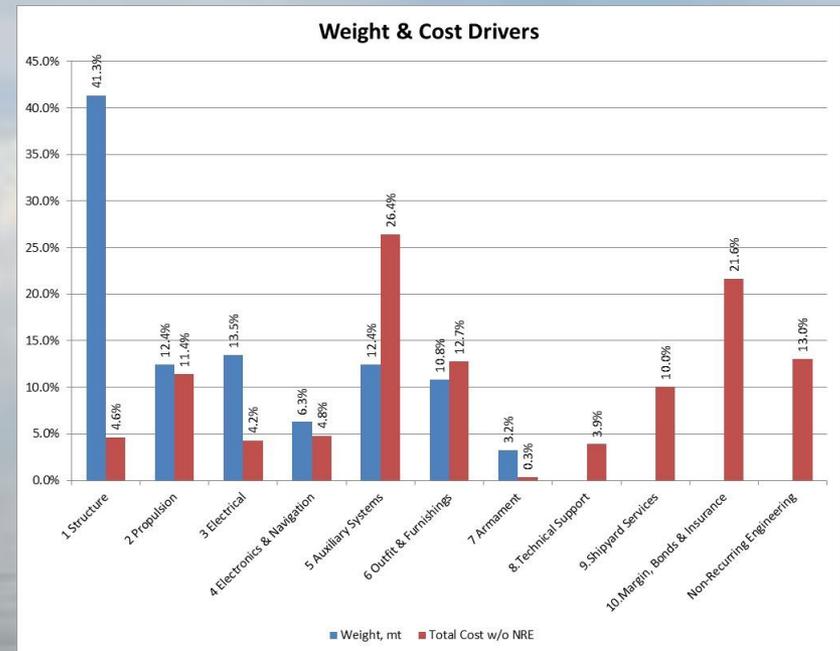
Adjustments are made to the model's standard CERs to reflect differences in ship types, complexity of design, difficulty to assemble, shipbuilder's productivity, and other considerations.

Elements of Ship Construction Costs



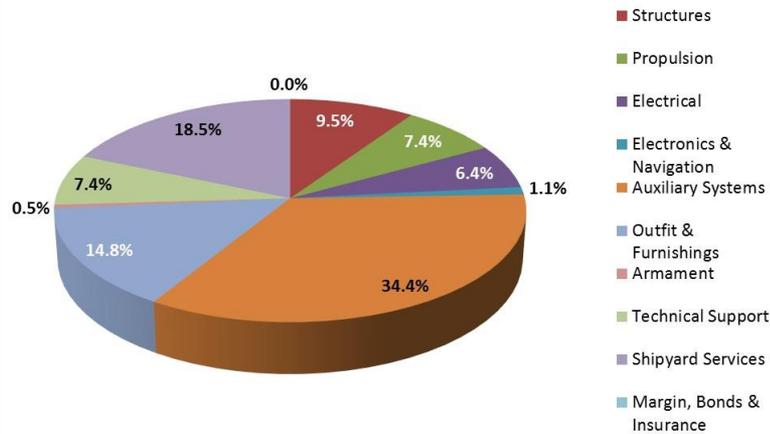
Cost Drivers – Automated Reports

Some costs are more important than others and should be reviewed more carefully. They represent costs that may contribute the most towards whether or not a ship design and construction program produces the “biggest bang for the buck.” If too high, a contract bid will likely fail in a competitive market.

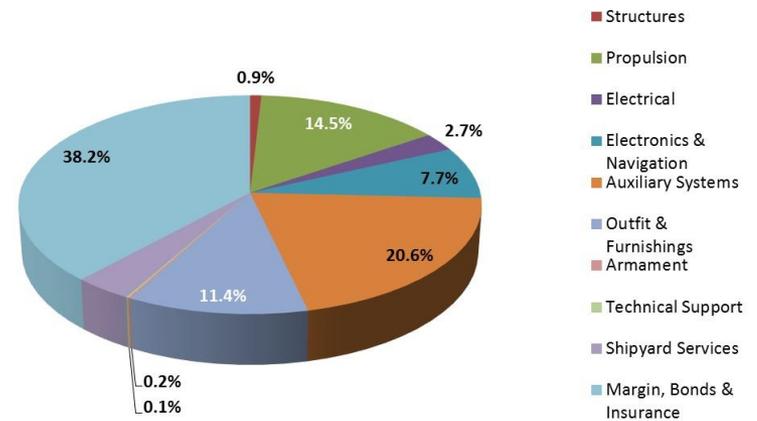


Labor & Material Cost Drivers Across 2-Digit SWBS

100 meter 30 Kt Surface Combatant Total Lead Ship - % Labor Cost Drivers

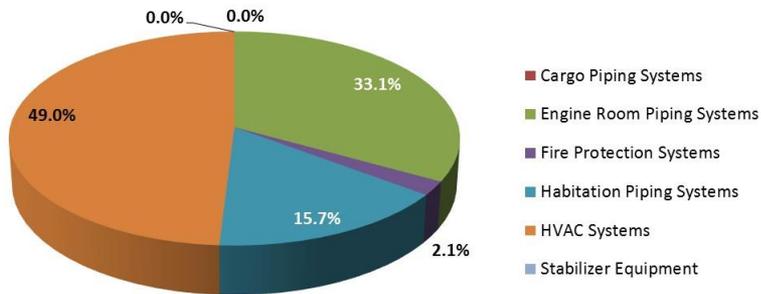


100 meter 30 Kt Surface Combatant Total Lead Ship - % Material & Equipment Cost Drivers

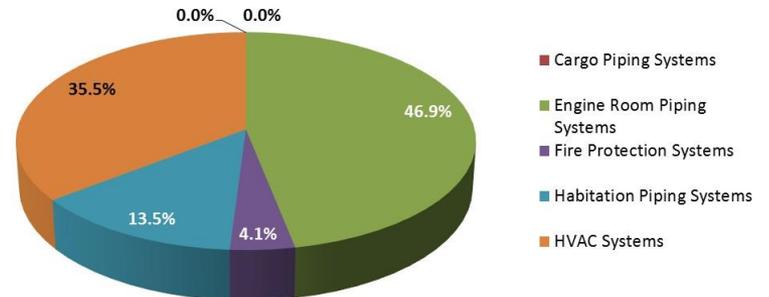


Labor & Material Cost Drivers within Auxiliary Systems

100 meter 30 Kt Surface Combatant Auxiliary Systems - % Labor Cost Drivers

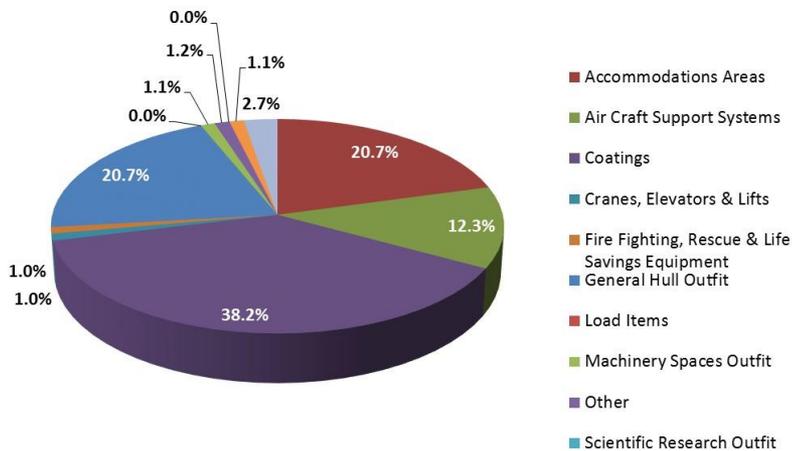


100 meter 30 Kt Surface Combatant Auxiliary Systems - % Material & Equipment Cost Drivers

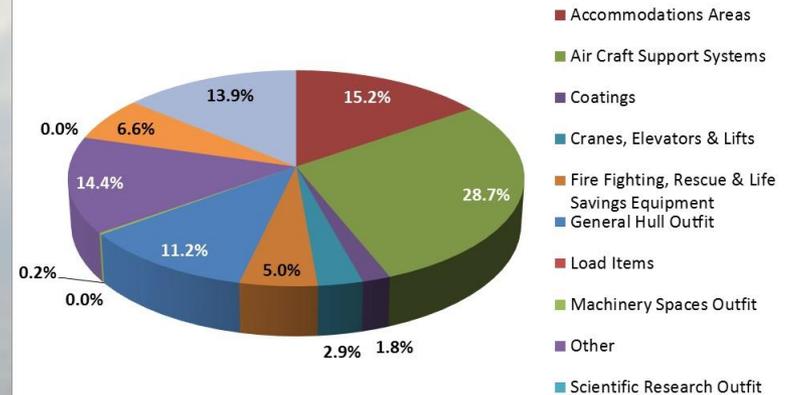


Labor & Material Cost Drivers within Outfit & Furnishing Systems

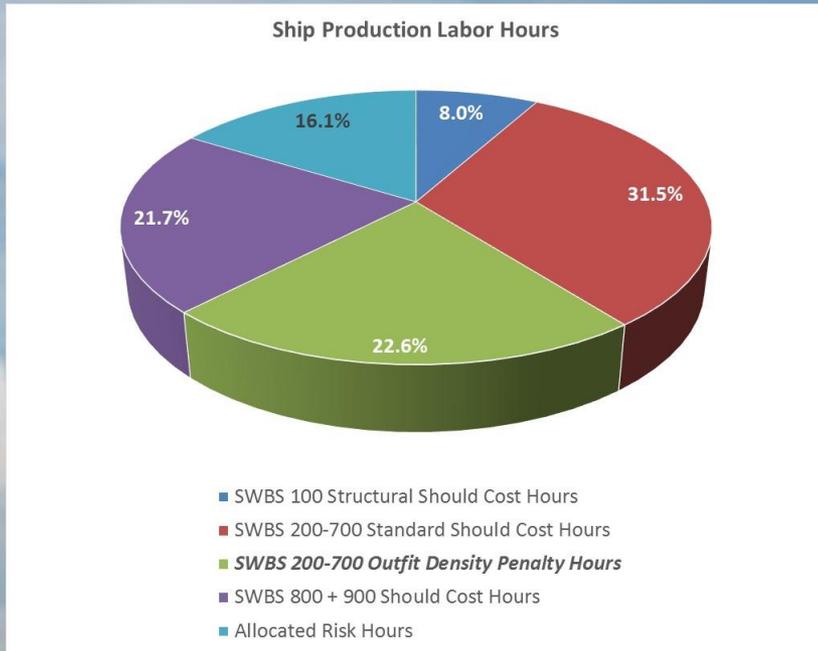
100 meter 30 Kt Surface Combatant Outfit & Furnishings - %
Labor Cost Drivers



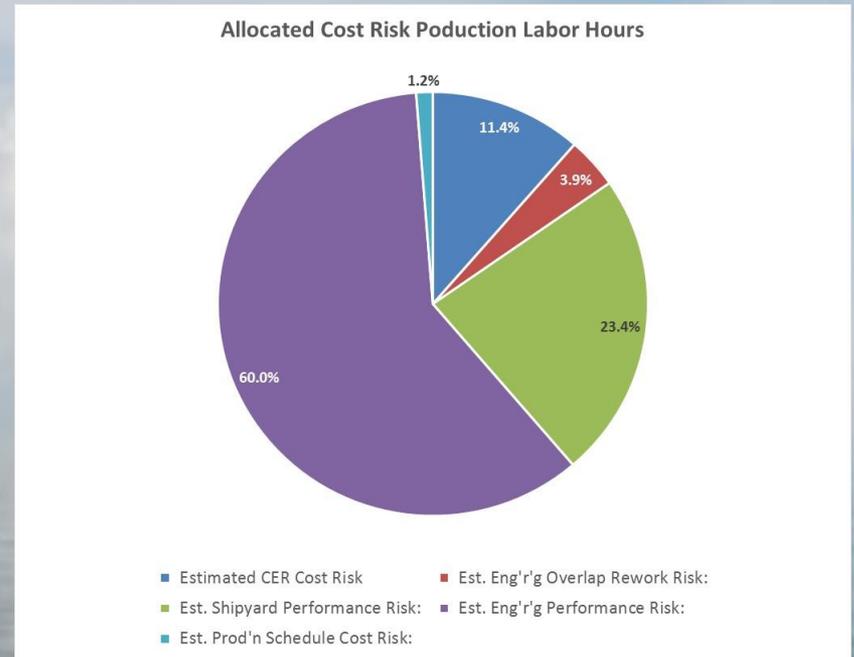
100 meter 30 Kt Surface Combatant Outfit & Furnishings - %
Material & Equipment Cost Drivers



Design Outfit Density Cost Driver



Drivers of Cost Risk

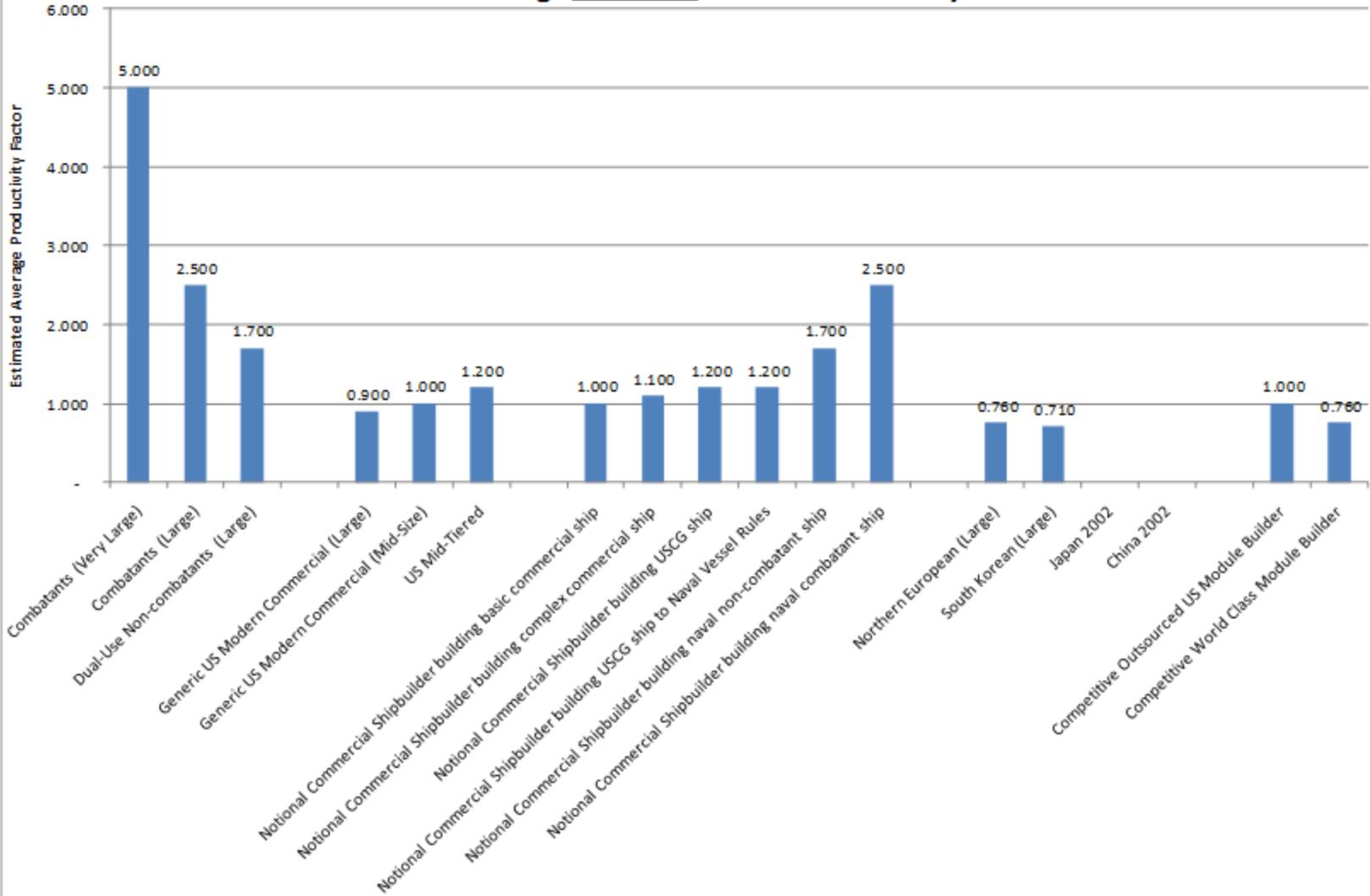


Productivity Factors

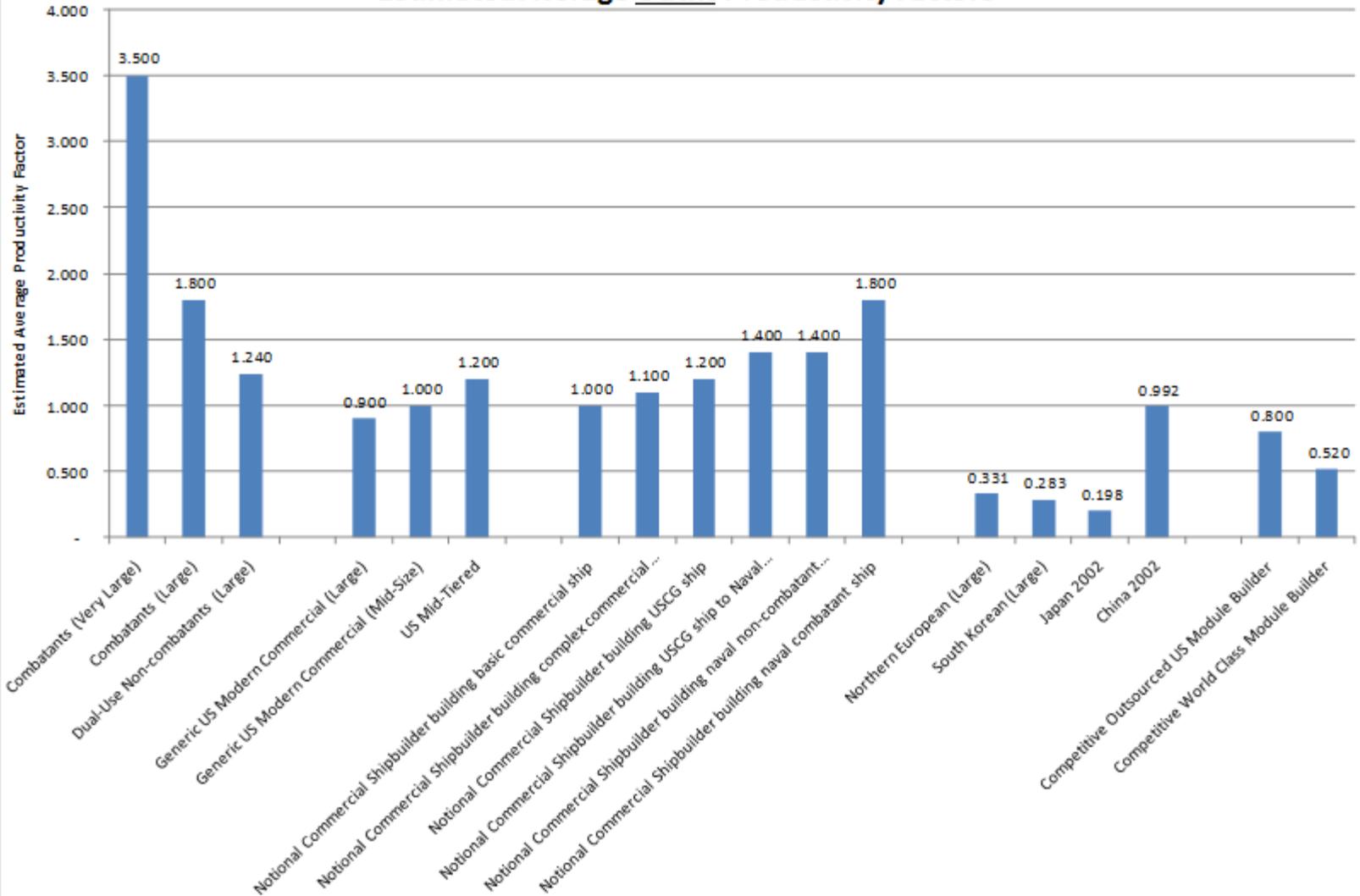
Productivity factors may be applied to the generic commercial shipbuilding CERs. They are based upon a cross-industry analysis of cost performance data collected from various sources.

Separate factors may be applied for structural work, outfit and technical.

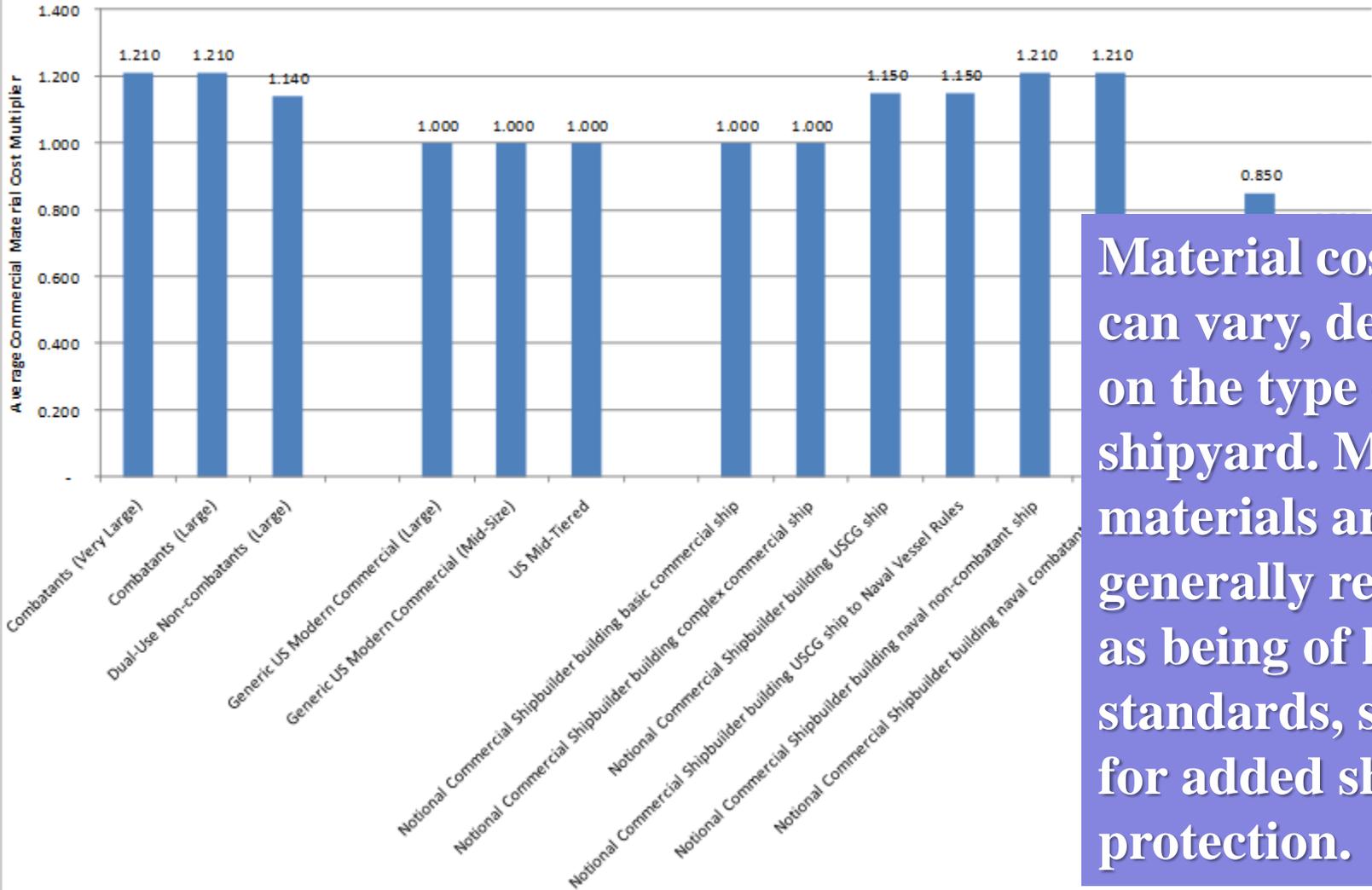
Estimated Average Structural Work Productivity Factors



Estimated Average Outfit Productivity Factors



Estimated Material Commercial Cost Multiplier



Material costs also can vary, depending on the type of shipyard. Mil-Spec materials are generally regarded as being of higher standards, such as for added shock protection.

**The cost models provide special
features for additional cost
savings build strategies**



The efficient shipyard pursues strategies that maximize productivity of the assembly processes:

- *Maximize under-cover work*
- *Maximize down-hand work*
- *Maximize assurance that correct material is available on time to support production*
- *Minimize material handling and storage requirements*
- *Eliminate all instances of non-value labor costs*
- *Maximize access to work for not only the worker, but also the supply of material for the worker*
- *Minimize number and complexity of parts*
- *Maximize opportunities for repeatable standardized parts and assemblies*
- *Maximize responsibility and problem solving down to the worker level*

Modules can be developed in a wide variety of ways:

- **Outfit and equipment modules,**
- **Hull assembly blocks,**
- **Outfitted hull blocks, and**
- **Outfitted panel assemblies**



Typical Hull Modular Blocks

Expanded use of modules carry the concept of early stage construction cost savings even further.

On unit outfit may be as small as a single piece of equipment mounted on its foundation and ready to install on panel, on block or on board.

Or, on unit outfit can be a complex assembly of equipment, piping, electrical and other systems all pre-mounted on a support structure.



Turbocharger Lube Oil Module



Accommodation Module



Alfa Laval Module



Lube Oil w/Pumps Module



Westfalia Separator Module



Hydrophore Module



Sewage Treatment Module



Refrigeration Compressor Module

**The cost models offer options
for developing cost estimates
that reflect significant savings
potential from extended
modularization of design and
construction**



Estimated Reduced Labor Hours from Extended Modularization

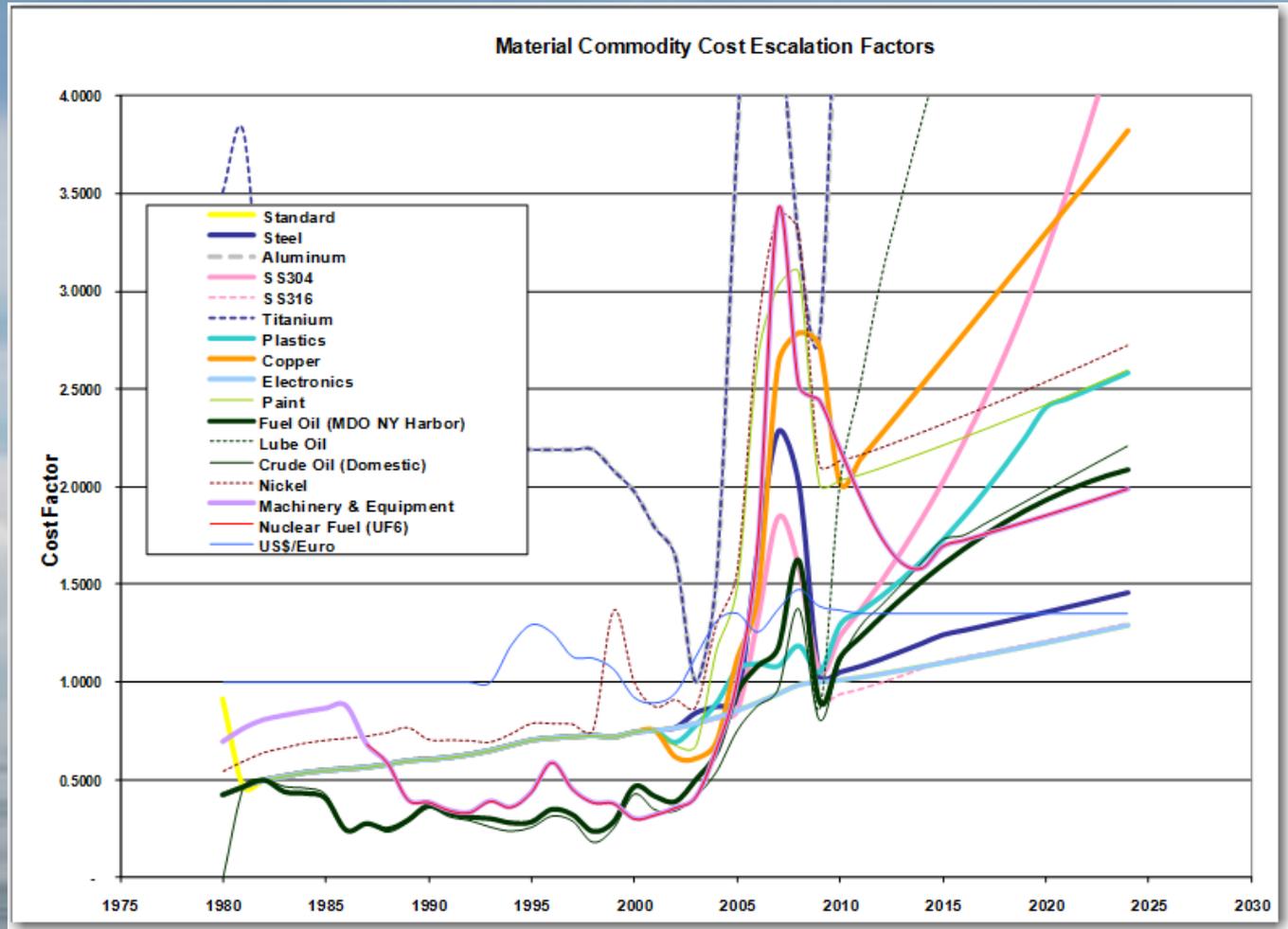


Cost Escalation

Material costs are summarized and escalated to a common, base year value.



All materials and equipment escalation and forecast for the future using commodity-based escalation tables that are updated on a regular basis.



Other Cost Model Adjustment Features

The Cost Model provides a user-defined entry for a currency exchange rate to convert from US\$ to another local currency. The Cost Model will apply this rate to all material cost generated by the model.

Still another factor can be defined that reflects a general increase or decrease in local material costs relative to average purchases of materials in the US.

Contingencies

The models allow for defined contingency costs for the following:

- Systems not yet defined or so far left out of the details;
- Limited owner changes; and
- Any design margin traditionally allocated for a preliminary design.



Cost Risk

The cost models generate estimates of cost risk.

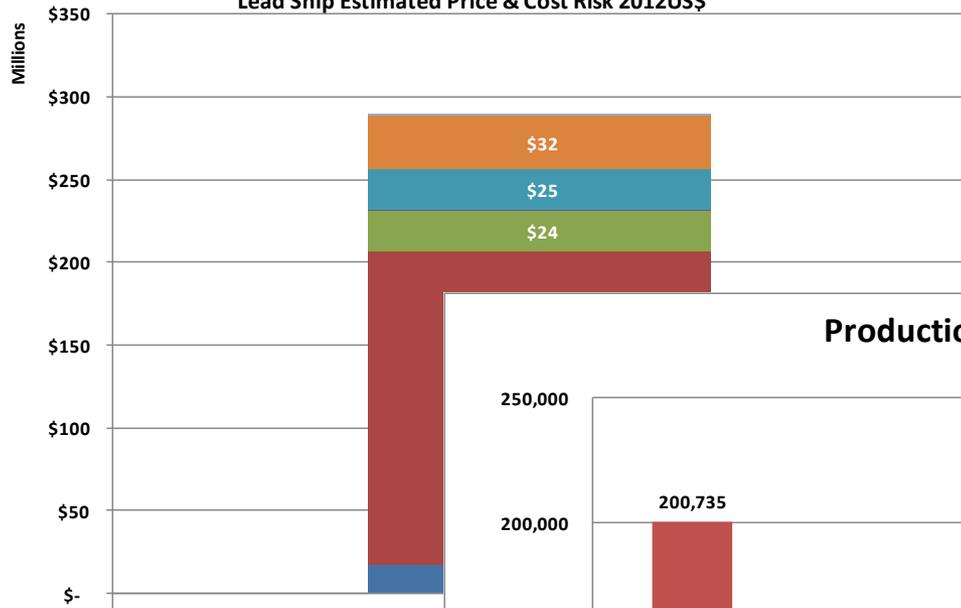


The cost models break out cost risk into five primary categories:

- 1. The production cost risk for labor and material.*
- 2. Cost risk of rework due to immature engineering.*
- 3. The inexperience cost risk that may be associated with a shipyard that has not built this type of ship before.*
- 4. The cost risk when detail design, engineering and planning cannot complete quality work in time to meet production schedules.*
- 5. The cost risk due to production schedules are so short that excessive manpower must be applied to meet a planned delivery.*

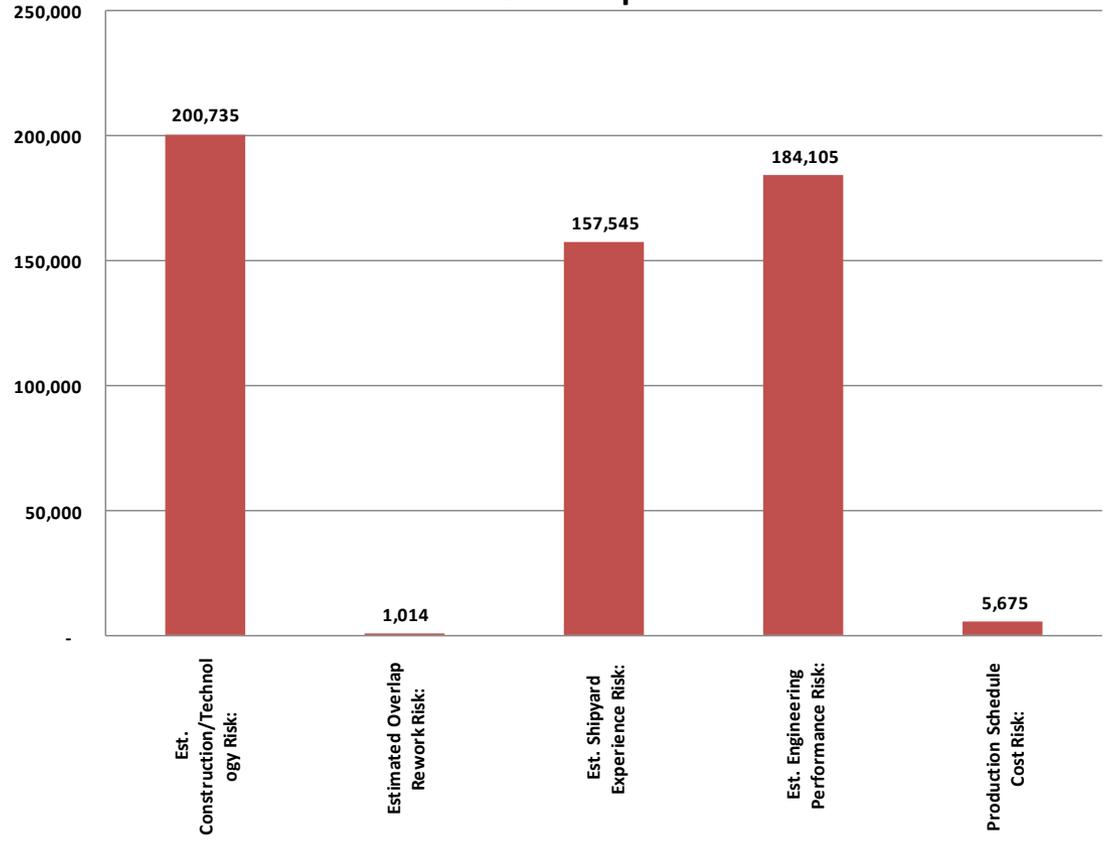


Lead Ship Estimated Price & Cost Risk 2012US\$

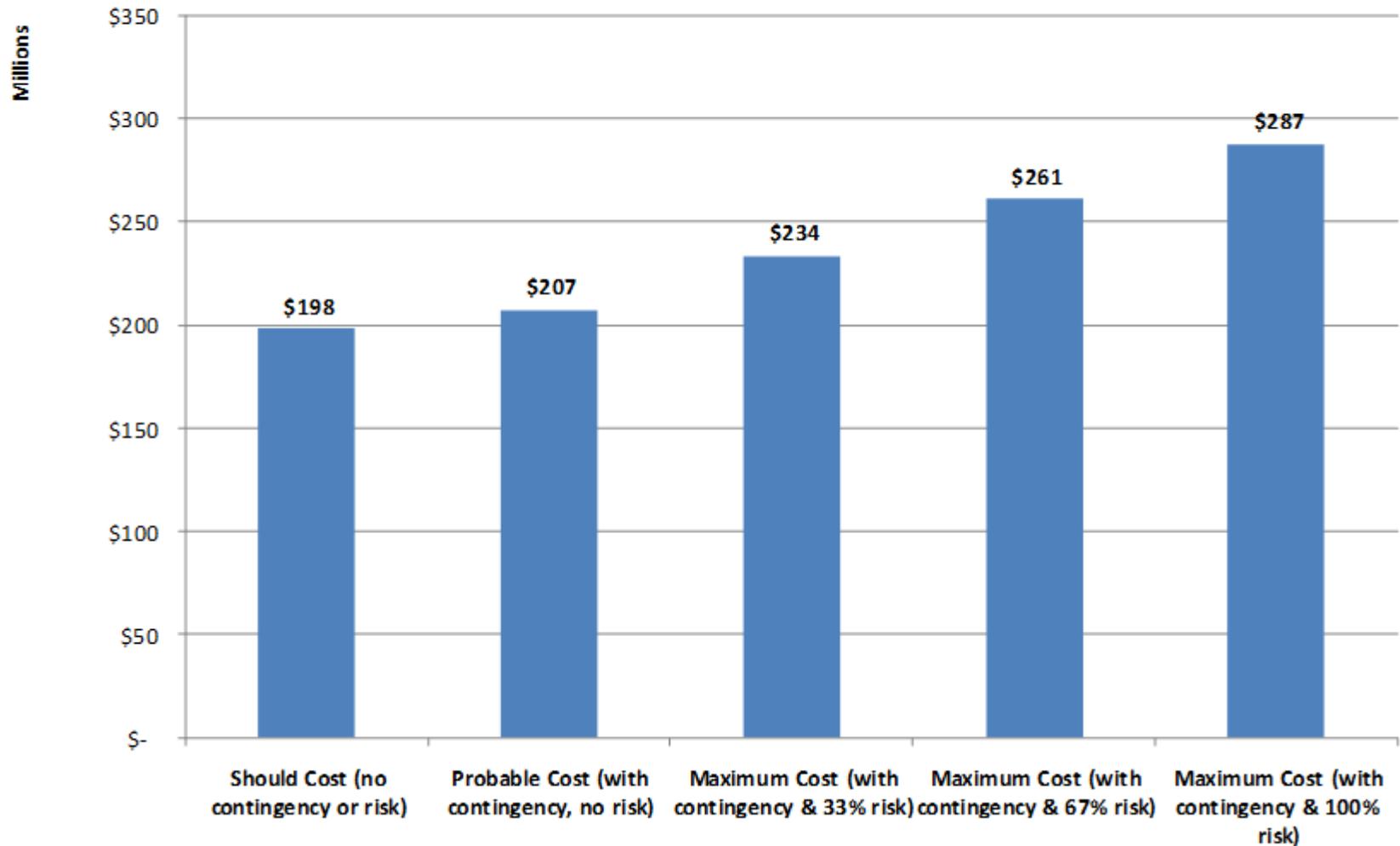


- Es. Schedule Cost Risk
- Est. Engineering Performance Risk
- Est. SY Experience Cost Risk
- Est. Rework Cost Risk
- Est. CER Cost Risk
- Est. Price of Construction
- Non-Recurring Design, Engineering & Planning

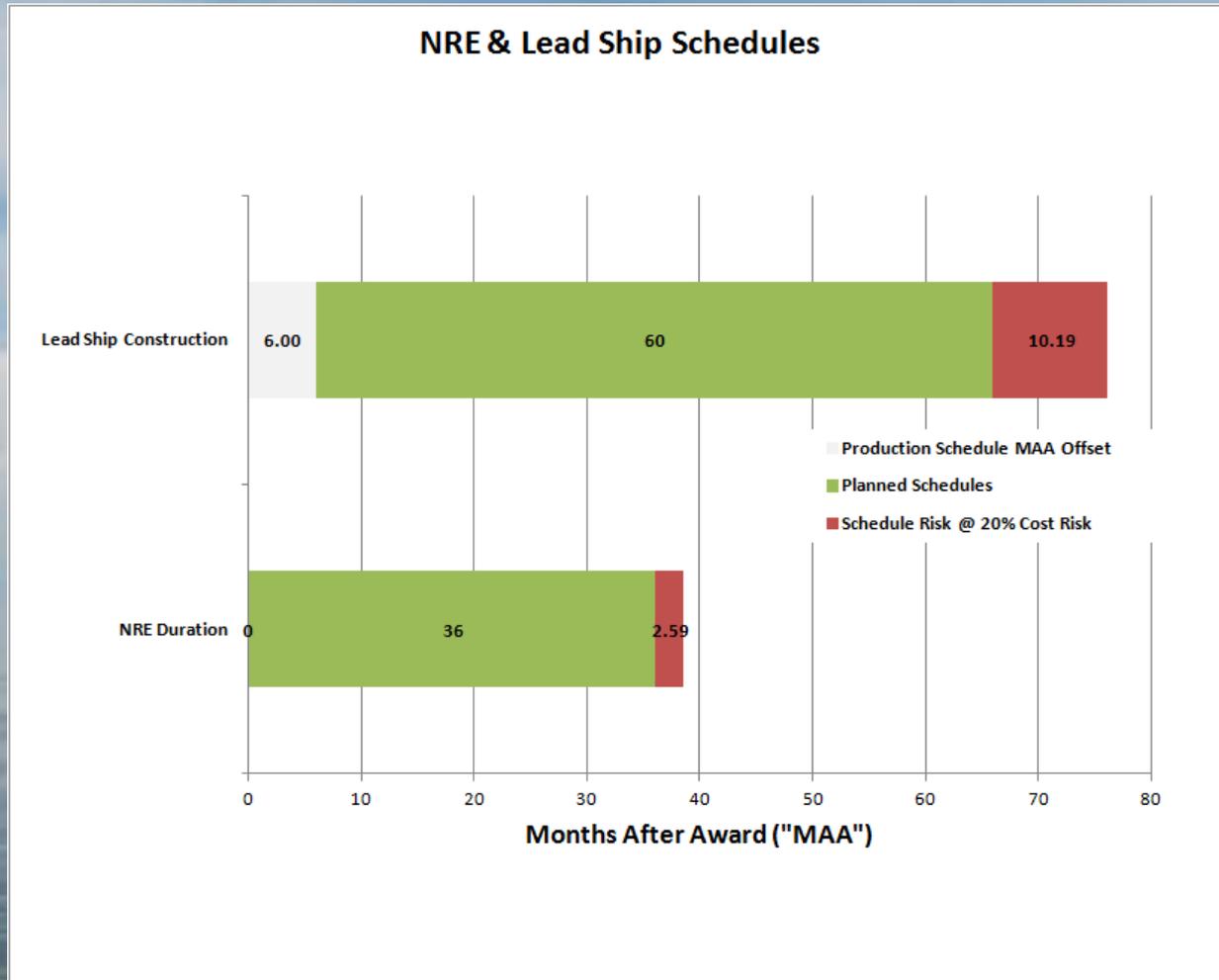
Production Risk of Labor Hours Lead Ship



Lead Ship Design & Build Cost 2012US\$



Estimating Potential Schedule Delays from Cost Risk



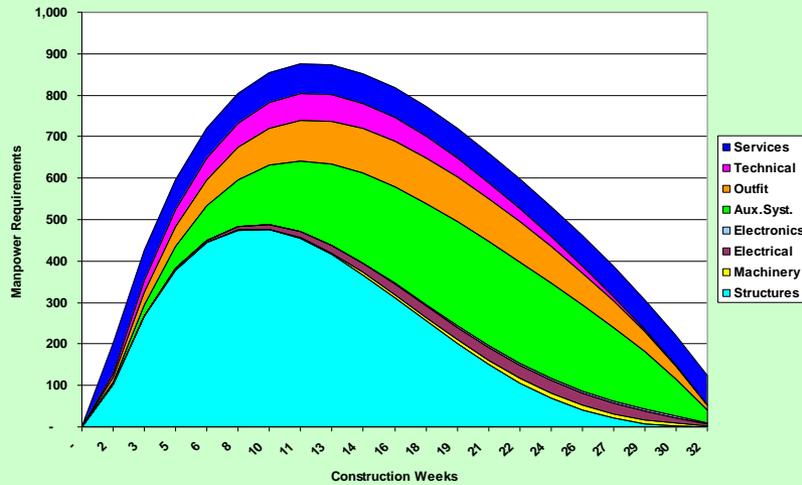
Estimating Manpower Requirements

The cost models automatically generate estimated engineering and shipyard production manpower requirements.

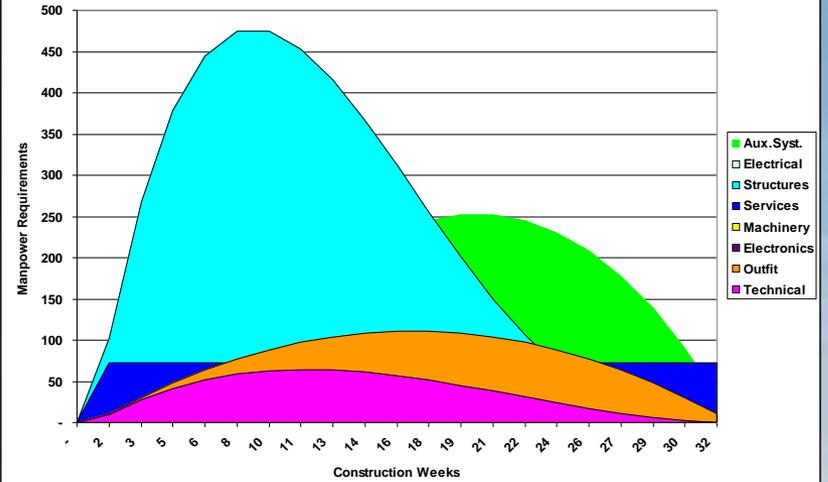
This is a good cross-check on the defined schedule and the estimated labor hours.



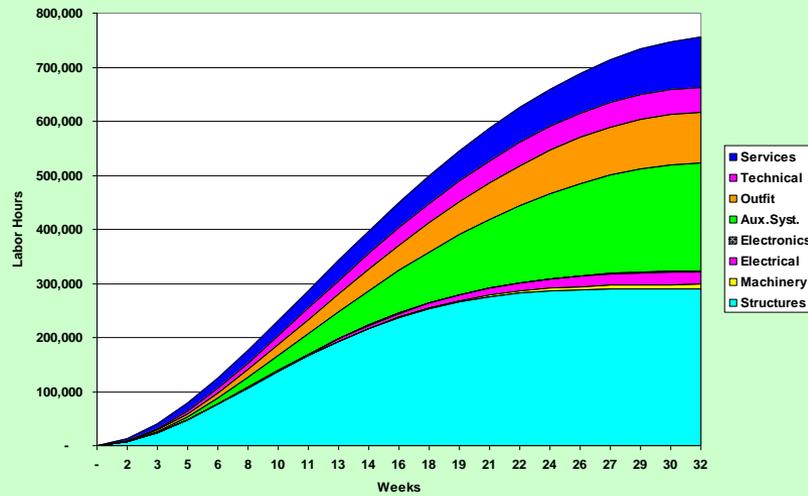
Production Manpower Distribution
Over Construction Period
(Not Including Non-Recurring Costs)



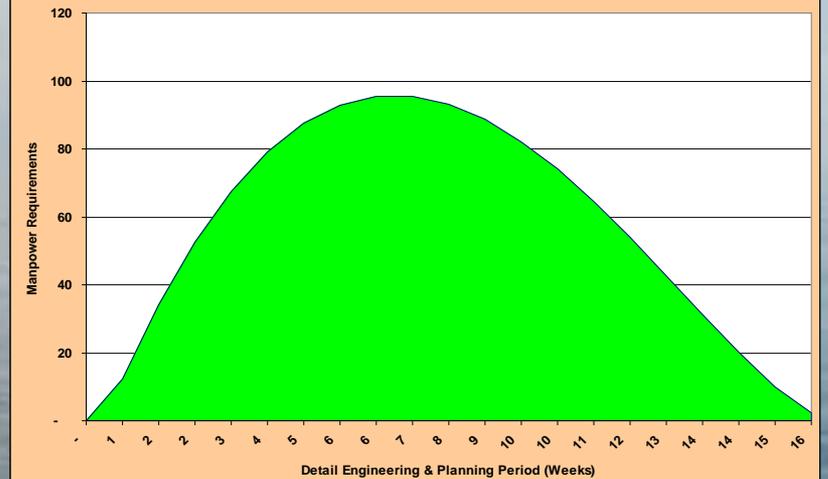
Production Manpower Requirements
Over Construction Period
(Not Including Non-Recurring Costs)



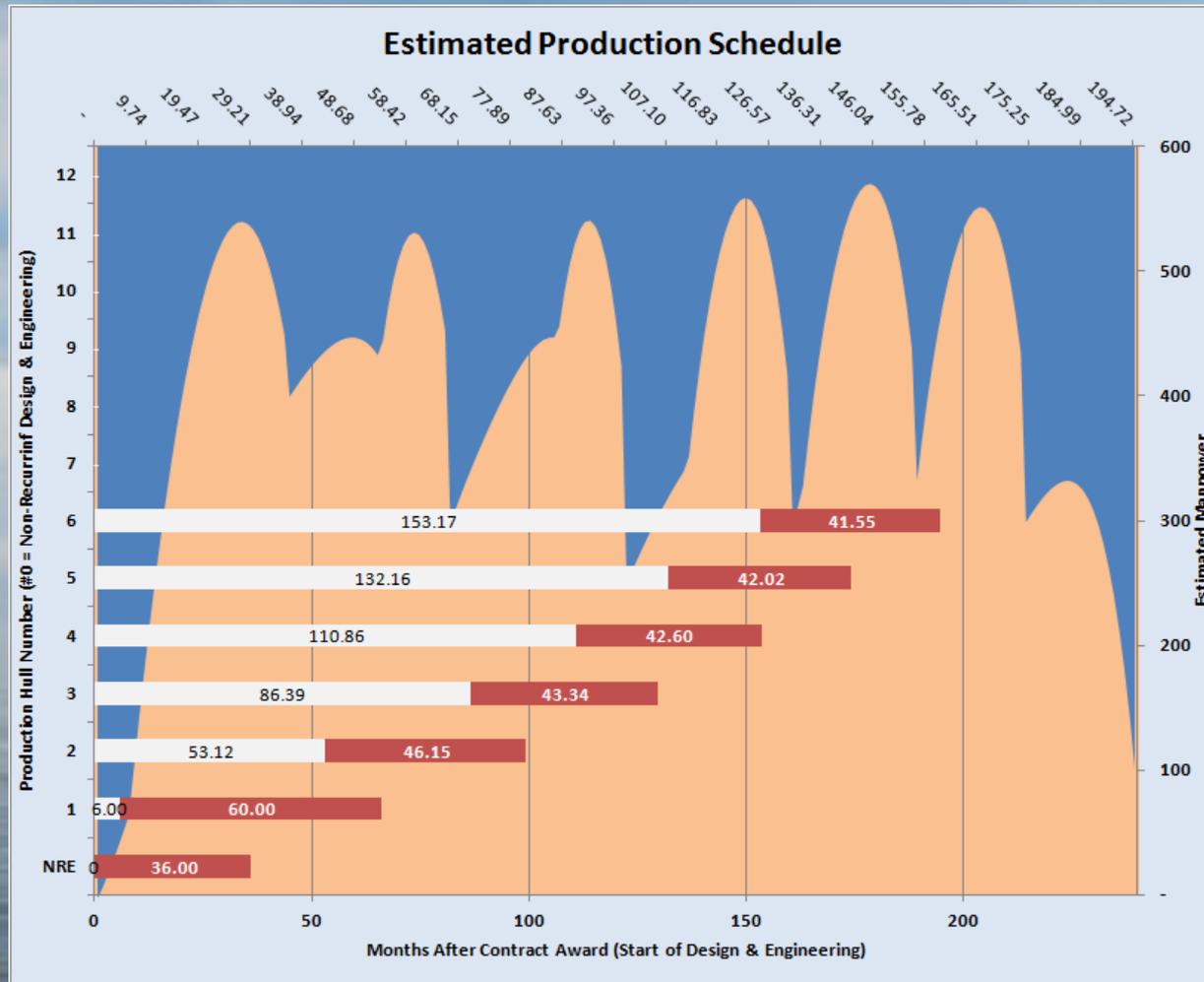
Labor Hours Over Construction Period
(Not Including Non-Recurring Costs)



Non-Recurring Detail Engineering & Planning
Manpower Requirements



Estimating Multi-Ship Production Schedule & Manpower Requirements Quickly & Easily



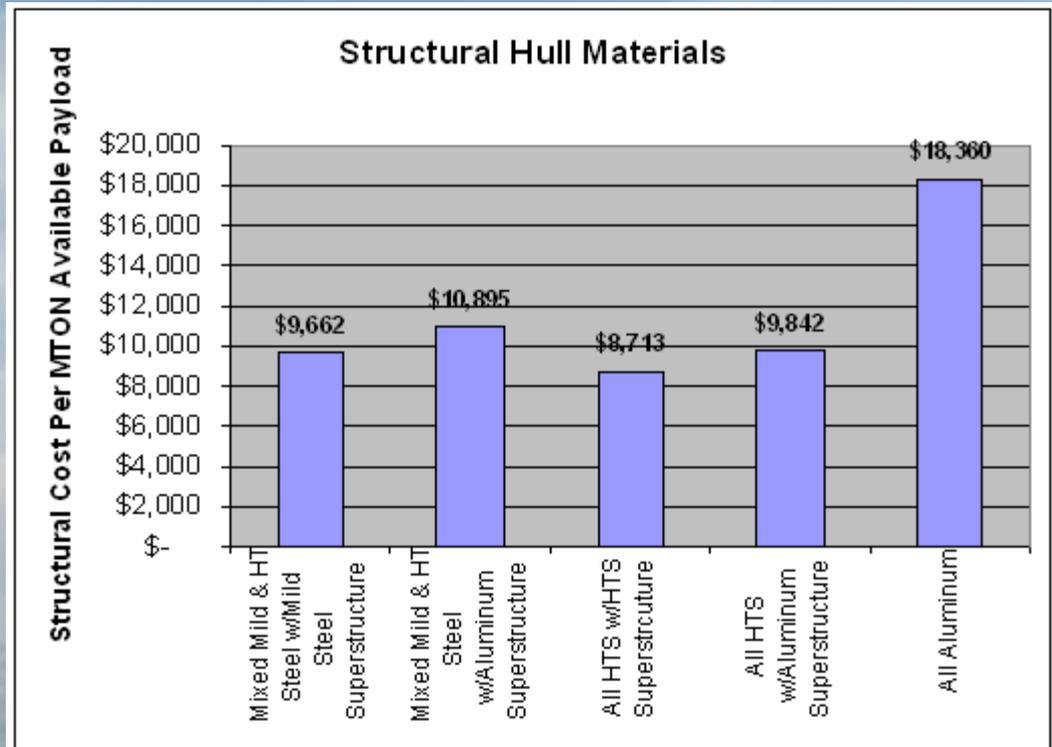
Design Trade-Off Studies

The model can quickly generate costs across a wide range of ship design parameters, materials alternatives and propulsion system options.



The model can quickly compare the cost of various materials and their weight characteristics.

Both of these variables impact the cost per available payload of the design displacement.

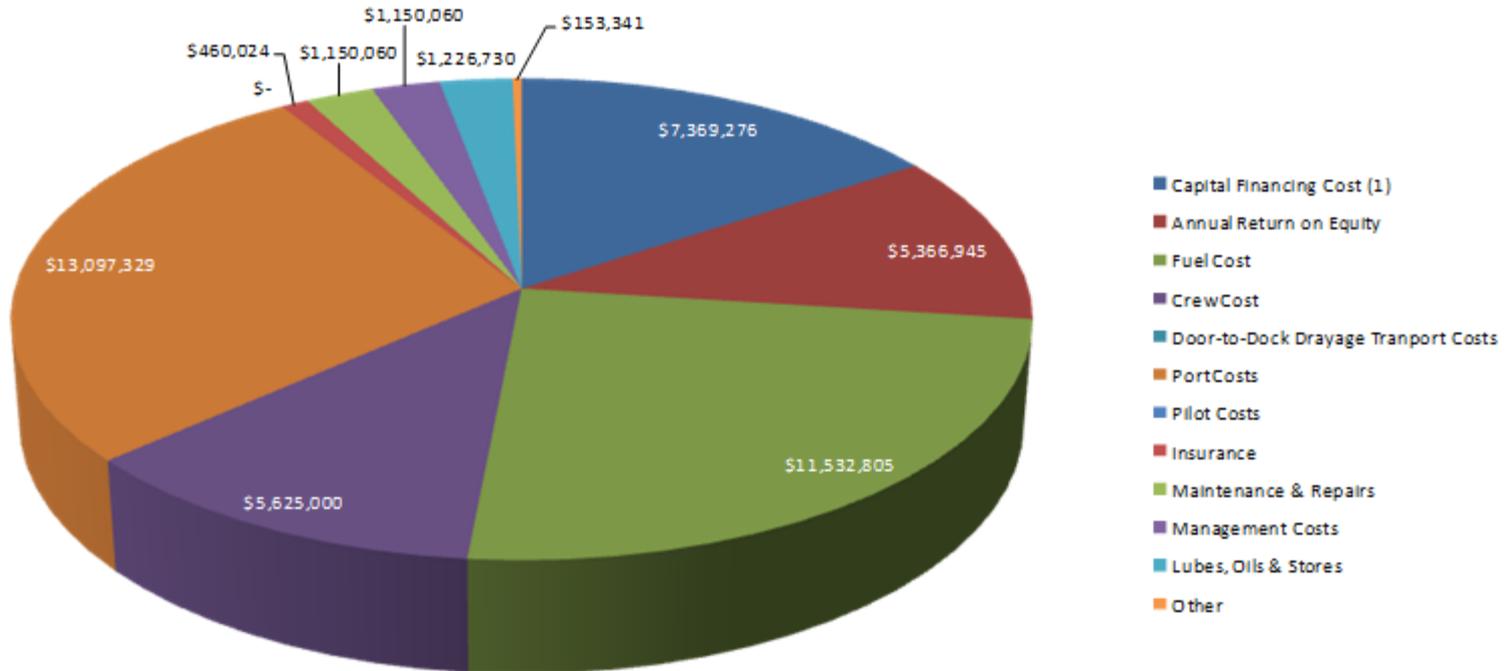


Annual Operating Cost Forecasts

For the specified trade route and business plan, the model summarizes the annual operating costs per ship.



Annual Maintenance & Operations Cost: \$47,131,571.



The model summarizes the annual cargo throughput of the trade route business plan.

Laydays & Repair Days per Annum	10	Days		
Total Hours per Round Trip	192	Hours		
Total Days per Round Trip	8.00	Days		
Total Round Trips per Annum:	44.38	Trips		
Trailers per Annum:	19,261	Trailers	48.3%	Total Units
Payload MTONs Trailers per Annum:	393,525	MTONs	48.6%	Total Units
Containers per Annum	20,592	Containers	51.7%	Total Units
Payload MTONs Containers per Annum:	416,516	MTONs	51.4%	Total Units
Units (Trailers + Containers) per Annum:	39,853	Units		
Payload Units per Annum:	810,041	MTONs		
Trailer Miles per Round Trip:	311,938	Trailer Miles		
Trailer Miles per Annum:	13,843,669	Trailer Miles		
Container Miles per Round Trip:	333,500	Container Miles		
Container Miles per Annum:	14,800,604	Container Miles		
Payload Units Miles per Annum:	28,644,273	Unit Miles		
Metric Tonnes Fuel per Round Trip:	299	MTONs	\$ 869	per MTON
Metric Tonnes Fuel per Annum:	13,277	MTONs		



Required Freight Rate Evaluation

The models compute the required freight rate (RFR) necessary for the shipping company to recover its capital and operating costs.

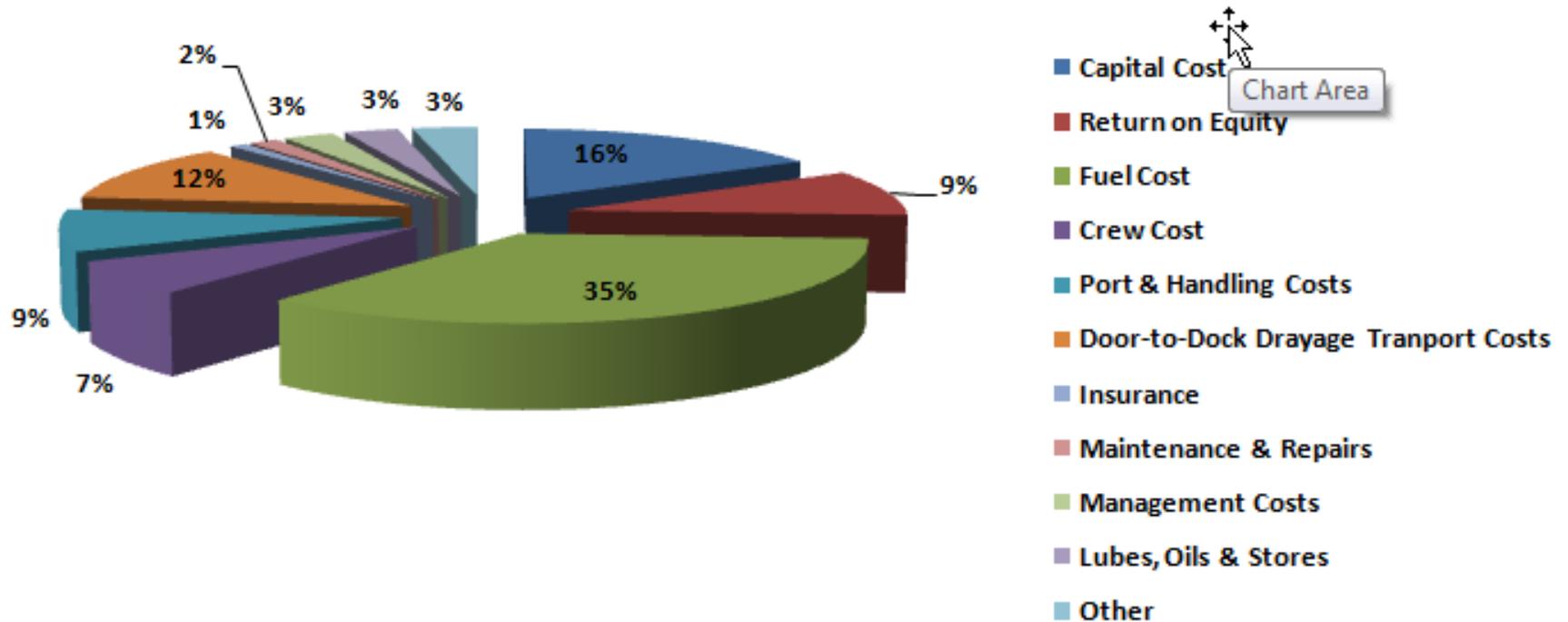
The RFR is broken down by its component costs. This rate is based not only on the trade route characteristics, but also the anticipated cargo carrying capacity, the amortized capital costs, the operating costs over the route, and the estimated port charges for loading and unloading, etc.



Estimating Required Freight Rates: per Unit, per ton, and per Mile

Train Annual Cost Breakdown:			% Annual Exp.	% Build Cost	(Trailers&Containers) Freight Costs		Freight Cost
					per Unit	per Unit MTON	per Unit Mile
Capital Financing Cost	\$	7,369,276	15.6%	4.8%	\$ 184.91	\$ 9.10	\$ 0.257
Annual Return on Equity	\$	5,366,945	11.4%	3.5%	\$ 134.67	\$ 6.63	\$ 0.187
Fuel Cost	\$	11,532,805	24.5%	7.5%	\$ 289.38	\$ 14.24	\$ 0.403
Crew Cost	\$	5,625,000	11.9%	3.7%	\$ 141.14	\$ 6.94	\$ 0.196
Door-to-Dock Drayage Transport Costs	\$	-	0.0%	0.0%	\$ -	\$ -	\$ -
Port Costs	\$	13,097,329	27.8%	8.5%	\$ 328.64	\$ 16.17	\$ 0.457
Pilot Costs	\$	-	0.0%	0.0%	\$ -	\$ -	\$ -
Insurance	\$	460,024	1.0%	0.3%	\$ 11.54	\$ 0.57	\$ 0.016
Maintenance & Repairs	\$	1,150,060	2.4%	0.8%	\$ 28.86	\$ 1.42	\$ 0.040
Management Costs	\$	1,150,060	2.4%	0.8%	\$ 28.86	\$ 1.42	\$ 0.040
Lubes, Oils & Stores	\$	1,226,730	2.6%	0.8%	\$ 30.78	\$ 1.51	\$ 0.043
Other	\$	153,341	0.3%	0.1%	\$ 3.85	\$ 0.19	\$ 0.005
Total Annualized Costs	\$	47,131,571	100.0%	30.7%	\$ 1,182.64	\$ 58.18	\$ 1.645

Required Freight Rate Per Trailer /Statute Mile



Freight Rate Trade-Off Studies

Required Freight Rate is sensitive to a number of different cost variables. In summary, it includes both capital and operating costs to carry variable payloads over variable distance and speed of transit.

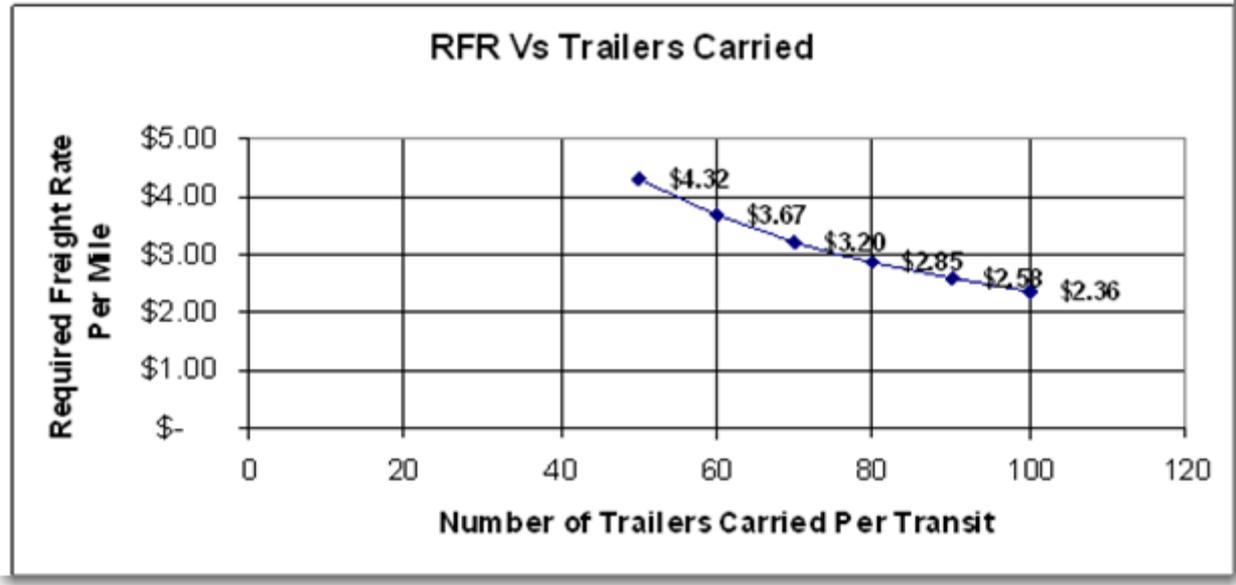
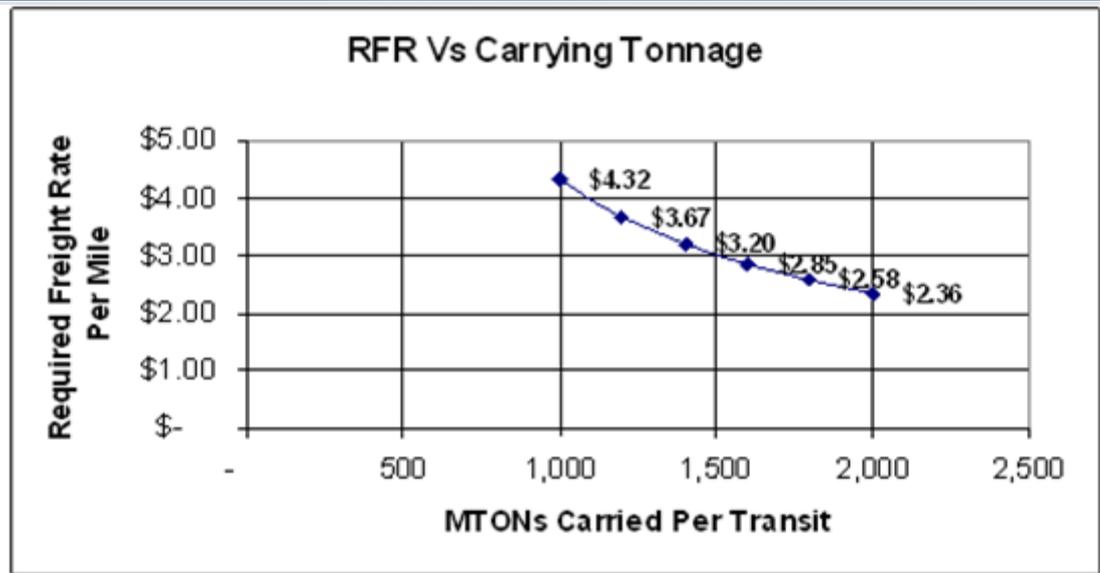


As changes occur to fuel costs, the model can quickly identify their impact upon the RFR.



The RFR is directly affected by the amount of cargo that is transported over the trade route.

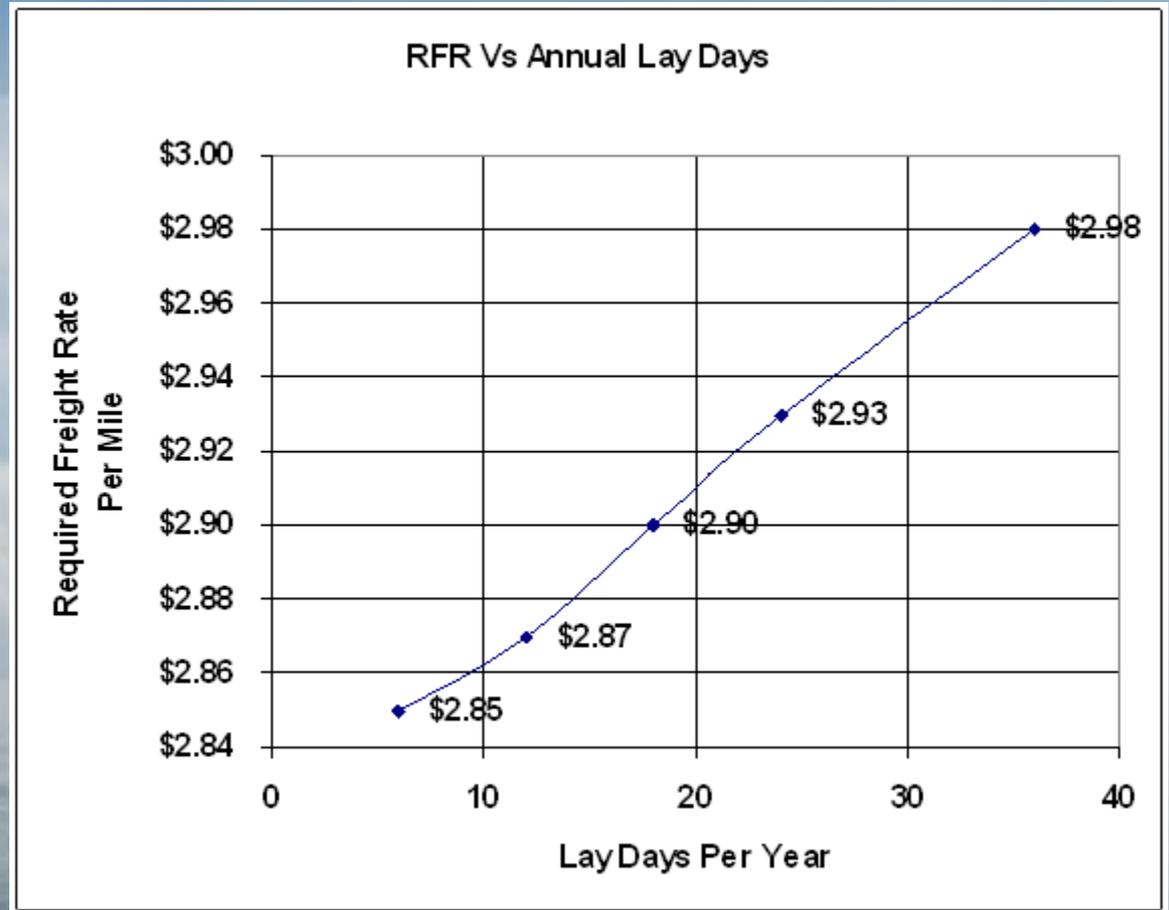
Full ship capacity translates to a lower RFR.



RFR is affected by the amount of time that the ship spends out of service.

The more days the ship is not working the trade route, the less time is available for maximizing its cargo carrying potential.

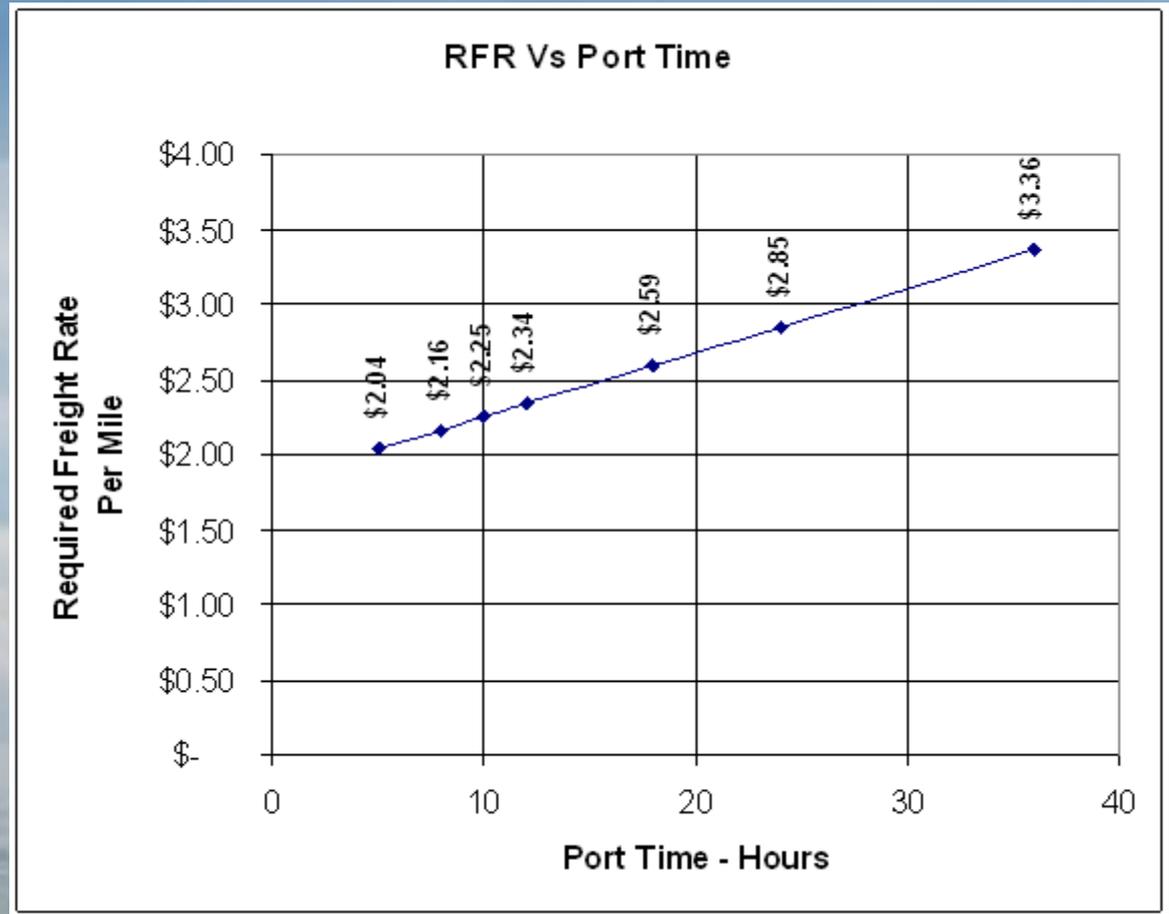
With fewer trips, the RFR will be higher.



Similarly, RFR is very much affected by the amount of time spent in port.

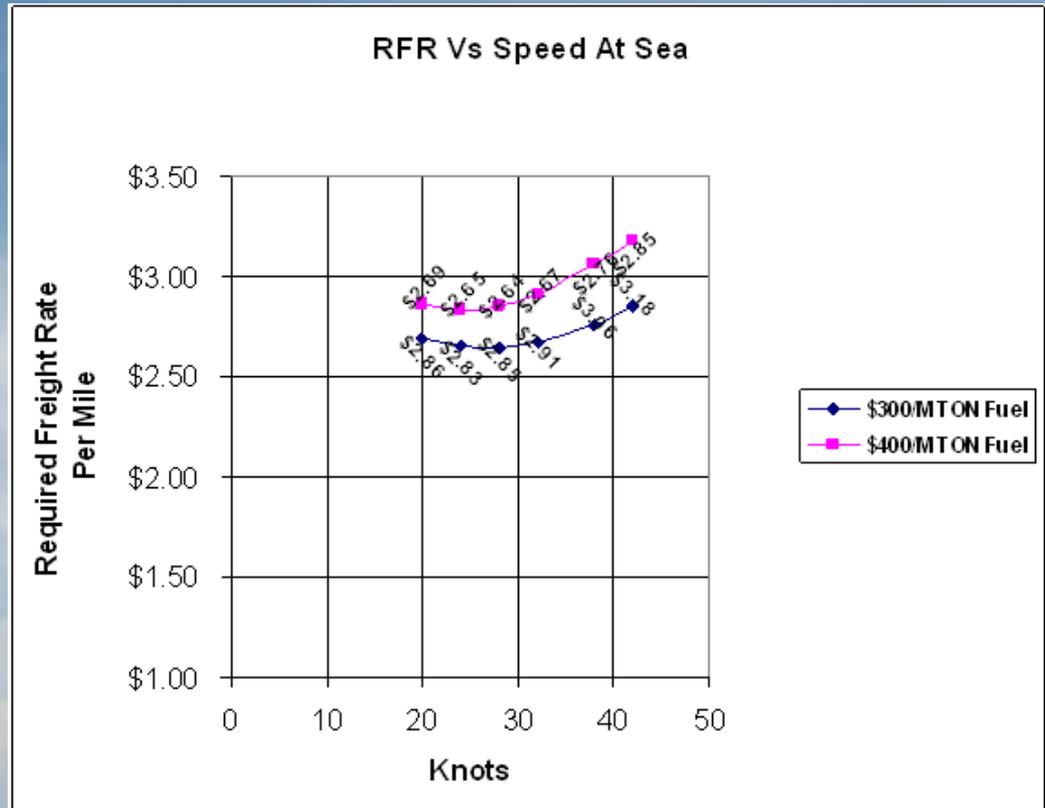
The greater the port time, the less time is available for making additional trips over the route.

With fewer trips, the RFR will be higher.



The RFR is directly affected by the ship speed over the route.

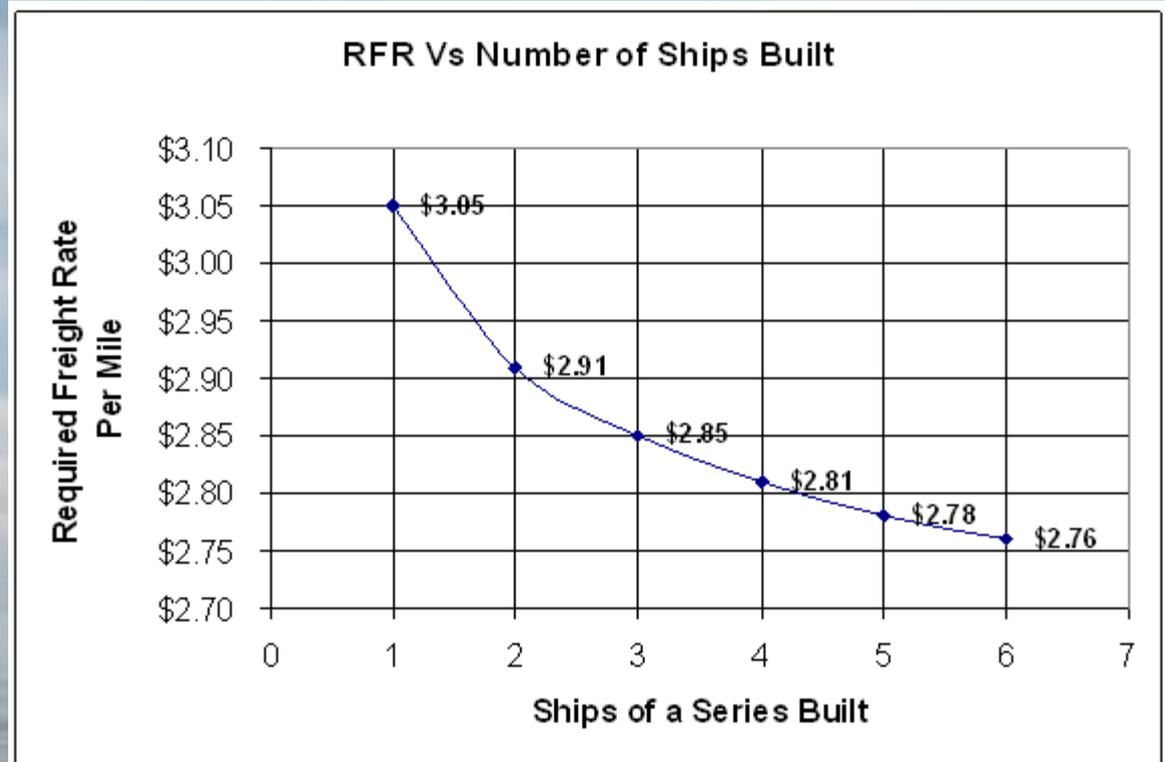
The faster the speed, the more cargo can be transported on an annual basis, thus decreasing the RFR.



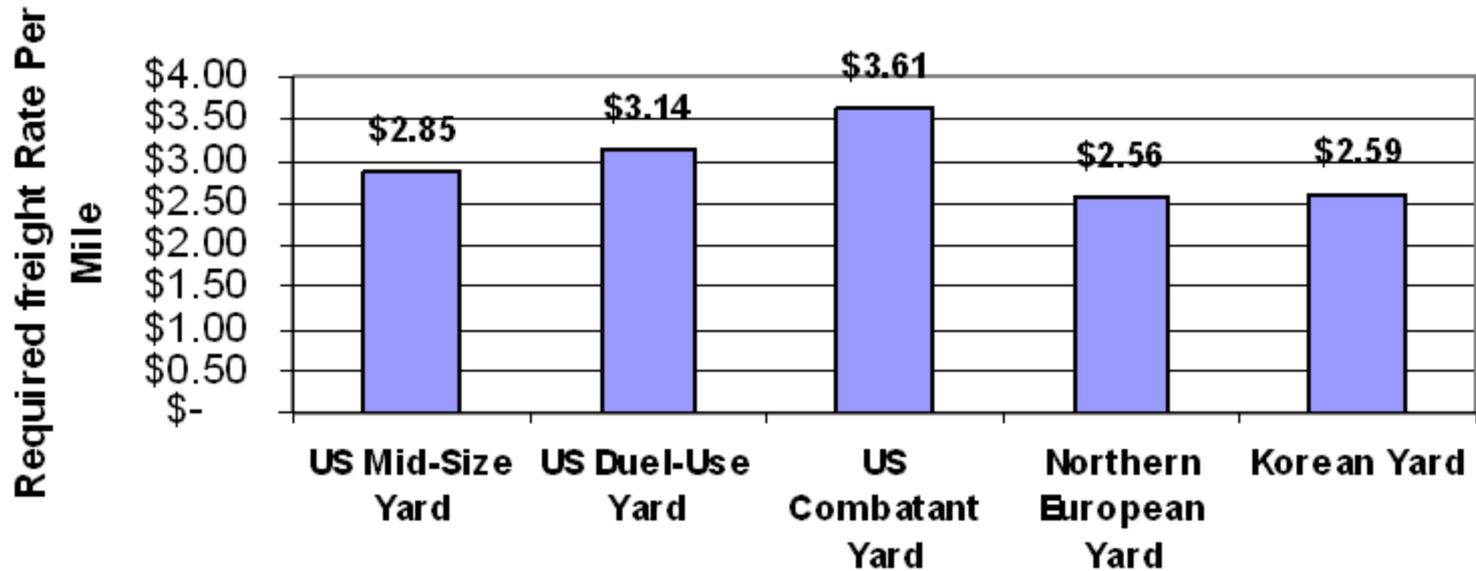
There is a point, however, where the RFR begins to increase with additional speed. This is the point where the operating cost of additional speed exceeds the cost benefits of carrying more cargo over time.

Since capital costs are high, they are a major component of the RFR.

Capital costs per ship can be reduced from a series ship construction program.



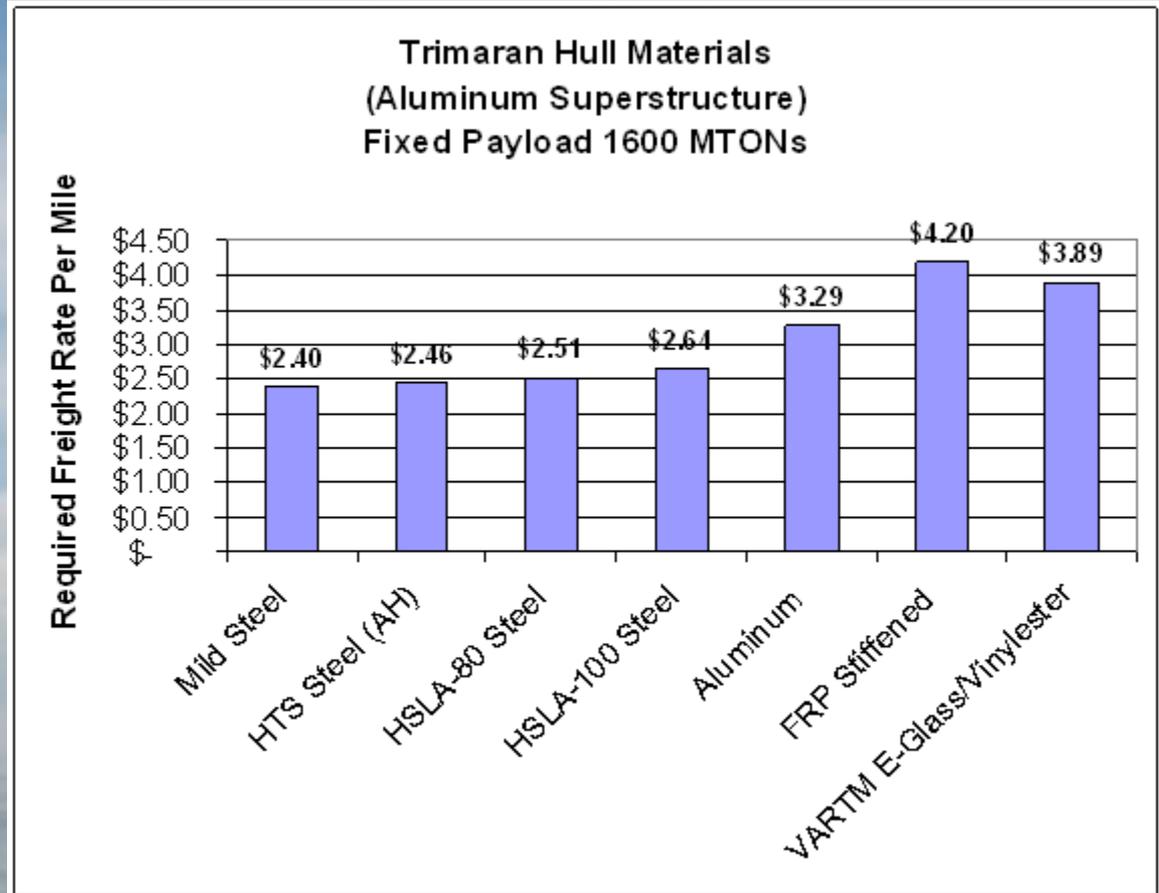
Required Freight Rate Vs Type Construction Yard



Capital costs will depend upon the type of shipyard that builds the ship.

These differences can be seen to be reflected in the RFR.

As changes are made to the ship design, the model can quickly identify their impact upon the RFR.



**Other variables may be evaluated,
such as financing costs, terms and
conditions.**



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