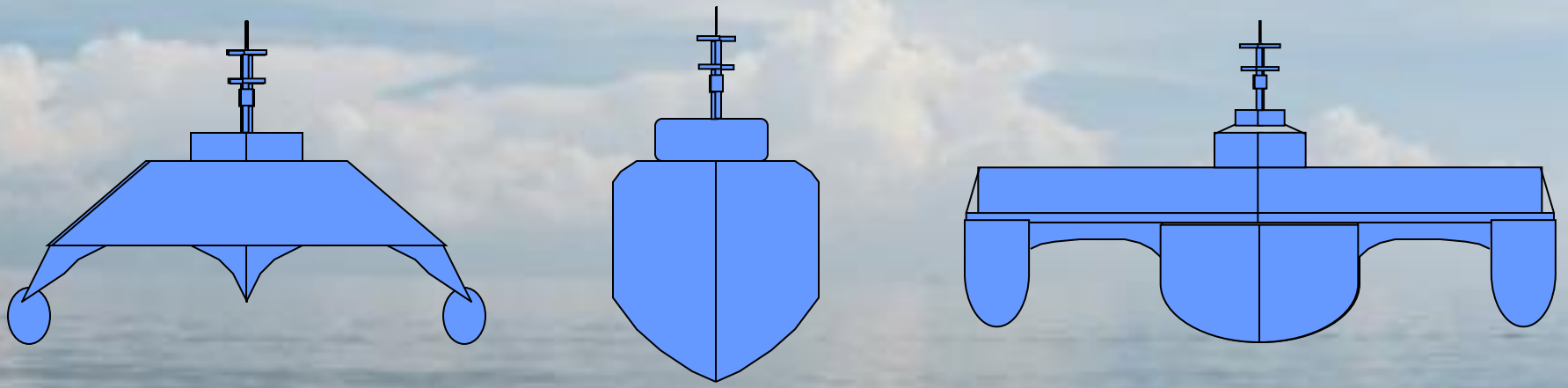
SPAR's Estimating Cost Models



SPAR ASSOCIATES, INC.

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 SPAR's ESTI-MATE database system or fully integrated within ESTI-MATE.

SPAR's cost models were developed to support early concept and preliminary stages of ship design. The cost models permit quick assessments of costs, risk, and design/mission trade-off and build strategy alternatives. ***There are options for Life Cycle Cost (LCC) Estimating Too.***

These cost models are parametric in nature, although they provide a granularity of cost details down to approximately the SWBS level 3.

Various versions provide construction cost estimates for lead ship, follow ships and non-recurring design and engineering efforts for different hull forms and mission requirements.

SPAR ASSOCIATES, INC.

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.

The models provide a range of structural and powering selections, as well as a wide range of other ship systems and equipment choices to predict costs and various performance characteristics.

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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.

SPAR Associates, Inc.
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 anc	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	Degausing 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 - Auxillary 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 Pip	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 pe	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

SPAR ASSOCIATES, INC.

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SPAR Associates, Inc.

SWBS Group Summary Report (SUM02)

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	0	0	0	0	0	0	0
8	Technical Support	[illegible]	[illegible]	[illegible]	0	0	[illegible]	0	3,999,876	6,696,251	669,625	7,365,876
9	Shipyard 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 Managment	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**

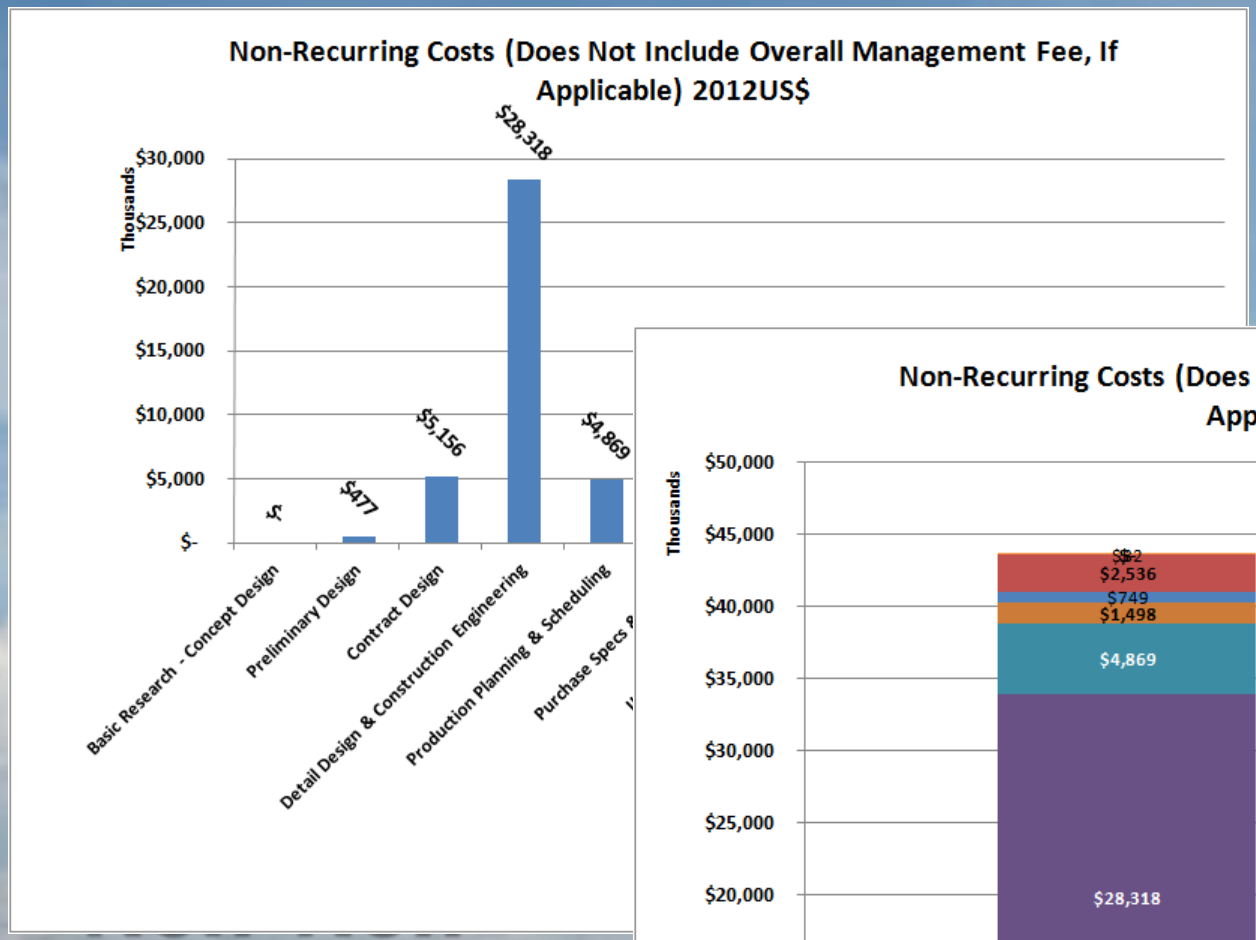
Summary Cost Estimate Reports

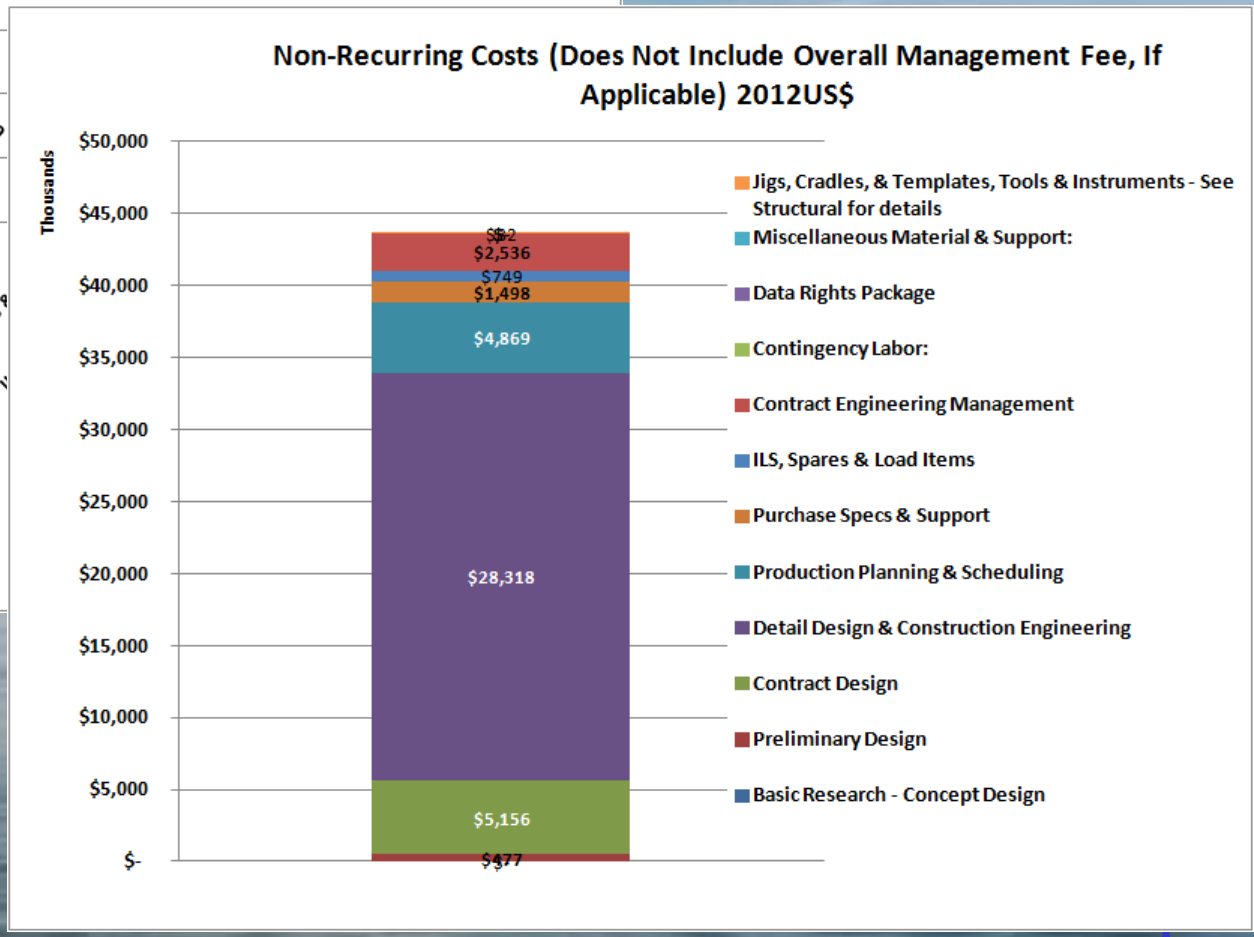
SPAR ASSOCIATES, INC.

The models estimate both recurring and non-recurring costs

Options for Life Cycle Costs (LCC)

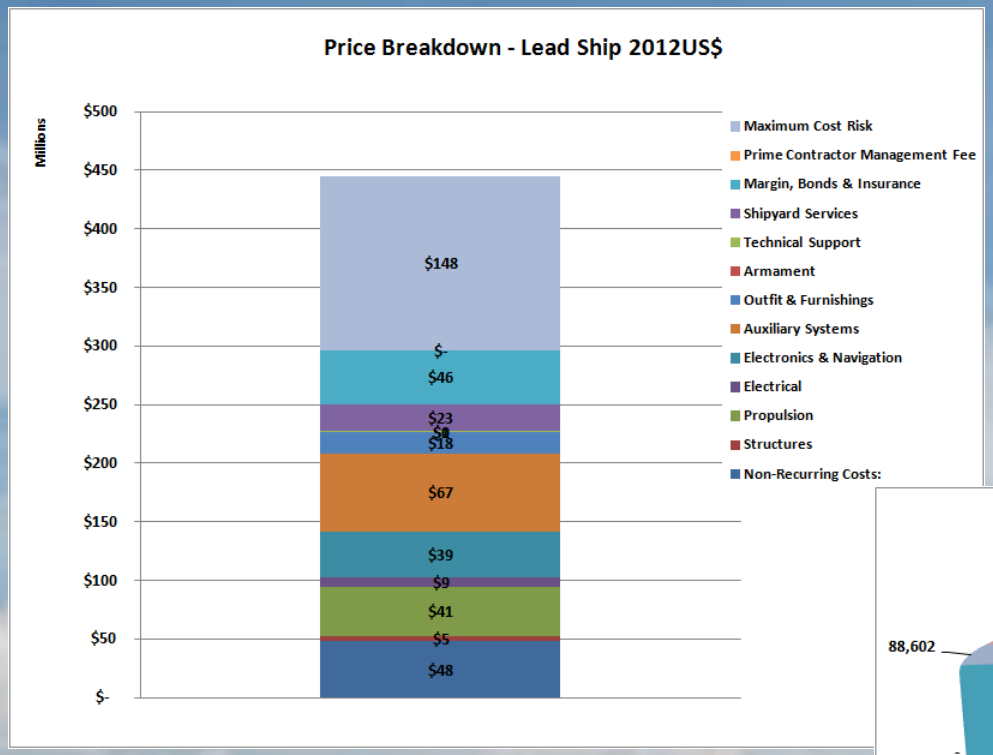
SPAR ASSOCIATES, INC.

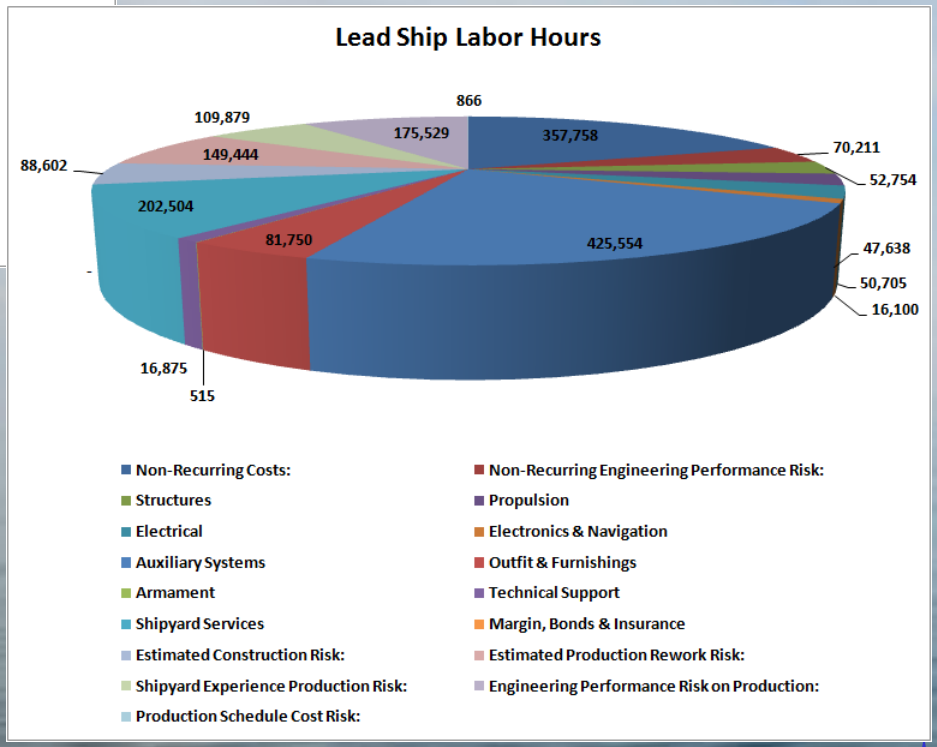




Non-Recurring Cost Estimate

SPAR ASSOCIATES, INC.

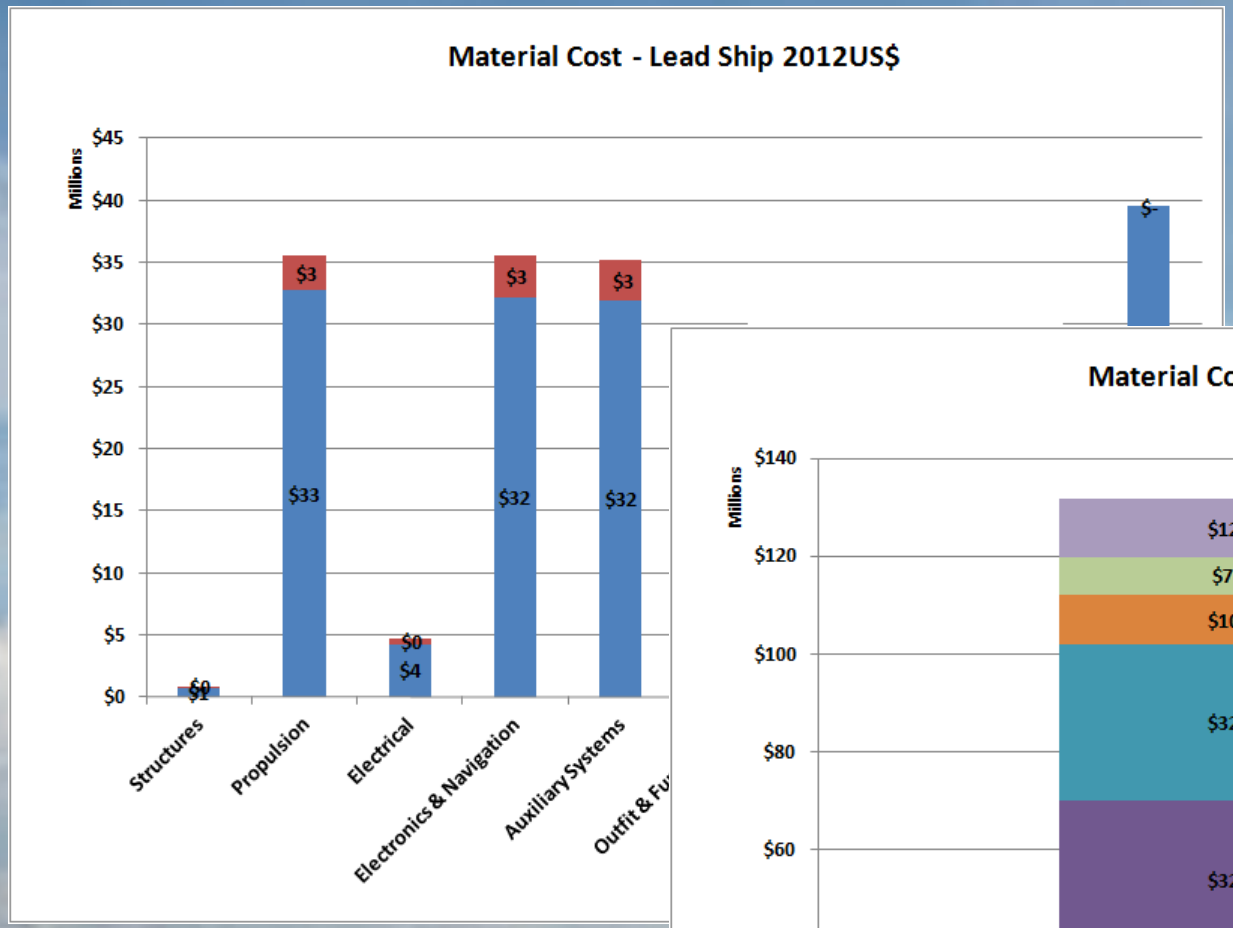


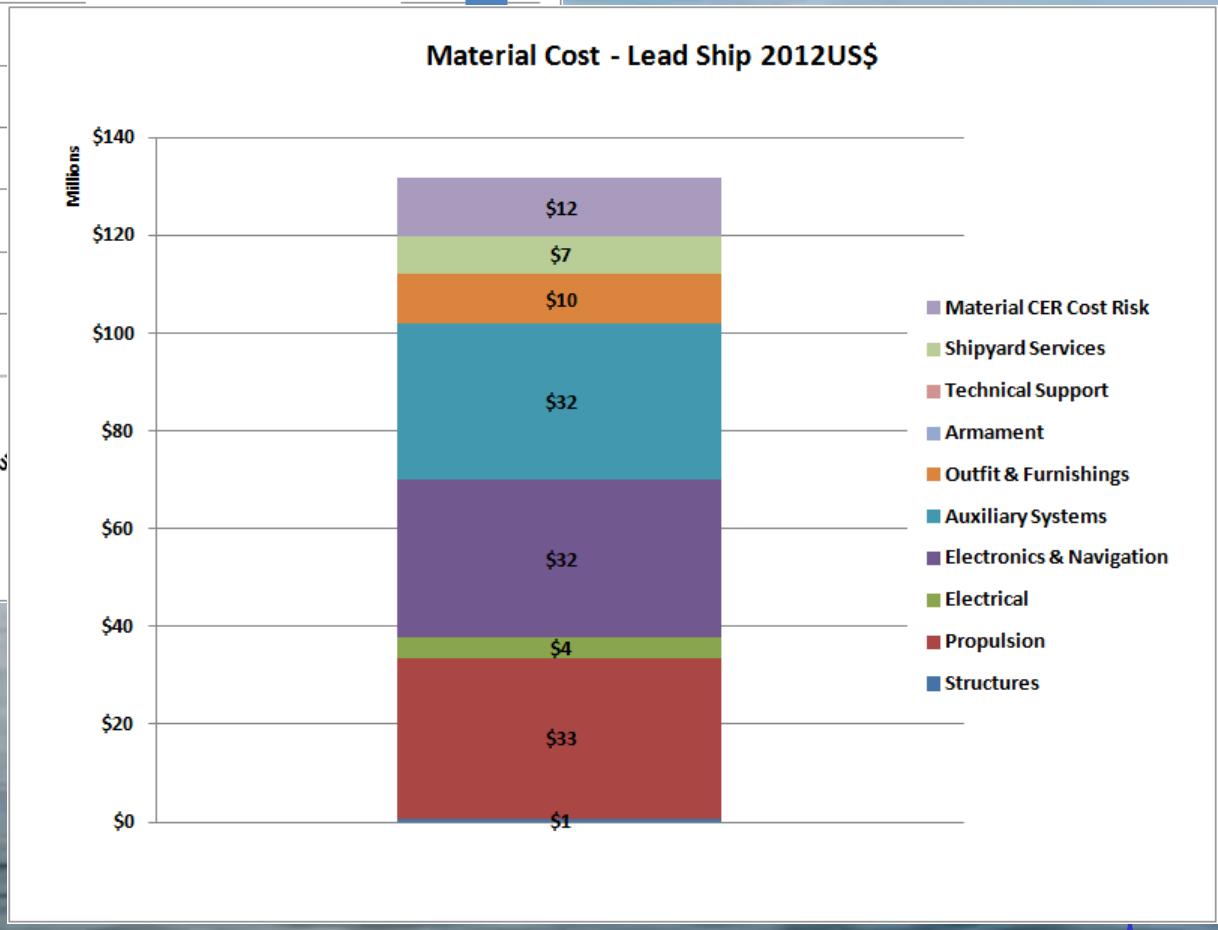


Lead Ship Cost Estimate

SPAR ASSOCIATES, INC.

Lead Ship Material Cost Estimate





Mono Hull Patrol Boat/Cutter/Frigate

(Model Version September 2012)

% Margin	-	%
% Mark-Up	-	%
% Change Orders	-	%
% Program Costs	-	%
% Contingencies	15.00	%

Ship Type: 80 Meter Offshore Patrol Vessel

Version: A

Date: 24-Oct-12

SPAR ASSOCIATES, INC.

NON-RECURRING COSTS

Basic Research - Concept Design	$	-
Preliminary Design	$	476,531
Contract Design	$	5,156,223
Detail Design & Construction Eng	$	28,318,022
Production Planning & Scheduling	$	4,868,645
Purchase Specs & Support	$	1,498,045
ILS, Spares & Load Items	$	749,022
Contract Engineering Manageme	$	2,535,965
Contingency Labor:	$	-
Data Rights Package	$	-
Miscellaneous Material & Suppor	$	-
Jigs, Cradles, & Templates, Tools	$	81,609
TOTAL NON-RECURRING COSTS:	$	43,684,061

Pricing:

Shipbuilder Economic Mark-Up/Down:	0.0%		
Technical Wage $/Mhr:	$ 33.97	$ 76.43	w/ overhead
Production Wage $/Mhr:	$ 28.31	$ 63.69	w/ overhead
% Overhead:	125.00	%	
% G&A Labor:	-	%	
% G&A Material:	6.00	%	
% Profit:	10.00	%	

Non-Recurring Engineering & Production Planning

Standard Work Week:			40.00	hours/week
Labor Rates:				
224%	Senior Professional/Manager	$	142.52	per hour
200%	Engineer	$	127.24	per hour
176%	Designer/Draftsperson/Planner	$	112.01	per hour
96%	Clerical	$	61.08	per hour
191%	Contingency (weighted average)	$	121.88	per hour

Navy C4ISR	Yes				
Jones Act Premium Material Factor:	No	1.00		Shipyard	Fab/Assy Mod'les
Current Year:	2012		Shipyard Tech Support Labor Factor:	1.0000	No Ext.Modules
Additional Material Escalation:	1.00	*1.000 = none*	Steel Productivity Factor:	1.1000	1.000
Shipyard Material Cost Factor:	1.15	MILSPEC Prem.=1.21	Outfit Productivity Factor:	1.1500	1.000
Combined Material Cost Factor:	1.15		On-Block Paint Factor:	1.0000	*40 % Hours On Block*

Estimated Schedules

Est. Detail Engineering Time:	24.00	Months	
Est. Construction Time:	20.00	Months	
Overlap:	10.00	Months	50.0%
RMS Men/Month: 145	0.02	Months	0.1%

	SWBS Group	Weight LTons	M-Hrs Per Lton	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	447.3	117.95	-	52,754	1,493,335	1,866,669	-	761,838	45,710	416,755	4,584,307	
Propulsion	2	317.4	150.10	-	47,638	1,348,529	1,685,662	-	32,727,700	1,963,662	3,772,555	41,498,108	
Electrical	3	76.1	665.90	-	50,705	1,435,333	1,794,167	-	4,291,056	257,463	777,802	8,555,821	
Electronics & Navigation	4	141.7	113.60	-	16,100	455,754	569,693	-	32,133,925	1,928,036	3,508,741	38,596,148	
Auxiliary Systems	5	173.6	2,451.90	-	425,554	12,046,446	15,058,058	-	31,878,973	1,912,738	6,089,622	66,985,837	
Outfit & Furnishings	6	153.9	531.29	-	81,750	2,314,145	2,892,681	-	10,376,736	622,604	1,620,617	17,826,783	
Armament	7	23.9	21.59	-	515	14,584	18,230	-	3,597	216	3,663	40,290	
Technical Support	8	2.5%	12.65		16,875	573,244	716,555	-	28,750	1,725	132,027	1,452,301	
Shipyard Services	9	30.0%	151.79		202,504	5,732,438	7,165,548	-	7,487,514	449,251	2,083,475	22,918,225	
Margin, Bonds & Insurance	10	-	-		-	-	-	-	39,499,892	2,369,994	4,186,989	46,056,874	
Lead Ship Totals:		1,334	670.39	-	894,395	$ 25,413,809	$ 31,767,261	$ -	$ 159,189,981	$ 9,551,399	22,592,245	$ 248,514,695	$ 248,514,695
Non-Recurring Costs:	% Total Lead Ship G1-7 Man-Hours:			40%	357,758	$ 43,602,452	$ -	$ -	$ 81,609	$ -	4,368,406	$ 48,052,467	$ 296,567,161

Technical Support:	0.82%	*Production $ Costs*	
Shipyard Services:	12.87%	*Production $ Costs*	
Fees & Insurance:	25.86%	*Production $ Costs*	
Non-Recurring Costs:	26.98%	*Production $ Costs*	
Production Costs (1-7):	$ 178,087,294	71.7%	GR 1-10

Estimated Cost for Prime Contractor Management Team:		$	-
Over-All Program Management Fee:	0.0%	$	-
Total Price with Prime Contractor Management:		$	296,567,161
Est. Construction/Technology Risk:		$	17,661,314 w/o Profit
Estimated Overlap Rework Risk:		$	41,524,097 w/o Profit
Est. Shipyard Experience Risk:	0.65	$	30,530,774 w/o Profit
t. Engineering Performance Risk:	0.65	$	58,202,484 w/o Profit
Production Schedule Cost Risk:		$	240,715 w/o Profit
Total Price with 100% Risk:		$	444,726,545 w/o Profit

Production Hrs/LSW:	670.39
LT/MT	*0.98421*

SPAR ASSOCIATES, INC.

Summary Non-Recurring Costs

% Margin	-	%
% Mark-Up	-	%
% Change Orders	-	%
% Program Costs	-	%
% Contingencies	15.00	%

Mono Hull Patrol Boat/Cutter/Frigate

(Model Version September 2012)

Ship Type: 80 Meter Offshore Patrol Vessel

Version: A

Date: 24-Oct-12

SPAR ASSOCIATES, INC.

NON-RECURRING COSTS	
Basic Research - Concept Design	$ -
Preliminary Design	$ 476,531
Contract Design	$ 5,156,223
Detail Design & Construction Eng	$ 28,318,022
Production Planning & Scheduling	$ 4,868,645
Purchase Specs & Support	$ 1,498,045
ILS, Spares & Load Items	$ 749,022
Contract Engineering Manageme	$ 2,535,965
Contingency Labor:	$ -
Data Rights Package	$ -
Miscellaneous Material & Suppor	$ -
Jigs, Cradles, & Templates, Tools	$ 81,609
TOTAL NON-RECURRING COSTS:	$ 43,684,061

Rates & Escalation

Pricing:

Shipbuilder Economic Mark-Up/Down:	0.0%		
Technical Wage $/Mhr:	$ 33.97	$ 76.43	w/ overhead
Production Wage $/Mhr:	$ 28.31	$ 63.69	w/ overhead
% Overhead:	125.0		
% G&A Labor:	-		
% G&A Material:	6.0		
% Profit:	10.00	%	

Non-Recurring Engineering & Production Planning

Standard Work Week:		40.00	hours/week
Labor Rates:			
	onal/Manager	$ 142.52	per hour
		$ 127.24	per hour
	person/Planner	$ 112.01	per hour
96%	Clerical	$ 61.08	per hour
191%	Contingency (weighted average)	$ 121.88	per hour

Navy C4ISR	Yes	
Jones Act Premium Material Factor:	No	1.00
Current Year:	2012	
Additional Material Escalation:	1.00	*1.000 = none*
Shipyard Material Cost Factor:	1.15	MILSPEC Prem.=1.1
Combined Material Cost Factor:	1.15	

Productivity Factors

	Shipyard	Fab/Assy Mod'les
Shipyard		
On-Block Paint Factor:	1.0000	*40 % Hours On Block*

Estimated Schedules

Est. Detail Engineering Time:	24.00	Months	
Est. Construction Time:	20.00	Months	
Overlap:	10.00	Months	50.0%
Month: 145	0.02	Months	0.1%

SWBS Summary Costs

	SWBS Group	Weight LTons	M-Hrs Per Lton	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	447.3	117.95	-	52,754	1,493,335	1,866,669	-	761,838	45,710	416,755	4,584,307	
Propulsion	2	317.4	150.10	-	47,638	1,348,529	1,685,662	-	32,727,700	1,963,662	3,772,555	41,498,108	
Electrical	3	76.1	665.90	-	50,705	1,435,333	1,794,167	-	4,291,056	257,463	777,802	8,555,821	
Electronics & Navigation	4	141.7	113.60	-	16,100	455,754						38,596,148	
Auxiliary Systems	5	173.6	2,451.90	-	425,554	12,046,446						66,985,837	
Outfit & Furnishings	6	153.9	531.29	-	81,750	2,314,145						17,826,783	
Armament	7	23.9	21.59	-	515	14,584						40,290	
Technical Support	8	2.5%	12.65		16,875	573,244	716,555	-	28,750	1,725	132,027	1,452,301	
Shipyard Services	9	30.0%	151.79		202,504	5,732,438	7,165,548	-	7,487,514	449,251	2,083,475	22,918,225	
Margin, Bonds & Insurance	10	-	-		-	-	-	-	39,499,892	2,369,994	4,186,989	46,056,874	
Lead Ship Totals:		1,334	670.39	-	894,395	$ 25,413,809	$ 31,767,261	$ -	$ 159,189,981	$ 9,551,399	22,592,245	$ 248,514,695	$ 248,514,695
Non-Recurring Costs:	% Total Lead Ship G1-7 Man-Hours:			40%	357,758	$ 43,602,452	$ -	$ -	$ 81,609	$ -	4,368,406	$ 48,052,467	$ 296,567,161

Shipyard Services:	12.87%	*Production $ Costs*	
Fees & Insurance:	25.86%	*Production $ Costs*	
Non-Recurring Costs:	26.98%	*Production $ Costs*	
		Production Costs (1-7)	$ 178,087,294 71.7% GR 1-10

Estimated Cost for Prime Contractor Management Team: $ -

Over-All Program Management Fee: 0.0% $ -

Total Price with Prime Contractor Management: $ 296,567,161

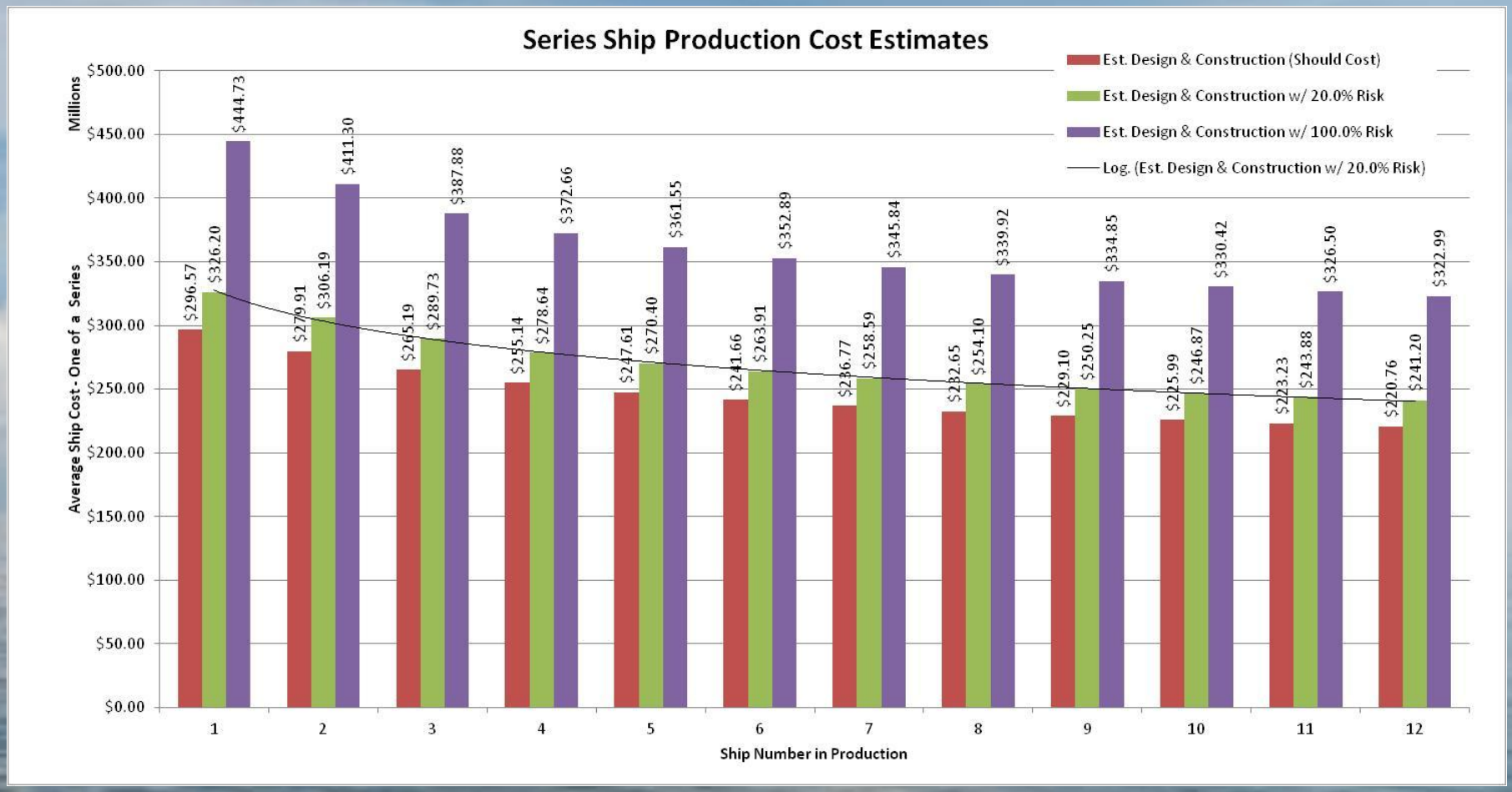
Production Hrs/LSW:	670.39
LT/MT	*0.98421*

Summary Cost Risk

	Est. Construction/Technology Risk:	$ 17,661,314	w/o Profit
	Estimated Overlap Rework Risk:	$ 41,524,097	w/o Profit
0.65	*Est. Shipyard Experience Risk:*	$ 30,530,774	w/o Profit
0.65	*t. Engineering Performance Risk:*	$ 58,202,484	w/o Profit
	Production Schedule Cost Risk:	$ 240,715	w/o Profit
	Total Price with 100% Risk:	$ 444,726,545	w/o Profit

SPAR ASSOCIATES, INC.

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



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.

SPAR ASSOCIATES, INC.

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.

35,000 DWT Product Carrier	Enter Ship Name	Metric Units		Computed					Model Default Values	
Hull:										
LOA, Length Overall	165.00	M		165.00						
LWL, Length Waterline	-	M		155.88	94%	LOA			155.88	M
Beam, Molded	-	M		28.31	17%	LOA			28.31	M
Depth, Molded	-	M		14.88	9%	LOA	53%	Beam	14.88	M
Draft, Design Full Load, Molded	-	M		9.80	6%	LOA			9.80	M
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	-	SQM		1,092					1,092	SQM
Volume of SuperStructure	-	CUM		3,081					3,081	CUM
Number Decks Below Weather Deck	-			-					-	
Total Areas of Cargo Decks OMS	-	SQM		-					-	SQM
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	**UJHR "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		26,826	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	-	SQFT/MTON		40.00	Default 40 SQFT/MTON				40	SQFT/MTON
Designed Deckspace per MTON Cargo		SQM/MTON		3.72						
Required Cargo Deck Space	-	SQM		99,684	4269%	Estimated Available			99,684	SQM
Number of TEUs	-	TEU		-					-	TEU
Number of Vehicles at Capacity	-	NO.		1,341					1,341.00	NO.
Average Weight per Vehicle	-	MTON/EA		20.00					20.00	MTON/EA
Average Deck Space per Vehicle		SQM		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	SQM	10.00	SQM/PERS	100.00%
Commissioned Officers	-	PAX	-	-	-	SQM	-	SQM/PERS	0.00%
Non-Commissioned Officers	-	PAX	-	-	-	SQM	-	SQM/PERS	0.00%
Enlisted	-	PAX	-	-	-	SQM	-	SQM/PERS	0.00%
Troop Force	-	PAX	-	-	-	SQM	-	SQM/PERS	0.00%
Overnight Passengers	-	PAX	-	-	-	SQM	-	SQM/PERS	0.00%
PAX Daytrippers	-	PAX	-	-	-	SQM	-	SQM/PERS	0.00%
	-	Total	20	Total	200	SQM	10.00	SQM/PERS	100.00%

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Defining Structural Components with Material Codes

Structure Weight: If no details, use "Default Total Ship." If limited details, use "General Hull Block Structures." If production-level details, use "Specific Hull Blocks." Always use "Miscellaneous" where applicable.	Enter -1 to zero item	Metric Units	Computed	Material Code No.
NOTE: If you want to use the default structures breakdown, but also have the total structural weight available, enter that total weight here to the right.		MTONs Total Structural Wt		
Default Total Ship - No Details Available		MTON		11
General Hull Block Structures				
Double Bottoms - Parallel	-	MTON	8.38	6
Double Bottoms - Shaped	-	MTON	12.56	6
Single Side Shell - Parallel	-	MTON	64.37	1
Single Side Shell - Shaped	-	MTON	42.91	1
Double Side Shell - Parallel	-	MTON	-	2
Double Side Shell - Shaped	-	MTON	-	2
Weather Decks	-	MTON	53.29	1
Flat Decks	-	MTON	44.25	1
Deck Platforms & Cross-Overs	-	MTON	-	2
Platforms/Flats	-	MTON	29.92	1
Stanchions	-	MTON	1.91	1
Transverse Frames	-	MTON	26.34	1
Longitudinal Frames	-	MTON	12.89	1
Transverse Bulkheads - Stiffened	-	MTON	30.30	1
Longitudinal Bulkheads - Stiffened	-	MTON	2.60	1
Bulkheads - Corregated	-	MTON	-	2
Ballistic Plating	10.00	MTON	10.00	6
Trunks and Enclosures	-	MTON	11.46	1
Deckhouse/Superstructure/Bridge	-	MTON	12.27	9
Specific Hull Blocks: Aft Units				
Double Bottoms Aft	-	MTON	-	1
Side Tanks Aft	-	MTON	-	1
Aft Cross Tanks	-	MTON	-	1
Aft Shell	-	MTON	-	1
Aft Peak	-	MTON	-	1
Flat Aft Deck	-	MTON	-	1
Bilge Keels & Skegs	-	MTON	4.71	1
Skegs, Large Ship	-	MTON	-	1
Stern Doors	-	MTON	-	2
Rudder & Horn	-	MTON	0.54	2

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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 - Average FRP Cored Panel	28
HTS (AH)	2	Composite - Average FRP Stiffened Panel	29
EH-36 Steel	3	Composite - Average FRP Stiffened Hull Section	30
HSLA-65 Steel	4	Composite - VARTM/SCRIMP FRP Cored Panel	31
HY-80	5	Composite - VARTM/SCRIMP FRP Stiffened Panel	32
HSLA-80	6	Composite - VARTM/SCRIMP FRP Stiffened Hull Section	33
HY-100	7	Composite - UV VARTM FRP Composite Cored Panel	34
HSLA-100	8	Composite - UV VARTM FRP Composite Stiffened Panel	35
HSLA-100M	9	Composite - UV VARTM FRP Composite Hull Section	36
HY-130	10	Composite - UV Pre-Preg FRP Composite Cored Panel	37
ASTM A 537 Steel - Low Temp High Strength	11	Composite - UV Pre-Preg FRP Composite Stiffened Panel	38
1/4 HTS & 3/4 Mild Steel	12	Composite - UV Pre-Preg FRP Composite Hull Section	39
1/3 HTS & 2/3 Mild Steel	13	Composite - Low Temp Cured Pre-Preg FRP Composite Cored Panel	40
1/2 HTS & 1/2 HSLA-80	14	Composite - Low Temp Cured Pre-Preg FRP Composite Stiffened Panel	41
1/3 HTS & 2/3 HSLA-80	15	Composite - Low Temp Cured Pre-Preg FRP Composite Hull Section	42
DeckHouse-50% Composite; 38% Mild Steel; and 12% HTS	16	Advanced Metalic or Non-metalic Composite	43
NEXT	17	Advanced Lightweight, 70MT Capacity	44
NEXT	18	NEXT	45
NEXT	19	NEXT	46
NEXT	20	NEXT	47
Titanium (CP Ti 50A & Ti 130) Plate	21	NEXT	48
Titanium 6-4 Plate	22	NEXT	49
Aluminum (5xxx)	23	ACV Skirt Material	50
Aluminum (2xxx & 7xxx)	24	NEXT	51
Stainless Steel 304	25	NEXT	52
Stainless Steel 316	26	NEXT	53
LASCOR Metal Sandwich	27	NEXT	54
		NEXT	55

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Wide Selection of Type Propulsion & Electric Generation Systems

Details of propulsion systems given in *Propulsion* Worksheet.

Machinery Configuration:	QTY	kW Each MAX.Service Speed	UoM	Computed QTY	kW MAX.Service Speed	SFC (g/kw-hr)	LNG Capable? Y/N
Diesel HS Geared Drive w/ CPP			KW	-	-	206.81	
Diesel HS Geared Drive w/ FPP			KW	-	-	206.81	
Diesel HS Geared Drive w/ Waterjet			KW	-	-	206.81	
Diesel MS Geared Drive w/ CPP			KW	-	-	200.73	Y
Diesel MS Geared Drive w/ FPP			KW	-	-	200.73	
Diesel MS Geared Drive w/Waterjet	2.0	7,400	KW	2.00	14,800	200.73	
Diesel LS w/ CPP			KW	-	-	170.32	
Diesel LS w/ FPP			KW	-	-	170.32	
Diesel MS Z-Drive w/CPP			KW	-	-	200.73	
Diesel MS Z-Drive w/Open Prop			KW	-	-	200.73	
Diesel MS Z-Drive w/Ducted Prop			KW	-	-	200.73	
Diesel Electric Drive w/FPP			KW	-	-	218.98	
Diesel Electric w/AZIPOD			KW	-	-	218.98	
Diesel Electric w/Water Jets			KW	-	-	218.98	
Gas Turbine Direct Drive w/FPP			KW	-	-	212.90	
Gas Turbine Direct Drive w/CPP			KW	-	-	212.90	
Gas Turbine Direct Drive w/ Waterjet			KW	-	-	212.90	
Gas Turbine Electric Drive w/FPP			KW	-	-	212.90	
Gas Turbine w/ Electric Waterjet			KW	-	-	212.90	
Gas Turbine w/ Electric AZIPOD			KW	-	-	212.90	
Nuclear G/T Electric Drive w/FPP			KW	-	-	48.66	
Nuclear G/T w/Waterjet			KW	-	-	48.66	
Nuclear G/T Electric Drive w/AZIPOD			KW	-	-	48.66	
Steam Turbine w/FPP			KW	-	-	-	
BOG (LNG) Steam Turbine w/FPP			KW	-	-	-	
BOG (LNG) Duel-Fuel SP Diesel Electric w/FPP			KW	-	-	170.32	
BOG (LNG) 2-Stroke Diesel w/FPP			KW	-	-	170.32	
PEM Fuel Cell Electric Drive			KW	-	-	212.90	

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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

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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

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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.

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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.

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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.

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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.

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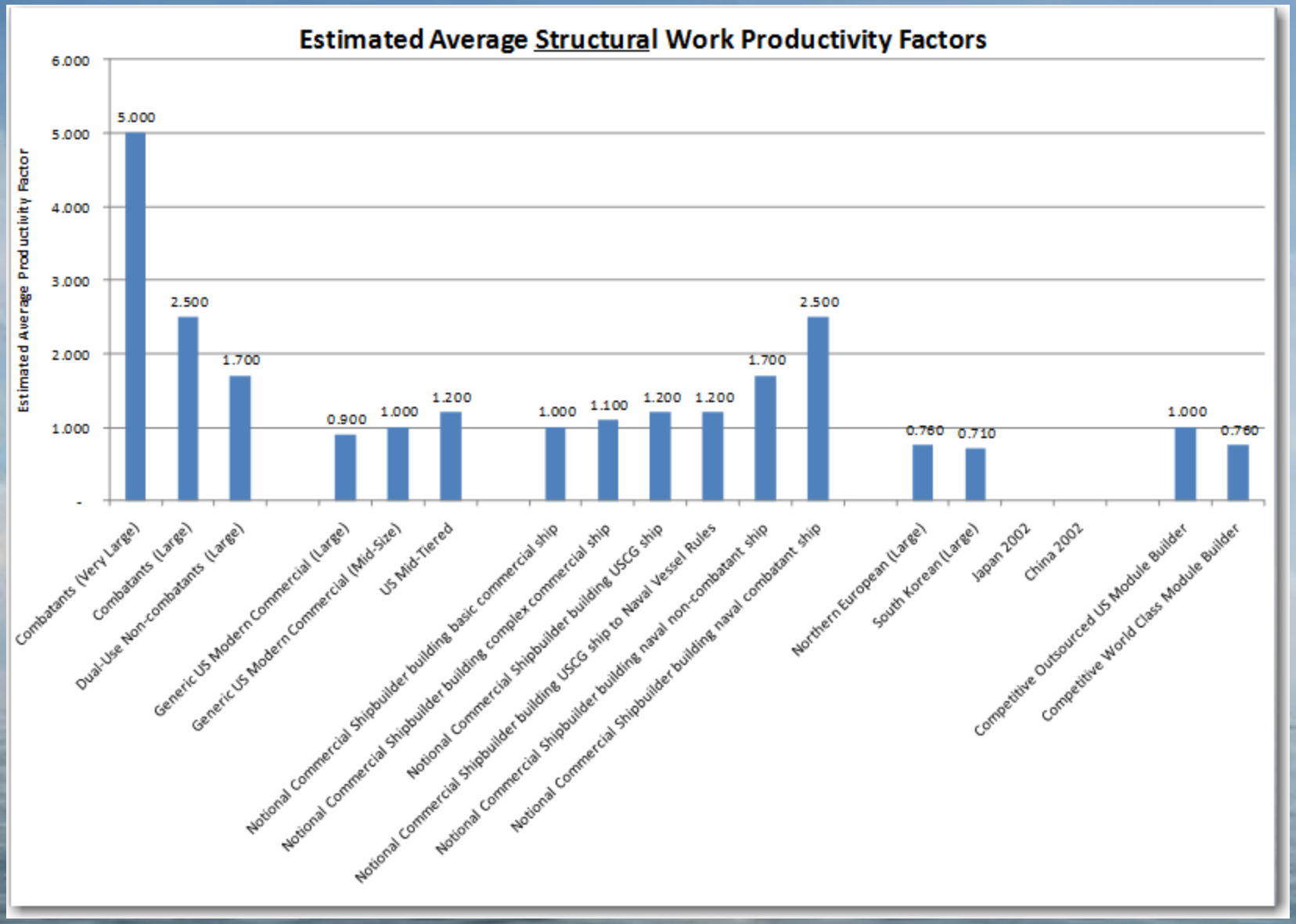
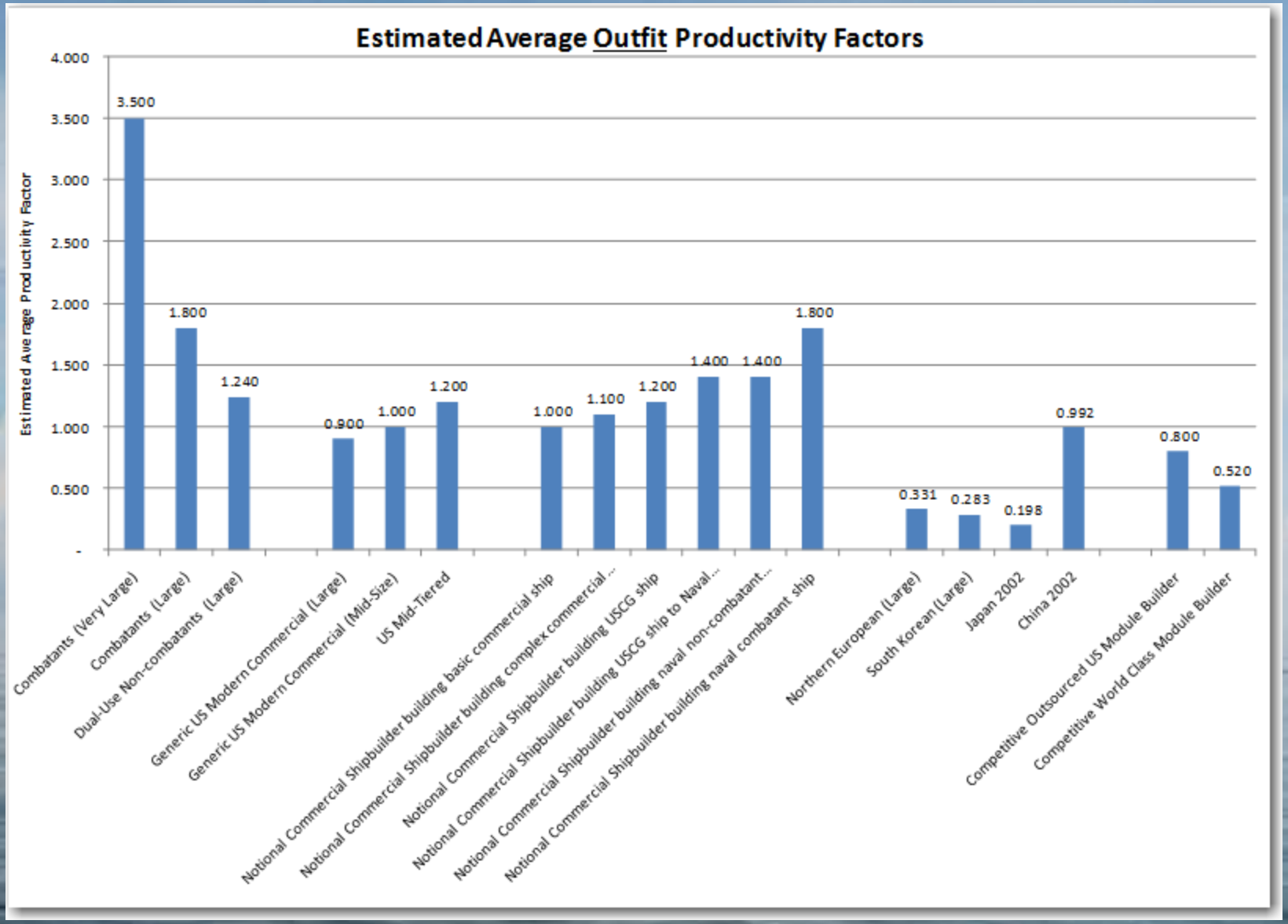
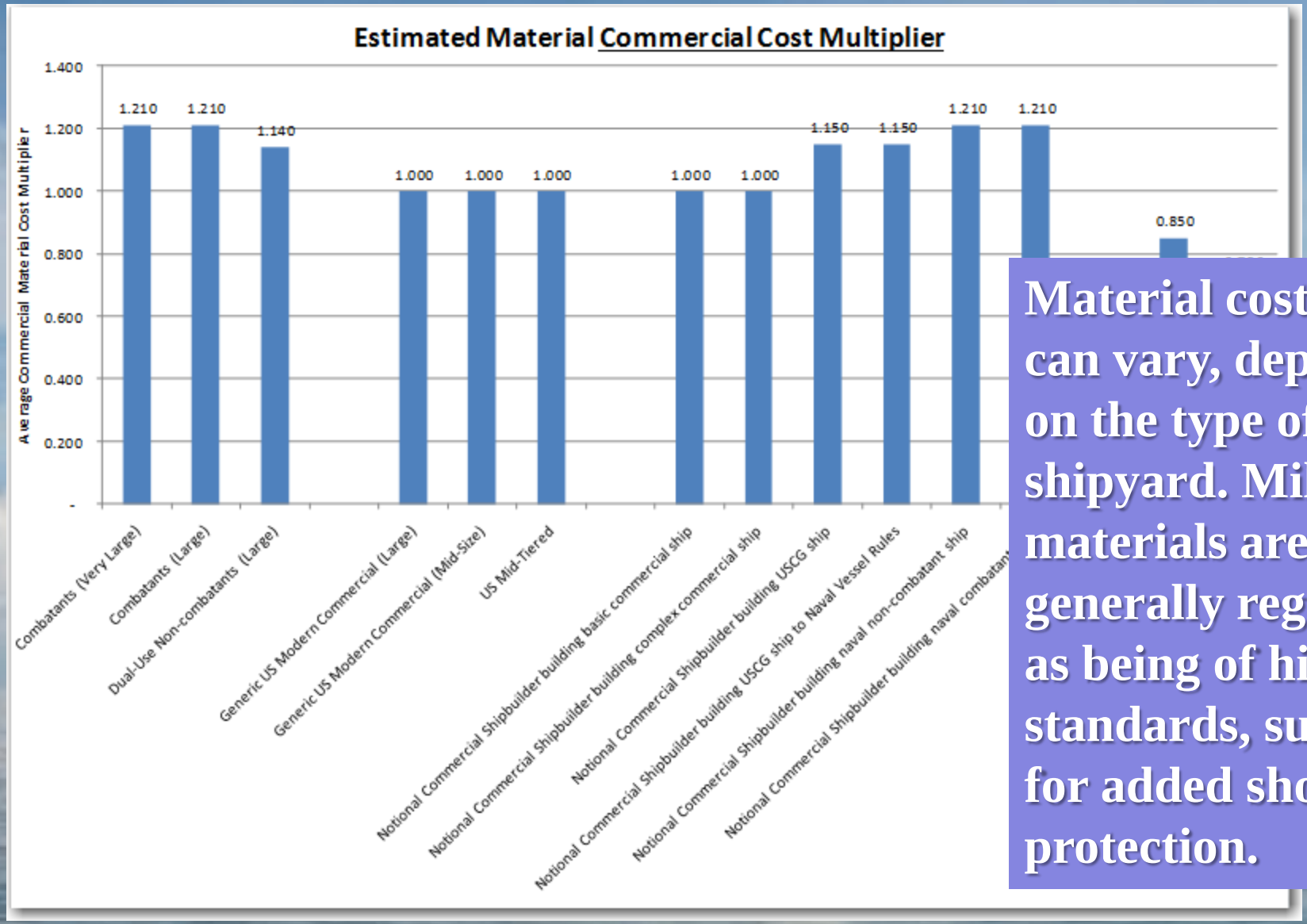

Estimated Average Structural Work Productivity Factors
Estimated Average Productivity Factor
6.000
5.000
4.000
3.000
2.000
1.000
-
5.000
2.500
1.700
0.900
1.000
1.200
1.000
1.100
1.200
1.200
1.700
2.500
0.760
0.710
1.000
0.760
Combatants (Very Large)
Combatants (Large)
Dual-Use Non-combatants (Large)
Generic US Modern Commercial (Large)
Generic US Modern Commercial (Mid-Size)
US Mid-Tiered
Notional Commercial Shipbuilder building basic commercial ship
Notional Commercial Shipbuilder building complex commercial ship
Notional Commercial Shipbuilder building USCG ship
Notional Commercial Shipbuilder building USCG ship to Naval Vessel Rules
Notional Commercial Shipbuilder building naval non-combatant ship
Notional Commercial Shipbuilder building naval combatant ship
Northern European (Large)
South Korean (Large)
Japan 2002
China 2002
Competitive Outsourced US Module Builder
Competitive World Class Module Builder


Estimated Average Outfit Productivity Factors
Estimated Average Productivity Factor
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
-
3.500
1.800
1.240
0.900
1.000
1.200
1.000
1.100
1.200
1.400
1.400
1.800
0.331
0.283
0.198
0.992
0.800
0.520
Combatants (Very Large)
Combatants (Large)
Dual-Use Non-combatants (Large)
Generic US Modern Commercial (Large)
Generic US Modern Commercial (Mid-Size)
US Mid-Tiered
Notional Commercial Shipbuilder building basic commercial ship
Notional Commercial Shipbuilder building complex commercial ...
Notional Commercial Shipbuilder building USCG ship
Notional Commercial Shipbuilder building USCG ship to Naval...
Notional Commercial Shipbuilder building naval non-combatant...
Notional Commercial Shipbuilder building naval combatant ship
Northern European (Large)
South Korean (Large)
Japan 2002
China 2002
Competitive Outsourced US Module Builder
Competitive World Class Module Builder



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.

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

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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

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

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

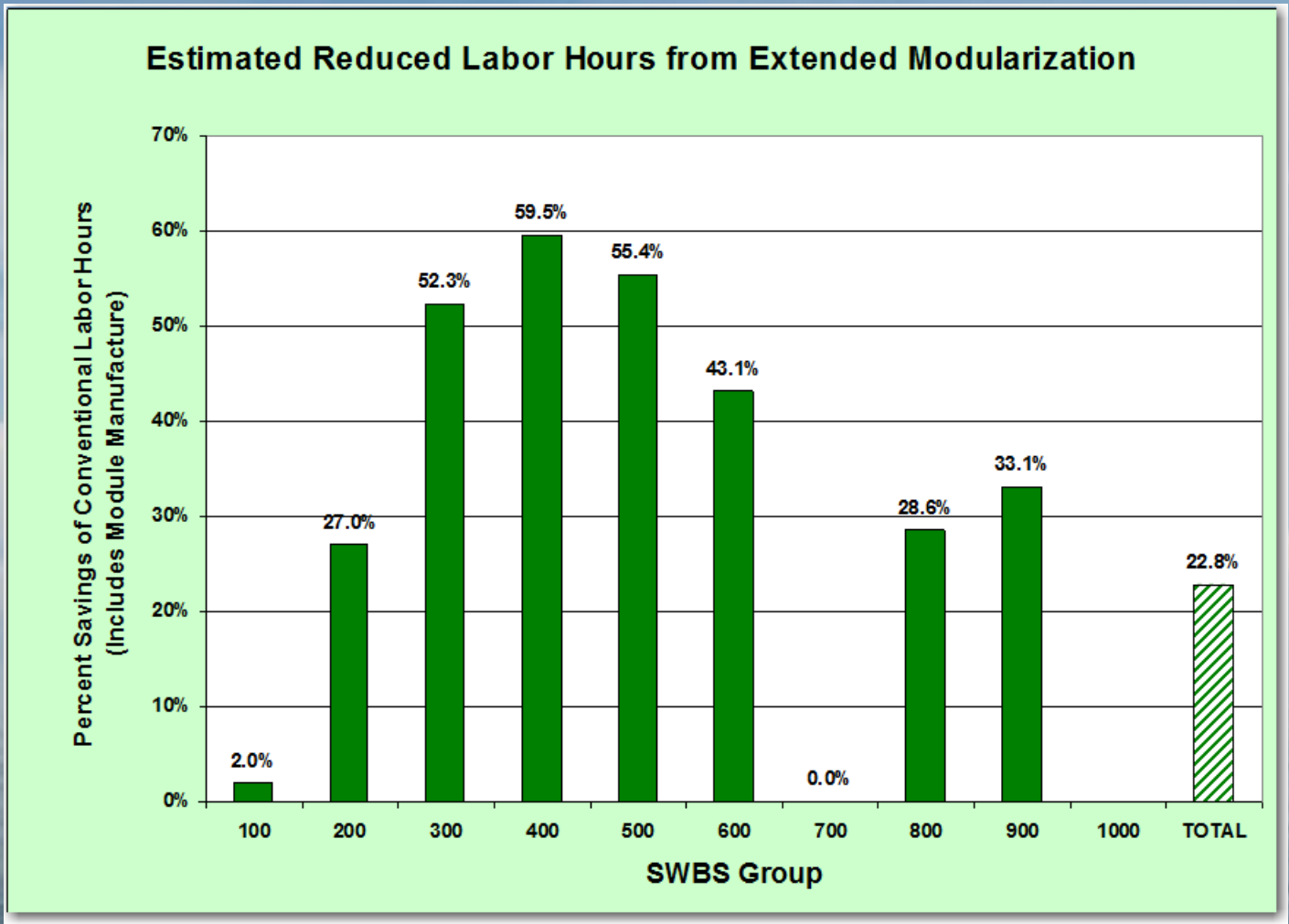
Lube Oil w/Pumps Module

Westfalia Separator Module

Hydrophore Module

Sewage Treatment Module

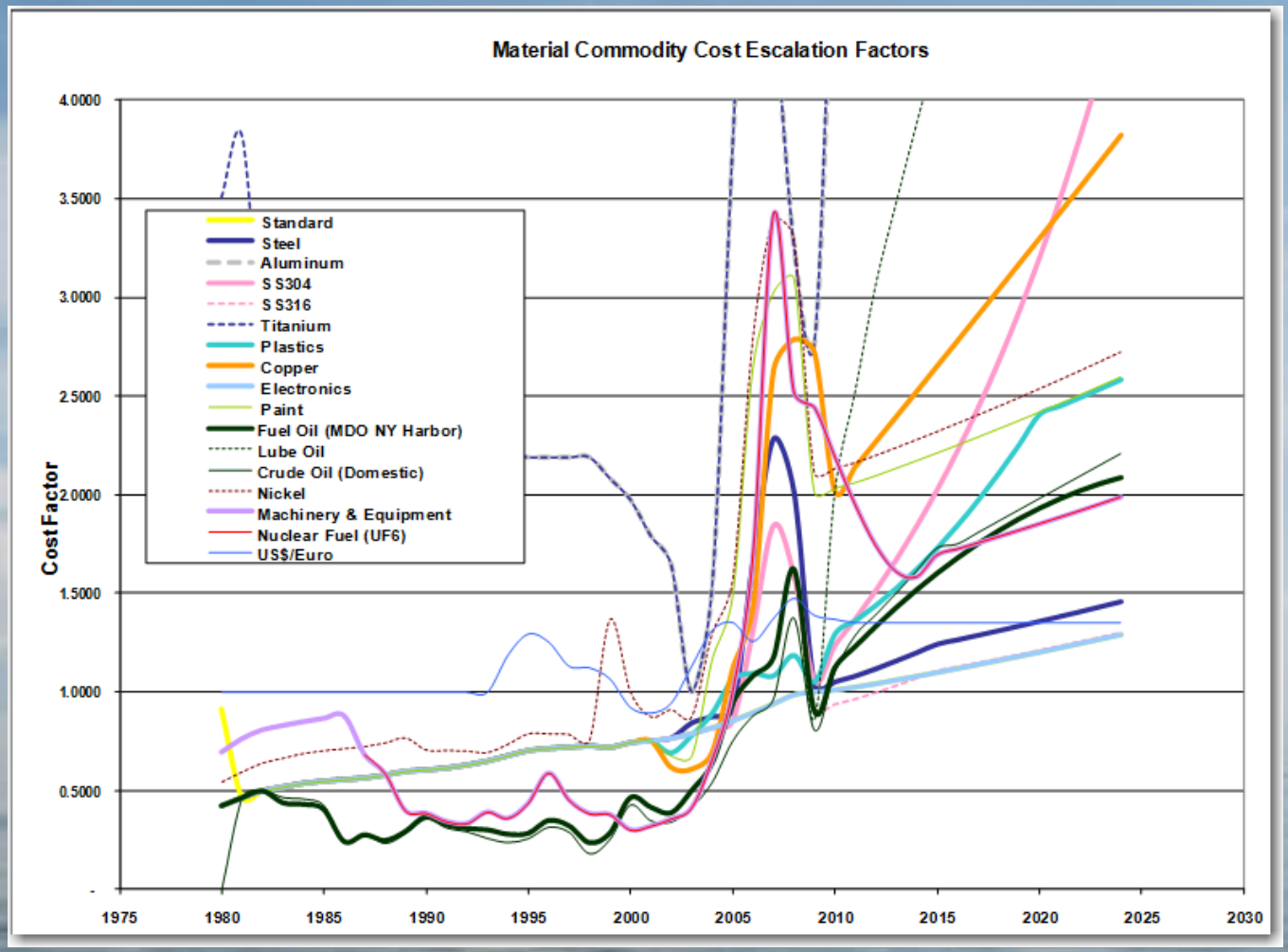
Refrigeration Compressor Module


Estimated Reduced Labor Hours from Extended Modularization
Percent Savings of Conventional Labor Hours (Includes Module Manufacture)
70%
60%
50%
40%
30%
20%
10%
0%
2.0%
27.0%
52.3%
59.5%
55.4%
43.1%
0.0%
28.6%
33.1%
22.8%
100
200
300
400
500
600
700
800
900
1000
TOTAL
SWBS Group

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.



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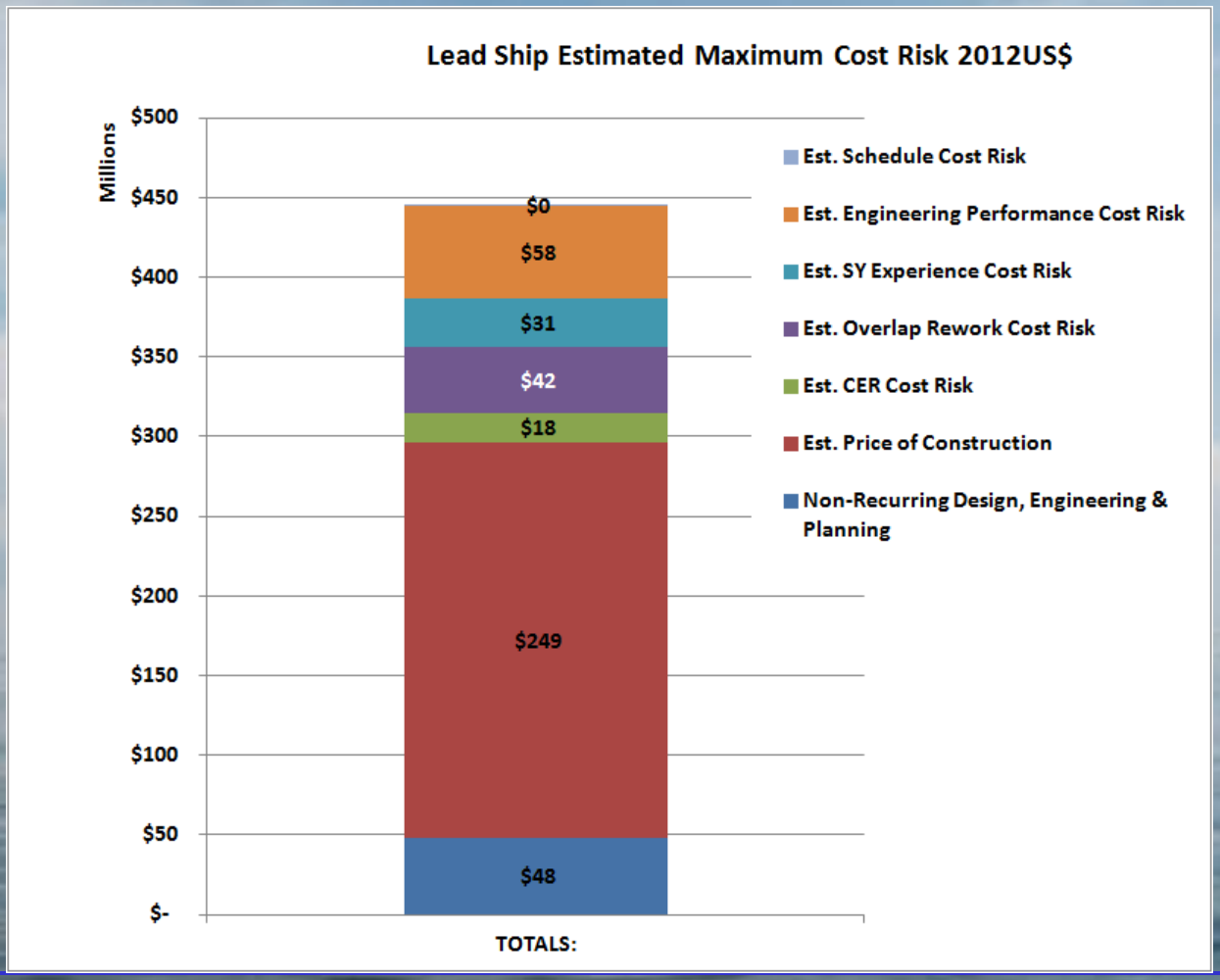
Contingencies

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.



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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.*

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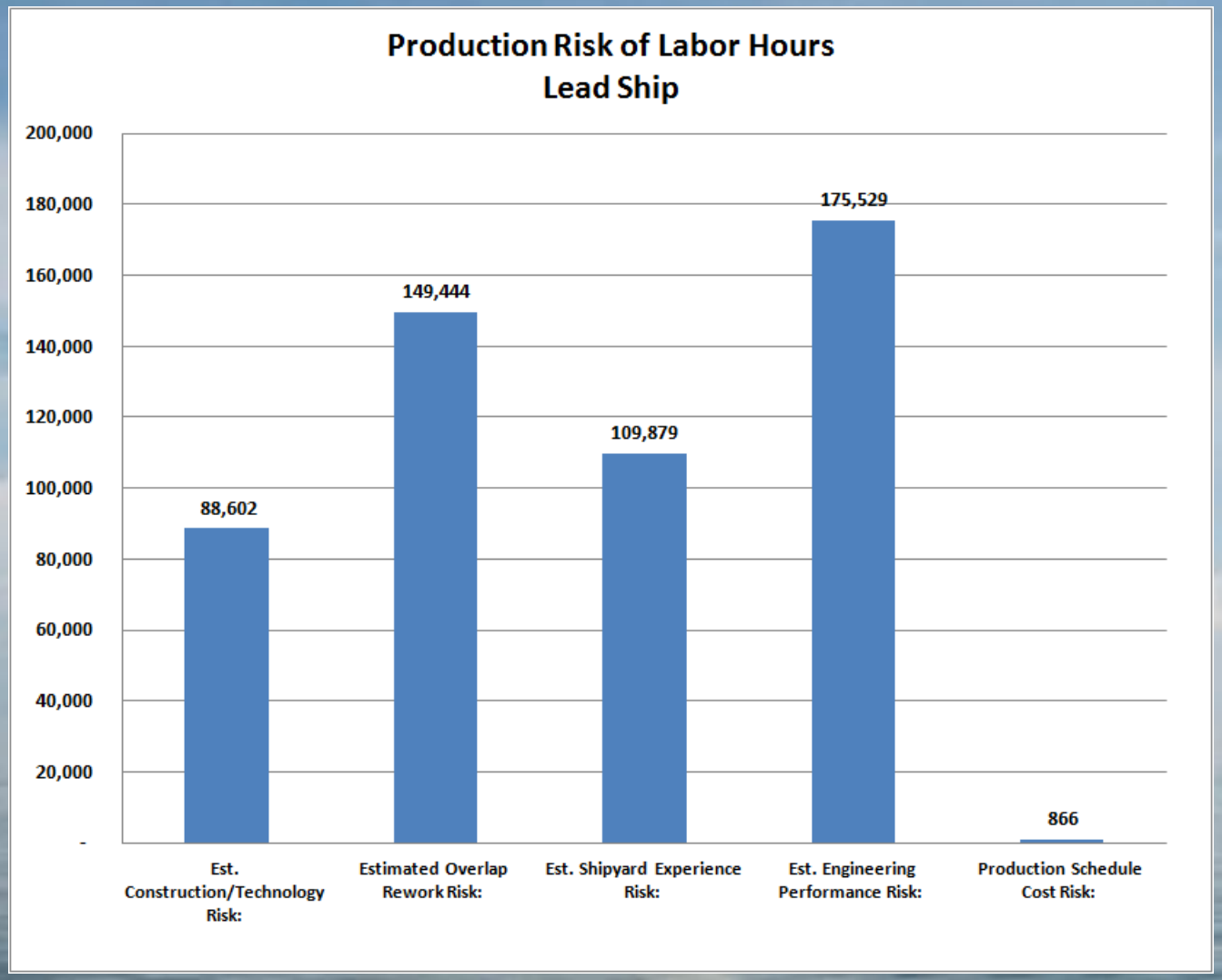
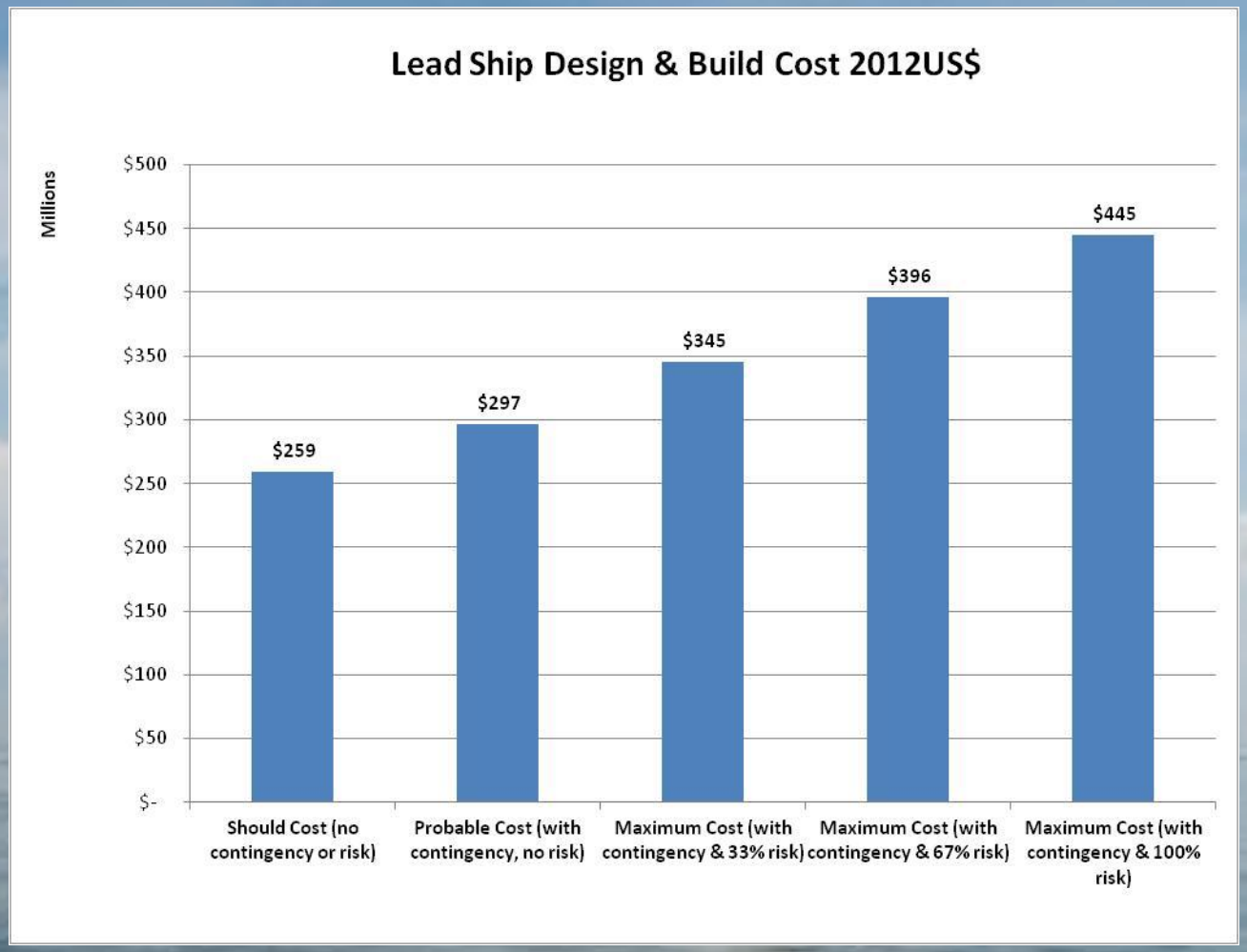
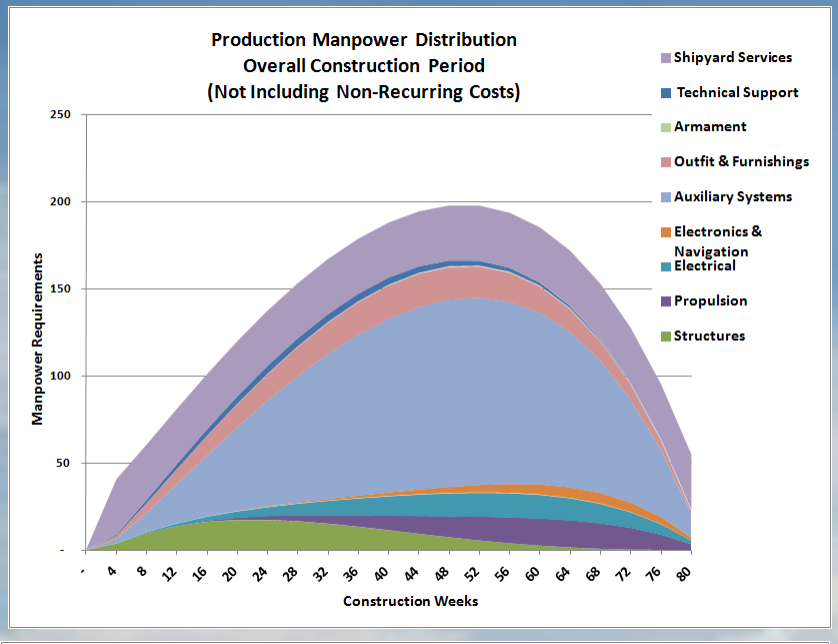

Production Risk of Labor Hours
Lead Ship
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
88,602
149,444
109,879
175,529
866
Est. Construction/Technology Risk:
Estimated Overlap Rework Risk:
Est. Shipyard Experience Risk:
Est. Engineering Performance Risk:
Production Schedule Cost Risk:

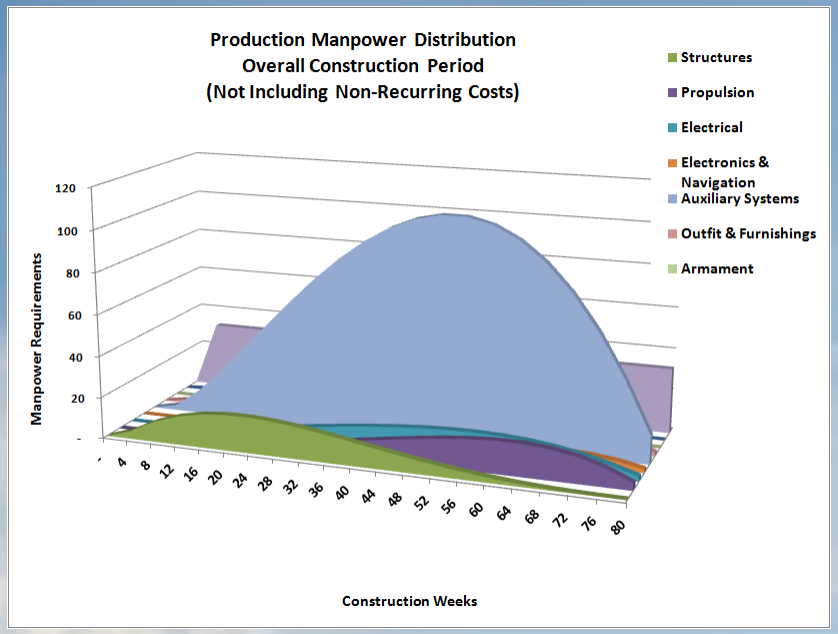

Lead Ship Design & Build Cost 2012US$
Millions
$500
$450
$400
$350
$300
$250
$200
$150
$100
$50
$-
$259
$297
$345
$396
$445
Should Cost (no contingency or risk)
Probable Cost (with contingency, no risk)
Maximum Cost (with contingency & 33% risk)
Maximum Cost (with contingency & 67% risk)
Maximum Cost (with contingency & 100% risk)

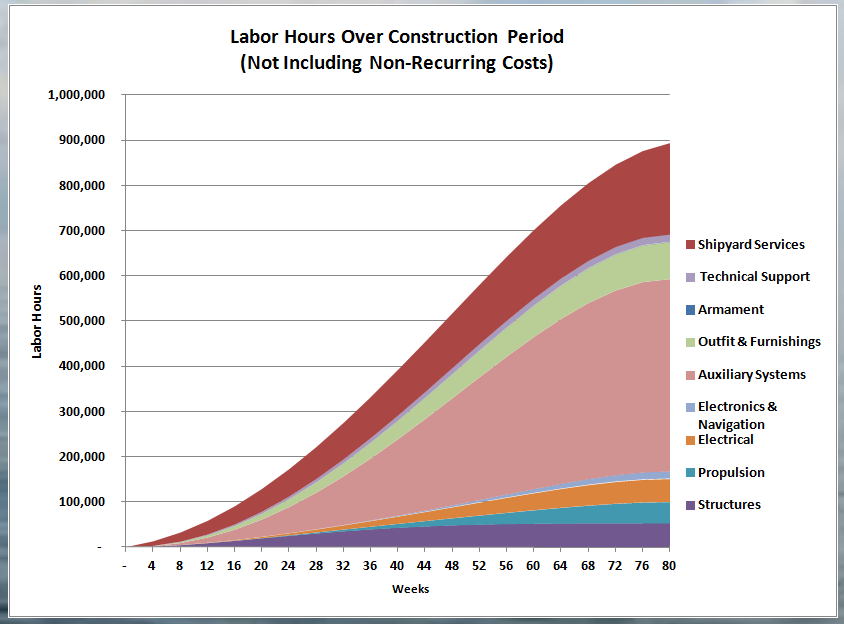
Estimating Manpower Requirements

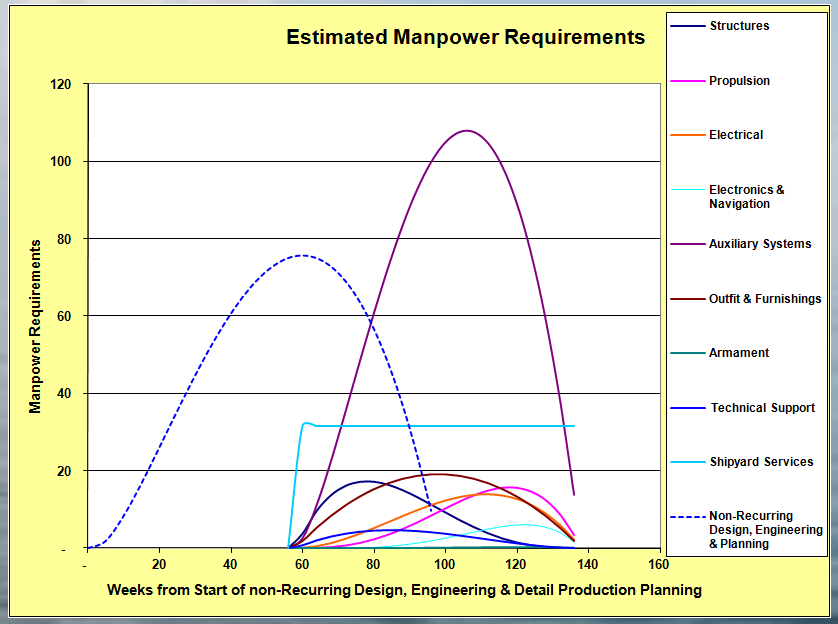
The cost models automatically generate estimated engineering and shipyard production manpower requirements.

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









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Design Trade-Off Studies

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

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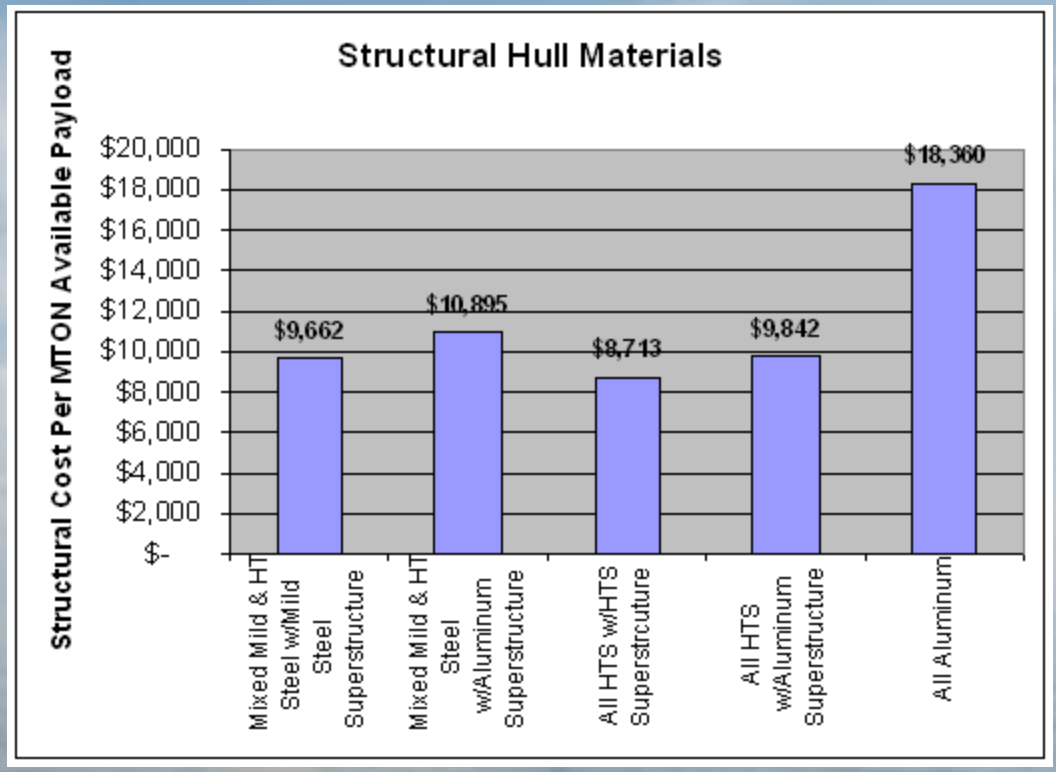
The model can quickly compare the cost of various materials and their weight characteristics.

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



A Single Design Change Can Impact Other System Costs

Example, changing a hull dimension affects the following costs:

- Structural
- General electrical ship distribution systems
- Bilge & ballast system
- Fire protection systems
- Coatings
- Hull & deck outfit, insulation, etc.

The cost models have these ship systems inter-linked to reflect overall changes to cost by this simple change.

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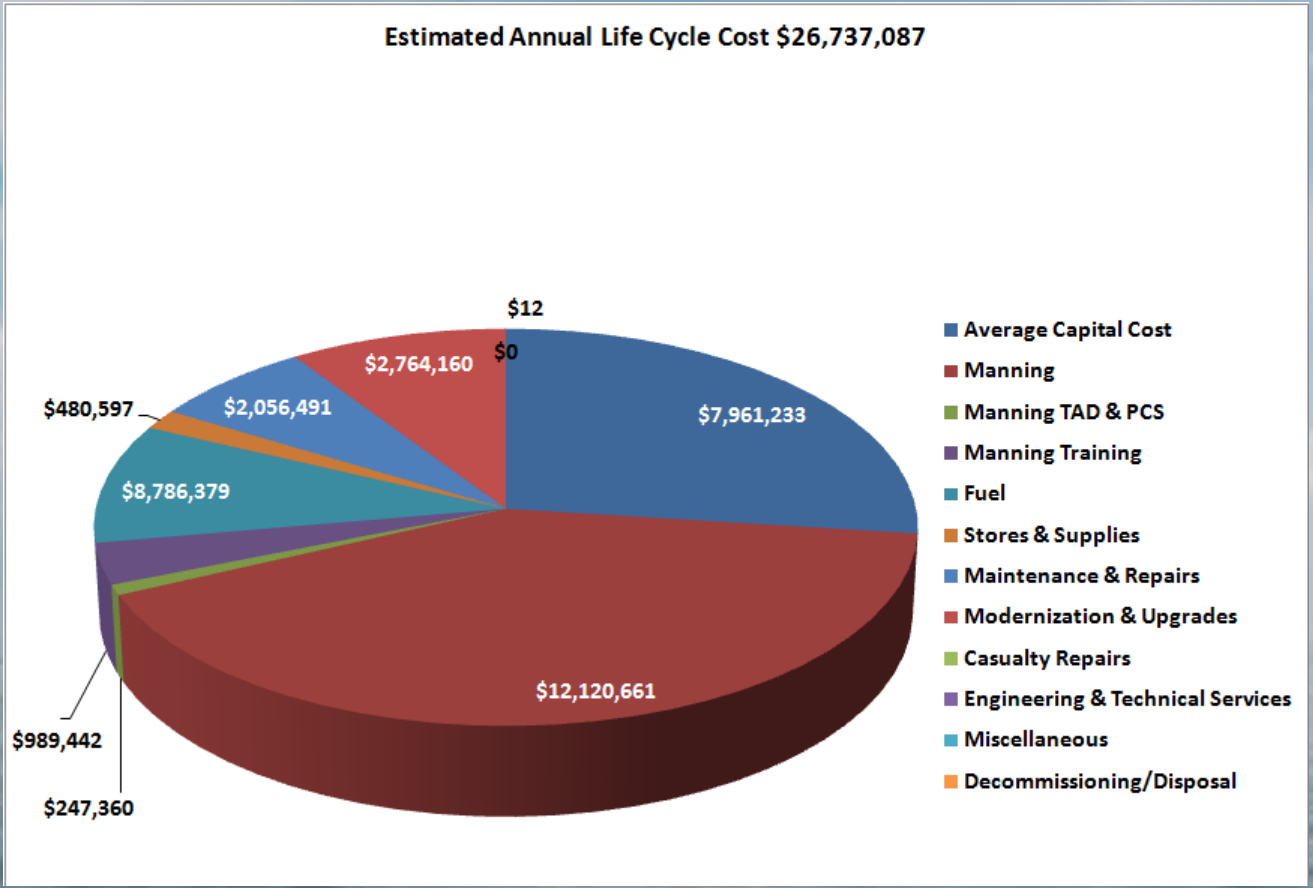
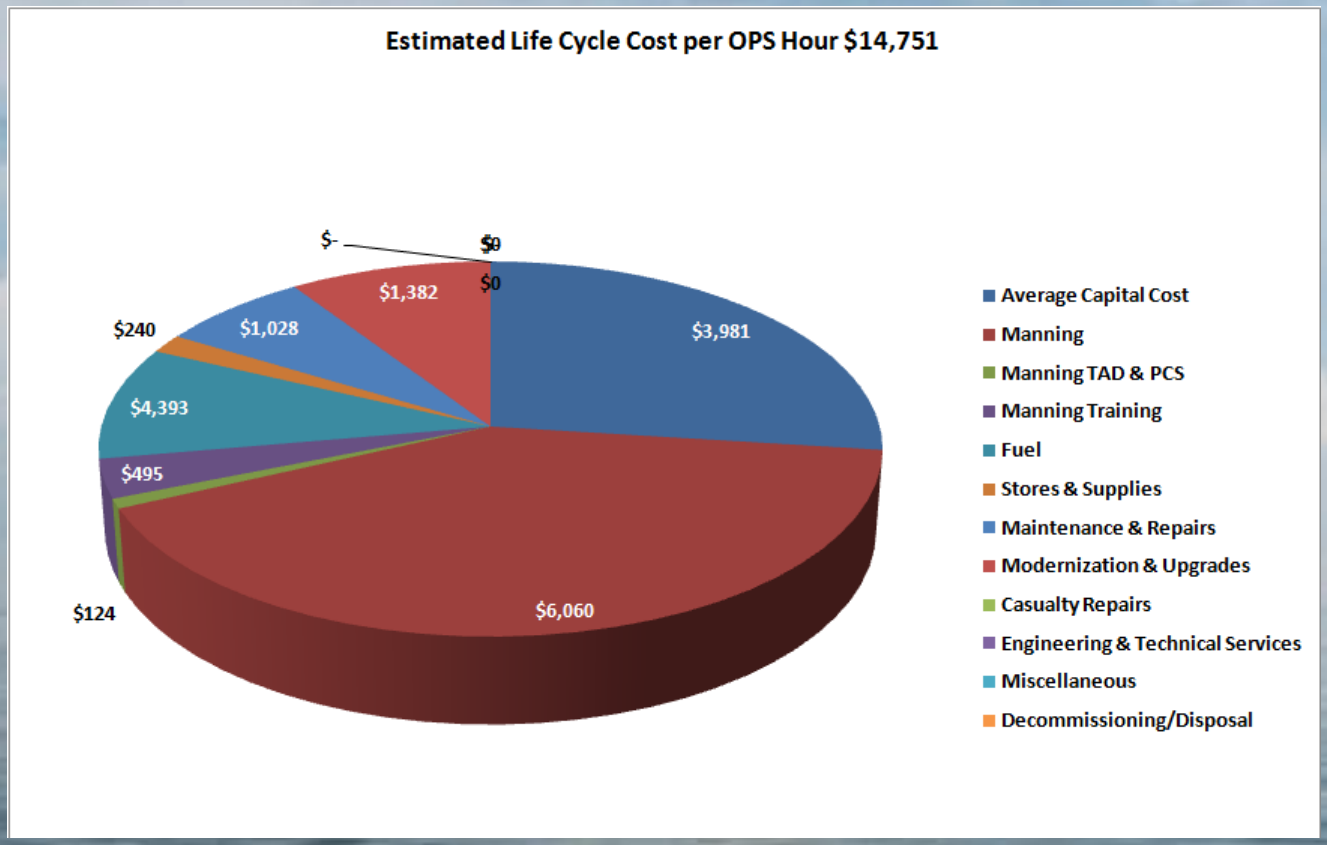
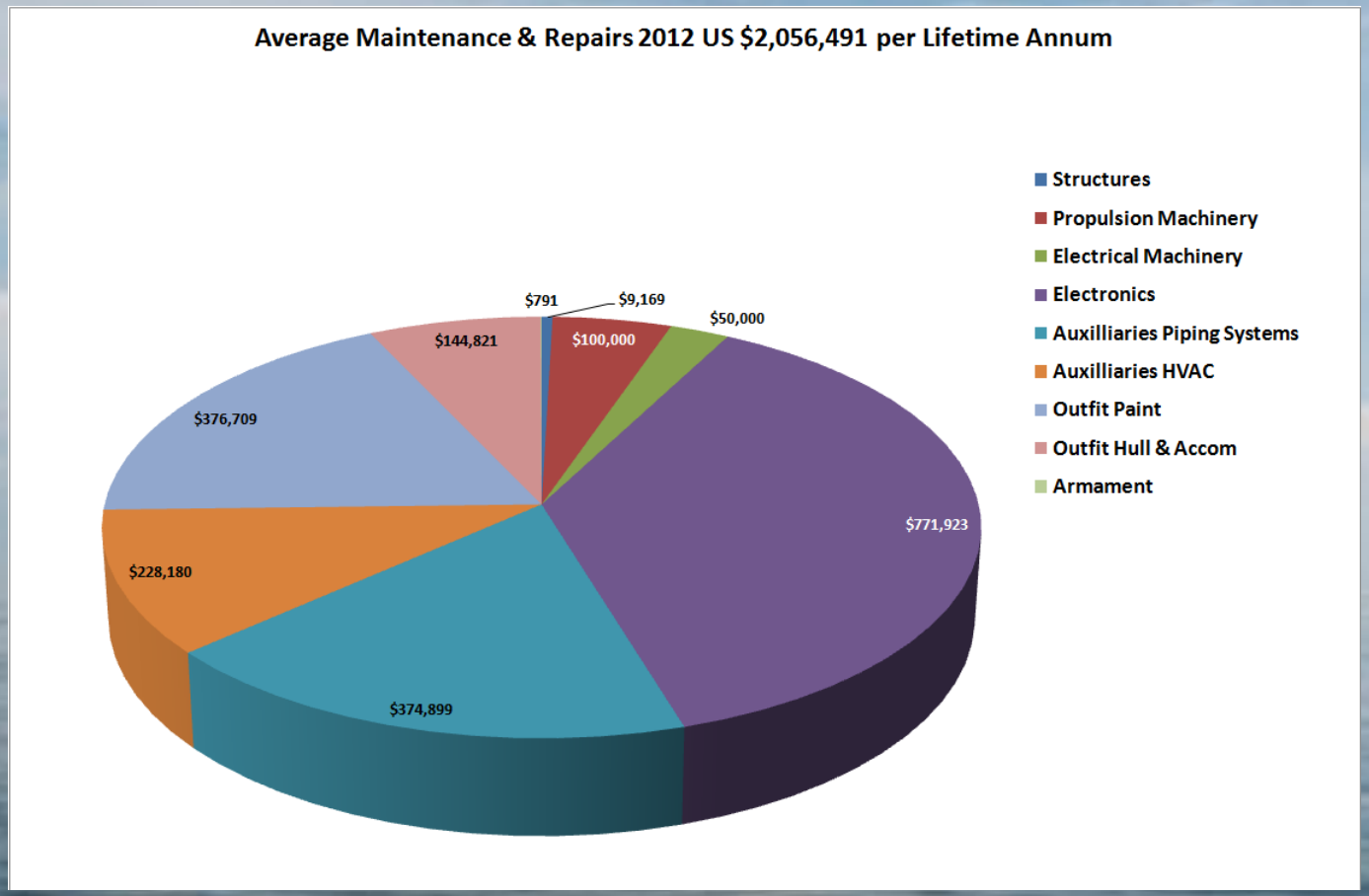
Estimating Annual Life Cycle Costs



Estimating Annual Life Cycle Costs per Operations Hour



Estimating Annual Maintenance & Repair Costs



LCC Cost Summary Average Cost/Annum	$/Annum	$/OPS Hour		Average Lost Ops Hour per Annum	Cost of Lost Ops Ho per Annum
Average Capital Cost	$ 7,961,233	$ 3,981	29.78%		
Manning	$ 12,120,661	$ 6,060	45.33%		
Manning TAD & PCS	$ 247,360	$ 124	2.04%		
Manning Training	$ 989,442	$ 495	8.16%		
Fuel	$ 2,881,303	$ 1,441	10.78%		
Stores & Supplies	$ 480,597	$ 240	1.80%		
Maintenance & Repairs	$ 2,056,491	$ 1,028	7.69%	-	$ -
Modernization & Upgrades	$ 2,764,160	$ 1,382	10.34%	986	$ 3,926,087
Casualty Repairs	$ 12	$ 0	0.00%	27	$ 109,058
Engineering & Technical Services		$ -	0.00%		
Miscellaneous		$ -	0.00%		
Decommissioning/Disposal	$ 0	$ 0	0.00%		
Total $ per Annum	$ 26,737,087	$ 14,751		1,014	$ 4,035,145

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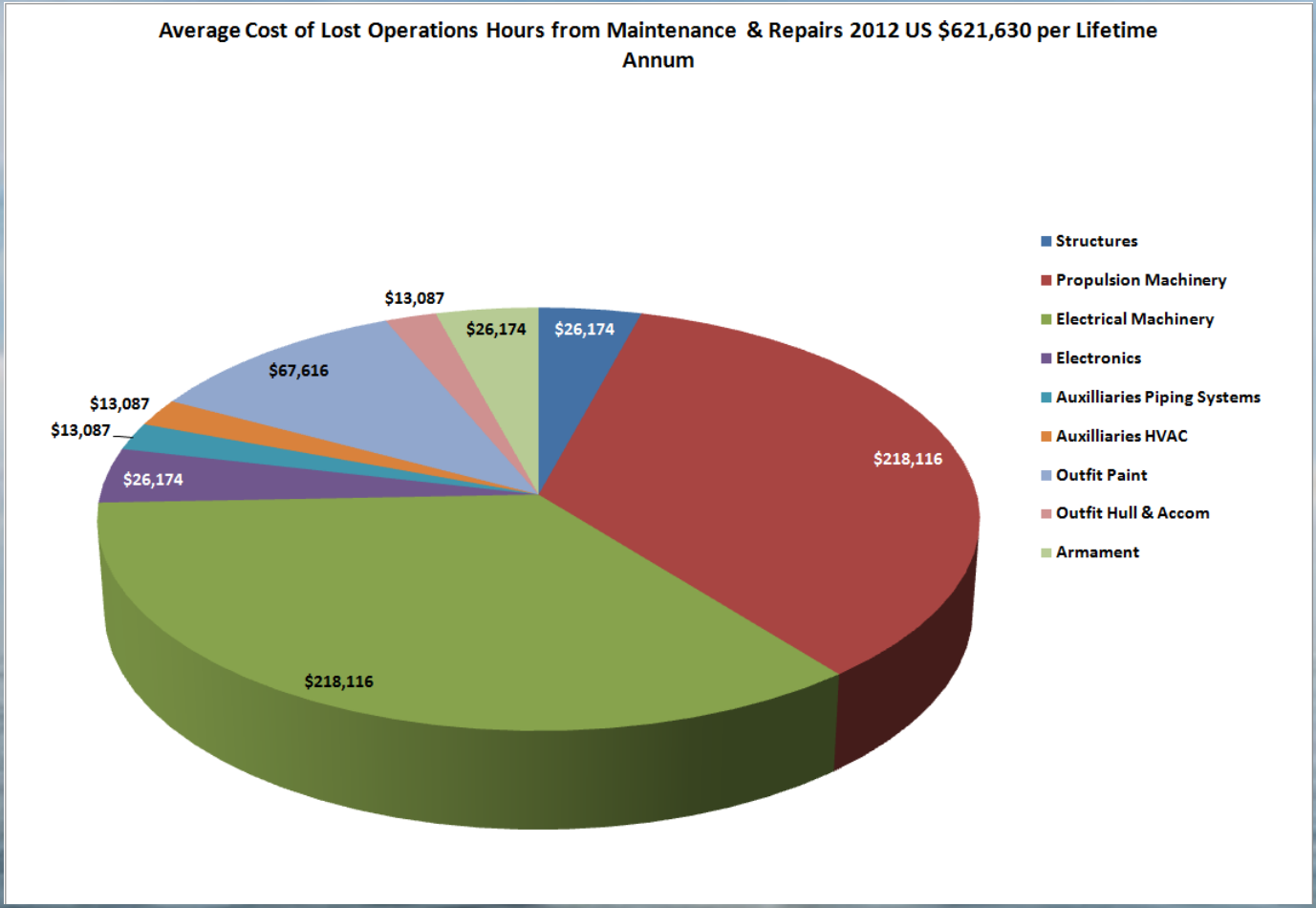
Estimating Costs of Lost Operations



Independent Naval Cost Estimates

- Naval Amphibious Assault Ship: Cost estimates adjusted for non-US costs and for planned multi-yard build strategy.
- Naval Hydrographic/Anti-Mine Warfare Ship: Cost estimates for three (3) size ships built under two different design & build strategies.
- U.S. Navy Heavy Air Lift Seabasing Ship (HALSS): Cost estimates & risk assessments for large trimaran to be built under two different design & build strategies.
- U.S. Navy Ship-To-Shore Connector Air Cushion Vehicle Design Preliminary Cost Estimate, 2010
- LCS Variant cost estimates

Independent Naval Cost Estimates

- Navy High Speed Sealift Navy Vision Trimaran (HSS) : Cost estimates for high speed composite sealift concept ship.
- Navy Joint High Speed Vessel (JHSV) Concept Trimaran: Cost estimates for baseline design plus three military variants.
- Navy Joint High Speed Vessel (JHSV) Concept Catamaran: Cost estimates for baseline design plus two military variants.
- Navy Aircraft Carrier HVAC Modernization

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Independent USCG Cost Estimates

- USCG FRP-B Fast Response Patrol Boat (Steel, Aluminum & Composite Variants)
- USCG NSC National Security Cutter Alternate Build Strategies (5 different scenarios)
- USCG ROM Estimates for Inland Work Barge & Towboat
- USCG Cutters, Patrol Boats & Buoy Tenders Cost Models
- USCG OPC Offshore Patrol Cutter Cost Trade-off Studies
- USCG Surface Forces Logistics Center (SFLC) Support: Cost Estimating Services & Life Cycle Cost Modeling

Recent Coastal Trades Independent Cost Estimates

- CCDoT Short Sea SuperRoute Trimaran Trailership: Cost estimates for concept trimaran design for commercial and military modes, 2003.
- CCDoT RORO/Container Carrier: Cost estimates for design & construction using domestic versus Korean detail design and material/equipment packaging; estimates for East Coast commercial trade required freight rates, 2010
- American Marine Highways High Speed Trimaran Trailership (HSTT-140x53'): Cost estimates for both commercial and dual-use; preliminary construction scheduling, 2009
- Four Variants of Seatrain Coastal Trades Design Concepts

Other
Independent Cost Estimates

- San Francisco Transit Authority Fast Ferry Designs
- NYC Sludge Tanker
- Containership RO/RO Modifications
- Alaskan Crude Tankers
- Tankers & Product Carriers
- Fore Body Replacement Cost Studies
- LNG Tank Design Cost Estimates
- Swedged Versus Stiffened Bulkhead Cost Analysis
- Fuel & Chemical Barges
- Alaska Region Research Vessel, 2008
- Jones Act RO/RO
- 144 Car/ 1500 PAX Ferry

Other Independent Cost Estimates

- Offshore Search & Rescue Vessel.
- Offshore Fire Control Vessel
- Cost estimates for commercial SWATH & SLICE ferries & crew/supply boats
- Offshore Energy Generation Systems
- US Army Transport Ship Design Variants:
  - Large Heavy Lift Trimaran
  - Dual-Use Trimaran Ro-Ro
  - Dual-Use Mono-Hull Ro-Ro
  - Mono-Hull FSS-SL-7 Transport Ship
  - Multiple Trimaran Seatrain

Pro Bono Estimates for Academia

- University of New Orleans – Catamaran Patrol Boat
- University of Michigan – Arctic Subsea Construction, Maintenance & Repair Vessel
- Cranfield University, UK – 2 High Speed RO-PAX & 1 High Speed RO-PAX Trimaran
- University of Michigan – 13,000 TEU G/T LNG Containership CAPEX (Korea) & OPEX (NY Port to Shanghai)

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