Sample SPAR Cost Model Cost Estimating Reports

Sample 150 Meter Offshore Patrol Vessel

Special Note: The sample reports contained in this presentation do NOT necessarily apply to any actual ship design, only to a fictitious design developed for this presentation

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The SPAR Cost Model generates cost estimates for the following:

1. **Non-Recurring Design, Production Engineering & Detail Production Planning**
2. **Lead Ship Construction**
3. **Follow Ships Construction**

Details of the estimates are generated at approximately SWBS 3-digits levels.

The cost model is very easy to use and offers many options to specify ship systems and equipment. The cost model allows users to add and modify systems, equipment and costing information to suit any special requirements.

All cost for a particular cost estimate are generated for a specific base year. Labor rates are entered as input. Material costs are all catalogued by date of entry into the model and automatically adjusted by commodity-based escalation tables to produce material costs appropriate for the specified base year.

While the cost model is based on standard U.S. labor and material costs, an option is provided to specify foreign currency reports.

Special factors may be defined to adjust costs for anticipated specific shipbuilding level of productivity and for estimated level of design producibility.

As the estimate evolves, the cost model automatically generates a comprehensive set of reports.

LEAD SHIP

1. Non-Recurring Design, Production Engineering & Detail Production Planning ("NRE")

2. Lead Ship Construction

Summary "Should Cost" Estimate for Lead Ship & NRE

Mono Hull Patrol Boat/Cutter/Frigate

(Model Version January 2015)

Ship Type: 150 meter 30 Kt Surface Combatant

Version: A

Date: 06-Aug-15

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

Pricing:

Shipbuilder Economic Mark-Up/Down:	0.0%		
Technical Wage $/Mhr:	$ 38.01	$ 85.51	w/ overhead
Production Wage $/Mhr:	$ 30.43	$ 68.48	w/ overhead
% Overhead:	125.00	%	
% G&A Labor:	-	%	
% G&A Material:	6.00	%	
Labor % Profit:	10.00	%	
Material % Profit:	10.00	%	
Navy C4ISR	Yes		
Jones Act Premium Material Factor:	No	1.00	
Current Year:	2014		
Currency Exchange	1.0000	1.000 = none	
Shipyard Material Cost Factor:	1.0000	MILSPEC Prem.=1.21	
Combined Material Cost Factor:	1.0000		

Non-Recurring Engineering & Production Planning

	Standard Work Week:		40.00	hours/week
	Labor Rates:			
125%	Senior Professional/Manager	$	85.51	per hour
125%	Engineer	$	85.51	per hour
125%	Designer/Draftsperson/Planner	$	85.51	per hour
125%	Clerical	$	85.51	per hour
125%	Contingency (weighted average)	$	85.51	per hour

	Shipyard	Fab/Assy Mod'les
Shipyard Tech Support Labor Factor:	1.0000	No Ext.Modules
Steel Productivity Factor:	1.3500	1.000
Outfit Productivity Factor:	1.7053	1.000
On-Block Paint Factor:	0.9500	40 % Hours On Block

NON-RECURRING COSTS

Basic Research - Concept Design	$	-
Preliminary Design	$	671,009
Contract Design	$	8,052,104
Detail Design & Construction Engin	$	43,615,565
Production Planning & Scheduling	$	8,723,113
Purchase Specs & Support	$	2,684,035
ILS, Spares & Load Items	$	6,710,087
Contract Engineering Management	$	8,723,113
Contingency Labor:	$	10,065,130
Data Rights Package	$	-
Miscellaneous Material & Support:	$	-
Production Jigs, Cradles, & Templa	$	333,709
TOTAL NON-RECURRING COSTS:	$	89,577,865
G&A & Profit		8,979,811
Total NRE	$	98,557,676

Estimated Schedules

Est. Detail Engineering Time:	36.00	Months	
Est. Construction Time:	60.00	Months	
Overlap:	10.00	Months	16.7%
RMS Men/Month: 416	0.94	Months	1.6%

	SWBS Group	Weight MTons	M-Hrs Per Mton	Modular M-Hrs	Production M-Hrs	$ Labor	$ Overhead	$ G&A Labor Only	2014 $ Material	$ G&A Material Only	$ Profit Labor + Material	$ Total	$ Cum.Total
Structures	1	2,266.7	142.83	-	323,753	9,853,374	12,316,718	-	2,829,371	169,762	2,516,922	27,686,147	
Propulsion	2	753.8	268.03	-	202,055	6,149,505	7,686,881	-	62,075,750	3,724,545	7,963,668	87,600,349	
Electrical	3	321.1	909.69	-	292,070	8,889,095	11,111,368	-	7,693,923	461,635	2,815,602	30,971,624	
Electronics & Navigation	4	269.3	1,907.57	-	513,705	15,634,521	19,543,151	-	118,147	7,089	3,530,291	38,833,199	
Auxiliary Systems	5	732.9	1,297.95	-	951,324	28,953,388	36,191,734	-	51,037,897	3,062,274	11,924,529	131,169,822	
Outfit & Furnishings	6	484.2	1,179.49	-	571,089	17,381,005	21,726,256	-	22,180,142	1,330,809	6,261,821	68,880,032	
Armament	7	187.7	1,269.50	-	238,272	7,251,777	9,064,722	-	-	-	1,631,650	17,948,149	
Technical Support	8	10.0%	61.65		309,227	11,752,317	14,690,396	-	250,000	15,000	2,670,771	29,378,484	
Shipyard Services	9	25.0%	154.12		773,067	23,528,166	29,410,208	-	10,176,629	610,598	6,372,560	70,098,160	
argin, Bonds & Insurance	10	-	-		-	-	-	-	118,982,502	7,138,950	12,612,145	138,733,597	
Lead Ship Totals:		5,016	832.23	-	4,174,560	$ 129,393,147	$ 161,741,434	$ -	$ 275,344,361	$ 16,520,662	58,299,960	$ 641,299,563	$ 641,299,563
Non-Recurring Costs:	*% Total Lead Ship G1-7 Man-Hours:*			25%	1,043,640	$ 89,244,156	$ -	$ -	$ 333,709	$ 20,023	8,959,789	$ 98,557,676	$ 739,857,239

Technical Support:	7.29%	*Production $ Costs*		
Shipyard Services:	17.39%	*Production $ Costs*		
Fees & Insurance:	34.42%	*Production $ Costs*		
Non-Recurring Costs:	24.45%	*Production $ Costs*		
Production Costs (1-7):	$ 403,089,322	62.9%	*GR 1-10*	

Production Hrs/LSW:	832.23
MT/MT	1

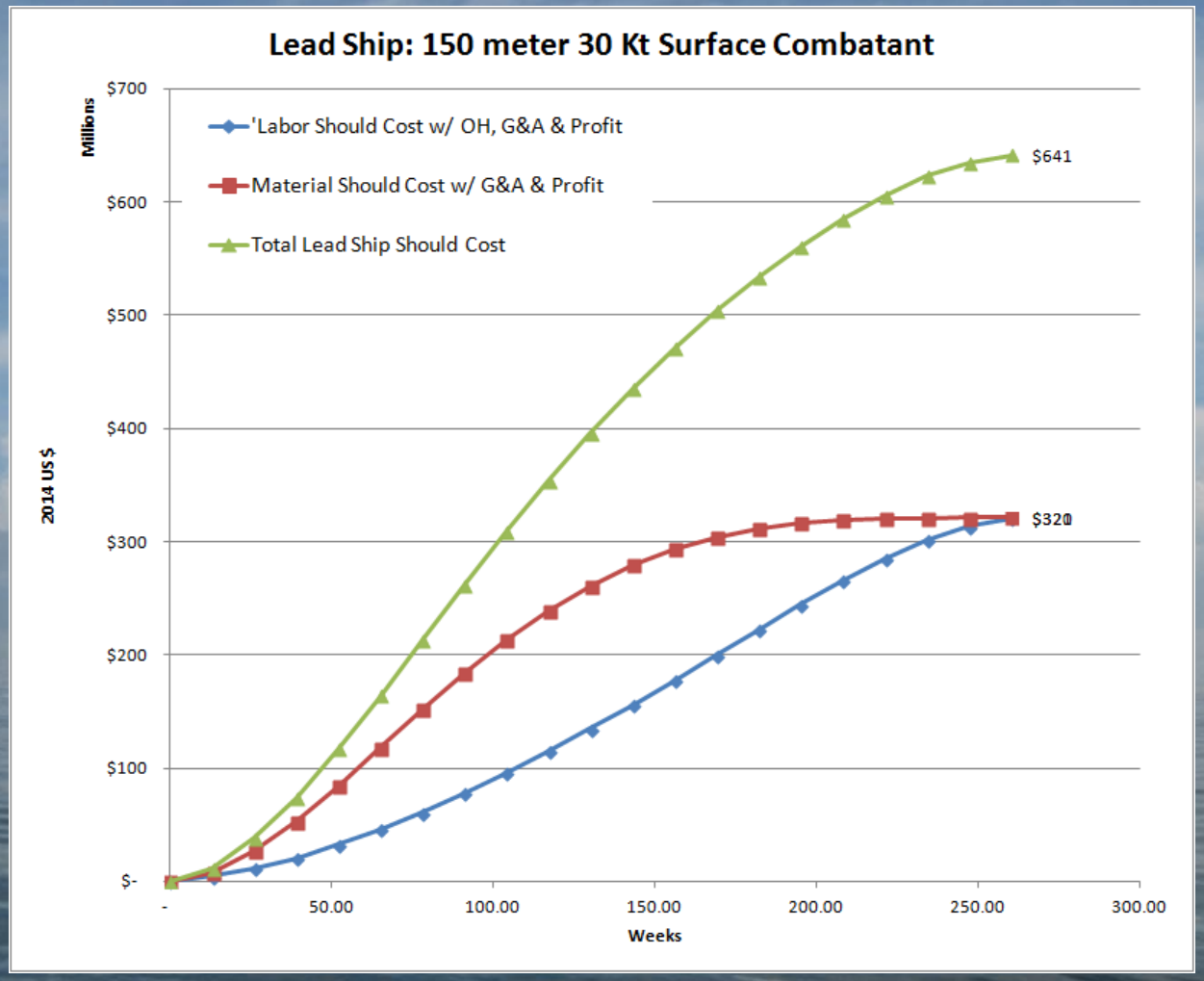
Estimated Cost for Prime Contractor Management Team:		$ -	
Over-All Program Management Fee:	0.0%	$ -	
Total Price with Prime Contractor Management:		$ 739,857,239	
7.3%	*Estimated CER Cost Risk*	$ 47,132,448	w/o Profit
0.1%	*Est. Eng'r'g Overlap Rework Risk:*	$ 469,892	w/o Profit
57.8%	*Est. Shipyard Performance Risk:*	$ 165,088,318	w/o Profit
57.8%	*Est. Eng'r'g Performance Risk:*	$ 219,668,720	w/o Profit
1.6%	*Est. Prod'n Schedule Cost Risk:*	$ 10,061,159	w/o Profit
59.8%	*Lead Ship Price with 100% Risk:*	$ 1,182,277,776	w/o Profit
Total Price with % Risk:	20%	$ 828,341,346	

NOTE

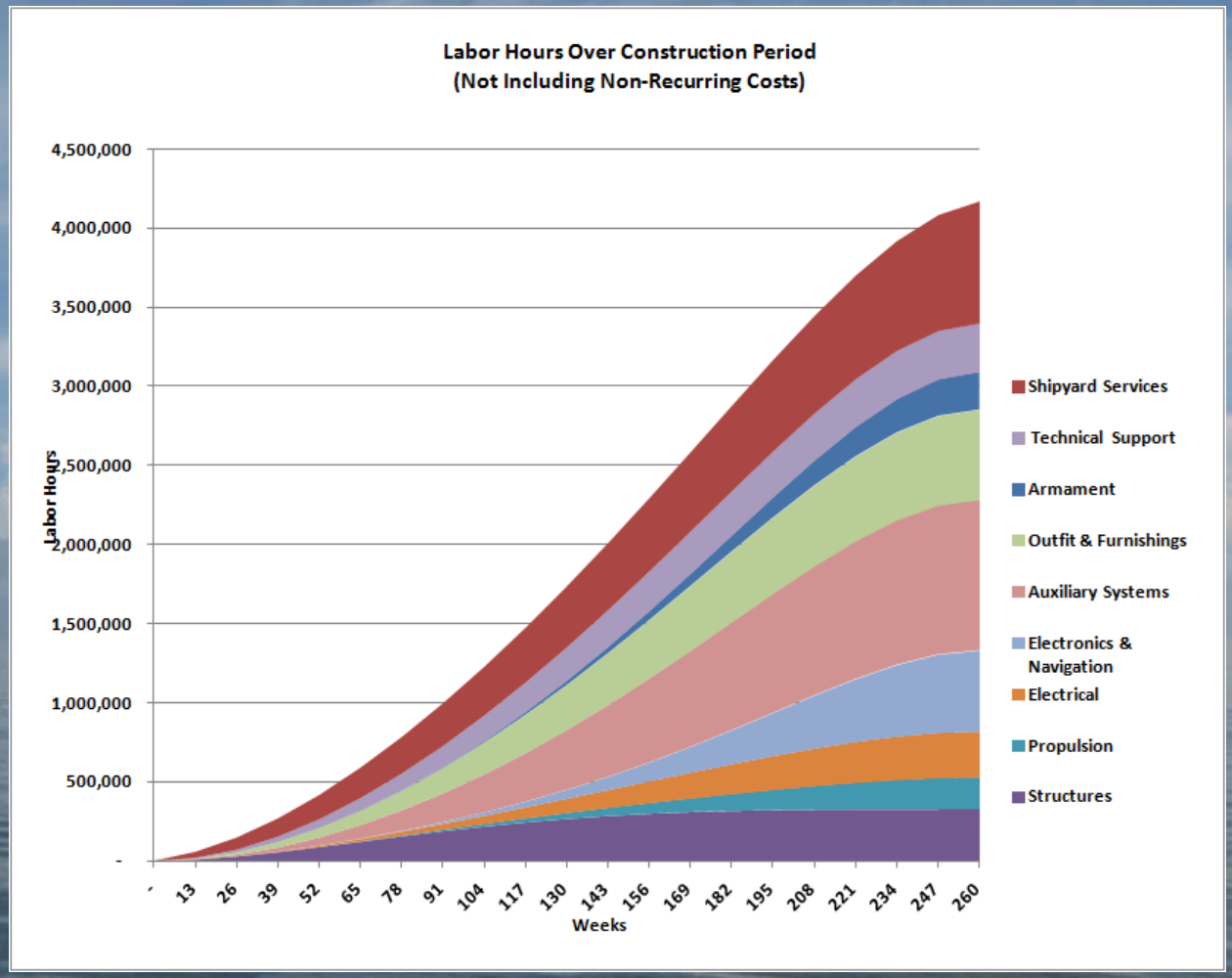
This notional ship estimate does not include costs for advanced electronics and communications (C4) nor weapons systems.

The user may add these costs as required to the cost model.

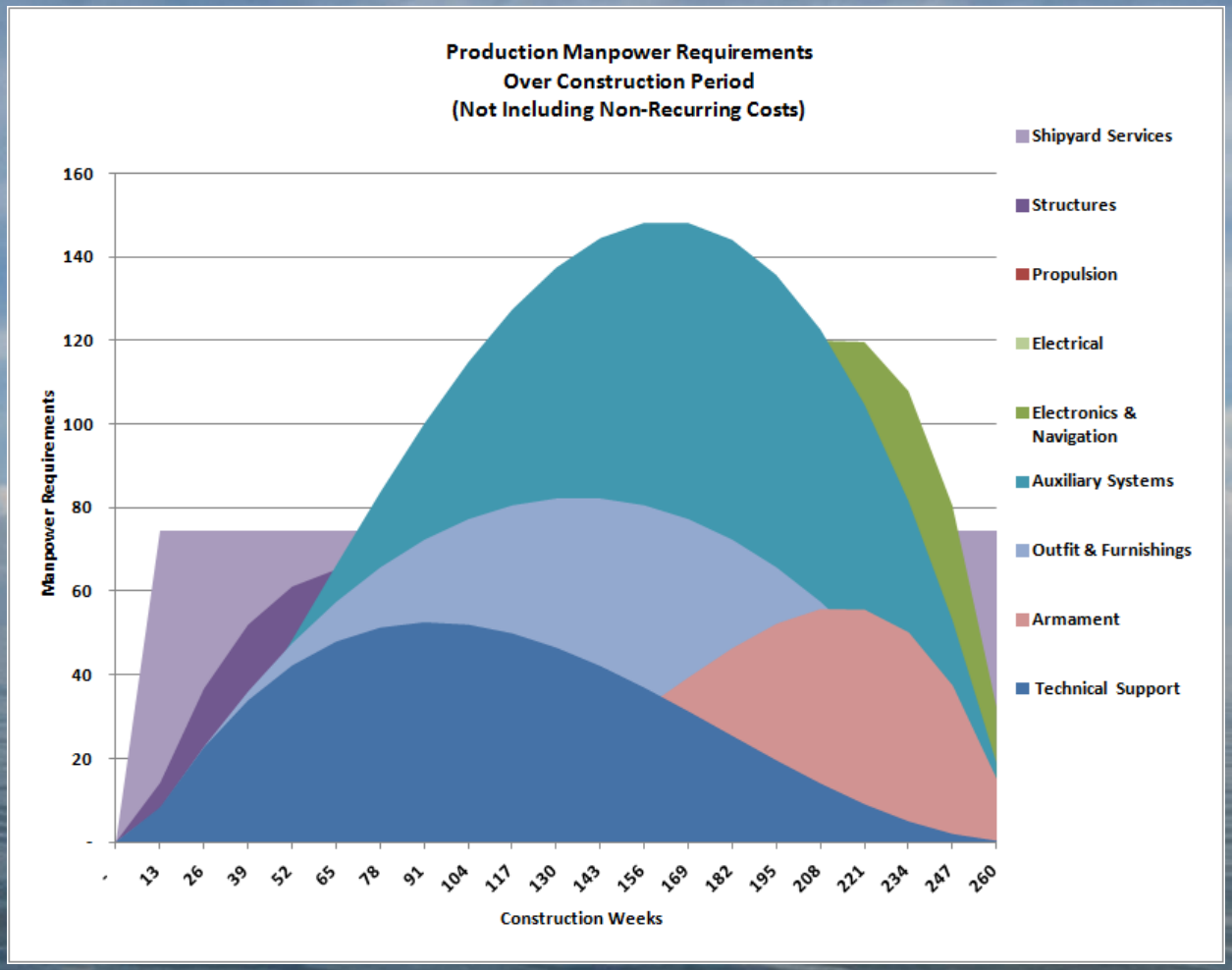
Summary “Should Cost” Estimate for Lead Ship



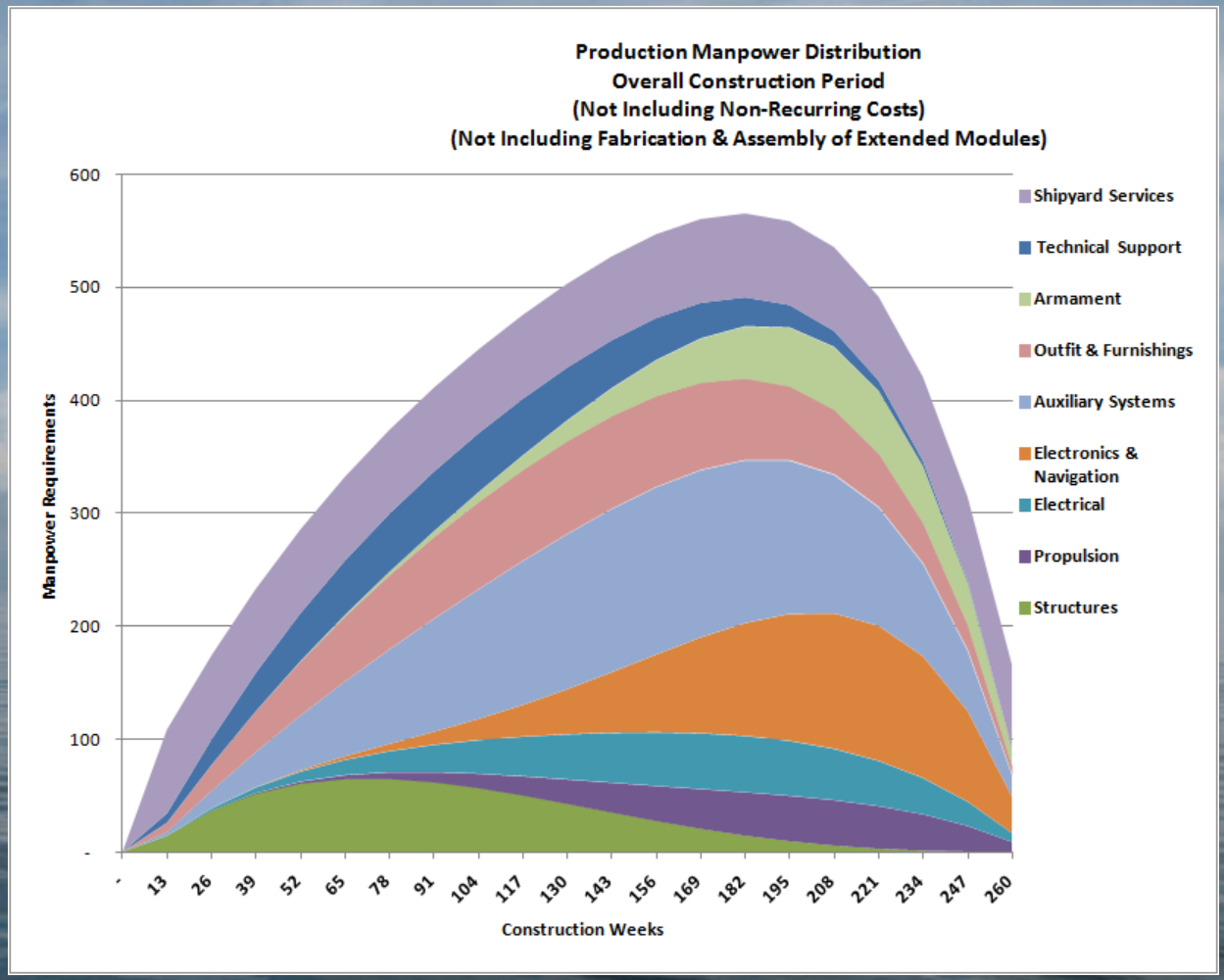
Time Distribution of Lead Ship Labor Hours



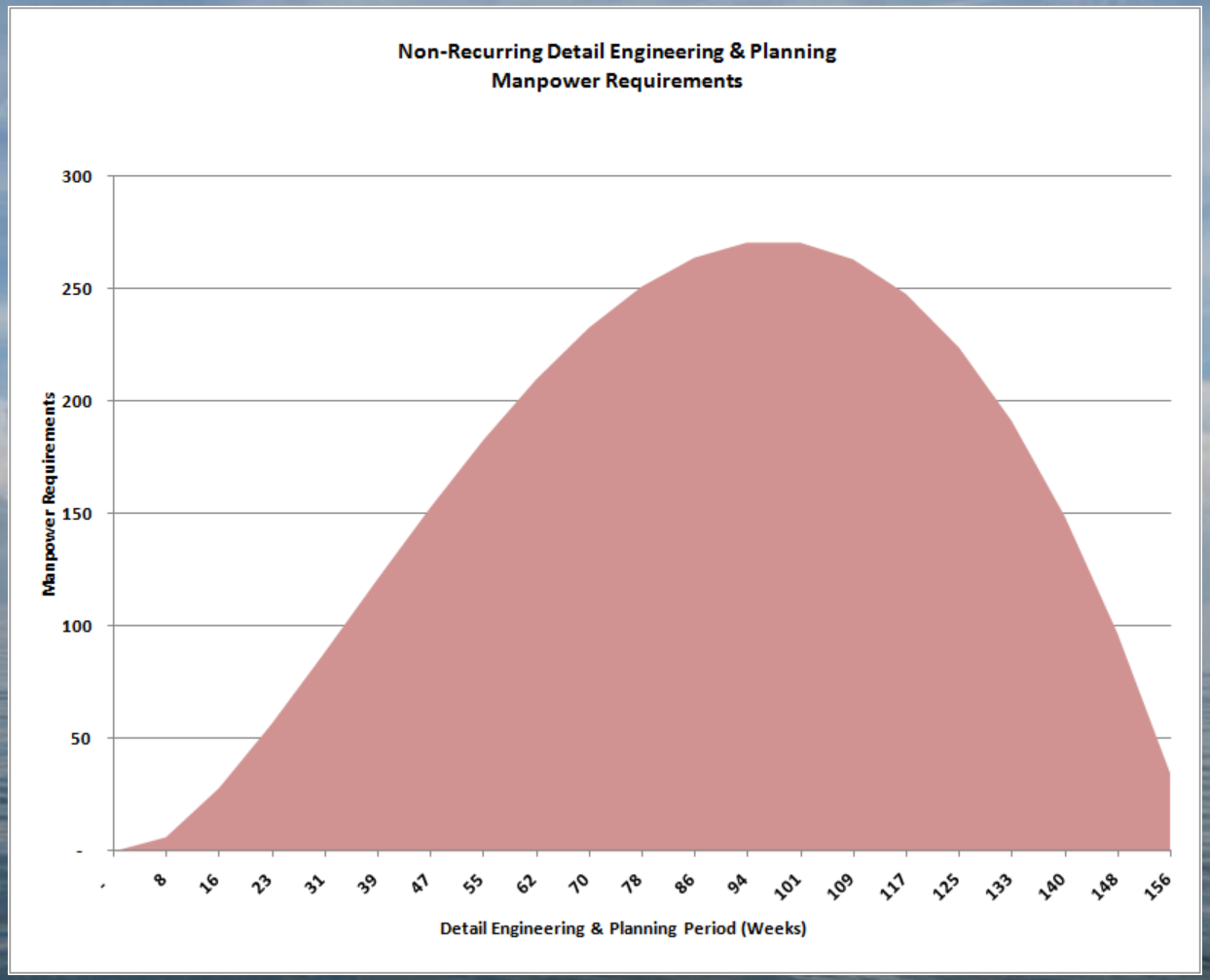
Estimated Lead Ship Manpower Requirements



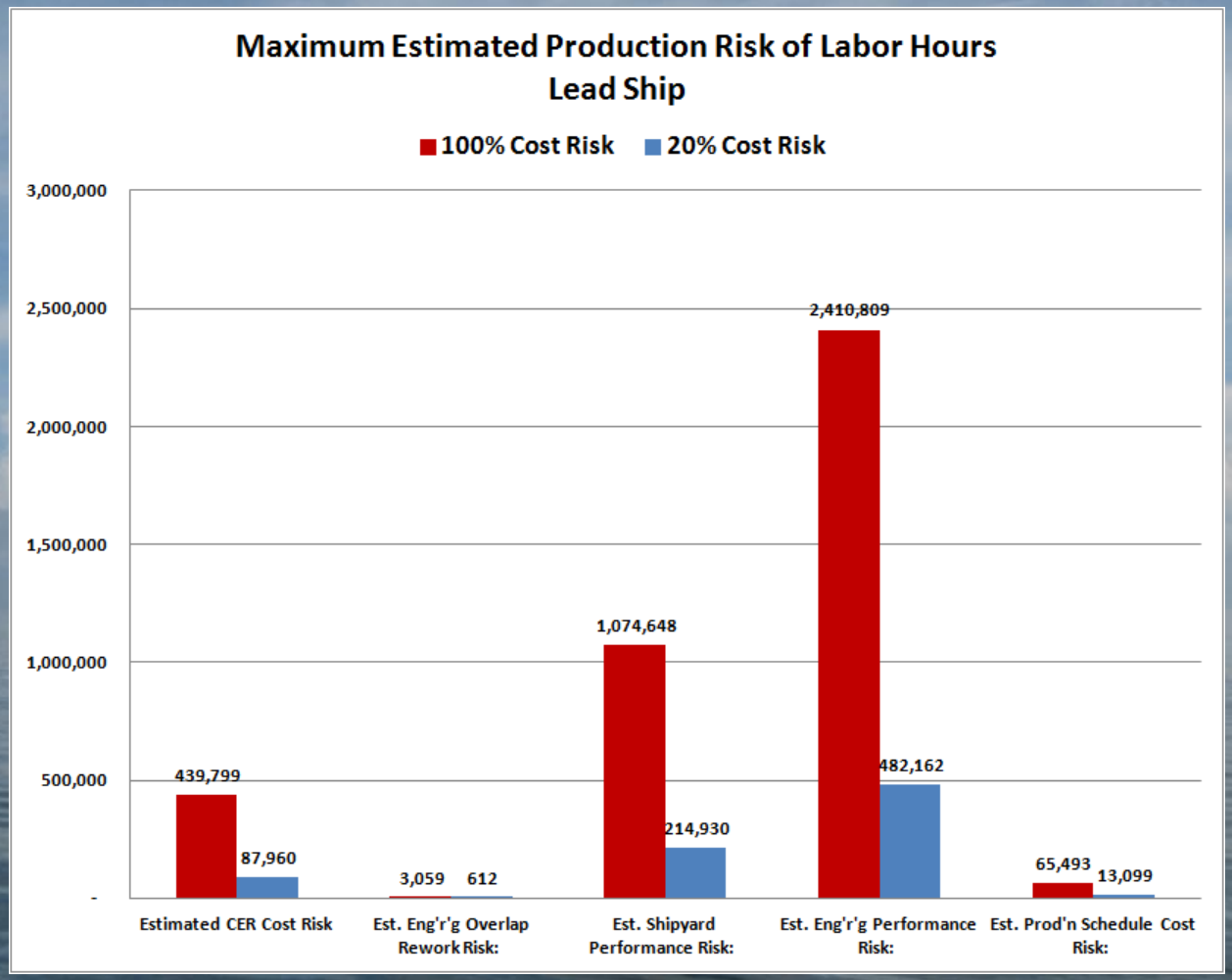
Estimated Total Lead Ship Manpower Requirements



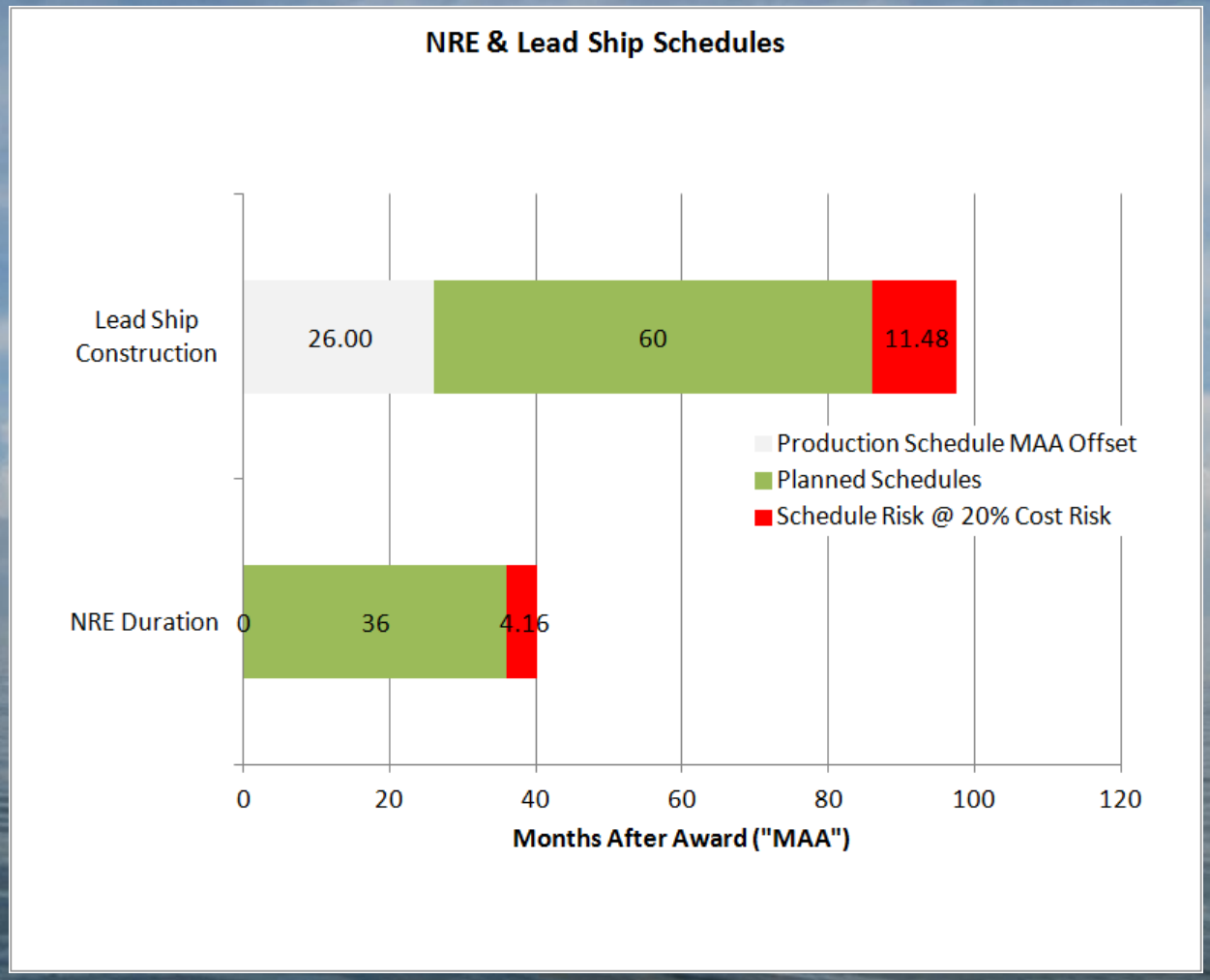
Estimated NRE Manpower Requirements



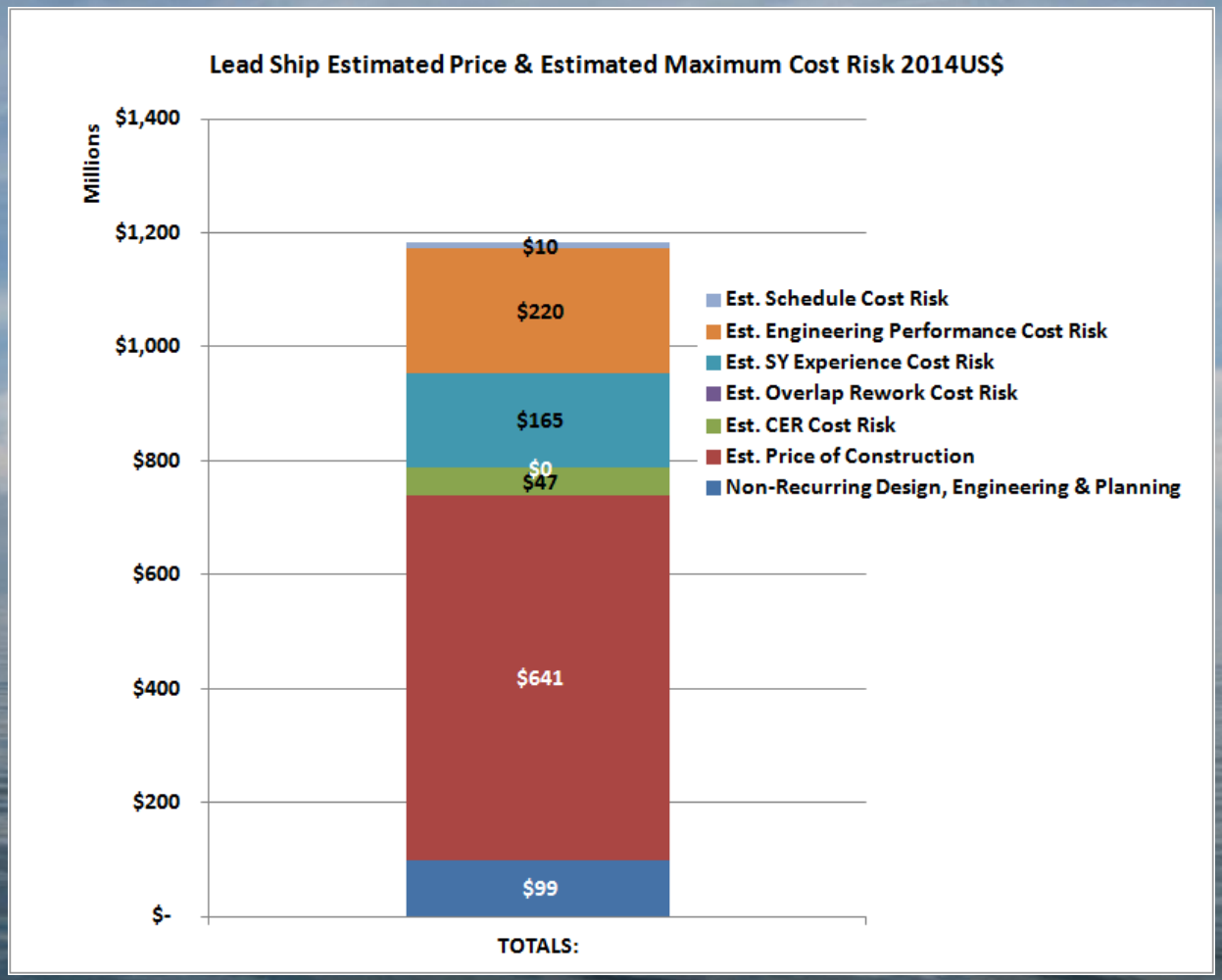
Estimating Potential Impact of Cost Risk Labor Hours



Estimating Potential Impact of Cost Risk on Schedules

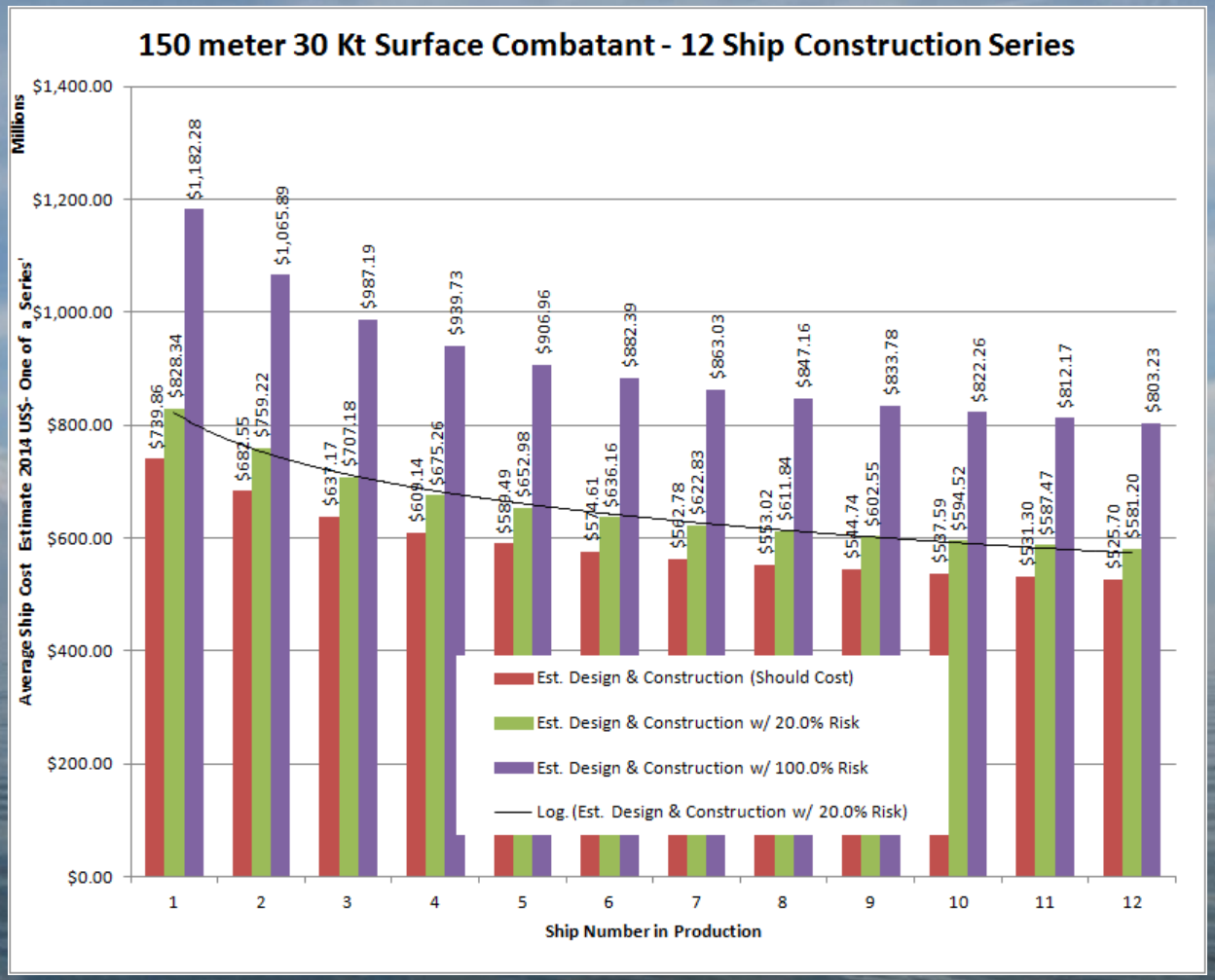


Estimating Potential Impact of Cost Risk on Total Cost

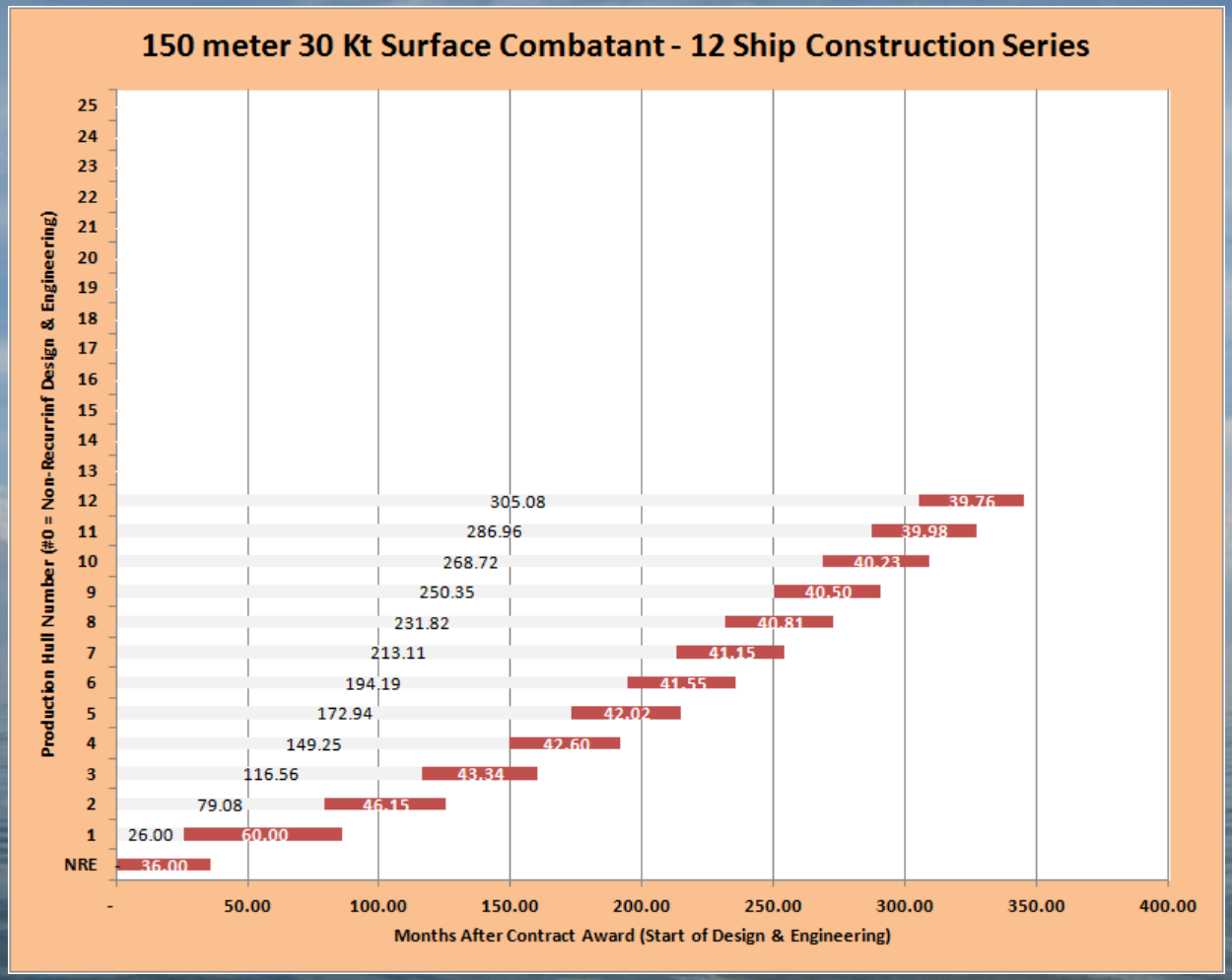


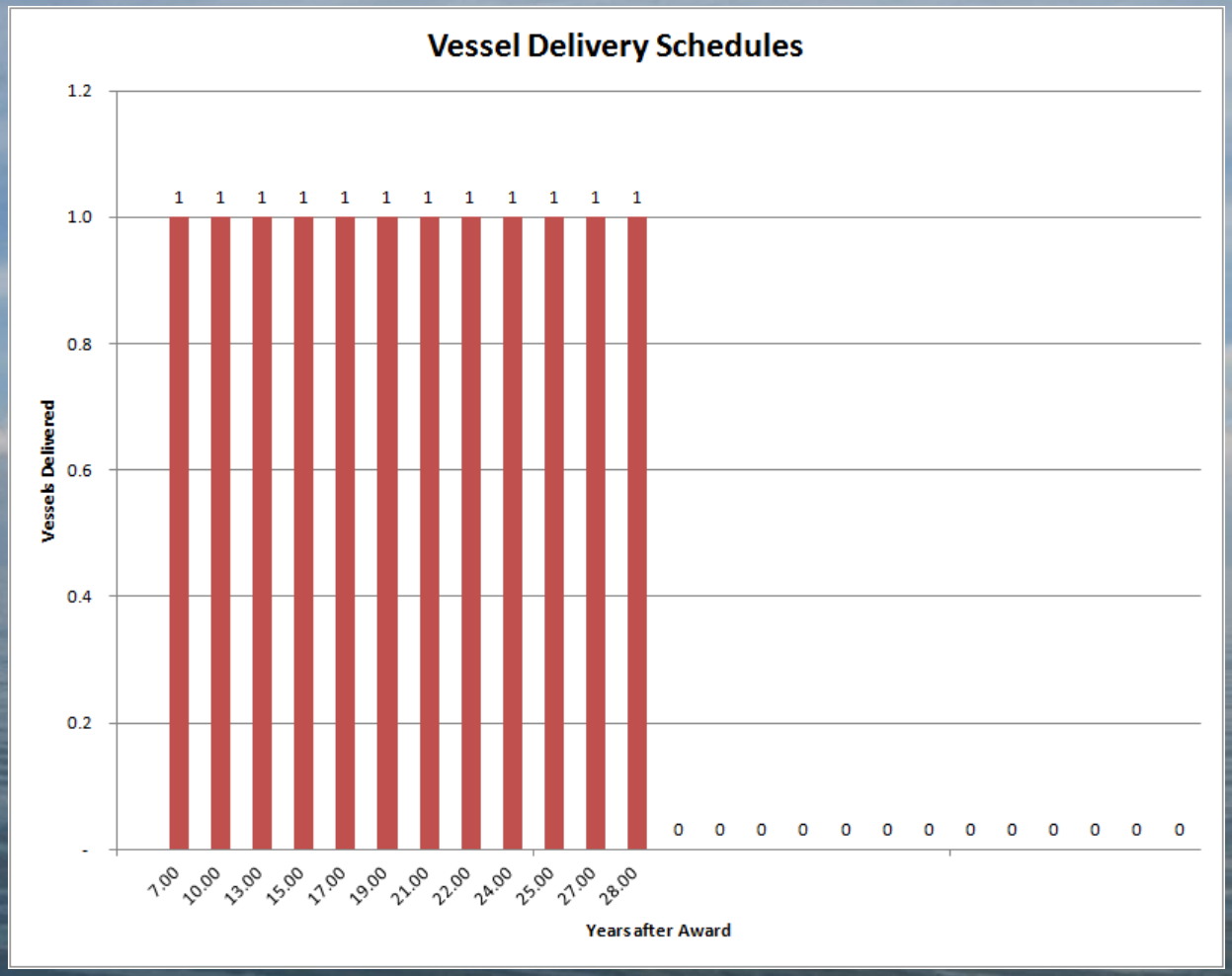
FOLLOW SHIPS

The cost model can be easily set to generate costs for just a lead ship or a series of ship for a multi-ship construction program

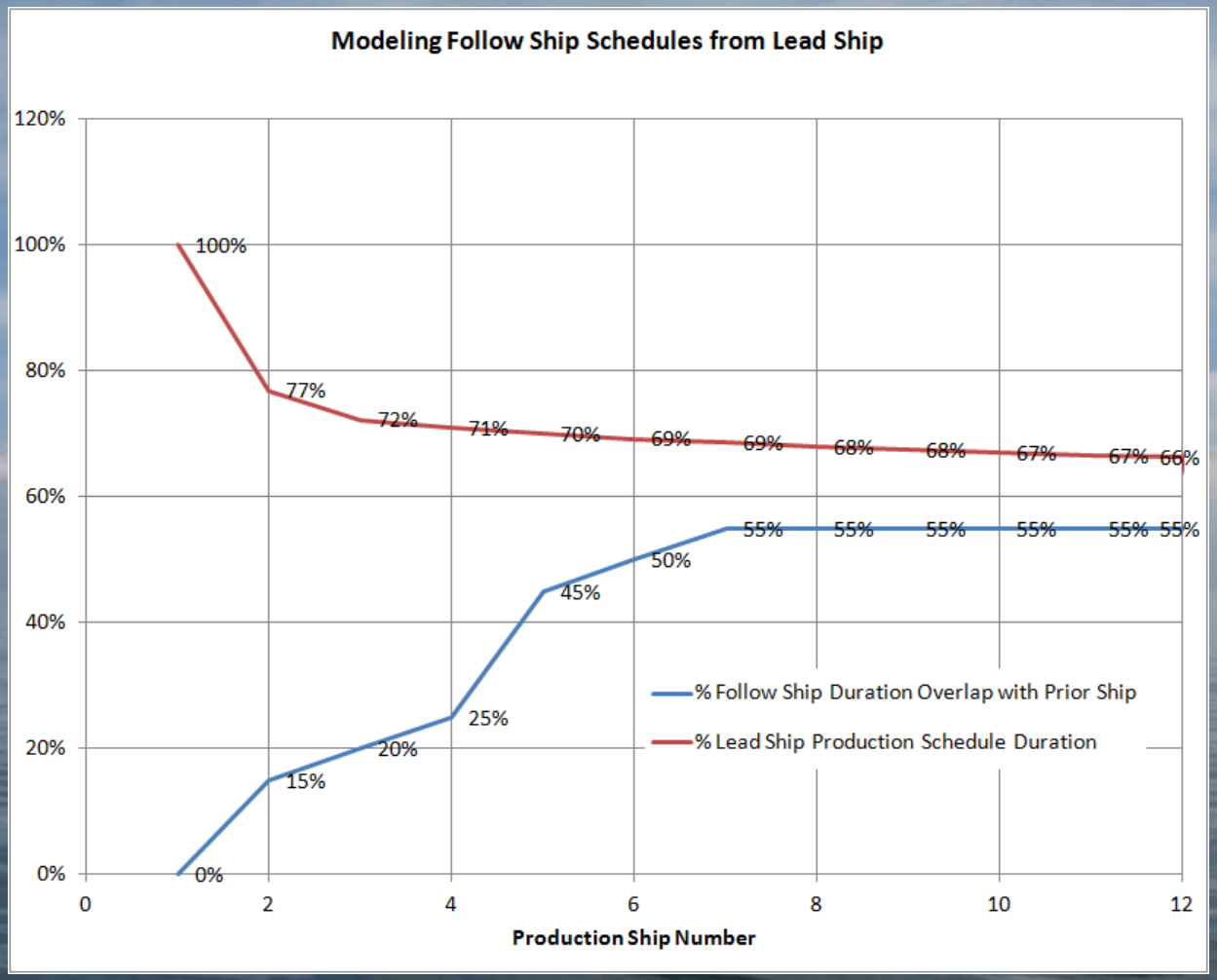

150 meter 30 Kt Surface Combatant - 12 Ship Construction Series
Millions
Average Ship Cost Estimate 2014 US$- One of a 'Series'
$1,400.00
$1,200.00
$1,000.00
$800.00
$600.00
$400.00
$200.00
$0.00
$739.86
$828.34
$1,182.28
$682.55
$759.22
$1,065.89
$637.17
$707.18
$987.19
$609.14
$675.26
$939.73
$589.49
$652.98
$906.96
$574.61
$636.16
$882.39
$562.78
$622.83
$863.03
$553.02
$611.84
$847.16
$544.74
$602.55
$833.78
$537.59
$594.52
$822.26
$531.30
$587.47
$812.17
$525.70
$581.20
$803.23
1
2
3
4
5
6
7
8
9
10
11
12
Ship Number in Production
Est. Design & Construction (Should Cost)
Est. Design & Construction w/ 20.0% Risk
Est. Design & Construction w/ 100.0% Risk
Log. (Est. Design & Construction w/ 20.0% Risk)

Estimated Follow Ship Production Schedules

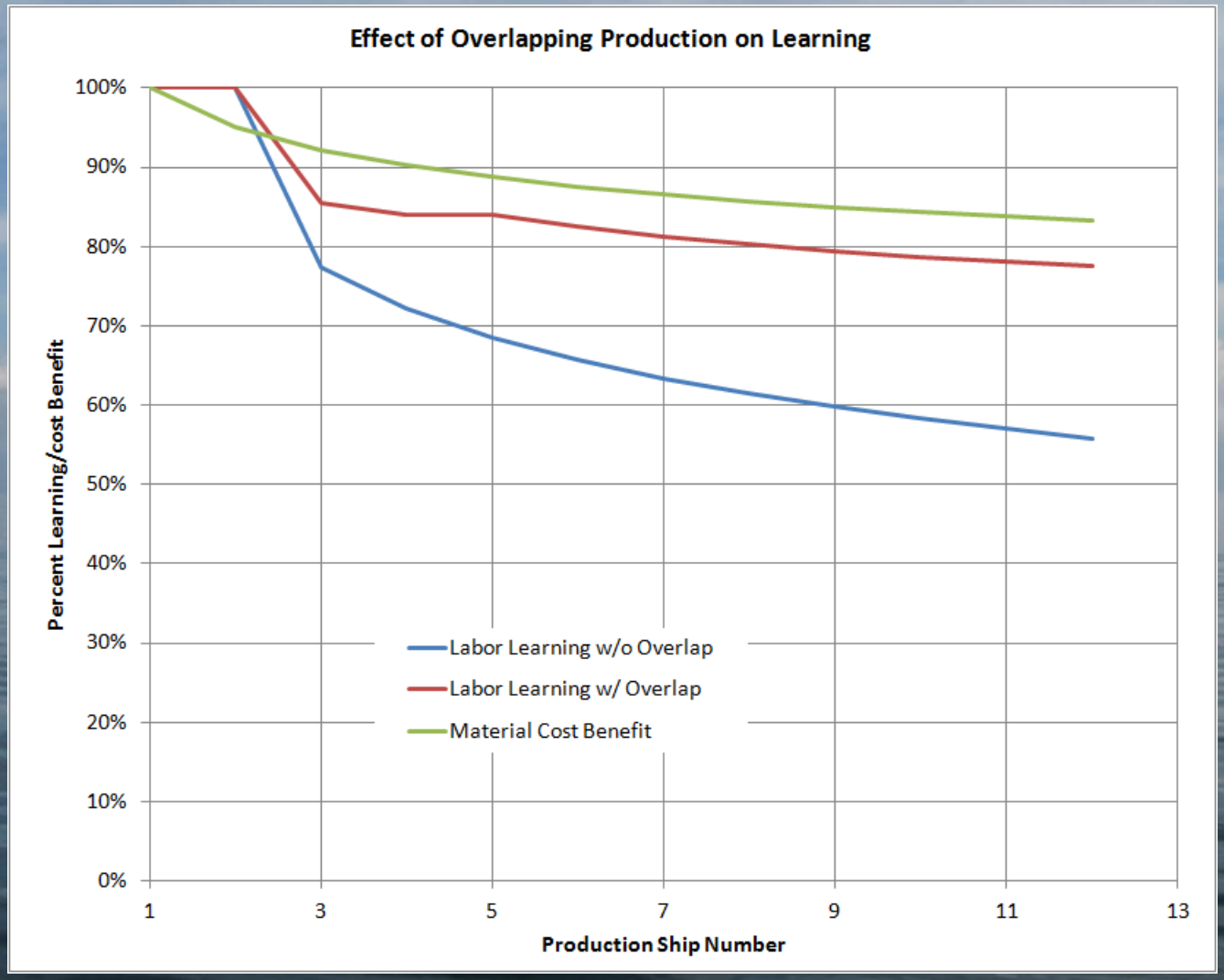



Vessel Delivery Schedules
Vessels Delivered
1.2
1.0
0.8
0.6
0.4
0.2
-
1 1 1 1 1 1 1 1 1 1 1 1
0 0 0 0 0 0 0 0 0 0 0 0
7.00 10.00 13.00 15.00 17.00 19.00 21.00 22.00 24.00 25.00 27.00 28.00
Years after Award

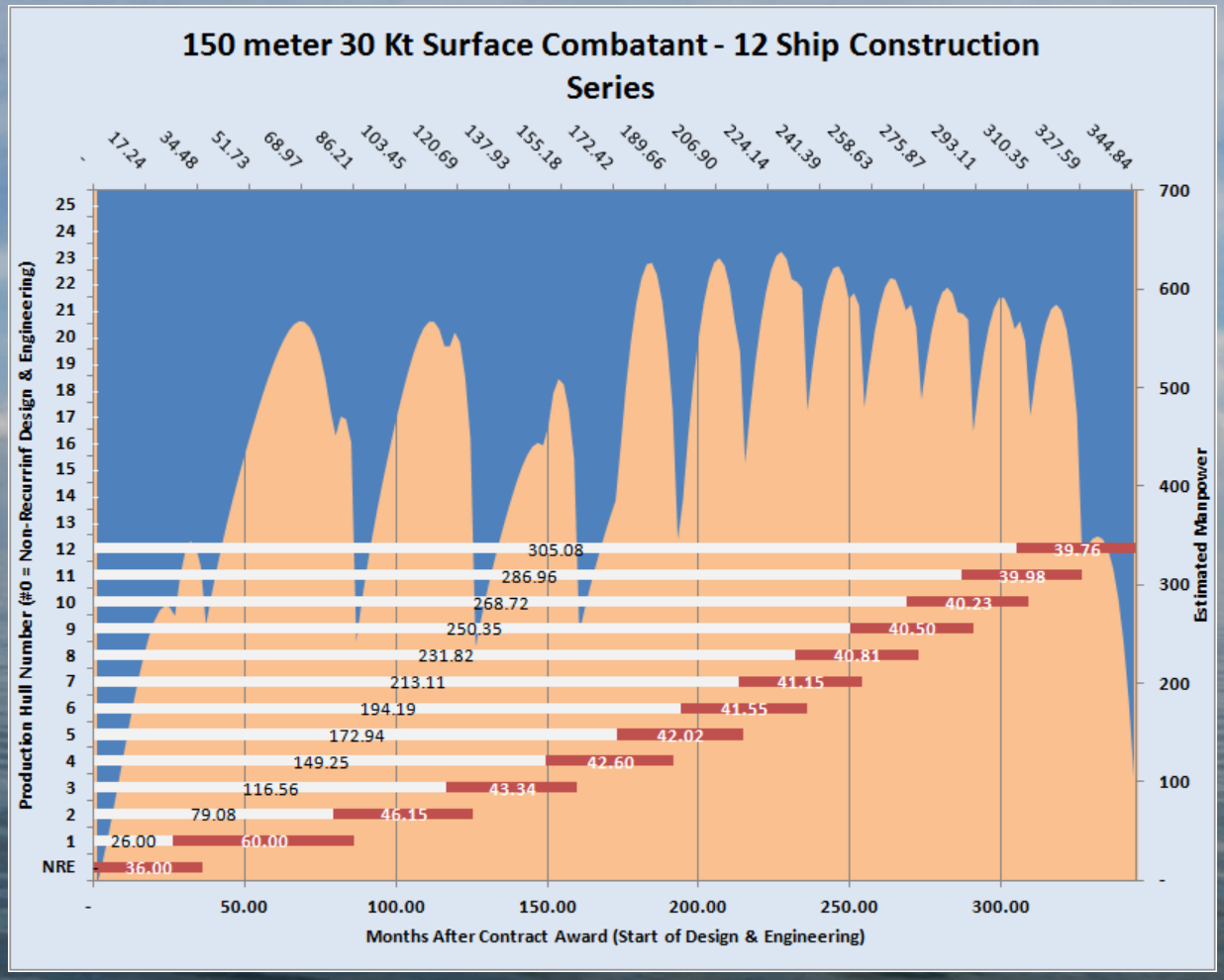
The Cost Model allows changes to follow ship production schedule durations and their overlaps with prior ship schedules.



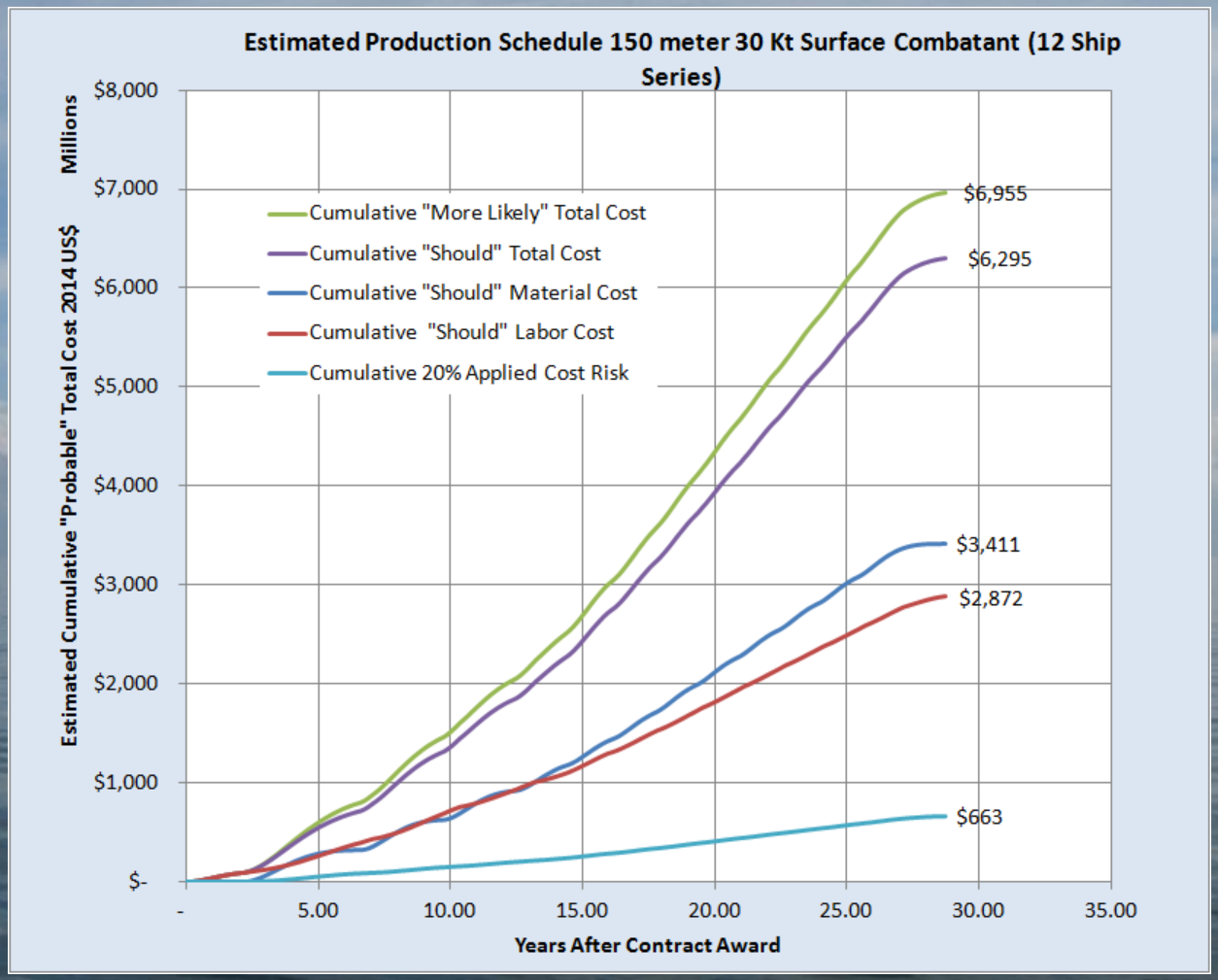
The user can specify the expected labor learning from follow ship to follow ship (also estimated material cost discounts). The cost model automatically adjusts the labor learning according to the extent of follow ship overlapping schedules; the greater the overlap, the less expected learning potential.



NRE, Lead Ship & Follow Ship Production Schedules (from Low Rate Production to High Rate Production options) with estimated manpower requirements are quickly and easily modeled by the user.



Estimating Time-Lines for Total Costs



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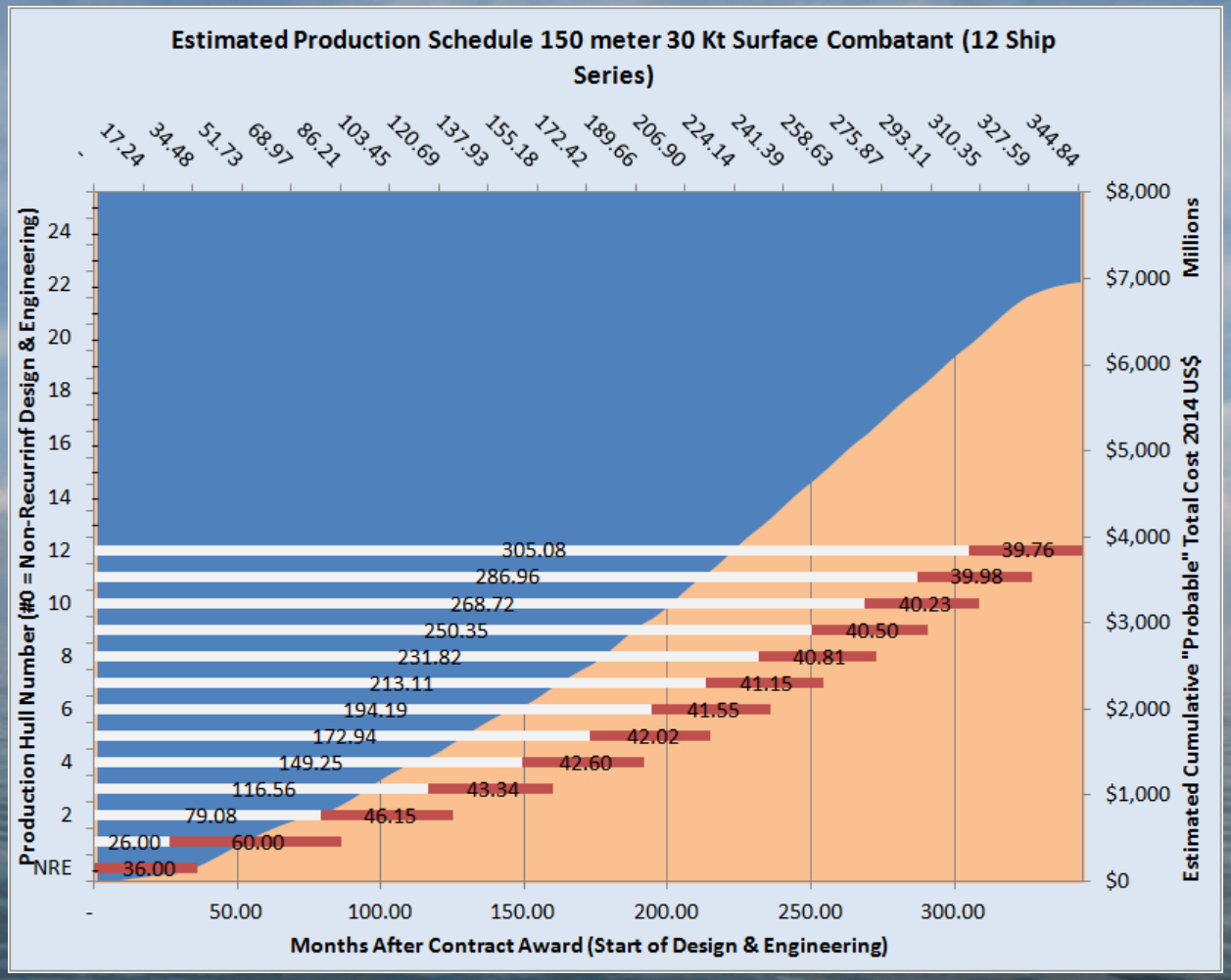
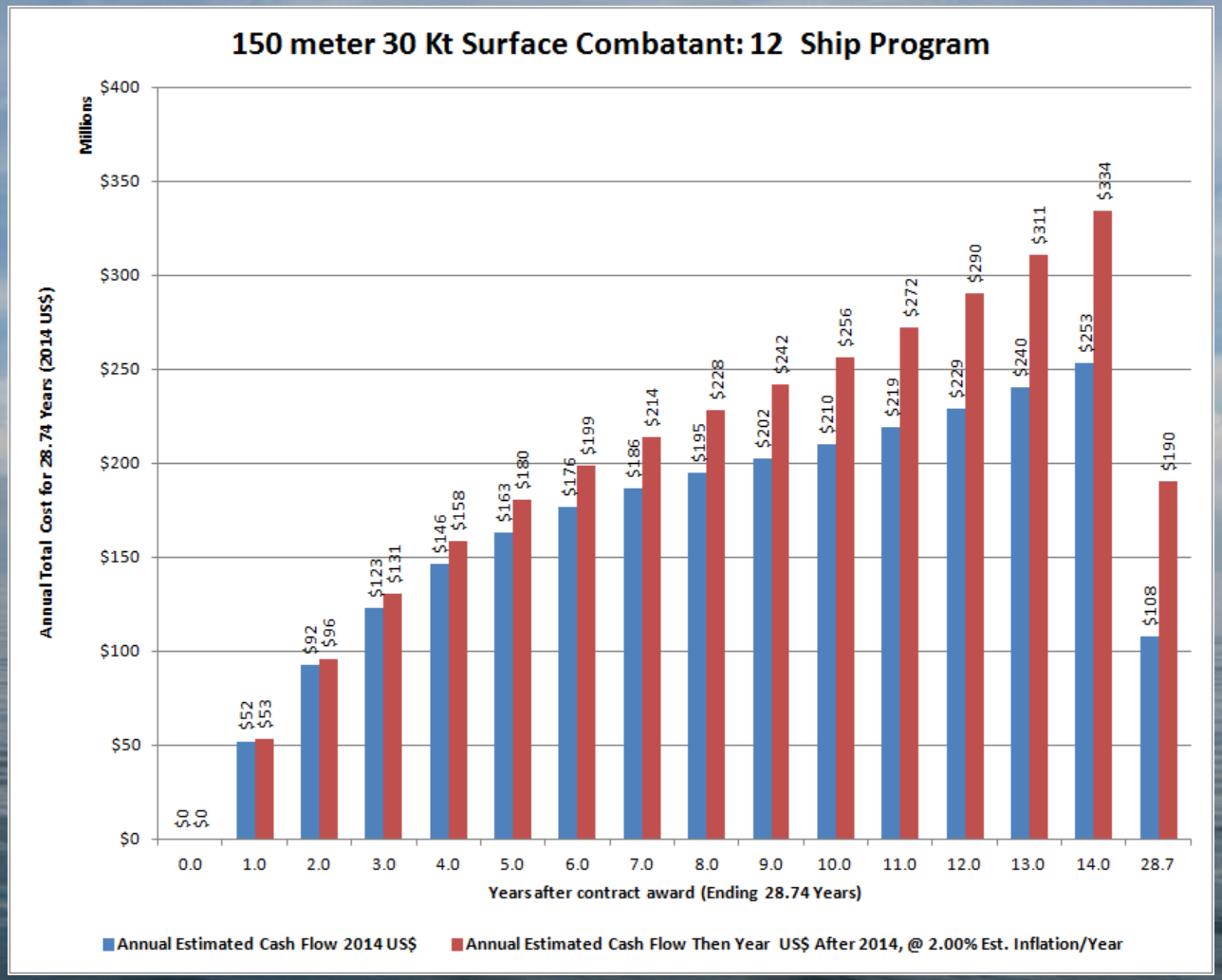


Estimating Annual Costs



The cost model will accommodate costs in non-U.S. currencies.

While the material costs are based on U.S. material dollar costs, the cost model provides factors for currency exchange rates as well as a general factor to increase/decrease material costs that more accurately reflect local costs versus those of the U.S.

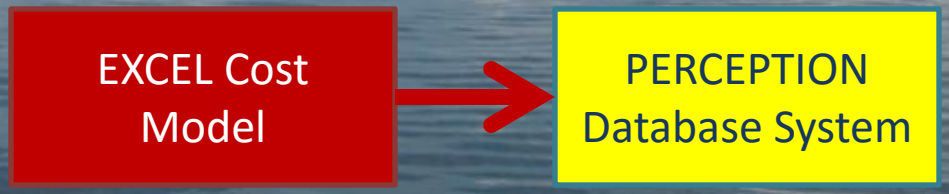
The labor hour and material cost data embedded within the cost model can be easily modified and expanded by the user.

The cost models enable the estimator to vary ship design dimensional characteristics (linear, volumetric and area) , speed, type and size of propulsion and electrical power systems. Other variables include crew size and type, structural configuration, including selections of type structural materials.

The cost models further provide a wide range of selections for outfit and auxiliary systems and equipment.

The Excel cost models provide only summary SWBS Group-Level estimate reports and many charts and tables. For more format reports, the data contents of the cost model can be down-loaded into the PERCEPTION ESTI-MATE database system. The following slides illustrate only three of the many varieties of formats that are available in PERCEPTION. PERCEPTION also has features for customizing formats for specific reporting requirements.

PERCEPTION has many features for modifying/adding/deleting the estimate details from the cost model. New estimates can be easily copied and modified from earlier estimates residing on the database. PERCEPTION provides many powerful database features for storing and managing detail cost data in libraries that are capable of generating cost estimates with or without using the cost models.



- **Add/Change/Delete Cost Items**
- **Generate Summary & Detail Reports**
- **Develop & Management Cost Libraries for Future Estimates**
- **Prepare Estimate Data for Transfer to Production Requisitions & Work Orders**
- **Plan & Manage Production Costs and Schedules**

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The cost model is a large comprehensive Excel workbook containing the various worksheets as listed in this slide. Also indicated are the number of individual cost line items arranged in worksheets corresponding to SWBS Groups. These line items are mostly parametric and utilize many different metrics such as power (kW), linear dimensions, surface areas, volumes, crew size, etc.

Cost Item Detail Value Report: A Selection of Estimated Structural Costs

12/3/2014 10:44:17 — SPAR Associates, Inc. — Page 1 of 10

(Date format: M/D/YYYY)

Cost Item Value Report by SWBS Groups(CI14)

Contract NavyResearchShip - Cost Estimate: Naval Research

Project Range:	101 to 101	Zone Range:	0 to ZZZZZZZZ	Assembly Range:	0 to ZZZZZZZZ	Cost Grp:	0 to ZZZZZZZZ
Group Range:	0 to ZZZZZZZZ	Outfit Zone Range:	0 to ZZZZZZZZ	Sub Assembly Range:	0 to ZZZZZZZZ	Cost Sub Grp:	0 to ZZZZZZZZ
Account Range:	0 to ZZZZZZZZ	Unit/Block Range:	0 to ZZZZZZZZ	MGF Part Range:	0 to ZZZZZZZZ	COA Item:	0 to ZZZZZZZZ
		Work Center Range:	0 to ZZZZZZZZ	CLINs Range:	0 to ZZZZZZZZ	Planned Start:	01/01/1950 to 01/01/2050

Cost Item	Description	Labor Hours	Labor Cost	Material Cost	Direct Cost	Taxes	Indirect Cost	Total Cost	Profit	Total Price
Project 101	**Lead Ship**									
Group 1	**- Hull Structure**									
Center	**SYH - Shipyard Hull Production Depts**									
111.18	Single Side Shell - Parallel	3,212	148,940	43,824	192,764	0	192,749	385,514	30,841	416,355
111.19	Single Side Shell - Shaped	11,342	525,933	81,387	607,320	0	669,625	1,276,945	102,156	1,379,100
113.16	Double Bottoms - Parallel	835	38,714	7,968	46,682	0	49,588	96,270	7,702	103,972
113.17	Double Bottoms - Shaped	2,563	118,846	14,798	133,644	0	150,778	284,422	22,754	307,176
114.43	Bilge Keels & Skegs	495	22,953	6,640	29,593	0	29,687	59,281	4,742	64,023
115.26	Stanchions	483	22,392	5,691	28,083	0	28,844	56,927	4,554	61,481
116.28	Longitudinal Frames	6,611	306,552	43,634	350,186	0	389,735	739,921	59,194	799,115
117.27	Transverse Frames	4,743	219,942	31,303	251,245	0	279,623	530,868	42,469	573,338
121.30	Longitudinal Bulkheads - Stiffened	4,599	213,260	37,943	251,203	0	272,267	523,470	41,878	565,348
122.29	Transverse Bulkheads - Stiffened	4,967	230,297	45,531	275,828	0	294,700	570,528	45,642	616,170
123.33	Trunks and Enclosures	3,320	153,939	19,920	173,859	0	195,412	369,271	29,542	398,813
130.24	Deck Platforms & Cross-Overs	209	9,691	949	10,640	0	12,257	22,897	1,832	24,729
131.22	Weather Decks	7,195	333,637	61,657	395,294	0	426,295	821,588	65,727	887,315
140.25	Platforms/Flats	21,606	1,001,879	73,040	1,074,919	0	1,263,305	2,338,225	187,058	2,525,283
150.34	Deckhouse/Superstructure/Bridge	1,678	77,786	9,024	86,810	0	98,586	185,395	14,832	200,227
164.32	Hull, Deckhouse, Misc Closures	1,690	78,347	19,920	98,267	0	100,921	199,188	15,935	215,123
165.83	Sonar Dome	10,899	505,377	19,920	525,297	0	634,710	1,160,007	92,801	1,252,808
100.113	Average Misc. Rooms, Lockers & Houses	15,971	740,571	53,526	794,097	0	933,742	1,727,839	138,227	1,866,066
100.116	Castings	2,638	122,315	17,842	140,157	0	155,570	295,727	23,658	319,385
123.163	Tanks - Machinery Space Volume	224	10,405	13,385	23,791	0	15,015	38,806	3,104	41,910
150.101	Deck House Total	13,141	609,330	72,018	681,348	0	772,465	1,453,812	116,305	1,570,117
162.137	Stacks and Macks	1,251	57,995	9,664	67,659	0	73,943	141,602	11,328	152,930
163.132	Sea Chest	275	12,752	1,487	14,239	0	16,163	30,401	2,432	32,834
170.145	Masts & Spars	701	32,491	3,717	36,208	0	41,172	77,380	6,190	83,571
180.138	Foundations - Propulsion	5,359	248,506	19,329	267,835	0	313,532	581,367	46,509	627,876
180.139	Foundations - Electrical	2,680	124,253	9,664	133,917	0	156,766	290,683	23,255	313,938
184.140	Foundations - Command and Control	2,267	105,125	8,178	113,303	0	132,633	245,937	19,675	265,612
185.141	Foundations - Auxilary	1,950	90,435	12,788	103,223	0	114,962	218,186	17,455	235,641
186.142	Foundations - Outfit	1,236	57,332	4,460	61,792	0	72,334	134,126	10,730	144,856
187.143	Foundations - Armament	2,885	133,791	10,408	144,199	0	168,800	313,000	25,040	338,040

SWBS Account Summary Report: A Selection of Estimated Structural Costs

12/3/2014 10:52:01 (Date format: M/D/YYYY)

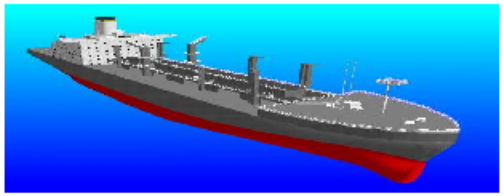
SPAR Associates, Inc. Page 3 of 14

SWBS Account Summary Report (SUM03)

Contract NavyResearchShip Cost Estimate: Naval Research Ship

Account	Description	Labor Hours	Labor Cost	Material Cost	Direct Cost	Taxes	Indirect Cost	Total Cost	Profit	Total Price
Project 101	**Lead Ship**									
Group 1	**Hull Structure**									
156	5th Deck House Level	0	0	0	0	0	0	0	0	0
157	6th Deck House Level	0	0	0	0	0	0	0	0	0
158	7th Deck House Level	0	0	0	0	0	0	0	0	0
159	8th Deck House Level	0	0	0	0	0	0	0	0	0
160	Special Structures	0	0	0	0	0	0	0	0	0
161	Structural Castings, Forgings, etc.	0	0	0	0	0	0	0	0	0
162	Stacks & Macks	1,251	57,995	9,664	67,659	0	73,943	141,602	11,328	152,930
163	Sea Chest	275	12,752	1,487	14,239	0	16,163	30,401	2,432	32,834
164	Structural	1,690	78,347	19,920	98,267	0	100,921	199,188	15,935	215,123
165	Structural	10,899	505,377	19,920	525,297	0	634,710	1,160,007	92,801	1,252,808
166	Sponsons	0	0	0	0	0	0	0	0	0
167	Hull Structural Closures	0	0	0	0	0	0	0	0	0
169	Special Purpose Closures	0	0	0	0	0	0	0	0	0
170	Structural	701	32,491	3,717	36,208	0	41,172	77,380	6,190	83,571
171	Masts Towers & Tetrapods	0	0	0	0	0	0	0	0	0
172	Kingposts & Support Frames	0	0	0	0	0	0	0	0	0
179	Service Platforms	0	0	0	0	0	0	0	0	0
180	Structural	8,039	372,759	28,993	401,752	0	470,298	872,050	69,764	941,814
181	Hull Structure Foundations	0	0	0	0	0	0	0	0	0
183	Electric Plant Foundations	0	0	0	0	0	0	0	0	0
184	Command & Surveillance Foundations	2,267	105,125	8,178	113,303	0	132,633	245,937	19,675	265,612
185	Auxiliary Systems Foundations	1,950	90,435	12,788	103,223	0	114,962	218,186	17,455	235,641
186	Structural	1,236	57,332	4,460	61,792	0	72,334	134,126	10,730	144,856
187	Armament Foundations	2,885	133,791	10,408	144,199	0	168,800	313,000	25,040	338,040
199	Special Tools	0	0	0	0	0	0	0	0	0
	Group: 1 Totals	**137,024**	**6,353,789**	**759,615**	**7,113,404**	**0**	**8,056,179**	**15,169,583**	**1,213,567**	**16,383,150**
Group 2	**Propulsion Plant**									

Bid Format Report: A Selection of SWBS Estimated Structural Costs (Shipyard's Own Logo Can be Defined for the Report)



Estimate Date
12/3/2014

TO CUSTOMER	ESTIMATE	PROPOSAL FROM
		SPAR Associates, Inc. 927 West Street Annapolis MD 21401 USA

Contract NavyResearchShip - Cost Estimate: Naval Research Ship

Project 101 - Lead Ship

Cost Item #	Quantity	UoM	Description	Unit Price	Extended Cost
Account 100			**Hull Structure**		
100.113	43.71	MTON	Average Misc. Rooms, Lockers & Houses	42,691.97	1,866,065.92
100.116	14.57	MTON	Castings	21,920.71	319,384.69
			Total for Acct: 100		**2,185,450.61**
Account 111			**Shell Plating**		
111.18	28.05	MTON	Single Side Shell - Parallel	14,843.30	416,354.68
111.19	52.09	MTON	Single Side Shell - Shaped	26,475.34	1,379,100.27
			Total for Acct: 111		**1,795,454.95**
Account 113			**Inner Bottom**		
113.16	5.10	MTON	Double Bottoms - Parallel	20,386.67	103,972.04
113.17	9.47	MTON	Double Bottoms - Shaped	32,436.71	307,175.66
			Total for Acct: 113		**411,147.70**

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