# Estimating the Cost of New Construction Using PERCEPTION





# **Computerized Cost Estimating**

- Computer-based tools to quickly formulate a cost estimate
- Manage cost data from central database
- Maintain current catalog of actual costs
- Maintain catalog of prior estimates



# **Establish Libraries of Centrally Available Cost Data**

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43 MS-S Shap 44 MS-S Shap 45 MS-S Skeg 46 P/CS-FIN		Stern zone		5 5 6	Fwd Stern Tube Seal	1.00		- -		
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46 P/CS-FIN		Mild steel		<b>9</b> 9	Fab Coupling Bolts		PKG	-		_,
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47 P/CS-Lab		Pipe, CS C	11	1 11	Bore & Fit Stern Tube	1.00	PKG	-	750.00	0.0
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48 PEP1		Shaft & Pr	13	3 13	Install Shafts	1.00	PKG	•	400.00	
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52 PM1		Anchor H								
53 PME1		Main Eng								
54 PME11		Engine Rc								
55 PME12		Ship Servi	•							
56 PME14		General Eng	zine Room (	Outfit				<b>-</b>		

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## **Benefits**

- Fewer cost surprises
- Faster bid response
- Lower cost risk
- Greater profit potential
- More competitive bids



## **Basic Tool Set:**

- Application of learning curves
- Complexity & productivity factors
- Cost escalation
- Cost risk analysis
- Cost trade-off
- Global edits and update features
- Return cost data analysis
- **User documentation of cost estimate**
- **Tracking of estimate sources and changes**



#### **Work Breakdown Structures**

The cost estimates are developed according to a Work Breakdown Structure (WBS):

- Identify work items
- Identify work process costs



## **Identify Work Items**

Work Items may be cataloged by

- Ship System WBS (SWBS)
- Shipyard Product WBS (PWBS)
- Ship Owner's WBS
- Government Contract Line Item (CLIN)

Each structure can be customized by shipyard, by contract.



#### **Identify Work Process**

Work Process may be cataloged by

- Stage of Construction (Rip-Out, Shop Work, On-Unit, On-Block, On-Board, Test)
- Shipyard Department (COA)

Each structure can be customized by shipyard, by contract.



# **Cataloging Standard Costs**

<u>F</u> ile <u>V</u> iew	Global	Library	Return Cost	Risk	Reports	Database	<u>W</u> indow	<u>H</u> elp			
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		Escalation Index Table									
		CERs And Equations			•	Structure CERs					
			Package Library				Machinery CERs				
			ard Parts Cata	log		Pipe CERs Electrical CERs HVAC CERs Outfit CERs Paint CERs					
			lassifications								
			or Catalog Df Measure								
		Units	DI Measule								
		Ship Types				Miscellaneous CERs					
		Stages of Construction Work Types			-						
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			Types Characteristics			Equations					
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		Projects Milestones									
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Cost Codes (COA)											
		GPW	3S Translation	To SV	/BS						
		Cost Items									

Catalog Standard Cost Estimating Relationships (CERs) onto Computer Database



## What is a CER?

A Cost Estimate Relationship (CER) is a formula relating the cost of an item to the item's physical or functional characteristics or relating the item's cost to the cost of another item or group of items.

**Examples**:

a) for steel block assembly, 25 man-hours/ton;

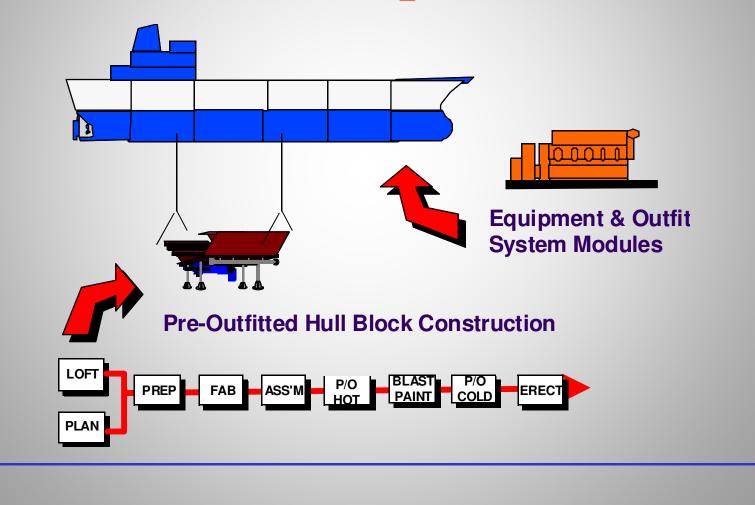
b) for pipe material, \$25/meter; and

c) for shipyard support service, 10% production

hours.

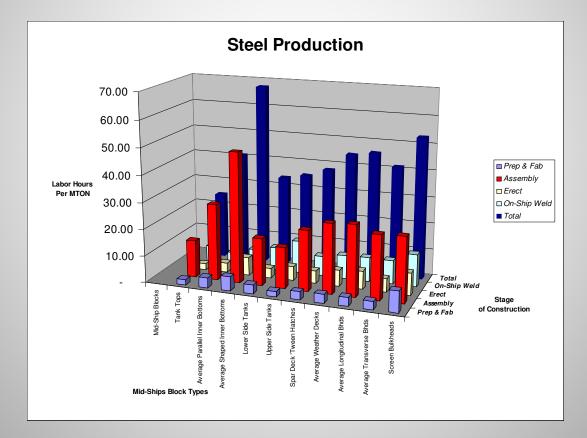


# Cataloging Standard Costs By Work Sequence





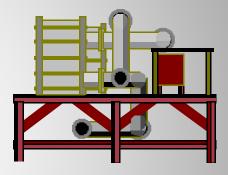
# Hull CERs by Block Type

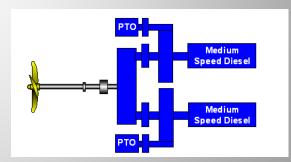




# Develop Standards of Labor & Material Cost Packages

Complete Equipment Packages Cargo Zone Packages Accommodations Outfit Packages Safety Equipment Packages Electronics Packages Shipyard Services Packages ....and more.





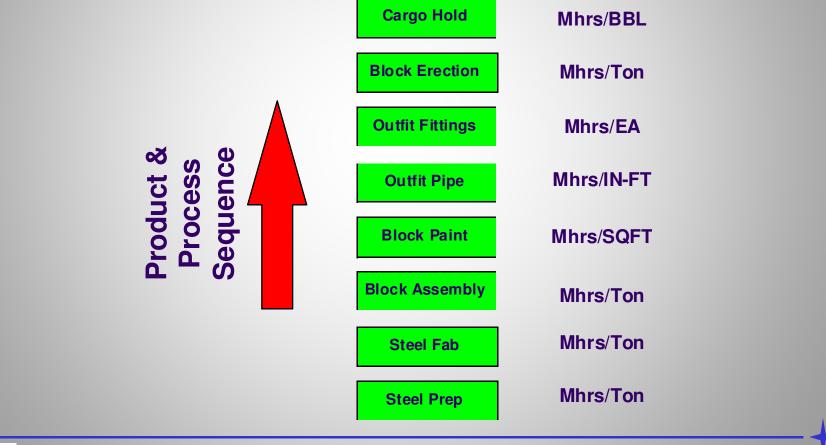


# Cataloging Standard Costs By Sequence

• Rip-Out Engineer • **Replace** Fabricate • Repair Assemble Install Install • Test Test Engineering Production Shop Component System **T**ests Specifications Drawings Fabrication Installation Rip-Out Repair Re-Install Test

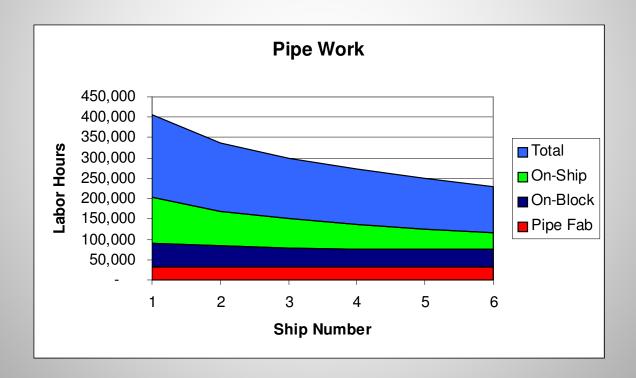


# Possible Levels of Product-Based CERs





# Outfit CERs by Stage of Construction





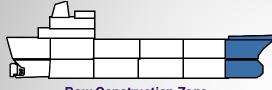
# Cataloging Standard Costs By Ship System (SWBS)

- Structural Work
- Machinery
- Piping
- HVAC

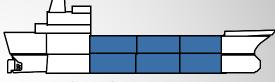
- Electrical
- Paint
- Outfit
- Shipyard Services



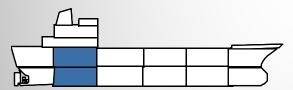
# Cataloging Standard Costs By Ship Zone (PWBS)



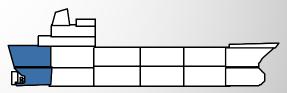
**Bow Construction Zone** 



**Cargo Construction Zone** 



**Machinery Construction Zone** 



**Stern Construction Zone** 





#### **Variations of CERs:**

#### **Line Item CER:**

Single V-butt weld size 3/16" - 5/16" (2 pass) 0.250 MH/FT

#### **Re-Use Package CER:**

Welding Repairs:Cracks	Labor CER	Labor UoM	Mate	erial CER
Drill Out	0.500	MH/FT	\$	-
Welding Repairs:	0.250	MH/FT	\$	1.4680
Gen Labor:	0.250	MH/FT	\$	-
Total:	1.000	MH/FT	\$	1.4680



#### **Variations of CERs:**

#### **CERs Based Upon Ship Design & Performance Characteristics:**

	Labor Hours	Material Cost	UoM
	CER	CER	CER
Cargo Transfer Pumps	0.0606	\$22.93	GPM
Paint	15.59	\$425.17	CuNo
Shafting	0.1695	\$20.26	kW
Dry Docking		\$0.27	Days-GRT
Hauling		\$0.50	Days-LOA



#### **Variations of CERs:**

#### **CERs Based Upon Multiple Parameters:**

Main PropulsionInstallation Labor Hours2.27 x [Displacement x Speed^3]/[SQRT(LWL)^3]

Ship Characteristics Parameters

**Displacement - LTONs** 

Speed - Knots

LWL - Feet



#### **Cost Adjustments**

#### Cost = fadjust x Standard Cost



#### **Automating Cost Adjustments**

**Work Productivity Work Site Work Access Economic Cost Escalation Learning Experience Standard Material Savings Material Waste Adjustments** 

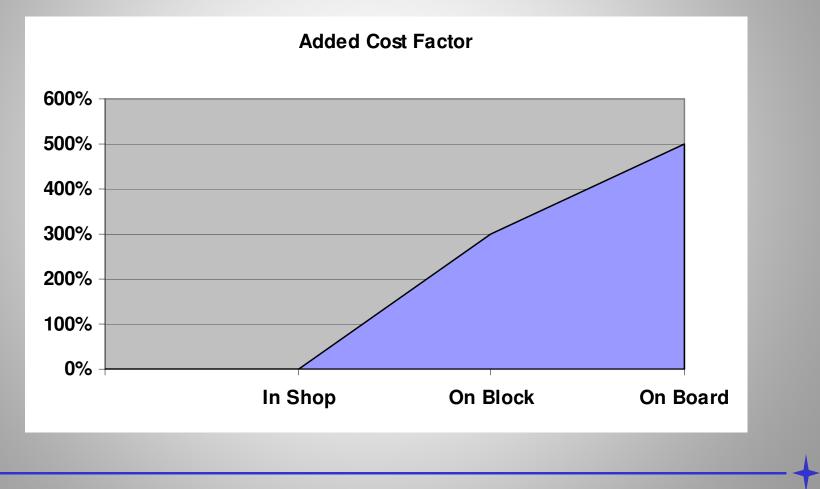


# **Impact of Work Productivity**

- <u>Alternate Methods</u>: Expensive staging versus mobile lift
- <u>Automation</u>: Manual versus automated welding
- <u>Alternate Resources</u>: In-House versus Sub-Contract
- Worker Skill Level

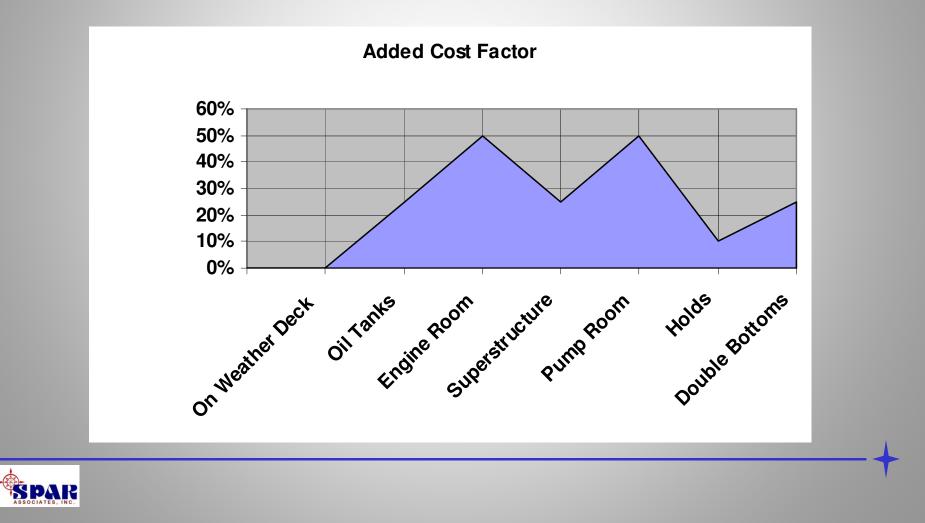


## **Impact of Work Site**

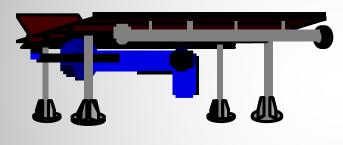




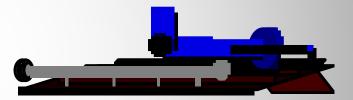
#### **Impact of Work Access:**



#### **Impact of Work Access:**



#### **Over-Head**

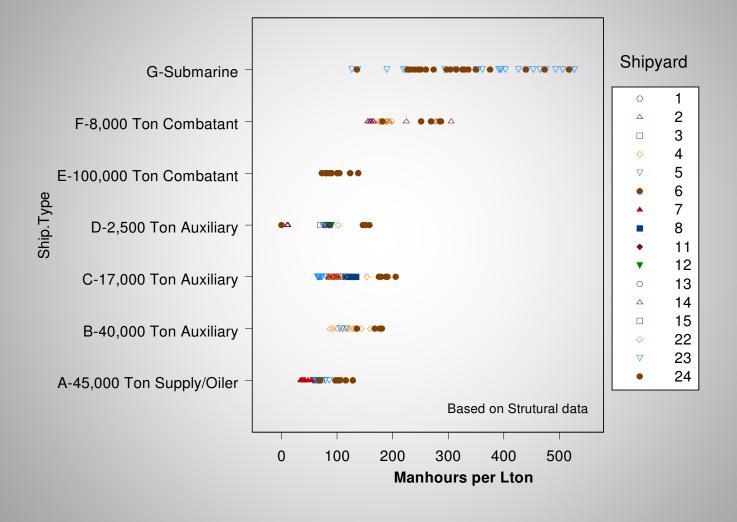


#### **Down-Hand**

#### **More Difficult = More Expensive**

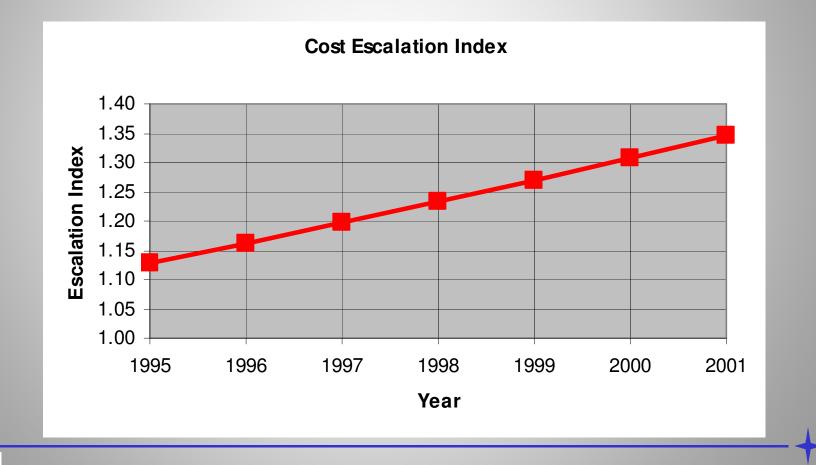


#### Productivity vs Ship Type and Shipyard



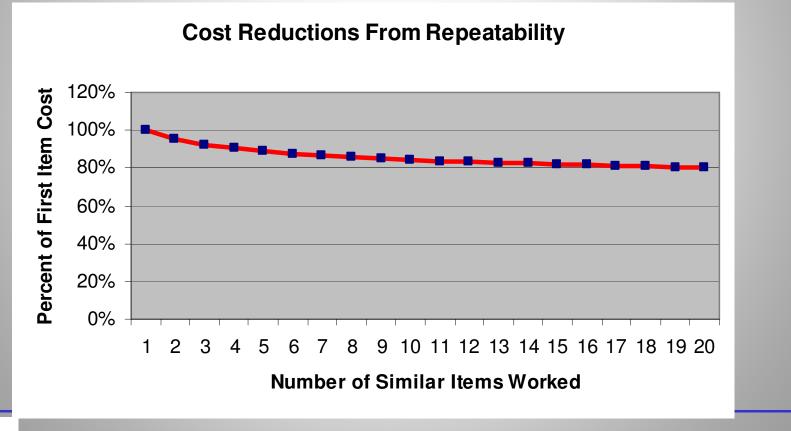
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### **Impact of Cost Escalation:**





## **Impact of Learning:**





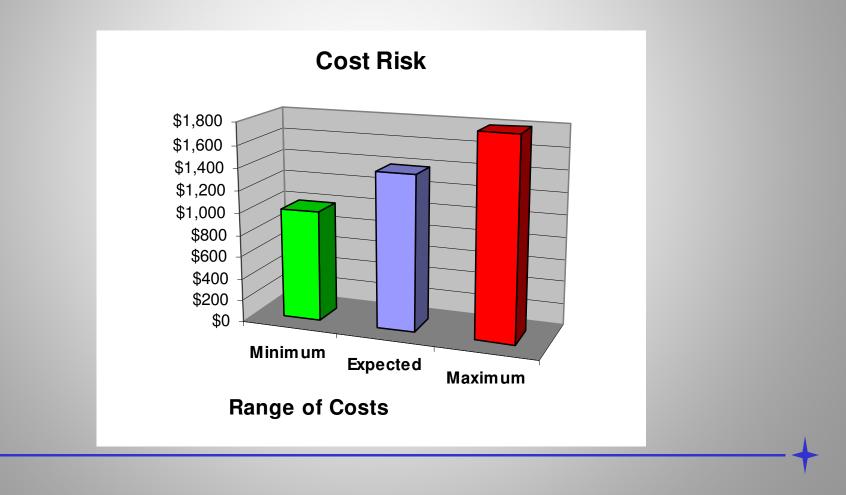
### **Impact of Standard Materials:**

■ <u>Standard material items</u> typically less expensive than non-standard items.

■ <u>Standard material deliveries</u> less expensive than high-priority rush orders

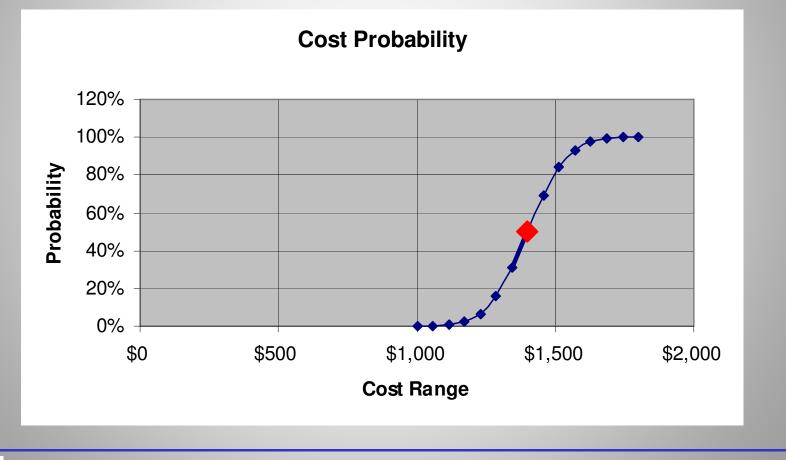


## **Cost Risk Analysis**





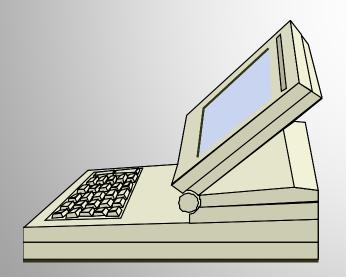
## **Cost Risk Analysis**



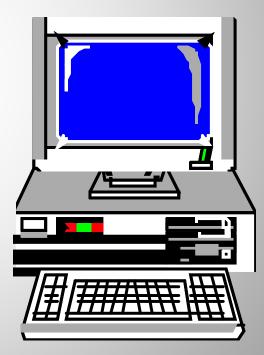


#### **Hardware Options**

#### **Single User Laptop**



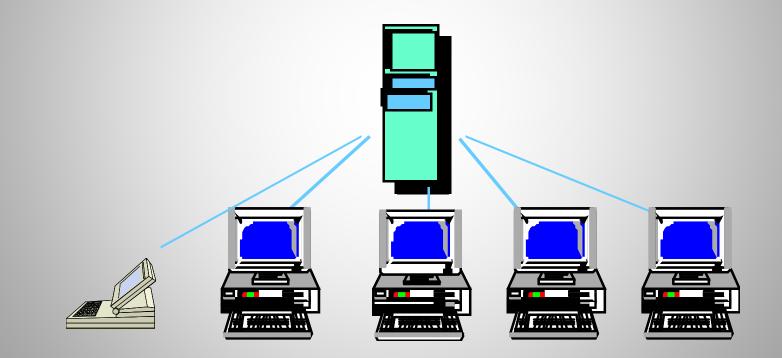
#### Single User Desktop





#### **Hardware Options**

#### **Multi-User Network**





## **Many Report Formats**

Detail Cost Item Reports
WBS Summary Reports
Major Equipment Lists
Detail Bills of Material



## **Cost Detail Information**

- Labor Hours
- Labor Costs
- Material costs
- Total Direct Costs
- Taxes & Duties
- Indirect Costs
- Profit
- Total Cost



# **Other Capabilities:**

- Import/Export: Spreadsheets & Databases
- <u>Data Analysis Module</u>: statistical analysis of cost information to develop CERs
- <u>Return Cost Module</u>: link to shipyard production management systems
- Link to CAD systems: automated cost estimating from design process
- <u>Link to CAD systems</u>: automated down-loading of bills of material



#### **Over 35 Years Serving the Shipbuilding & Repair Industry**



