

# 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

PERCEPTION - ESTI-MATE

File Edit View Global Library Return Cost Reports Database Window Help

C P G A Z U

Package Items For Reuse Package: PEP1

Package	Description	Quantity	UoM	Labor Hours	Material Cost
30	MS Bulkheads				
31	MS-B Deck w/shell				
32	MS-B Shaped Side Shell				
33	MS-C Deck w/shell				
34	MS-C Flat deck				
35	MS-C Flat Inner Bottom				
36	MS-C Shaped Outer Btm				
37	MS-C Shaped Side Shell				
38	MS-M Deck w/shell				
39	MS-M Flat deck				
40	MS-M Shaped Inner Btm				
41	MS-S Deck w/shell				
42	MS-S Flat deck				
43	MS-S Shaped Outer Btm				
44	MS-S Shaped Side Shell				
45	MS-S Skeg				
46	F/CS-FIN				
47	F/CS-Lab				
48	PEP1				
49	PEP2				
50	FG2				
51	FG3				
52	PM1				
53	PME1				
54	PME11				
55	PME12				
56	PME14				

Package Item ID	Description	Quantity	UoM	Labor Hours	Material Cost
1	Line Shaft	2.00	EA	0.00	35,000.00
2	Tail Shaft	1.00	EA	0.00	20,000.00
3	Line Shaft Bearings	4.00	EA	0.00	25,000.00
4	Stem Tube Bearing	1.00	EA	0.00	25,000.00
5	Thrust Bearing	1.00	EA	0.00	15,000.00
6	Fwd Stem Tube Seal	1.00	EA	0.00	1,000.00
7	Propeller	1.00	EA	0.00	35,000.00
8	Fairwater Cap	1.00	EA	0.00	2,500.00
9	Fab Coupling Bolts	1.00	PKG	100.00	1,000.00
10	Machine Stem Tube	1.00	PKG	400.00	0.00
11	Bore & Fit Stem Tube	1.00	PKG	750.00	0.00
12	Assemble Gear Box Intermediate Coupling	1.00	PKG	150.00	0.00
13	Install Shafts	1.00	PKG	400.00	0.00
14	Shaft Alignment	1.00	PKG	300.00	0.00
15	Assemble Propeller	1.00	PKG	500.00	0.00
16	Install Rope Guard	1.00	PKG	50.00	0.00

Ready



# 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

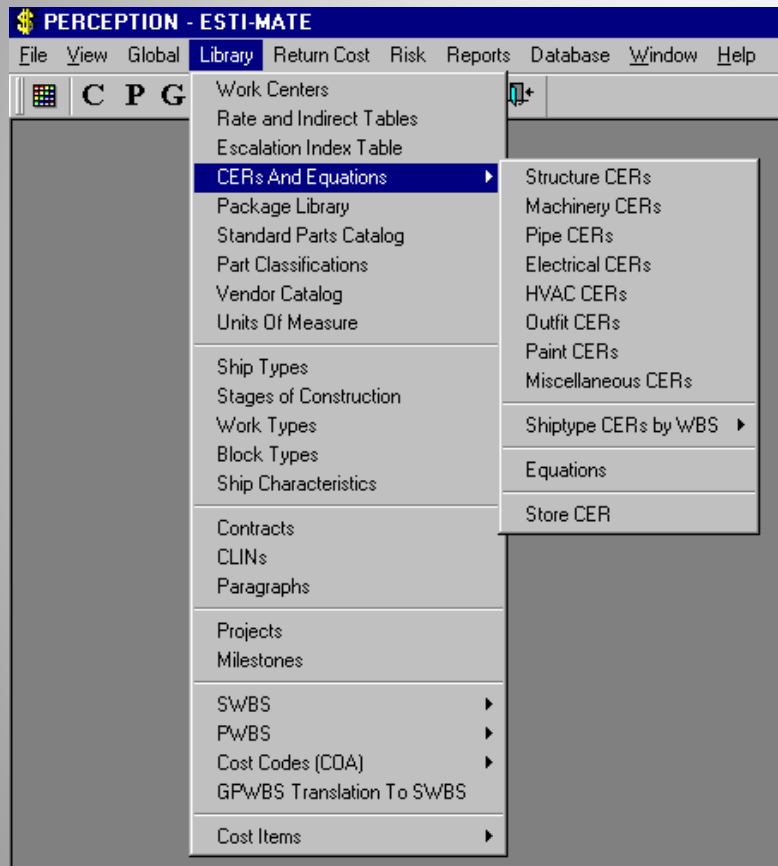
Work Process may be cataloged by

- 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



**Catalog  
Standard Cost  
Estimating  
Relationships (CERs)  
onto Computer  
Database**



# What is a CER?

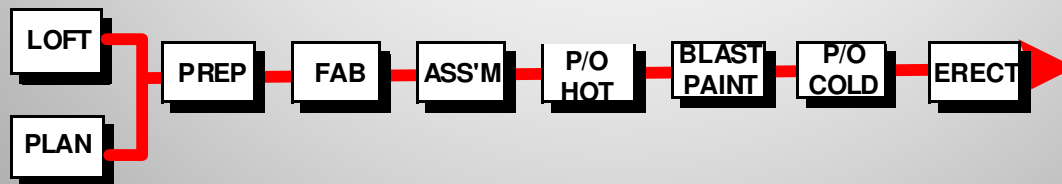
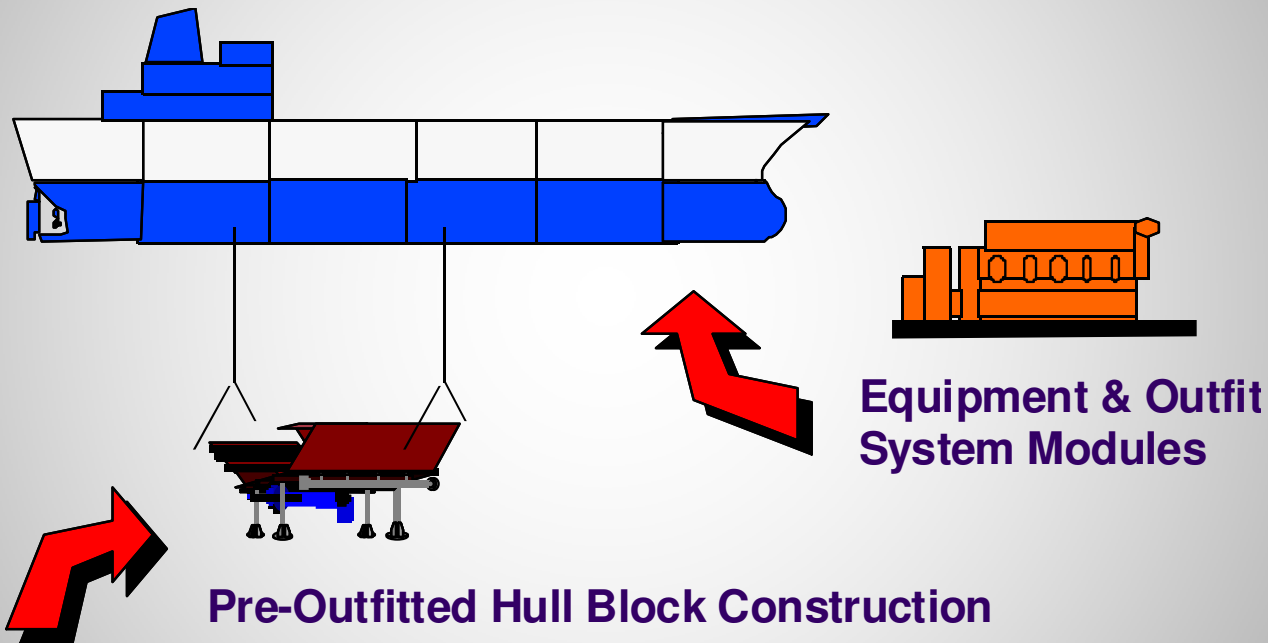
A Cost Estimate Relationship (CER) is a formula relating the cost of an item to the item's physical or functional characteristics or relating the item's cost to the cost of another item or group of items.

## Examples:

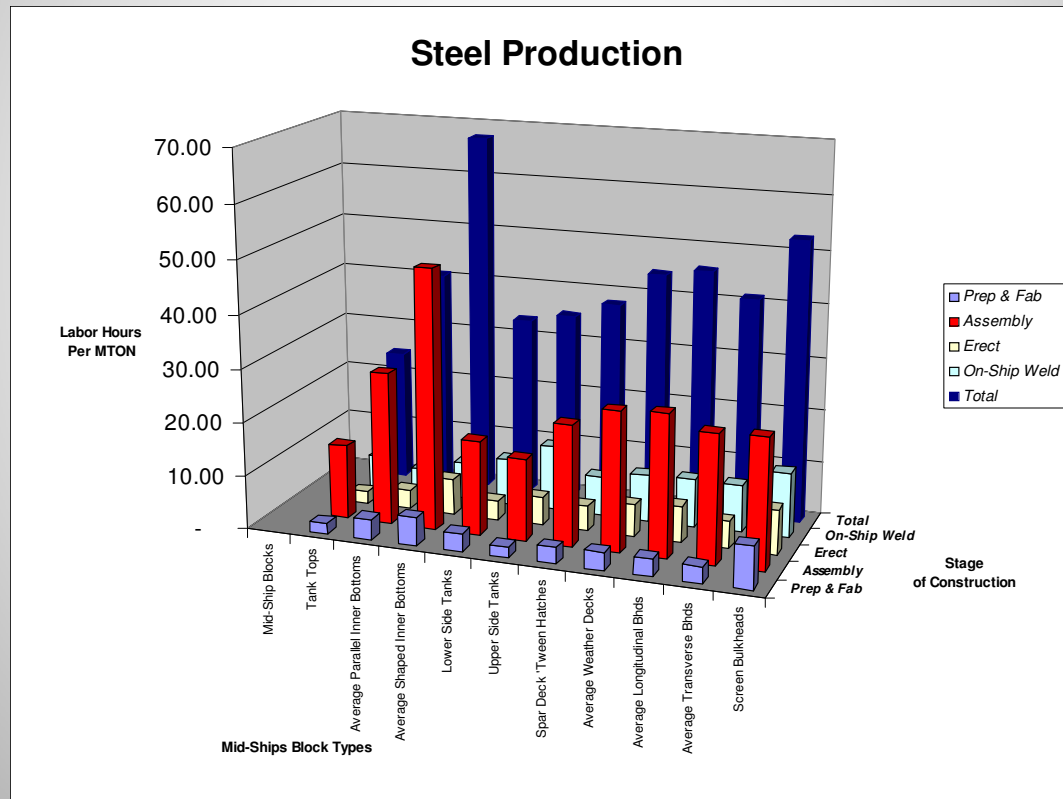
- a) for steel block assembly, 25 man-hours/ton;
- b) for pipe material, \$25/meter; and
- c) for shipyard support service, 10% production hours.



# Cataloging Standard Costs By Work Sequence



# Hull CERs by Block Type



# Develop Standards of Labor & Material Cost Packages

Complete Equipment Packages

Cargo Zone Packages

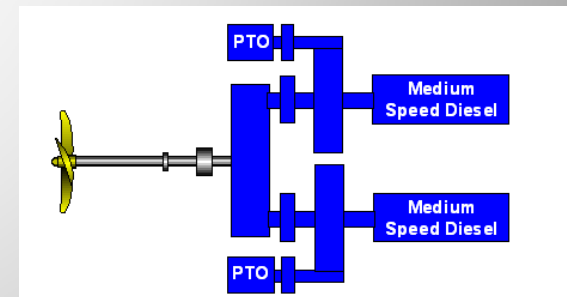
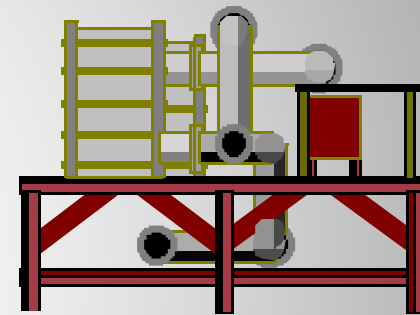
Accommodations Outfit Packages

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



# Possible Levels of Product-Based CERs

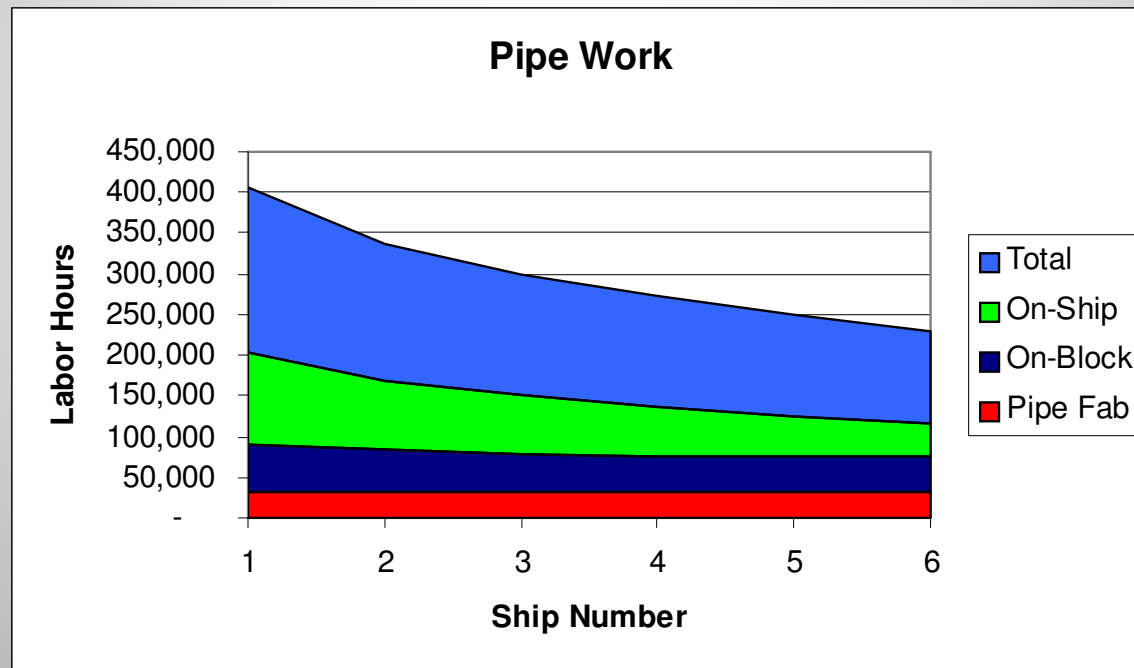
Product &  
Process  
Sequence



Cargo Hold	Mhrs/BBL
Block Erection	Mhrs/Ton
Outfit Fittings	Mhrs/EA
Outfit Pipe	Mhrs/IN-FT
Block Paint	Mhrs/SQFT
Block Assembly	Mhrs/Ton
Steel Fab	Mhrs/Ton
Steel Prep	Mhrs/Ton



# Outfit CERs by Stage of Construction

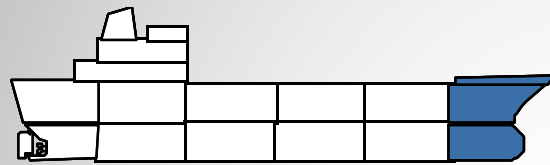


# Cataloging Standard Costs By Ship System (SWBS)

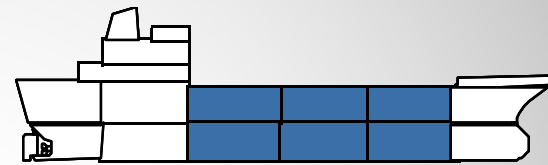
- Structural Work
- Machinery
- Piping
- HVAC
- Electrical
- Paint
- Outfit
- Shipyard Services



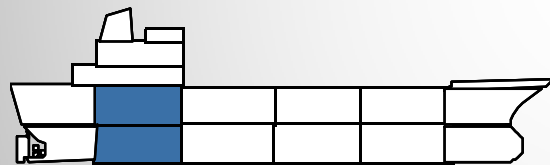
# Cataloging Standard Costs By Ship Zone (PWBS)



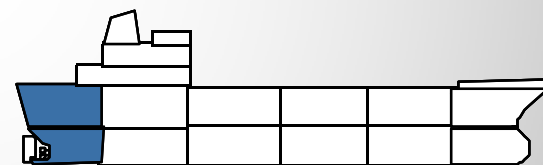
Bow Construction Zone



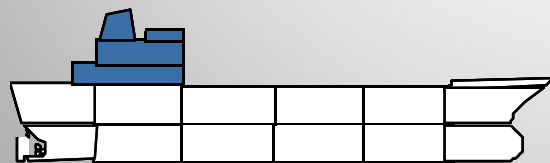
Cargo Construction Zone



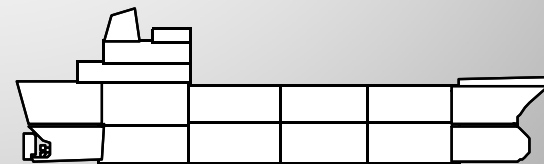
Machinery Construction Zone



Stern Construction Zone



Deckhouse Construction Zone



Ship-Wide Construction Zone



# Variations of CERs:

## Line Item CER:

Single V-butt weld size 3/16" - 5/16" (2 pass)	0.250	MH/FT
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## Re-Use Package CER:

Welding Repairs:Cracks	Labor CER	Labor UoM	Material CER
Drill Out	0.500	MH/FT	\$ -
Welding Repairs:	0.250	MH/FT	\$ 1.4680
Gen Labor:	0.250	MH/FT	\$ -
<b>Total:</b>	<b>1.000</b>	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:

<b>Main Propulsion Installation Labor Hours</b>	$2.27 \times [\text{Displacement} \times \text{Speed}^3] / [\text{SQRT}(\text{LWL})^3]$
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<b>Ship Characteristics Parameters</b>
Displacement - LTONS
Speed - Knots
LWL - Feet



# Cost Adjustments

$$\text{Cost} = f_{\text{adjust}} \times \text{Standard Cost}$$



# Automating Cost Adjustments

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

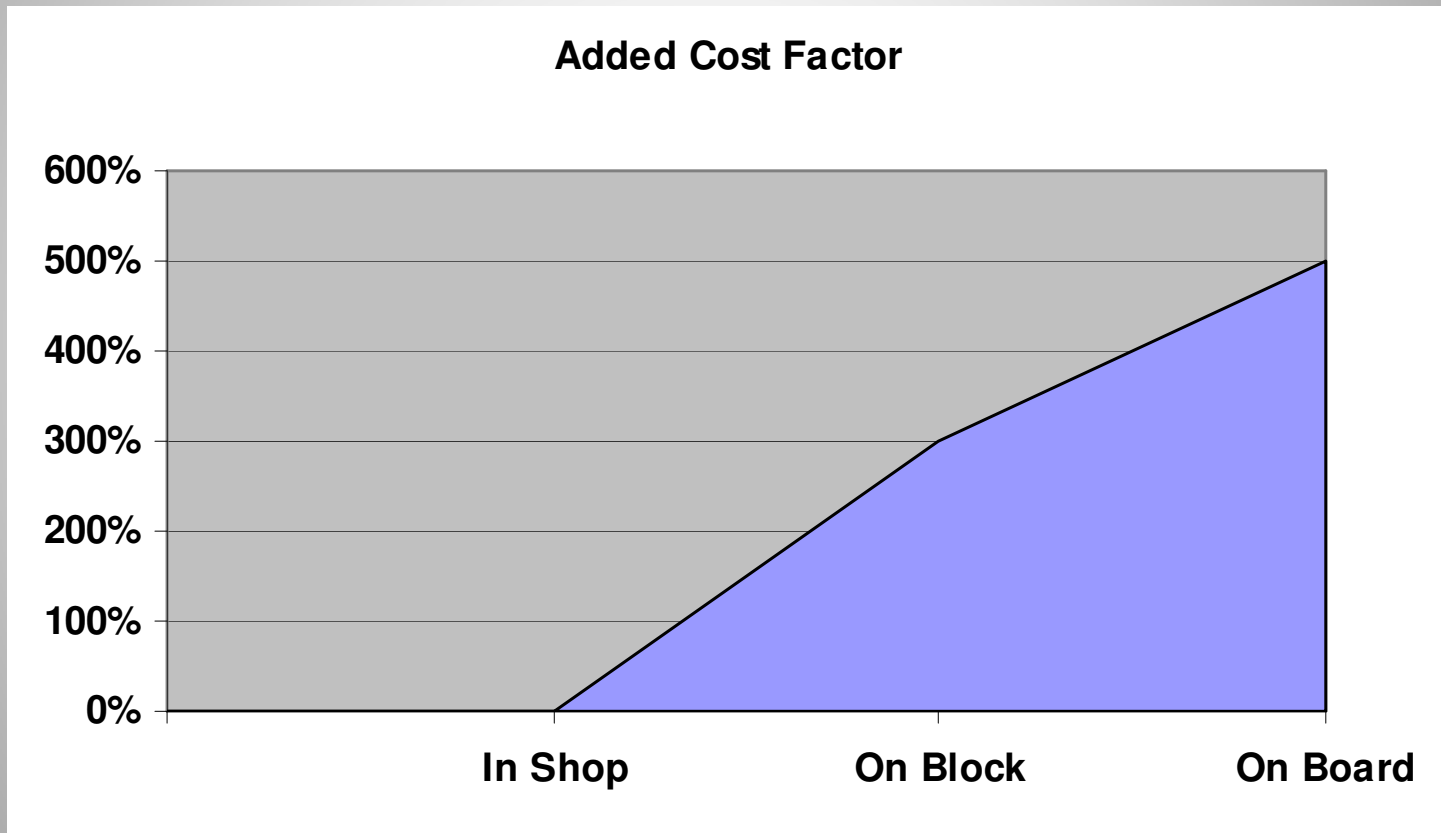


# Impact of Work Productivity

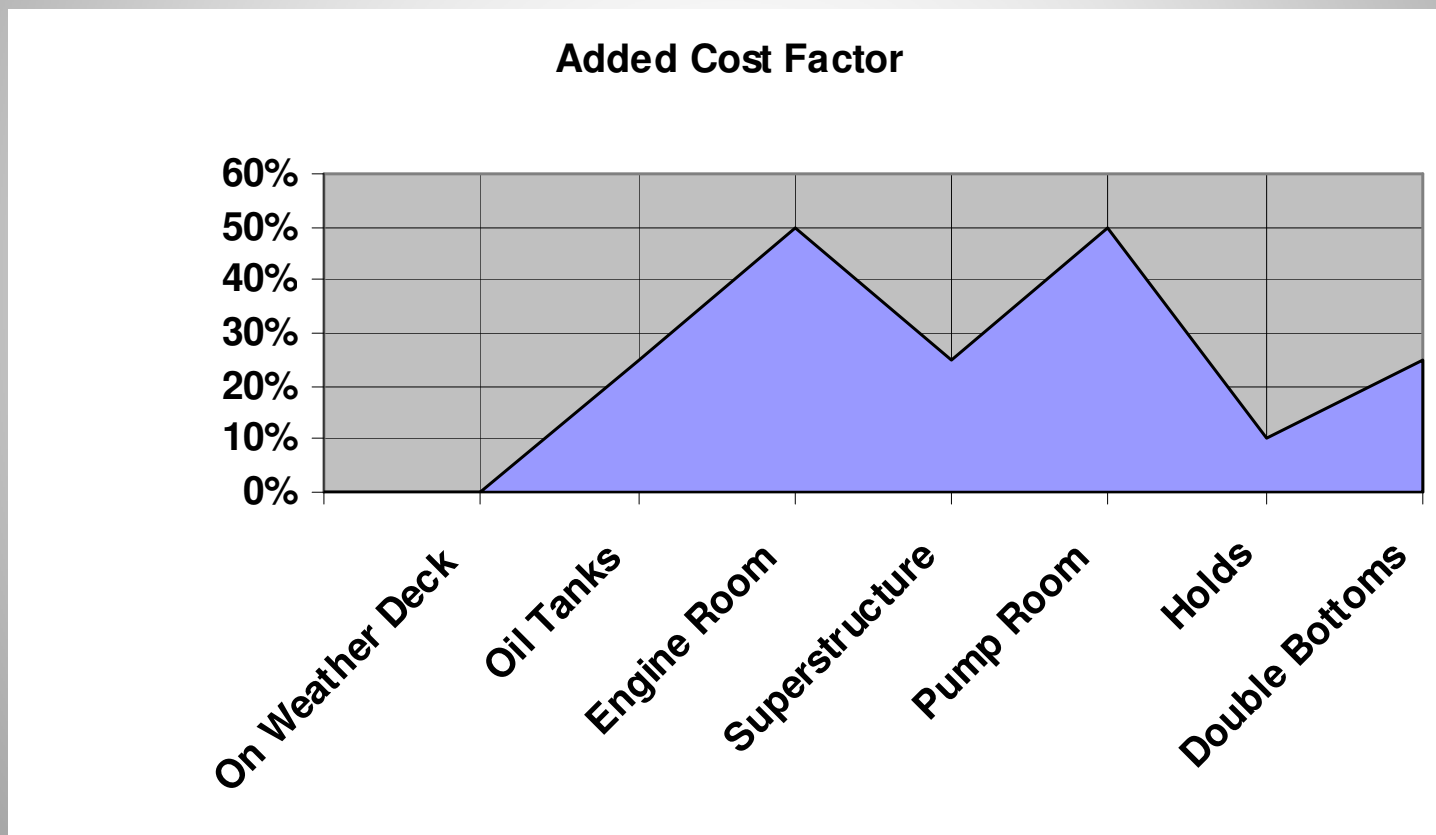
- Alternate Methods: Expensive staging versus mobile lift
- Automation: Manual versus automated welding
- Alternate Resources: In-House versus Sub-Contract
- Worker Skill Level



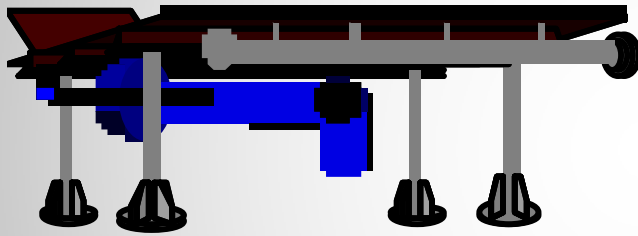
# Impact of Work Site



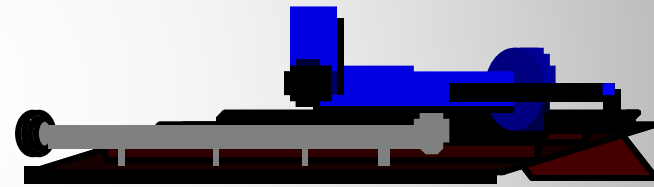
# Impact of Work Access:



# Impact of Work Access:



**Over-Head**

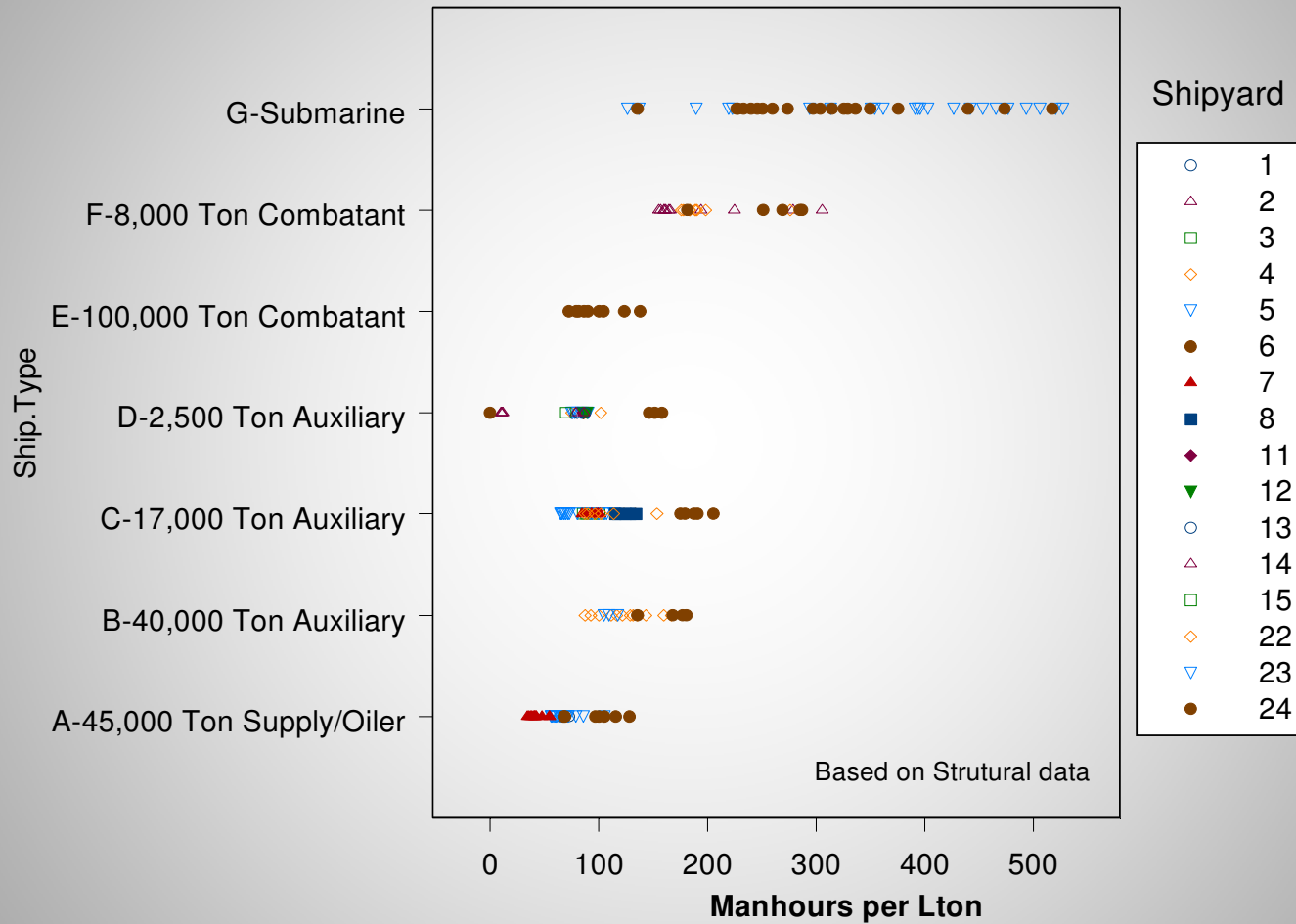


**Down-Hand**

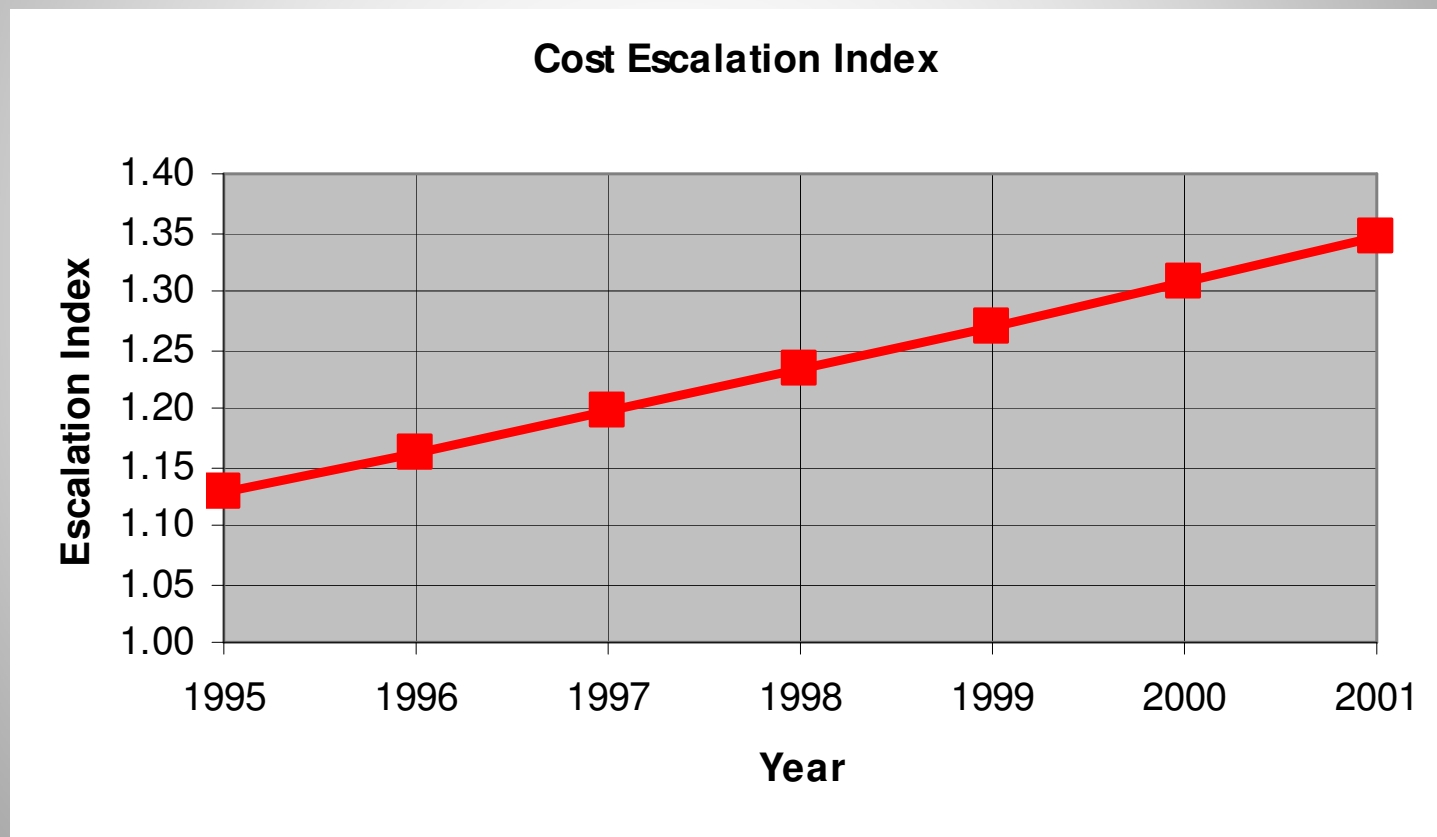
**More Difficult = More Expensive**



## Productivity vs Ship Type and Shipyard

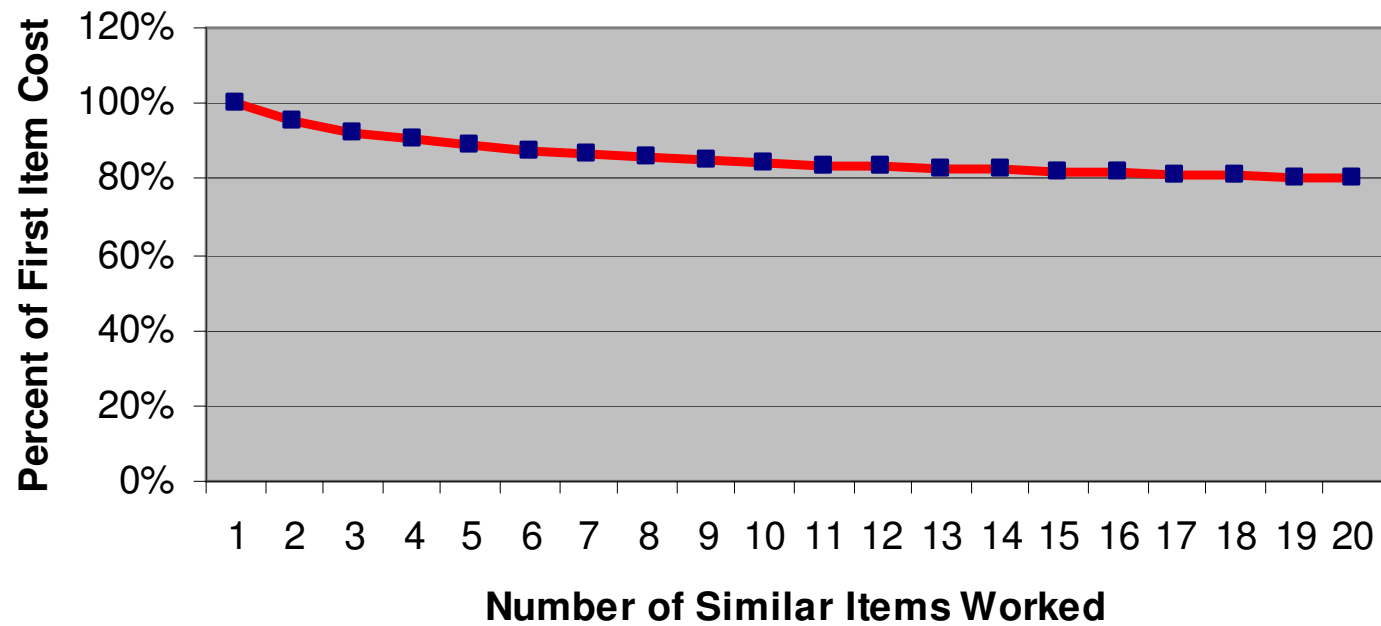


# Impact of Cost Escalation:



# Impact of Learning:

## Cost Reductions From Repeatability



# Impact of Standard Materials:

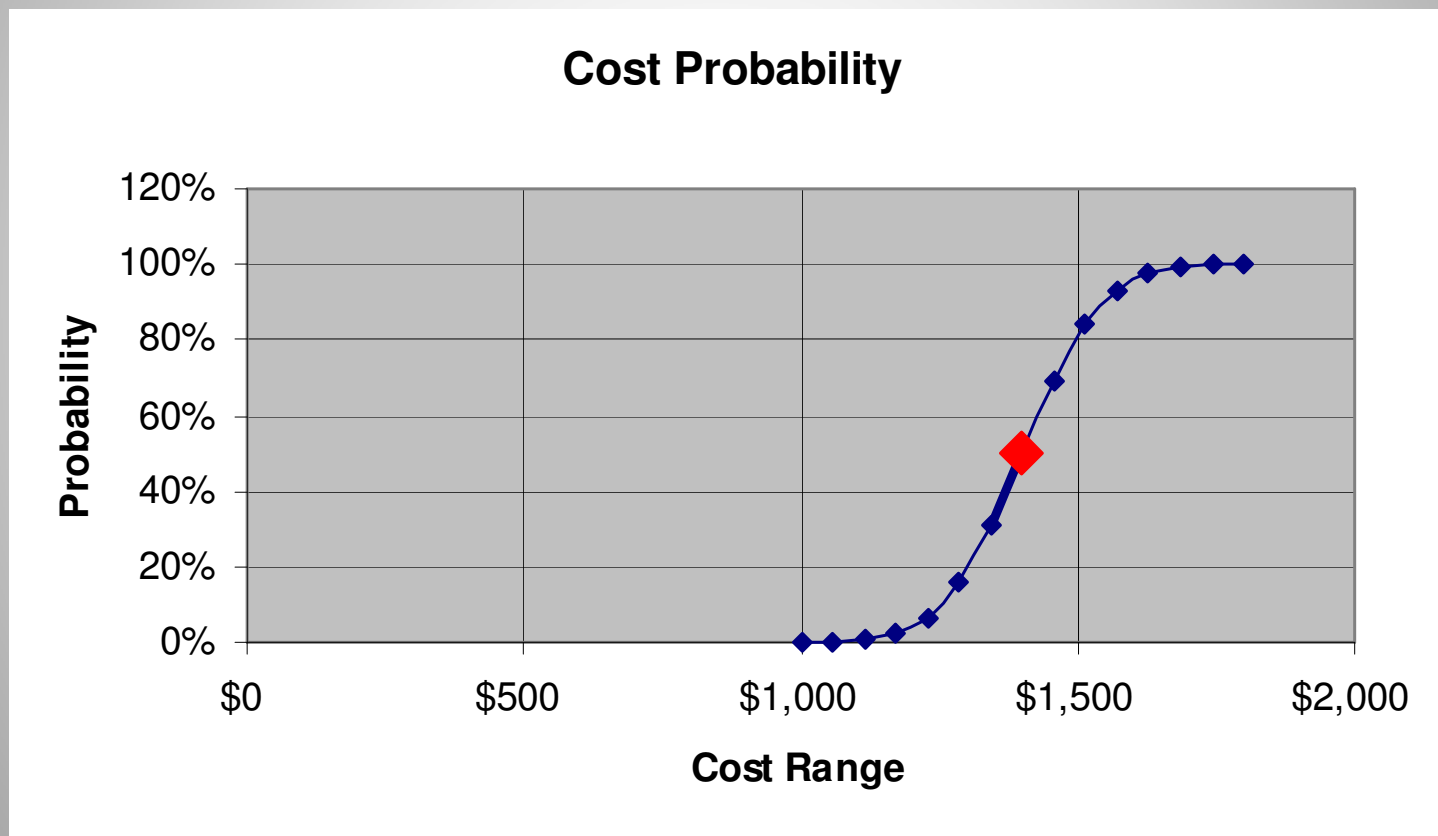
- ❑ Standard material items typically less expensive than non-standard items.
- ❑ Standard material deliveries less expensive than high-priority rush orders



# Cost Risk Analysis

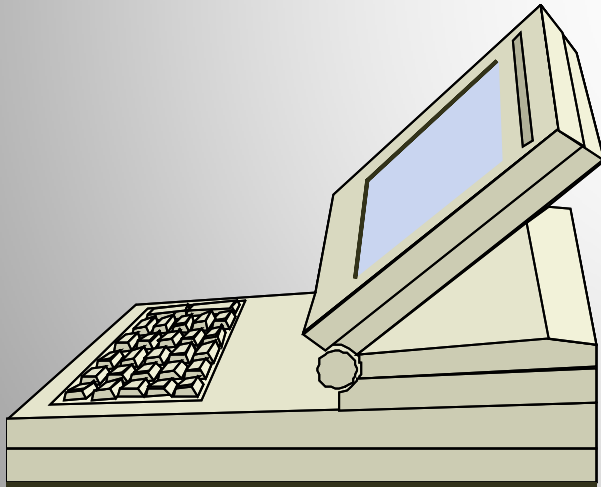


# Cost Risk Analysis

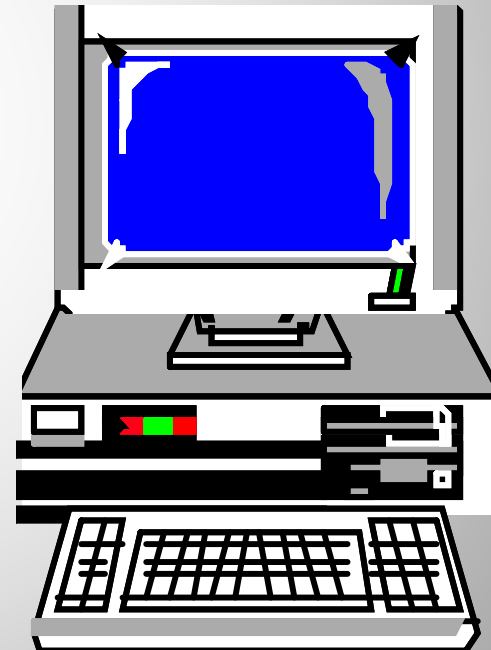


# Hardware Options

## Single User Laptop

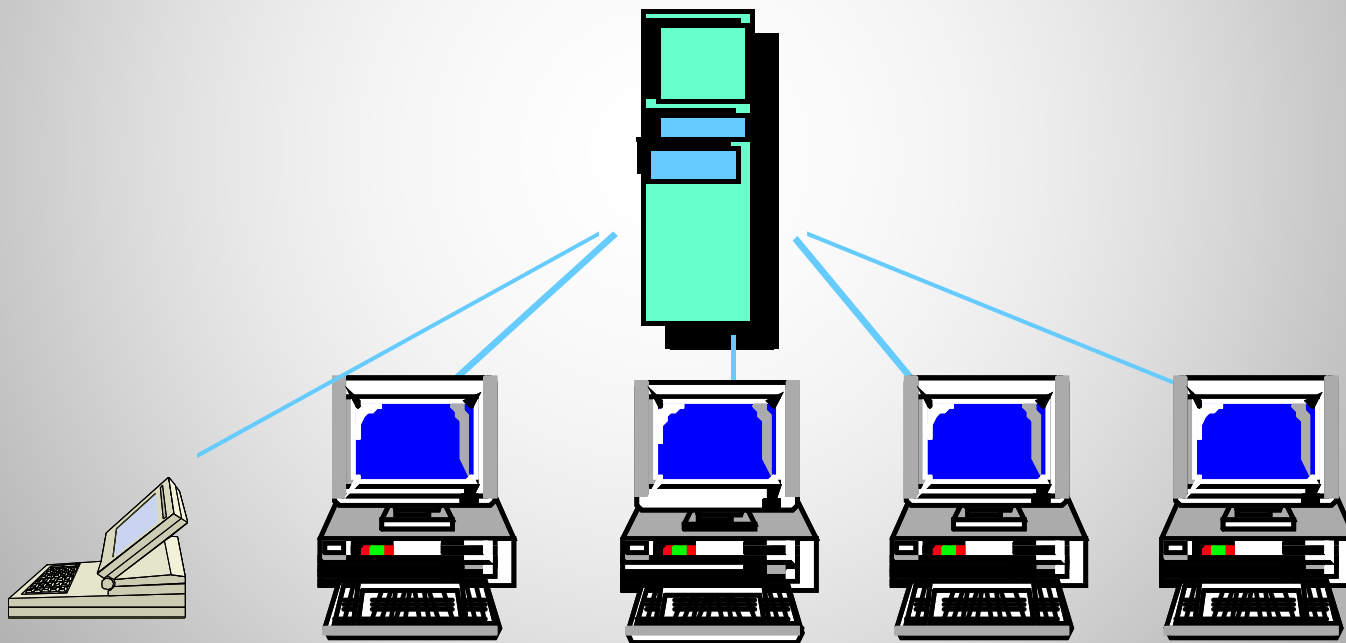


## Single User Desktop



# 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
- Data Analysis Module: statistical analysis of cost information to develop CERs
- Return Cost Module: link to shipyard production management systems
- Link to CAD systems: automated cost estimating from design process
- Link to CAD systems: automated down-loading of bills of material



# Over 35 Years Serving the Shipbuilding & Repair Industry

