

# **Independent Cost Estimating Services**

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**SPAR provides independent cost estimates to design agents, ship owners shipyards and various government agencies.**

**SPAR uses its *ESTI-MATE* software system to quickly estimate ship costs based on initial design data and to provide the impact on costs of alternate design and build strategy decisions.**

**In addition, *ESTI-MATE* produces estimates of cost risk that need to be considered and minimized.**

# **Sample Independent Cost Estimating Projects**

**The following outlines several independent cost estimating projects undertaken by SPAR for its clients.**

# 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**
- **MARAD Training Ship Concept Designs, 2015**

# 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
- Swaged Versus Stiffened Bulkhead Cost Analysis
- Fuel & Chemical Barges
- Alaska Region Research Vessel, 2008
- Jones Act RO/RO
- Coastal Cruise Ship
- Canadian Fisheries Science Vessel
- Canadian Hydrographic Research Vessel
- Maritime Academy Training Vessel
- Tugs & Push Boats

# 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 Michigan – Arctic Subsea Construction, Maintenance & Repair Vessel**
- **University of Michigan – 13,000 TEU G/T LNG Containership CAPEX (Korea) & OPEX (NY Port to Shanghai)**
- **University of New Orleans – 23 Kt RO-RO**
- **University of New Orleans – Catamaran Patrol Boat**
- **University of New Orleans – 3 Containership Concept Designs**
- **MIT – Structures CERs**
- **MIT – Fuel Cell Cost Data**
- **Cranfield University, UK – 2 High Speed RO-PAX & 1 High Speed RO-PAX Trimaran**



# Naval

## Independent 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**

# Naval Independent 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**
- **Canadian Surface Combatant Design Variants**
- **Foreign Offshore Security Patrol Vessels**
- **Auxiliary Oiler**
- **Amphibious LHD**
- **Amphibious LHA**
- **Assault Landing Craft**

# **USCG**

# **Independent 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**
- **USCG WPB87 Replacement Program Concept Proposal**
- **Canadian Coast Guard Offshore Science Vessels**

# Cost Estimating Services (USCG “Deepwater”)

SPAR provided cost estimating services to the U.S. Coast Guard for the review of industry proposals for the \$10-billion “Deepwater” program.

SPAR’s efforts provided the Coast Guard with assessments of cost realism for these proposals.



# Other Estimating Related Projects

**SPAR has been involved in a variety of other R&D projects related to cost estimating.**

# Development Projects

- **DARPA Maritech – Modular Tanker Consortium (Kvaerner Masa Marine, Bethship, McDermott, Proteus) – *ESTI-MATE* development**
- **U.S. Navy PODAC (Prime Contractor) – application of *ESTI-MATE* at shipyards**
- **DARPA Maritech – FIRST Project (Proteus, Intergraph & Newport News) – design/cost systems integration**
- **Maritech ASE – Parametric Design & Cost Model (NASSCO, Halter, Proteus)**



# Cost Estimating (US Navy "PODAC")

**SPAR provided a new cost estimating model to the U.S. Navy that reflects modern shipbuilding methods.**

**The system is called the Product Oriented Design and Construction ("PODAC") Cost Model.**

# **PODAC Shipyard Participants**

**As the Navy's prime contractor, SPAR worked with most of the large U.S. shipyards:**

- **Bath Iron Works, Bath, ME**
- **National Steel & Shipbuilding, San Diego, CA**
- **Ingalls Shipbuilding, Pascagoula, MS**
- **Avondale Shipbuilding, New Orleans, LA**



# **Support to RAND Europe Project on "Long Term Issues for the United Kingdom's Shipbuilding Industrial Base"**

- 1. A qualitative and quantitative assessment of the relative labor productivity when performing outfitting work at different stages of the production process (block, grand block, on ship, etc.).**
- 2. The relative costs under different conditions for outsourcing of various functions and tasks as compared to performing those functions or tasks with shipyard resources.**
- 3. A comparison of the business and management characteristics of shipyards that have orders from exclusively commercial customers versus those whose projects are exclusively for naval/government customers.**

# Established Cost Estimating Libraries

**SPAR continues to develop and maintain large databases of ship construction and ship repair cost data:**

- **“Commercial Shipbuilding New Construction Cost Estimating Relationships”**
- **“U.S. Navy Shipbuilding New Construction Cost Estimating Relationships”**
- **“Commercial & Government Ship Repair Cost Estimating Relationships”**

# Basis for Cost Estimating Libraries

The libraries of cost data used for estimating reside on SPAR's estimating system called *PERCEPTION ESTIMATE* and represents a wide cross-section of current and historical shipyard construction costs at many levels of detail.

These libraries of cost estimating relationships (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.

# Generic Cost Estimating Relationships

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

This generic yard employs efficient methods of work organization and has competent worker and management skills comparable with internationally competitive shipyards.

The approach to ship design and construction is partially based on insights obtained in a comprehensive evaluation of northern European shipyards.

# Cost Adjustments

1. Application of commodity cost escalation to estimated future year material costs
2. Application of shipbuilder's productivity factors
3. Application of interim product size and manufacturing complexity factors
4. Impact of cost estimates & production schedules on projected manpower requirements

# Shipyard 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.

Factors are available to adjust costs so that they are relevant to shipyards of different sizes, types of facilities, and management capabilities. Factors differentiate commercial yards from yards that provide primarily naval ship construction.

# Generic Material Cost Factors

Material costs are summarized and escalated to a common year set of values.

Costs assume commercial-grade shipbuilding materials and management methods. Variations due to specific materials, equipment modules and configurations, and vendor pricing methods should be expected.

Foreign acquired equipment is subject to changes in exchange rates, which are often different from general price changes of domestic goods.

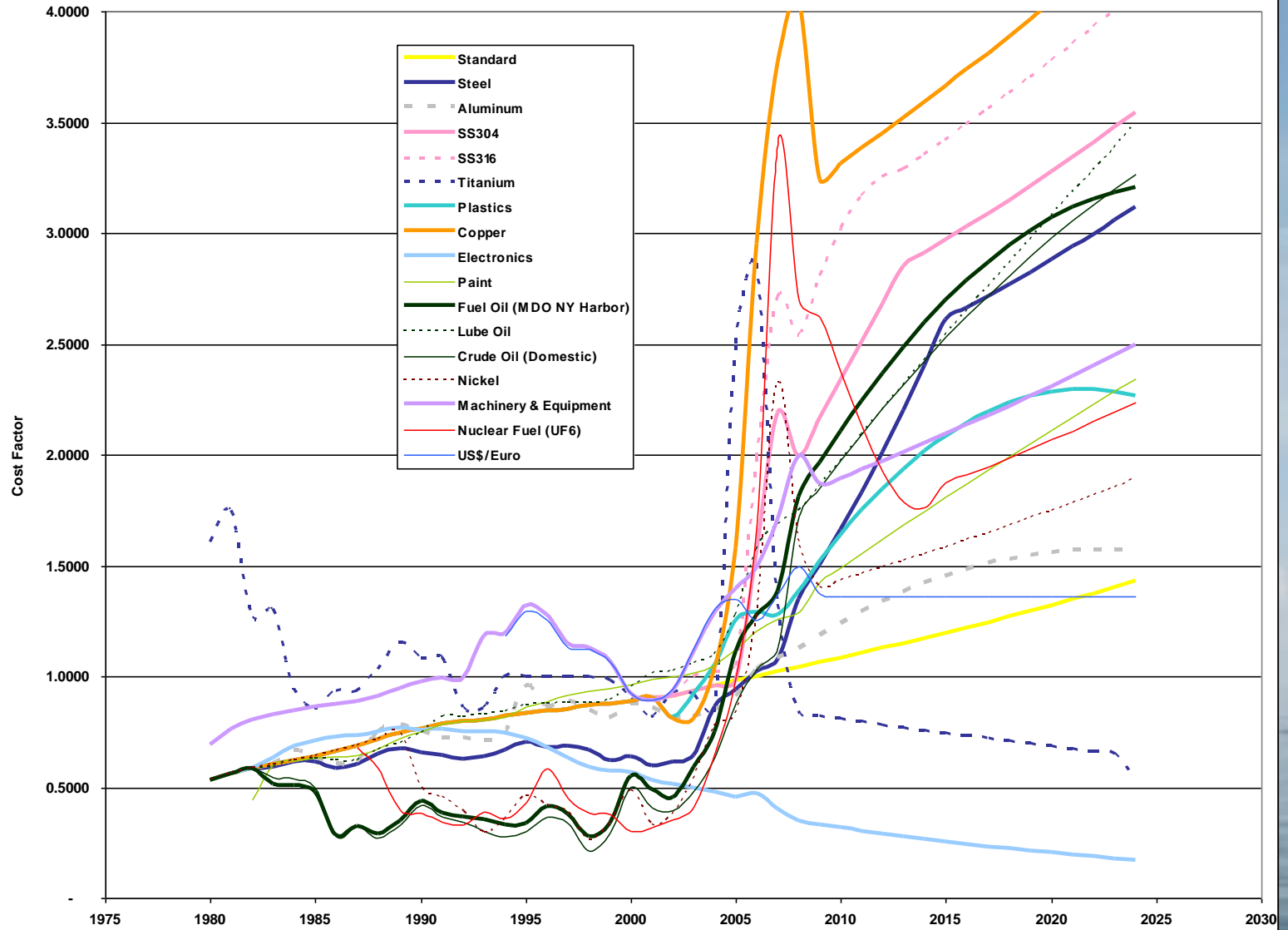
New technology also should be considered as it can affect prices significantly.

# Escalating Material Cost to Estimate Out-Year Costs

All material costs are escalated to a common year using commodity-based escalation tables. These tables are developed from recognized government and commercial sources and forecast for future years based on predictions from qualified industry observations.



Material Commodity Cost Escalation Factors



# Commodity-Based Escalation Index Tables

# **Adjusting for Material Cost Above Normal Escalation**

**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.**

**More significantly, vendors and suppliers will increase their prices to cover their added costs to provide the usually required significant military Mil-Spec documentation on their products.**

# Impact of Build Strategy on Cost

The methods and organization of work by stage of construction has a very large impact upon cost.

Other cost implications can be recognized by outsourcing selected work to specialty vendors and subcontractors that can offer better cost than using the shipyard's own in-house resources.

Other cost-saving strategies include exploiting repeatable interim products in the ship design.

# Cost Risk Evaluations

The cost estimates developed are expected to be realistic for the circumstances and environment under which the construction program would be expected to be executed.

However, SPAR's cost models provide functions for identifying cost risk.

Risk factors can be applied at any level of detail and can represent either potential cost benefits or penalties.

# **Estimates Cost Risk due to Various Factors**

- 1. Cost risk of applied CERs**
- 2. Cost risk due to shipbuilder's inexperience**
- 3. Cost risk due to compressed production schedule**
- 4. Cost risk of rework due to immature detail engineering**
- 5. Cost risk due to anticipated producibility & management performance of detail engineering**

# Level of Cost Estimate Detail

The cost estimate is broken down into three major cost categories:

1. **Non-Recurring Design, Production Engineering & Detail Planning Costs**
2. **Recurring Construction Costs (Lead Ship & Follow Ships)**
3. **Annual Operating & Maintenance Costs (Optional Analysis)**

# **Non-Recurring Design, Production Engineering & Detail Planning Costs**

**The non-recurring costs include detail design, engineering and planning**

- 1. Preliminary Design & Design Validation**
- 2. Detail Functional Engineering**
- 3. Detail Transitional (Production) Engineering & Construction Drawings/Shipyard Instructions, Including Lofting**
- 4. Detail Production Planning**
- 5. Integrated Logistics Support Planning**

# Recurring Construction Costs

Recurring costs include all basic construction costs for each ship. For series ship construction programs, costs are estimated for follow-on ships using estimated learning curves for labor and potential material cost savings for multiple ship projects.

The recurring cost estimate is broken down into cost categories similar to the Navy's Ship Work Breakdown Structure (SWBS). Differences lie primarily in SWBS 200 which carries only propulsion machinery items. Piping systems for propulsion are cataloged under SWBS 500 for auxiliary systems along with all other piping systems for the ship. SWBS 300 carries all electric generation equipment for ship services, as well as all electrical distributed systems, lighting, etc.

SWBS 800, Technical Services, includes only technical support for change orders, etc. after non-recurring activities are complete as well as production engineering development.



# Estimating Annual Funding & Manpower Requirements

For both one-off and multi-ship production programs, annual funding requirements are estimated.

Various scheduling scenarios for follow ships can be simulated with different levels of overlapping production schedules from a limited rate of production to full rate of production.

The effects of these scheduling scenarios impact the annual funding requirements and the shipbuilder's necessary levels of manpower.

# Support Services

- **Training**
- **Customized Software Development**
- **Systems Integration**
- **Data Conversion**
- **Software Maintenance**
- **Management Consulting**
- **Independent Cost Estimating**

# Publications

- **“Shipyard Cost Estimating”**
- **“Planning New Construction & Major Ship Conversions”**
- **“Guide For Shipyard Material Control”**
- **“Implementation of a Shipyard Earned Value Management System (EVM)”**
- **“Shipbuilding Schedule & Cost Benefits from Modularized Design & Build Strategies”**
- **Estimating Ship Surface Areas for Coating Systems**
- **SNAME “Ship Design and Construction,” Chapter 10, Cost Estimating with J. Trumbule, NSWCCD.**

# **SPAR Associates, Inc.**

## **A Full Service Company**

- **Systems Development**
- **Systems Sales, Training & Support**
- **Independent Cost Estimating**
- **Planning & Scheduling Services**
- **Contract Cost/Schedule Tracking & Performance Analysis**

# Over 40 Years Serving the Shipbuilding & Repair Industry

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