National Shipbuilding *[& Ship Repair]* Research Program

Collaboration on Technologies and Processes to Boost Naval Capability Per Dollar –
Asymmetric Attack on Cost Drivers in Ship Construction & Repair

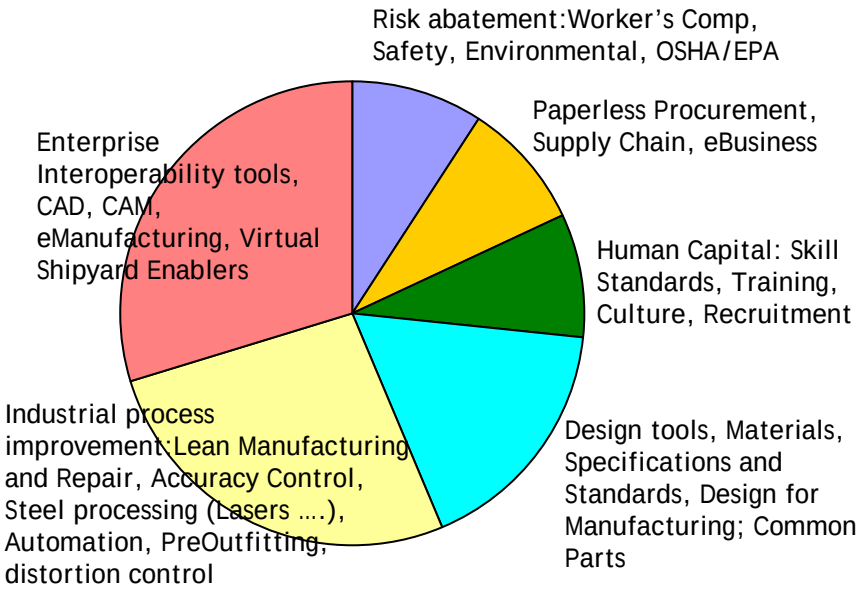
Mission - Manage and focus national shipbuilding and ship repair research and development funding on technologies that will reduce the cost of ships to the U.S. Navy and other National Security Customers by leveraging best commercial practices and improving the efficiency of the U.S. shipbuilding and ship repair industry. Provide a collaborative framework to improve ship-related technical and business processes.

NSRP Rationale & Principles of Operation

- **Rapid PROCESS Technology Implementation across the shipbuilding and repair enterprise**
- **OPEN competition for the best ideas from any source**
- **Strong focus on Business Case and ROI (Alignment)**
  - Investment decisions driven by consensus priorities
  - Implementation in shipyards is the litmus test
- **Greater Leverage and ROI**
  - Focus on common cost drivers
  - Shared pre-competitive R&D
  - Accelerates standards to enable enterprise integration
  - Lessons learned transcend stovepipes
- **Technology transfer networks speed broad implementation**

Strategic Investment Plan

Actively Managed, National R&D Investment Portfolio



Shipyard Commitment and Buy-In

Signed by 11 CEOs - Managed by their Senior Execs

T.B. Bender
President and CEO
Bender Shipbuilding & Repair Co., Inc.

A.C. Cameron
President
Bath Iron Works Corp.
A General Dynamics Company

Frank J. Foti
CEO
Cascade General, Inc.

Tom C. Schievelbein
President and Corporate Vice President
Northrop Grumman Newport News

George W. Gibbs III
Chairman of the Board and CEO
Atlantic Marine Holding Co.

George Yount
Vice President
Northrop Grumman Ship Systems
Avondale Operations

Anil Raj
COO
VT Halter Marine, Inc.

Michael W. Toner
President
Electric Boat Corp.
A General Dynamics Company

Richard H. Vortmann
President and CEO
National Steel & Shipbuilding Co.
A General Dynamics Company

Roland H. Webb
President and COO
Todd Pacific Shipyards Corp.

Paul Robinson
Vice President
Northrop Grumman Ship Systems
Ingalls Operations

Updated Frequently

Shipbuilding & Repair Industry "Joint Forces" Approach

Organization

Industry Ownership, Leadership & Accountability

Pervasive Collaboration via Active National Networks

Focus

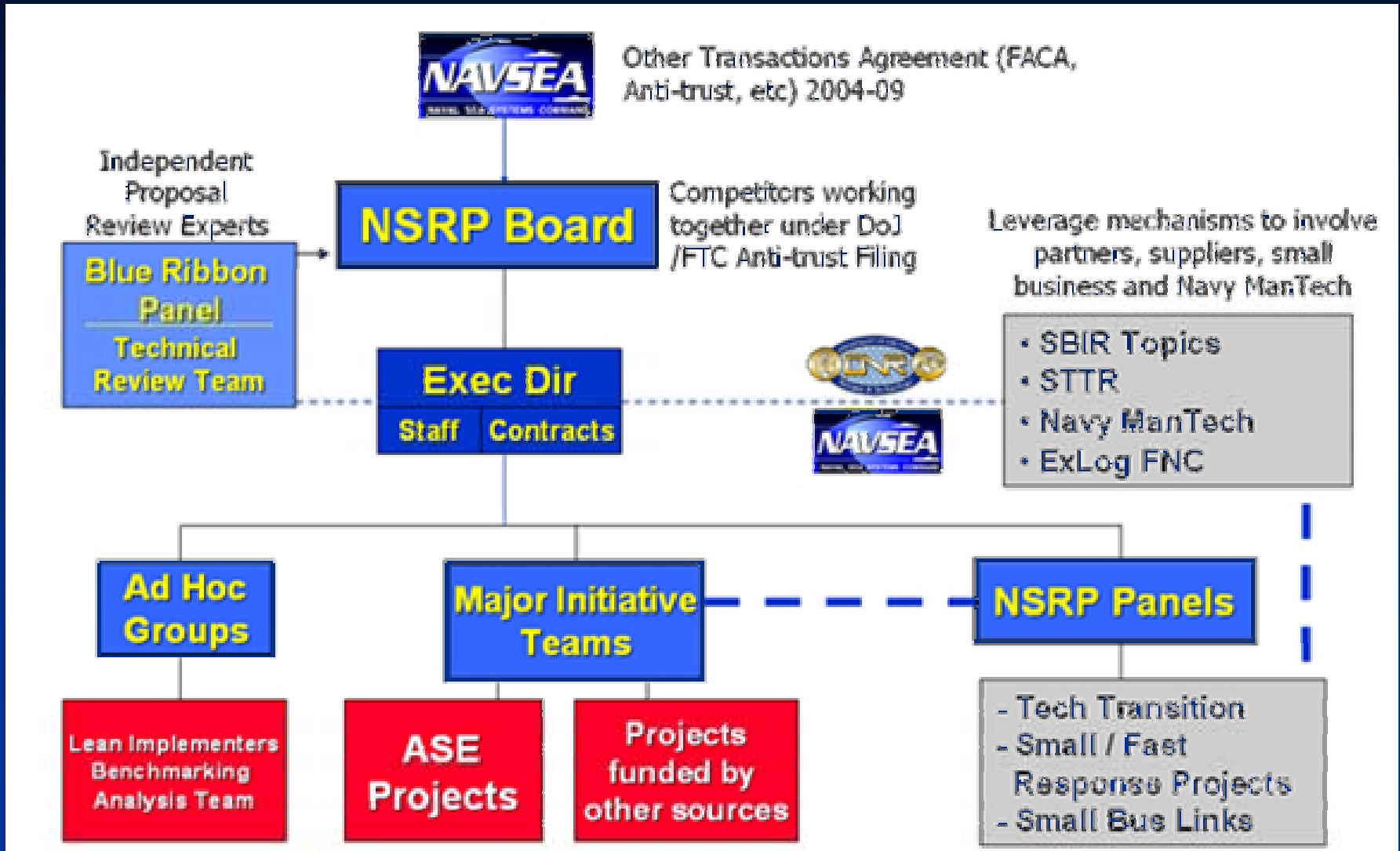
$400 Million (multi-source) National Consensus Roadmap

Operations

Flexible, Responsive R&D Business Processes

Balanced R&D Portfolio of Shared, Team Projects

NSRP Organization



NSRP Operations

Operating across administrative boundaries & stovepipes

Investment Priorities

- SNAME / ASNE
- Industry & National Labs
- Government Recommendations & Participation
- ONR Investmts

ECB Approval

Management Portfolio

Focus / Leverage Portfolio

- Other: SeaBasing FNC Projects, Common Parts Catalog Pilots, etc.
- Navy Progs (Small Business, MANTECH)
- Navy Selection & Award Process

Competitive Selection

Fast Track	Large projects
RFP	RA
Staff Review	Tech Review
	Blue Ribbon Panel

Executive Control Board Approval

- 30-day Contracting
- Project Execution
- Implementation @ Many Yards
- Feedback: Results, Benchmarking, Metrics

Implementation Report

	National Shipbuilding Research Program Implementation Status of NSRP ASE Projects								
	Atlantic	Electric Boat	Bath	Bender	NASSCO	NGNN	NGSS Ingalls	NGSS Avondale	Todd
Lean Enterprise Model	Impl	Appl	Impl	Impl	Impl	Impl	Impl	Impl	Impl
Integrated Shipbuilding Environment	Appl	Impl	Plan	Appl	Impl	Impl	Plan	Impl	Appl
Shipbuilding Partners & Suppliers (SPARS)	Appl	Impl	Plan	Plan	Appl	Impl	Impl	Impl	Plan
Advanced Structural Joining/Laser	Appl	Impl	Appl	Impl	Appl	Appl	Plan	Plan	Appl
Laser-Assisted Oxygen Cutting (LASOX)	Appl		Appl	Impl	Appl	Appl	Impl	Appl	Appl
Five-S	Impl	Impl	Impl	Impl	Impl	Impl	Impl	Impl	Impl
Welding Emissions	Impl	Plan	Impl	Appl	Impl	Impl	Plan	Plan	Appl
Line Heating	Impl		Appl	Plan	Appl	Appl	Appl	Appl	Appl
Knowledge-Based Modular Repair	Impl		Appl	Appl	Appl	Appl	Appl	Appl	Appl
Auto Generation of Control Programs for Welding Robots	Appl	Appl	Appl	Plan	Appl	Appl	Impl	Impl	
Ultra-High Pressure Water Blasting	Impl	Appl	Appl	Impl	Appl	Appl	Appl	Appl	Impl
World Class Mfg. Model	Impl	Appl	Impl	Appl	Impl	Appl	Impl	Impl	Impl
Material Standards	Impl	Impl	Impl	Appl	Impl	Impl	Appl	Appl	Appl
Shipbuilding Appl Protocols	Appl	Plan	Appl	Appl	Appl	Impl	Plan	Plan	Appl
Ergonomic Guidelines	Impl	Appl	Impl	Appl	Appl	Impl	Appl	Appl	Impl
Crosscut Virtual Resource Center	Appl	Impl	Appl	Appl	Appl	Appl	Appl	Appl	Appl
Stormwater Treatment			Appl		Impl		Appl	Appl	
Integrated Steel Processing Environment	Appl	Appl	Appl		Appl	Plan	Plan	Plan	
Structural Fire Protection			Appl	Appl					
Stormwater MOP-UP	Appl		Appl		Appl		Appl	Appl	
FY 2004 Projects									
Extended Lean Enterprise	Plan	Appl	Impl	Appl	Appl	Impl	Impl	Impl	Impl
Shipbuilding Partners & Suppliers (SPARS)-SHIPREC/VXPD	Appl	Impl	Appl	Appl	Appl	Appl	Plan	Plan	Plan
Integrated Shipbuilding Environment-HVAC/CPC	Appl	Plan	Plan	Appl	Appl	Appl	Plan	Plan	Appl
2nd Tier Shipyard Design Enhancement	Appl	Appl	Appl	Impl	Appl	Appl	Impl	Impl	Plan
Common Parts Catalog	Appl	Impl	Impl	Impl	Appl	Appl	Impl	Impl	Plan
Lean Simulation Training	Appl	Appl	Appl	Appl	Appl	Plan	Plan	Plan	Appl
Wireless Equipment Monitoring	Appl	Appl	Appl	Plan	Impl	Plan	Impl	Plan	Appl

Lean Manufacturing

Zero waste, max flexibility, optimal flow

Focused Technology Solutions

Applying new technologies to specific cost and cycle time drivers

Supply Chain Management

The flow and transformation of materials and related information from source to end user

Common Issues

Critical mass to tackle common concerns (EPA, Ergonomics, Worker's Comp, Skill Stds, Coatings …)

e-Manufacturing

Using the Internet and other electronic means to manage the entire manufacturing enterprise

Common Cost Drivers

Treatment of Shipyard Storm Water

- **Evaluated a low-cost treatment option that consists of passive filtration of storm water in underground vaults to remove metals and suspended solids.**
  - **Preliminary testing of the system showed total copper reductions ranged from 56 to 77 percent. Total zinc reductions ranged from 60 to 86 percent.**
  - **Demonstrated effective treatment of shipyard stormwater using a passive filtration system.**
  - **ROI of $3.7M over a 10 year period for a 40-acre shipyard**

Ultra-High Pressure Water Blasting

- Goals were to reduce:
  - the cost of UHP Water Blasting
  - the potential storm water contamination associated with this process
- Demonstrated a 22-28 percent reduction in total life cycle cost on a destroyer project over the project's baseline, a previous destroyer repair job. Specific metrics include:
  - overall process productivity – improved by over 38 percent
  - blasting gun on-time – doubled from 24 percent to 47 percent
  - setup time – cut in half
  - wait time – dropped from 42 percent to 19 percent
  - labor per sq. ft – 38 percent reduction
  - Environmental disposal cost/gallon – 94 percent reduction (expected in near term).

Panel Regulatory Intervention

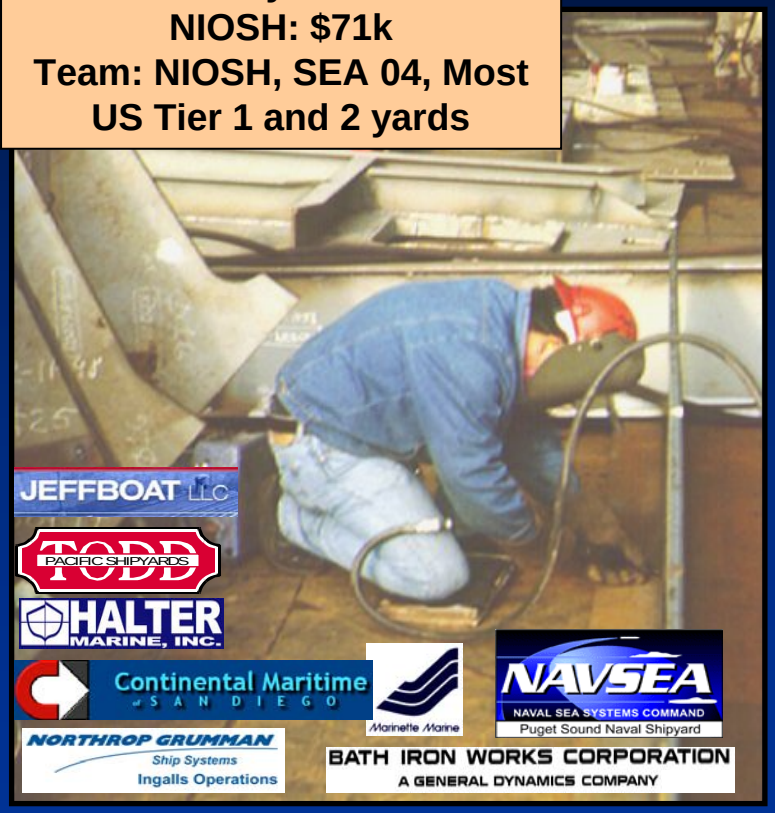
Regulation	*Description*	*Outcome*
Worker Exposure to Hexavalent Chromium thru welding fumes	Analyze/assess risk to shipyard workers, technical & economic feasibility of remedies, and impact of OSHA-proposed reduced exposure limit	Maritime industry standard separate from general industry standard. Panel-funded study formed basis for coordinated shipbuilding industry input to regulatory process.
Preliminary Health Risk Assessment (EPA) ↑ Potential Weld Fume Risk to Public ↓	Develop credible information for EPA proving carcinogenic risk is lower than the EPA calculated risk to alleviate tighter environmental regulations for shipyards	Successful - EPA accepted shipyard feedback and new path will avoid major cost impacts. Project efforts demonstrated that the model used by EPA to determine carcinogenic risks was flawed. This project's findings prompted the EPA to meet with shipyards to discuss the issue which led to a follow-on project by shipyards to develop their own Air Emissions Model
Shipyard Air Emissions Model (EPA)	EPA evaluation of carcinogenic risk and a risk assessment model.	Successful. Computer model was delivered to shipyards in spring 2004; most reps in attendance asserted that they would begin using immediately

Worker's Comp

- $60B annual direct cost to US Industry
- 4x additional indirect cost
- Estimated shipyard cost = $1B+
- Federal Act covering Shipyards very generous
  - $50k tax free, 100% medical, COLA, indef, passes to spouse
  - No offsets for pension or Social Security
  - High injury rate industry with aging work force
- Joint efforts between Private & Public Yards
  - Prevention: Ergonomics, Safety (Weld fumes …)
  - Cost reduction: Aged Cases, Legislation, 2nd Injury Fund
    - » CT cut 2nd Injury costs by 50%
- Projected 2001 Savings @ 3 shipyards projected
  - $2.3M on new injuries, compared to 2000
  - This does not include past year injuries, where actions are being taken to reduce associated workers' comp costs during this year

Worker's Comp and Consensus Ergonomics Guidelines

09/99 – 08/02
Navy: $323k
Industry : $313k
NIOSH: $71k
Team: NIOSH, SEA 04, Most US Tier 1 and 2 yards



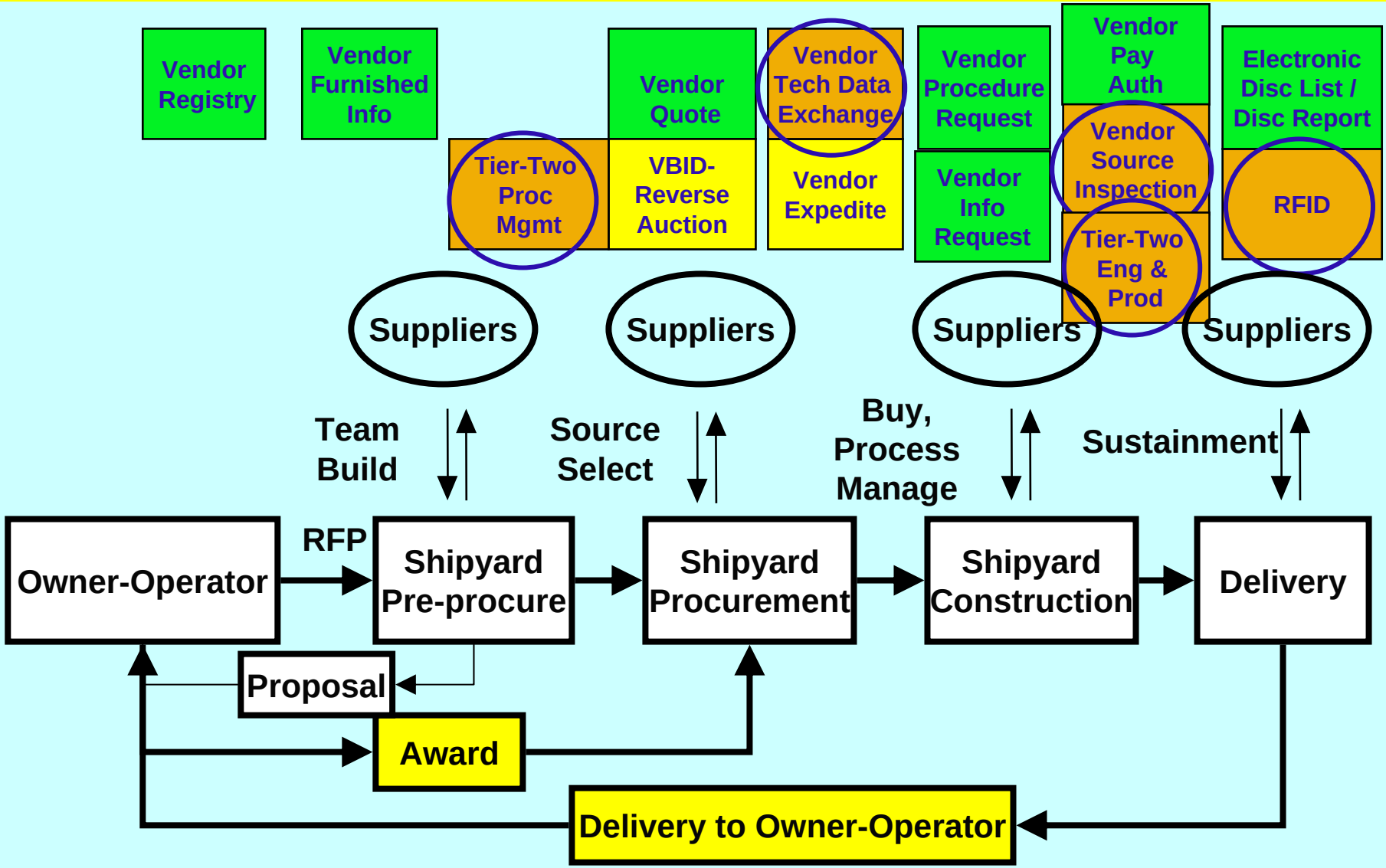
Related NSRP ASE Project: Welding Fume Reduction

- **Joint efforts of Private & Public Yards with NIOSH and Labor**
  - **Prevention efforts : Ergonomics, Safety (Weld fumes …)**
  - **Ergonomics project called "Gold Standard" of Industry-Government cooperation by NIOSH**
  - **OSHA supporting consensus guidelines approach**
  - **Cost reduction: Aged Cases, Legislation, 2nd Injury Fund**
- **Implementation**
  - ➔ **Yards share best practices and innovative solutions thru the Panel and Website**
  - **Projected 2001 Savings @ 4 shipyards**
    - » **Results varied from 16% - 28% of First year costs**
    - » **$2.3M on new injuries, compared to 2000**
    - » **This does not include past year injuries, where actions are being taken to reduce associated workers' comp costs this year**

Shipyards / Suppliers eBusiness

Shipbuilding Business Processes (SPARS)

BIW, EB, NGSS , NGNN, Tier 2



Vendor Info Request (VIR)

Sample of Results from SPARS Project

- **The VIR transaction is in place to support communications between suppliers and Electric Boat including non-conformance reports, questions the supplier may have on ordering data, EB supplied material, specification changes or weld repair.**

BEFORE: Paper-based Process

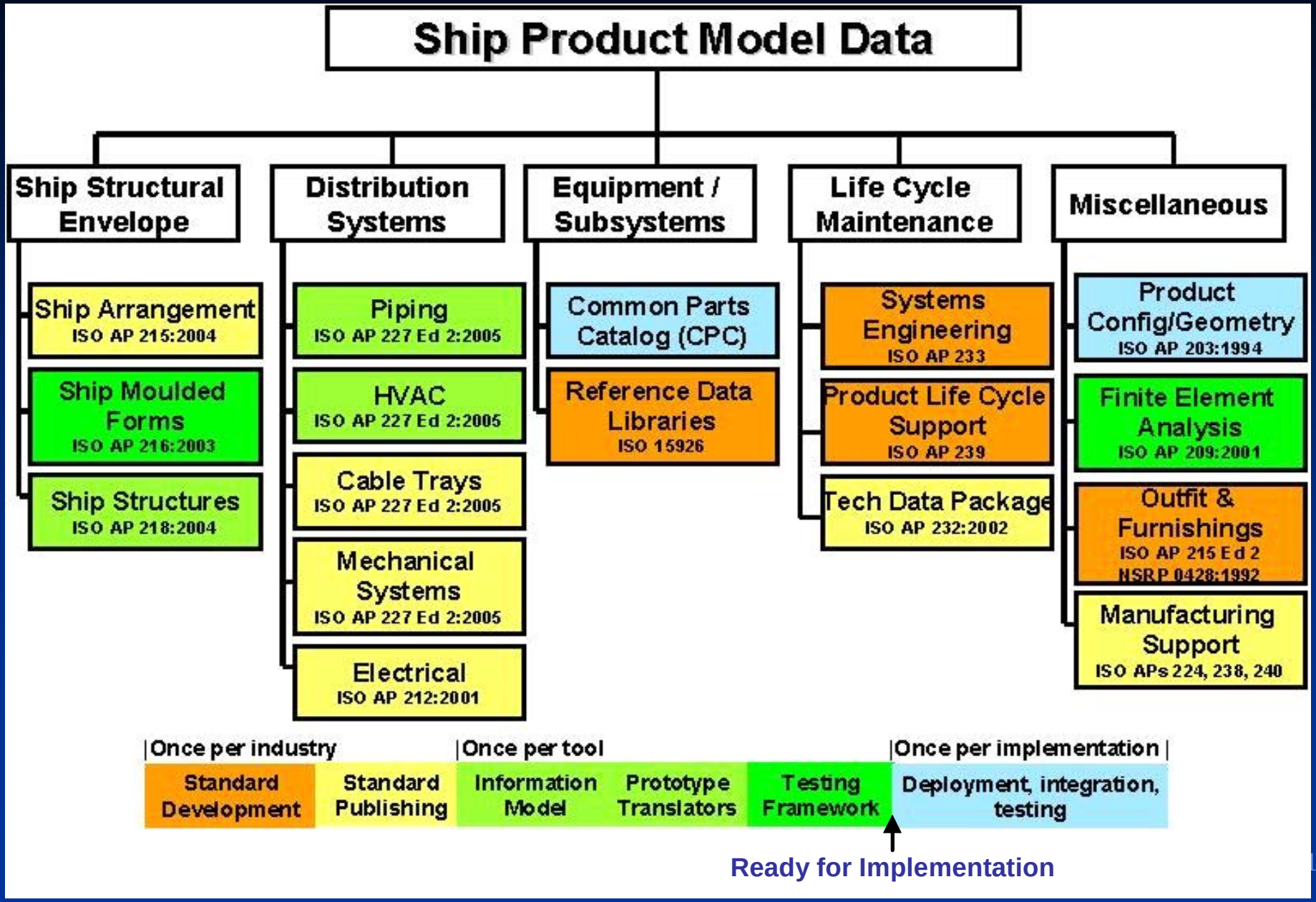
- Average Cost Per Transaction: $800
- Cycle Time (avg): 30 Days
- Other Metrics
  - Admin Log Entries: 6
  - Daily Courier Runs: 1
  - Line Item per VIR: 1
  - VIR Board Hrs: 1hr
  - Mail Delay: 6 days
  - Reporting: Weekly
  - Audit Reporting: Days
- Limited visibility to Virginia Class VIRs that affected both EB & NGNN

AFTER: SPARS Process

- 11,200 VIRs processed over 3 years
  - 1000 EB, SUPSHIP and NGNN users
  - 377 supplier reps registered representing 107 suppliers
- Cost per Transaction: $600
- Cost savings - $2.7M
  - Cost Avoidance of an additional $985K
- Cycle Time (avg): reduced > 50%
- Other metrics
  - Admin Log Entries: Eliminated
  - Daily Courier Runs: Eliminated
  - Line Item per VIR: 10 (+1000%)
  - VIR Board Hrs: Eliminated
  - Mail Delay: Eliminated
  - Reports Real-time
  - Audit Reporting: Hours
- Visibility: Extensive in real-time

Integrated Shipbuilding Environment

Scope and Maturity Status



ISE Accomplishments

- ✓ National consensus architecture for interoperability
- ✓ Published 100's of industry use cases defining requirements for information sharing
- ✓ Developed common data element definitions and common taxonomy for transferring data between shipyard parts libraries and supplier catalogs
- ✓ Based on architecture and use cases, developed toolsets for interoperability of piping and structural data
- ✓ Successfully demonstrated Phase 3 target capabilities

Common Parts Catalog

Common Parts Catalog Potential

- **Common Part Catalog Collaboration makes systematic Part Reduction Program achievable on multi-yard ship designs**
  - Over time, total Navy parts inventory will drop (Big Money)
- **<u>Logistics Opportunity</u>: Build on NSRP's working solution to add life-cycle logistics capabilities for inventory visibility, access and management**
  - Private sector repair yards are already moving to implement CPC
  - CPC provides Logistics community with inventory control and visibility opportunities
  - CPC was designed to interface with diverse legacy systems
  - Navy logistics community was briefed in detail and is assessing appropriate action

Shipyard Production

Advanced Structural Joining

- Reduced the time spent in both fitting and welding of structural steel using laser cutting, new joining strategies, precision forming and laser welding.

- EB installed lasers at Quonset based upon Bender's success.

EB Estimates $51M in savings on VA Class submarines

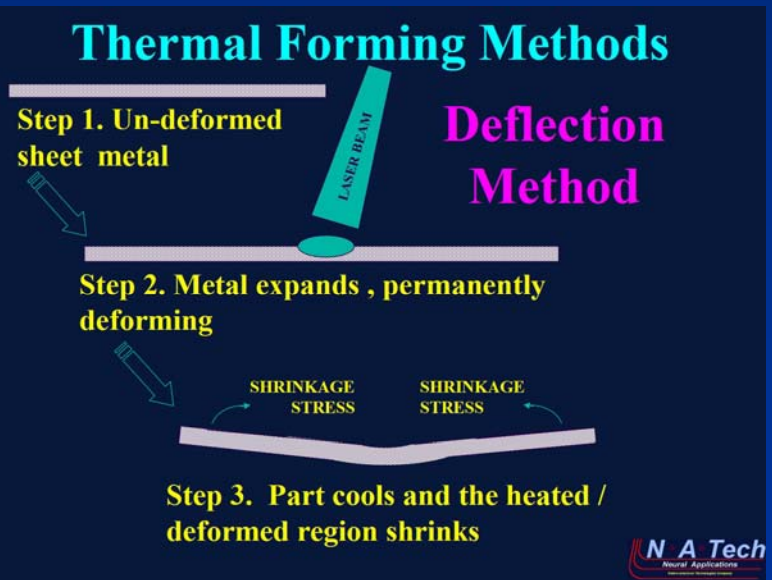
LASer Assisted OXygen Cutting
NSRP Investment $672k

- Builds on earlier laser cutting R&D project:
  - Prior success (30% time, 8% steel @ Bender)
  - EB Implementation (Saved $51M)
  - Recent NGSS Implementation
- Adapts advantages of laser technology (fast, precise, finish quality) to cutting thicker steel (>3/4" thick)
- Laser heats steel, supersonic O_2 stream ignites / burns
- Technical challenges:
  - Piercing: Explosive effect of initial pierce away from plate edge clogged cutting tip
  - Gas control: Needed variable O_2 control w/o manual intervention
  - Height sensing: Needed auto control of cutting head height to preclude need for manual intervention
- **Installed at Bender's facility May 2005 (in production)**
  - 1st production LASOX in the world
  - Demo cut samples of 7/8 (8"/min), $1^{1/4}$, $1^{1/2}$
- For heavy plate cutting:
  - significantly reduced processing time
  - reduced heat-affected zone = less plate strength degradation
  - cut to tighter tolerances = less post-cutting machining

Assumptions:	*Cost Reduction Mechanism*	*Dollars*
800K hours steel work/yr (12.5% of hours on thick steel) @ $45/hr for labor	39,000 fit-up hours saved	$1,800,000
	1,125 rework hours saved	$ 51,000
$0.25/lb for steel	20% reduction in steel drop	$ 30,000
	annual 1 yard savings	**$1,881,000**
	NSRP Investment	**$ 672,000**

Portable Automated Plate Straightener

- **Adapt thermal forming technology to on-board application in shipyard**
  - **Remove distortion in deck plates caused by fitting and welding**
  - **Automated process**
  - **Remove the worker from the heat source**
  - **Free craftsmen to do other needed jobs**
  - **Reduce Total Ownership Cost of Navy ships**
- **Goal: reduce cost of plate straightening by 35%**



Lean Efforts

Lean Shipbuilding Initiative

Lean Forum
ASE Lean Projects
Bulletin Board
Presentations
Events
Lean Contacts
Links

Notify me by email when

Lean Implementers Group

Back to NSRP ASE

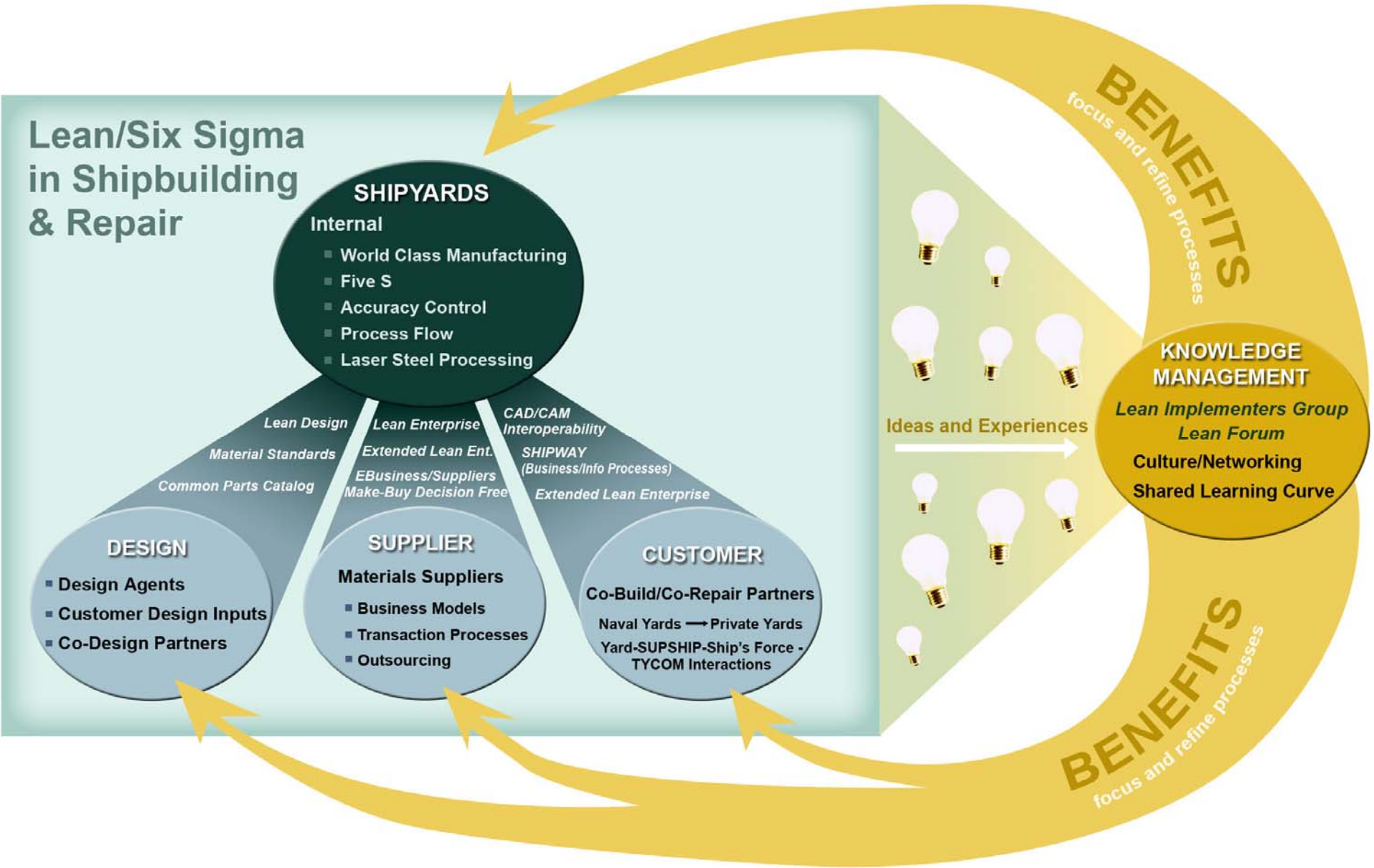
Lean Shipbuilding Initiative

Sponsored by the National Shipbuilding Research Program

The increased shipbuilding industry demand for information about Lean has led NSRP to create the Lean Shipbuilding Initiative (LSI). This initiative provides the Lean community a virtual gathering place in order to better leverage industry's successes to date and accelerate shipyard Lean transformation by facilitating a joint learning curve. LSI offers a single access point for details about Lean in this industry, significantly reducing time spent searching for this information on other websites and in a variety of publications.

LSI is the result of a growing body of Lean work by NSRP, particularly in the area of collaborative R&D and technology transfer. During 2001, final deliverables from successfully completed Lean projects, such as Five S and Ultra High Pressure Water Blasting and preliminary deliverables from new Lean

Lean Shipbuilding Initiative®



Lean Repair – 5S

Sorting, Simplifying, Systematic Cleaning, Standardizing, and Sustaining

- **Pilot success drove rapid, yard-wide incorporation plans @ both yards**
- **Cost / Benefit Analysis**
  - Rapid Improvement workshops cost = $80,000 x 8 shops = $640k (total)
  - Total savings = $150k x 8 shops = $1.2M annually
  - Significant drop (to Zero) safety incidents where implemented
  - Sustained 30% Productivity Improvements
  - Cycle time cut from 2.8 days to 2 hours per pipe spool
  - Cycle time reduction for 1 rigger = 32 hours (33%)
    - (Cycle time analysis for a standard ABS wheel check was used as a baseline. This activity represents approximately 40 percent of shop volume.)

➔ **Published How-To Manual for industry & public yards and held Industry-wide workshop**

Lean Repair at Public Shipyard in NSRP Project

PSNSY Circuit Breaker Depot Level Repair for Naval Reactors

	Reductions	
• Cycle time	50%	178 to 93 days New Goal = 8 days
• Labor content reduced	32%	84 hrs to 57 hrs
• Large backlog cleared out		

The Second Experiment: Job Summary Process

• Handoffs	58 to 10
• Steps	70 to 23
• Man-Days	down 34%
• Process time	down 73%

These early successes led to similar work in other areas: hydraulic, steel fabrication, …

Technology Transfer

Private-Public Technology Transfer

- **Conferences:**
  - Ship Production Symposium
  - Shipbuilding Technologies
  - ONR: DMC, Partnership Conf
  - Misc: Lasers, Automation …
- **Panel Network: Meetings, Email lists**
- **Newsletter**
- **Booklet / CD**
  - 1-page synopsis of each project; Includes projects funded by NSRP and ONR programs that support our Strategic Investment Plan
- **Websites: www.nsrp.org**
  - Provide industry and Navy access to deliverables and coordinate efforts for rapid, concurrent nation-wide implementation
- **Technology demos and industry workshops spread knowledge effectively**
- **Program Manager, PEO, CTO, Directorate briefings, Symposia**


NSRP Home Page
Overview
Common Parts Catalog
R&D Programs
eBusiness Solutions
Standards Coordination
Conferences/Seminars
Technology Transfer
Industry Analysis/Plann
Newsletter
Press Releases
FAQ
Points of Contact
Links
Search
Co-funded by NAVSEA and the shipbuilding industry
NAVSEA
NAVAL SEA SYSTEMS COMMAND
Lean Shipbuilding Initiative
NATIONAL SHIPBUILDING RESEARCH PROGRAM
ADVANCED SHIPBUILDING ENTERPRISE
Reducing Naval Ship Construction & Repair Costs
Shipbuilding Industry Web site
Research Announcement Published 23 August 2004
(revisions to PPK and TIA posted 3 Sept.)
Downloads
Ship Production Panels
R&D Project Information
Common Parts Catalog
Industry Analysis and Planning
Standards Coordination
NSRP ASE
eBusiness Solutions
R&D Programs
Technology Transfer
Lean Shipbuilding Initiative ®
Conferences / Seminars
The National Shipbuilding Research Program was created by U.S. shipyards at NAVSEA request to reduce the cost of building and maintaining U.S. Navy warships. NSRP is structured as a collaboration of 11 major U.S. shipyards focused on industry-wide implementation of solutions to common

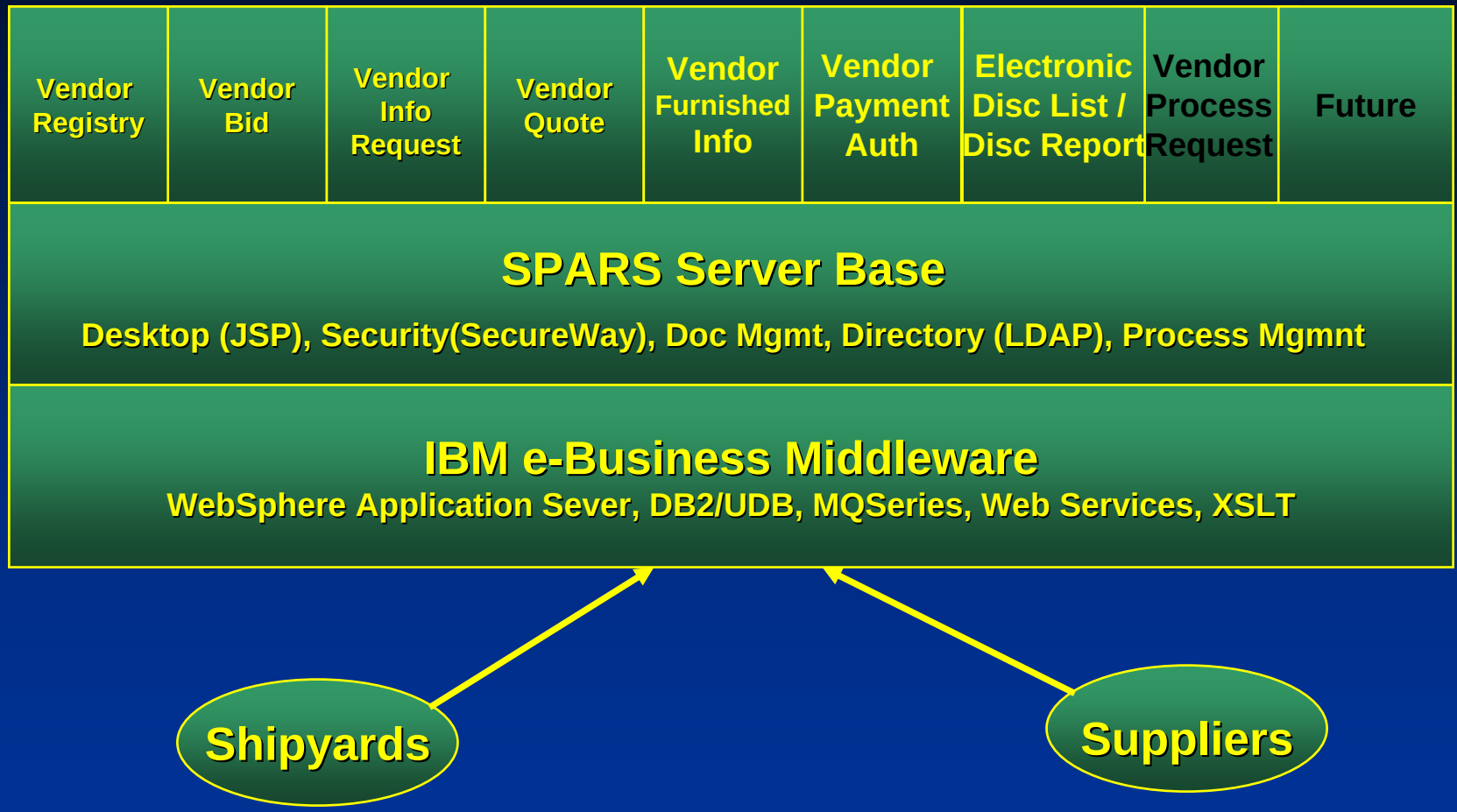
www.nsrp.org

Backup Slides

Productivity Enhancement Paths

- **Minimize adverse cost impact of regulations**
  - Environmental (Weld fumes, Stormwater)
  - Safety (Ergonomics, Workman's Comp)
- **Process improvements**
  - Design for producability
  - Lean design
  - Manufacturing flow
  - Supply chain flow
  - Accuracy Control
  - Better tools (Line heating, Lasers, etc.)
  - Eliminate waste (Lean)
- **Business Models**
  - Outsourcing
  - Component factory
  - Standards
  - Supplier roles

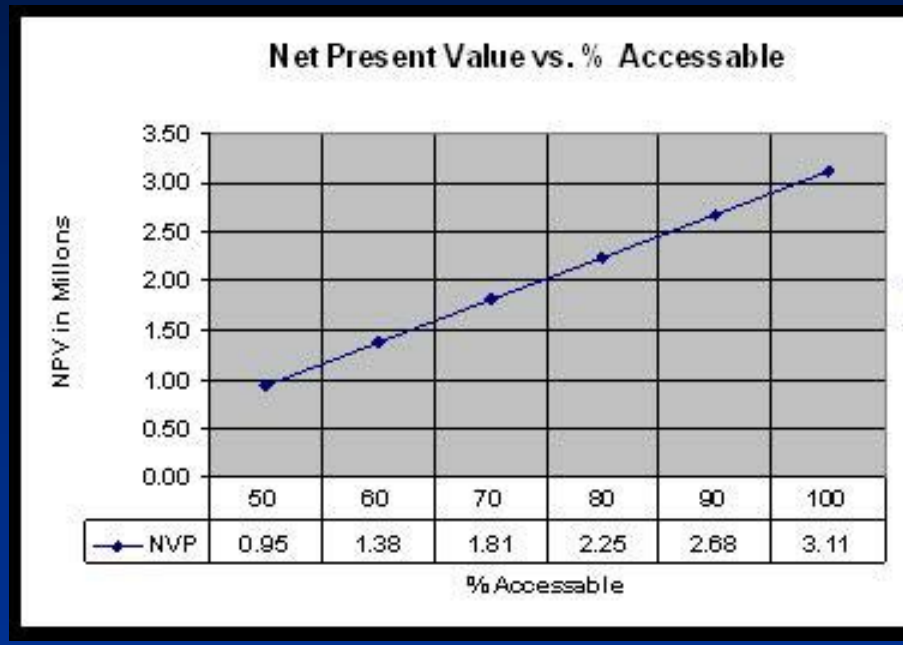
Shipbuilding Partners & Suppliers (SPARS) Business Processes



Multiple Business Processes on a single base

Portable Automated Plate Straightener
NSRP Investment: $566k

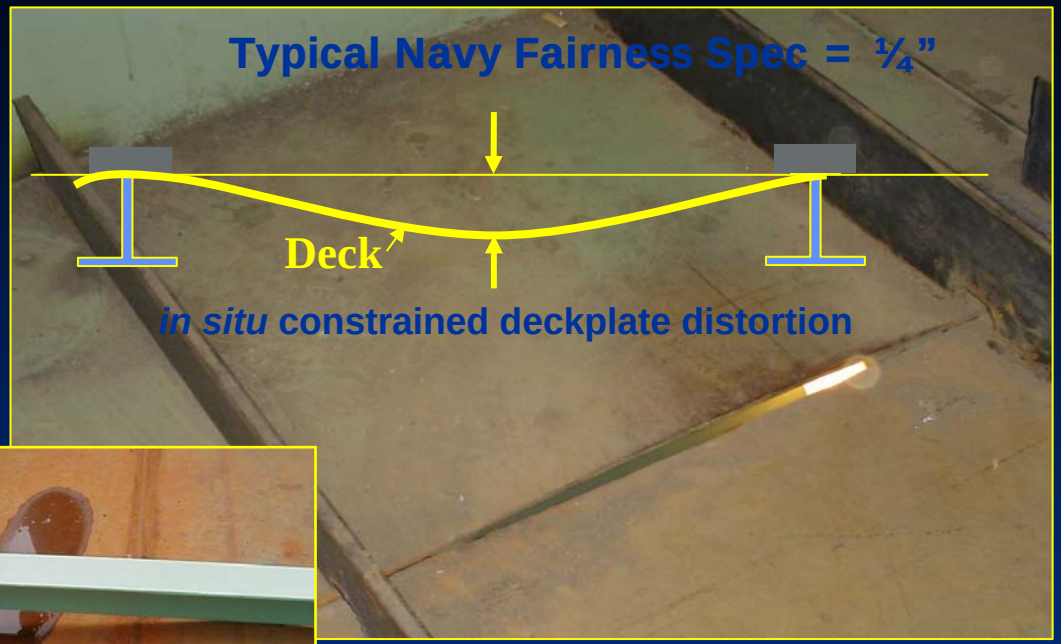
- **Business Case Assumptions**
  - 8,367 M man-hrs / hull for straightening at one yard
  - $45 per man-hr
  - 70 % of the deck that needs straightening is PAPS accessible
  - Min Goal: PAPS reduces labor time by 50%
  - Labor Savings = $527K
    - » Per year per yard
    - » 1 year payback from 1st yard
    - » BCA included only decks, whereas vertical (bulkheads) are an intended follow-on application

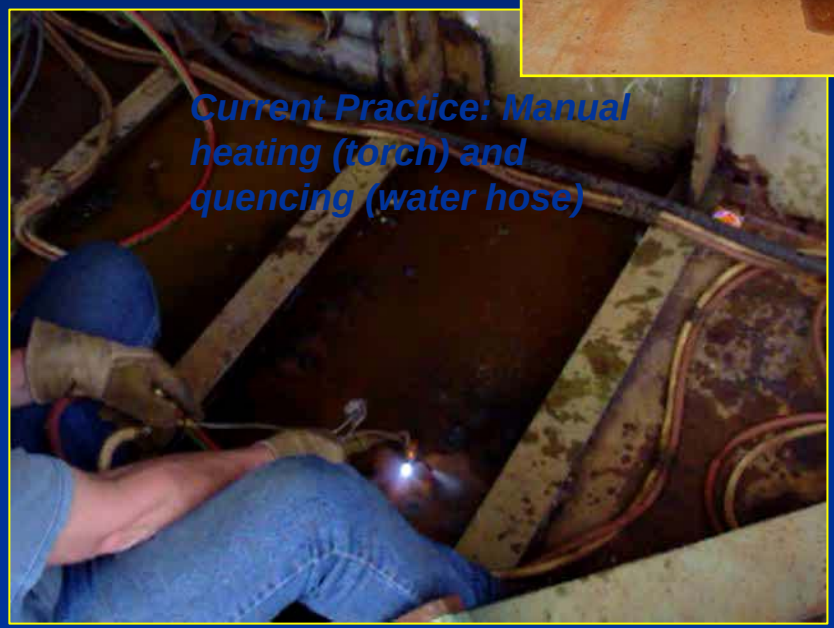


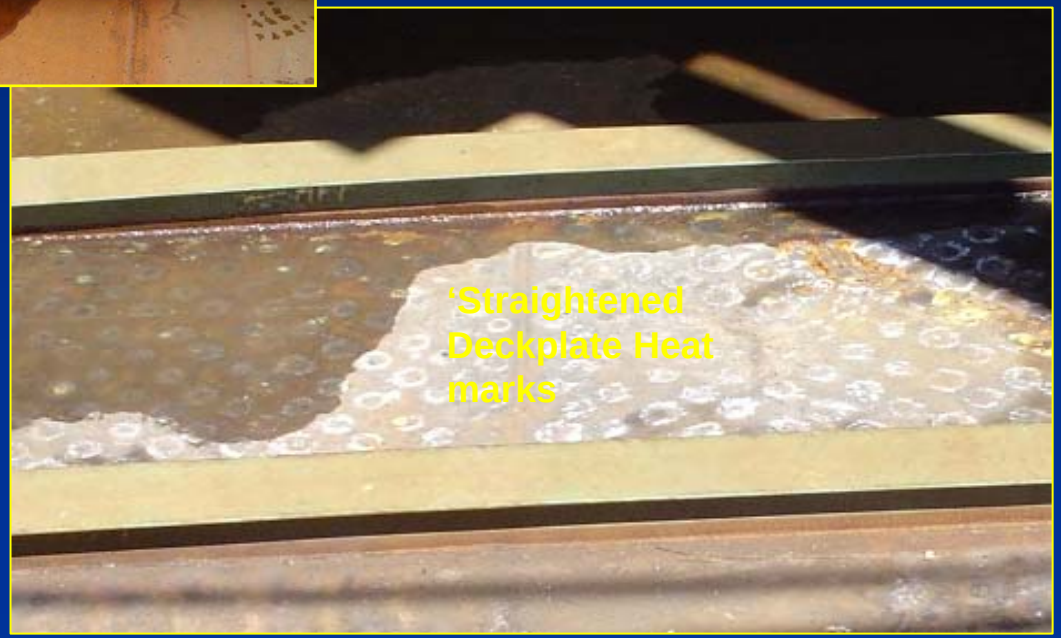
- **Preliminary lab test: 86% time reduction**
  - If that holds, Labor reduction = $904K annually per yard

Accessibility will be assessed once the portable variant of the system is field tested at NGSS


Hot Rolled Steel on the panel Line


Typical Navy Fairness Spec = ¼”
Deck
in situ constrained deckplate distortion


Current Practice: Manual heating (torch) and quencing (water hose)


‘Straightened Deckplate Heat marks