



The National Shipbuilding Research Program and the Lean Shipbuilding Initiative

*Reference Package developed for
Students at the
Defense Acquisition University*

Contents:

- Lean Shipbuilding Initiative Point Paper
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NSRP is a collaboration of 11 U.S. shipyards working with government, industry, and academia to achieve the continuous product and process improvements necessary for the U.S. shipbuilding industry to become internationally competitive, directly resulting in more affordable Navy ships. NSRP's mission is to manage and focus national shipbuilding and ship repair research and development funding on technologies that will reduce the cost of warships to the U.S. Navy by leveraging commercial practices and improving the efficiency of the U.S. shipbuilding and ship repair industry. NSRP also provides a collaborative forum to improve business and acquisition processes. NSRP is sponsored by the Naval Sea Systems Command.

Further Information on NSRP and LSI is available online at these links:

NSRP: www.nsrp.org
LSI www.nsrp.org/lean/index.html
NSRP Projects www.nsrp.org; click on "R&D Project Information"
Ship Production Panels www.nsrp.org; click on "Ship Production Panels"
Events www.nsrp.org; click on "Conferences/Seminars" on the left

Or, by contacting Chuck Kramer at kramer@aticorp.org or (843) 760-3493



LEAN SHIPBUILDING INITIATIVE

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SYNOPSIS

In order to help fulfill its mission of reducing the cost of warships to the U.S. Navy and establishing U.S. international shipbuilding competitiveness, NSRP has funded a number of Lean-Six Sigma oriented projects, and has launched its Lean Shipbuilding Initiative to provide a focal point for Lean activities and facilitate transformation to Lean practices throughout the shipbuilding and ship repair industries.

NSRP co-funded efforts in 1999 and 2000 at several shipyards that quickly demonstrated the significant benefits gained by implementing Lean principles. The results of these efforts spurred the rest of the shipbuilding and repair industry into action and in turn, caused the program to examine its role in industry’s adoption of Lean Six Sigma. NSRP launched the Lean Shipbuilding Initiative (LSI) in response to the need for linking the growing spectrum of Lean production activities throughout industry to facilitate a joint learning curve. Through LSI, NSRP funds are leveraged to create opportunities in which public and private sector shipyards share successes and lessons learned in implementing Lean.

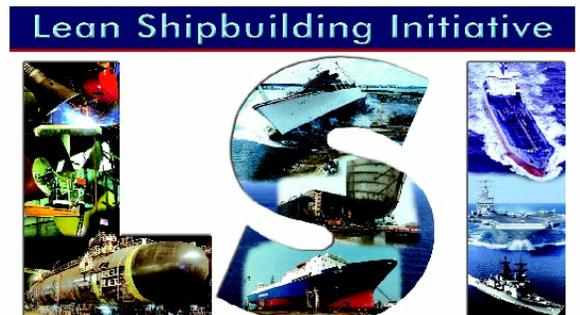
Implementation – Most yards have implemented Lean-Six Sigma practices to some extent, some fairly extensively. Results have included dramatic drops in cycle time for repair, significant savings and cost avoidance in construction, decreases in injuries and worker compensation claims, and cost under-runs on Navy contracts

Savings to Date – \$38+M savings over 2 years at NGNN attributable to Lean in engineering, manufacturing and construction; in less than 2 years, \$2.8M in cost benefit to the Navy on repair contracts at Todd Pacific; reduction in DSRA docking time for CGs and FFs of 11 days and 4 days, respectively, at Atlantic Marine. NGSS has also reported considerable savings / cost avoidances directly to the PEO SHIPS office. Puget Sound Naval Shipyard also reports considerable savings from activities resulting from NSRP Lean projects.

PROBLEM DIMENSIONS AND BUSINESS CASE

Lean Production and Six Sigma

The term “lean production” was coined in the late 1980’s by MIT researchers studying reasons behind the competitive advantage held by Japanese automobile manufacturers over their U.S. and European counterparts. In this context, *lean* production refers to an evolution from *mass* production practices of the last 100-plus years; it was so named because it entails *less* of everything compared with mass production—less human effort, manufacturing space, investment in tools, product development time, inventory, and defects. Lean production initiatives in place today were derived largely from the Toyota automobile production model studied by the MIT researchers, and share considerable common ground with Total Quality Management practices.



Sponsored by the National Shipbuilding Research Program

The definition of lean production or lean manufacturing (hereafter referred to simply as “Lean”) and the description of Lean activities vary somewhat across applications, but as described in *Lean Thinking* (Womack and Jones, 1996), five basic principles of Lean stand out:

- Define *value* for each product, and determine the *value stream*
- Eliminate unnecessary steps (waste) in each value stream
- Make value *flow* smoothly, minimizing unproductive waiting time between processes of value
- Realize that the customer *pulls* activity; products should not be built in the absence of customer demand
- Pursue *perfection* continuously

Shipbuilding and Repair Industry Adopts Lean Six Sigma

While Lean Production had been implemented to varying degrees by the U.S. auto and aerospace industries over the past decade, shipbuilders were concerned that what appeared to be a mass-production methodology was not well-suited to the low volume, high mix nature of ship construction and repair. Furthermore, the complexity of Lean transformation in the co-design, co-production world of Navy and commercial ship production and repair, where the customer is tightly integrated in many aspects of the entire design and construction/repair process, offers special challenges not faced by high volume manufacturers with mass markets.

The general industry view began to shift as U.S. yards began to work together through NSRP. A few shipyards, experimenting with Lean production through NSRP-funded projects, shared through industry collaboration their success in piloting Lean tools and techniques in different areas of their operations – from trade shops to design, engineering, and business processes.

This collaboration enabled shipyard executives to benefit from access to small scale testing across the industry and across the spectrum of shipyard operations—rather than the conventional view from limited in-house testing. As a result, most of the shipyards launched aggressive Lean Production programs and looked to the NSRP collaboration to accelerate their learning curve and avoid reinvention. NSRP collaboration in general and Lean activities in U.S. shipyards in particular represents the beginning of a fundamental process and culture change in our industry.

NSRP APPROACH - LEAN SHIPBUILDING INITIATIVE

NSRP’s Lean Shipbuilding Initiative —designed to link the growing spectrum of industry Lean activities for maximum impact on an accelerated schedule—is the collaboration’s joint response to this important trend and is consistent with the mission of greater warship affordability and commercial competitiveness. LSI provides Lean implementation leaders at each yard a means to better leverage a consolidated industry knowledge bank to accelerate their yard’s transformation. Based on early reports from these Lean team leaders at several shipyards, the NSRP benefit to their Lean efforts includes a shared learning curve, ready access to multiple resources, professional development, and seed money that helps break down internal budget barriers to implementation.

The role envisioned for NSRP in Lean shipbuilding and repair falls into four general categories: facilitate, educate, communicate, and assess. More specifically, the role can be described as assisting—and in some cases, coordinating—industry efforts to:

- Develop the means to facilitate U.S. shipyards’ transformation to Lean practices across their entire enterprise
- Educate shipyards and other organizational entities associated with U.S. shipbuilding and repair about Lean
- Promote and facilitate communication about Lean activities to enhance technology transfer within the industry
- Assess the industry’s progress along the Lean journey

In addition to establishing the LSI as an umbrella activity for various Lean activities in the shipbuilding and ship repair industries, the NSRP has taken the following steps in support of Lean implementation.

- Providing seed funding for collaborative Lean implementation projects in the manufacturing, design, and supply chain integration – both larger scale efforts through the annual NSRP funding competitions and smaller scale efforts through the existing industry Panels
- Hosting and facilitating a “Lean Implementers Group” of Lean practitioners from each yard as a peer resource pool
- Supporting Ship Production Panel events that promote and facilitate Lean implementation
- Publicizing industry Lean activities through a newsletter and event-based press releases
- Giving specific emphasis to Lean in the NSRP ASE Strategic Investment Plan and in Research Announcements
- Sponsoring industry technology transfer events such as the annual Lean Shipbuilding and Ship Repair Forums
- Providing an industry-specific lean knowledge clearinghouse through an on-line site that includes project details, case studies, bulletin board, presentations from past events, news of upcoming events, Lean points of contact, and links to related web sites

Project Funding

Lean projects funded through NSRP have experienced dramatic ROI results that not only improved the bottom line but also led to culture changes embraced by both management and labor. Navy co-funding of Lean projects through NSRP encourages sharing of experiences and lessons learned that accelerate the adoption of Lean processes and culture change throughout the industry. However, since Navy funding for NSRP is quite limited and is much less than the total resources being applied toward Lean across the enterprise, shipyards are exploring other avenues to leverage the strength of the industry collaboration towards this common objective.

Panels

NSRP/SNAME Ship Production Panels are an integral element of the industry’s ability to rapidly and effectively share knowledge and experience – in areas ranging from welding and coatings to design, production and worker’s compensation. The Panels have already become active in adapting their agendas to include a focus on Lean implementation within their domain. LSI will ensure that the Panels are kept updated on enterprise knowledge and experience and provided access to the resources (people and funds) to effectively fulfill their role in furthering Lean adoption among their membership—complementing each yard’s internal Lean efforts. Additionally, the LSI website offers single-stop shopping for Lean-related presentations and minutes from panel events.

Lean Forums

LSI’s first major event was an in-depth technical forum, held June 4-6, 2002 in Lexington, KY, that facilitated the understanding and adoption of Lean concepts within the U.S. shipbuilding and ship repair enterprise, including U.S. companies, government and academia. Widely recognized Lean experts who have worked with shipyards through NSRP Lean projects and understand the shipyard environment for Lean implementation coordinated the technical program.

The Lean Forum included guest participants from other industries whose experiences in making successful Lean transformations were relatable to the shipbuilding and ship repair industry. Participants gained first-hand experience with Lean organization and transition tools and realized the real potential of Lean by visiting Toyota and supplier facilities.

Based on the overwhelming positive response from attendees, NSRP held a second Lean Forum in April 2003, in Seattle. In addition to plenary session presentations by representatives from shipyards, other industries and the Navy, the second Forum featured technical tracks in Construction, Repair, and Lean Above the Shop Floor. Attendees had the opportunity to see Lean implementation firsthand in tours of Seattle-area facilities; options included Boeing Aerospace and its suppliers, and Genie Industries.

A third Lean Shipbuilding and Ship Repair Forum was held in 2004 in Norfolk, VA. This forum generated the largest audience yet, over 300 shipyard associates, suppliers, and other businesses related to the shipbuilding and ship repair industry. Participants were allowed to tour Tidewater-area shipyards and other local industries that have found success through Lean/six sigma.

Enthusiasm within the shipbuilding and repair industry—both in the public and private yards—continues, and a fourth Forum is tentatively envisioned for 2005 or 2006.

Web-based, Industry-specific Lean Knowledge Clearing House

LSI's online service is a section of the NSRP website tailored specifically to consolidate Lean information and services.

- Lean Forum – Information on the next Lean Forum to be sponsored by NSRP
- NSRP ASE Lean project information – Descriptions of each NSRP ASE project related to Lean production, including access to deliverables and technology transfer materials from those projects.
- Case Studies – Lessons learned from shipyard implementation of Lean methods.
- Bulletin Board - industry members with a question regarding Lean can solicit advice from experts or others in industry facing similar challenges.
- Events Calendar – Schedule and registration information on upcoming shipbuilding and repair industry Lean events.
- Shipyard contacts - contact information for Lean team leaders at U.S. shipyards.
- Links – to websites on Lean including other industry initiatives and Lean service providers.
- E-mail notification list - Notifications will be sent on request when new Lean information is posted.

Lean Implementers Group

NSRP forms industry-wide teams for a variety of both short-term and long-range collaboration. Many people are familiar with the standing teams: Executive Control Board, Major Initiative Teams and Ship Production Panels. Periodically, NSRP facilitates short-term groups such as purchasing managers, CFOs, and others for collaboration on specific tasks. Shipyard executives asked NSRP to form a Lean Implementer's Group as a longer term team to: (a) increase industry awareness, understanding, and adoption of Lean processes; (b) provide a steering committee for industry-wide Lean events; (c) assist in distilling individual company and project feedback and reports to spread the word quickly on the attendant culture, process, and productivity changes; (d) provide oversight of the online knowledge base, and (e) identify appropriate roles for NSRP in industry Lean efforts. The group will work closely with other NSRP team and panel leaders to avoid duplication of effort.

Group membership currently includes representation from ten NSRP shipyards and the Ship Production Crosscut Panel, five public shipyards (4 Navy, 1 Coast Guard), NAVSEA, SUPSHIPS, and Navy Program Executive Offices.

PROGRESS, IMPLEMENTATIONS AND EARLY RESULTS

Lean initiatives are taking off throughout the US shipbuilding and repair industry as a result of early NSRP ASE projects. Workshops held with management and labor to implement Lean principles in production shops at Todd cost \$80,000 each, but saved \$150,000 in each of eight shops (average) in the first year alone. Shop foremen also attributed the sharp drop (to zero in many cases) in safety incidents to the Lean projects. Savings at similar shops in a much larger Tier 1 yard are expected to increase in proportion to the greater throughput – and evidence from implementation at several yards is validating this. The pipe shop at Newport News realized a 28% reduction in cycle time and a 5:1 reduction in consumable usage. Similarly, the Ingalls pipe shop experienced cut an average tooling changeover by 73%. Puget Sound Naval Shipyard, a team member with BIW, Atlantic Marine and Todd on the Lean Enterprise project, was able to reduce the cycle time of a breaker overhaul from 155 days to 8 days. Similarly, Northrop Grumman and General Dynamics yards have recently launched aggressive Lean programs with stretch goals for the reduction of labor costs

and time - predicated on work accomplished under NSRP ASE. Throughput time for a panel line at Avondale was cut from 31 days to 21 days and wait time from 29.5 days to 18.5 days.

The Lean Enterprise Model project, completed in early 2004, began to deliver value early in taking Lean manufacturing methods beyond the shops and into other shipbuilding processes, such as design, engineering and procurement. Indicators of the value include a recent report that that Todd shipyard senior management (CEO, COO, etc) trained 12-14 hours each day for a week in order to internalize the principles of Lean. At Atlantic Marine, production shop implementation of Lean principles is spreading into yard processes such as water blasting. Process improvements at Atlantic Marine led to a 38% increase in overall productivity and a 50% reduction in setup time on successive Destroyer availabilities. The adoption of Lean is now moving toward “above the shop floor” areas such as engineering and production planning.

The same project team joined with suppliers and Navy customers in starting a new, follow-on project that extends the work done in the Lean Enterprise project into the full value chain associated with the shipyard enterprise.

LEAN MANUFACTURING APPLICABILITY ACROSS NSRP MAJOR INITIATIVES

While Lean spans the full range of NSRP major initiatives, it is possible to highlight evidence of Lean implementation—both past successes and future plans—within each major initiative area.

Shipyard Production Process Technologies

The NSRP ASE World Class Manufacturing Model, Ultra-High Pressure Water Blasting, Knowledge Based Modular Repair, Five-S (Sorting, Simplifying, Systematic Cleaning, Standardizing, and Sustaining) Applications, and Lean Enterprise project are providing significant insight and understanding into the changes required to effectively implement world-class or Lean-manufacturing practices. These process-oriented projects are currently in the implementation phase, and are demonstrating significant bottom line improvements in product quality, cost, and cycle time.

Systems Technologies

Systems Technologies projects have developed and demonstrated automated and seamless processing of vendor data, engineering and design data within the shipyard environment. The automated processes implemented have been streamlined from prior manual processes. The Integrated Shipbuilding Environment project has demonstrated seamless exchange of design and supplier data in various stages of the ship design process. For example, the direct download of piping and structural parts data from vendor electronic catalogs into shipyard digital parts libraries has been successfully demonstrated. This illustrates the potential for significantly reducing the waste associated with the costly, time-consuming and error-prone manual reentry of part information into shipyard parts libraries.

Business Process Technologies

Business Process Technologies is an area rich in opportunities for cost and cycle time reductions, regardless of whether the business area in question is marketing and sales, pre-contract activity, or contracting. One significant ongoing activity under this initiative involves a collaboration of five U.S. shipyards working with IBM to reengineer and web-enable shipyard supplier business processes for electric commerce on the NSRP ASE Shipbuilding Partners and Suppliers (SPARS) Supply Chain Virtual Enterprise project. Virtual enterprises enable sourcing and supply chain integration to provide business process interactions among shipyards and suppliers that are transparent of the underlying processes and computing environments of the participants. This capability will support eCommerce acquisition practices and global sourcing by enabling supply chain integration from the pre-contract phase through procurement, contract management & delivery.

Another significant activity underway is the Lean Materials portion of the Lean Enterprise Project. This portion of the project is examining all of the supply chain and materials process within the shipyard to identify the value stream, improve the process flow and remove all wasted activities. The process

reengineering efforts of the SPARS and Lean Enterprise projects are enabling the removal of non-value added activities in these key business processes and is in concert with the principles of Lean manufacturing.

Product Design and Material Technologies

There is strong evidence that the lack of parametric design rules and commercial design and material standards result in U.S. commercial ship designs having significantly greater material and labor content, and therefore higher cost, than similar world-class designs. The three-year “World Class Material Standards and Parametric Design Rules” project made significant strides in developing a rule-based design process supported by early-stage computer-based design tools, standard interim products, and a database of type-approved spec equipment and non-spec materials. The project advanced the concept of designing a ship as a hierarchy of pre-engineered functional volumes, with the application of Lean design principles at every level of the hierarchy. The project underscored the value of re-usable design/engineering products linked to standard interim products, as an essential element of a world-class, Lean shipbuilding enterprise model which can deliver dramatic improvements in the quality, cost and cycle time of a yard’s design, material procurement, planning, and production processes.

Facilities and Tooling

Significant progress has been made towards improving workplace organization through the funding and execution of the project to implement application of the Five-S Lean Manufacturing methodology (sorting, simplifying, systematic cleaning, standardizing, sustaining). The Five-S project created a shipyard focused implementation program that will assist U.S. shipyards in implementing Five-S programs quickly and effectively. This project resulted in 30 percent improvements in productivity in pilot tests at Todd Pacific Shipyards, leading Todd to accelerate implementation. Based on tours and workshops that demonstrated these results to professionals throughout the Navy and industry, most major U.S. shipyards (both private and public) report efforts to accelerate application of Lean manufacturing to shipbuilding.

Crosscut Initiatives

The Crosscut Initiatives area has a crucial role to play in the successful adoption and implementation of Lean principles in ship construction and ship repair. Each of the four Crosscut sub-initiatives represents a key enabler in the adoption and implementation of Lean. Organizational Change will be at the core of successful Lean implementation. Modifying the culture of individual shipyards and the industry as a whole to embrace and sustain Lean principles is critical to the Lean Shipbuilding Initiative’s success. Acceptance of changes in production and business processes, relationships to suppliers and customers (both internal and external), and standardization of methods and procedures will be necessary. In addition, commitment to continuous improvement will be required for sustaining Lean principles. Adaptive Human Resource approaches also will be key to the successful integration of organizational change and the implementation of Lean. Flexible work force schemes and team organizational structures will be needed. Changes to enhance employee involvement and to offer rewards and incentives will be important. Creating work environments in which shipyard employees are able to “operate as surgeons” will require innovative approaches. Training and Education will be critical to ensure the proper introduction of Lean principles, their acceptance and follow-on continuous improvement. Familiarization and understanding of Lean principles, development of robust team skills and problem solving skills, and the ability to apply Lean processes and tools will require workforce training and education. Technology Transfer also will be key to the successful implementation of Lean. The effective and timely transfer of processes, tools, and technologies that enable and support the creation and maintenance of Lean enterprises will be important to the success of the Lean Shipbuilding Initiative. In support of Lean implementation, the Crosscut Initiative currently is sponsoring the customization of lean training for shipyard workers, and the creation of industry-wide skills standards and certification.

LEAN AEROSPACE INITIATIVE (LAI)

One well-known Lean undertaking is the Lean Aerospace Initiative, launched in 1993 when the U.S. Air Force, faced with declining defense procurement budgets and military industrial overcapacity, teamed with

MIT and defense aerospace industry and labor unions. This academia-led, consortium-guided endeavor was created “to revolutionize the aerospace industry and reinvigorate the military aircraft workplace—answering a demand for ‘cheaper, faster and better’ production.” Its mission statement stresses continuing transformation and systems that offer the best life-cycle value.

Since Lean has taken a firm foothold in the shipbuilding and ship repair industry, to the question of how NSRP’s efforts compare to LAI periodically arises. Like LAI, the NSRP has as its goal “cheaper, faster and better” production. The key difference is one of approach – NSRP’s industry-led structure and emphasis on technology transfer and industry implementation compared to LAI’s stronger emphasis on research and analysis, led largely by MIT. Additionally, while the LAI understandably delves deeply into Lean research, the NSRP incorporates Lean as just one of five elements of program focus, the other four being: Supply Chain Management; eManufacturing; Focused Technology Solutions, and Common Issues across the industry.



Lean Implementers Group



Background

As part of its Lean Shipbuilding Initiative—an effort designed to link the growing spectrum of industry Lean activities for maximum impact on an accelerated schedule—the National Shipbuilding Research Program, through its Executive Control Board, established the “Lean Implementers Group”—a peer resource pool of Lean practitioners at U. S. shipyards. Group membership currently includes representation from eight ECB shipyards and the Ship Production Crosscut Panel, as well as four Navy shipyards and NAVSEA.

This document describes the basic functions and mode of operations envisioned for the Lean Implementers Group.

Functions

The role envisioned for NSRP in Lean shipbuilding and repair falls into four general categories: facilitate, educate, communicate, and assess. More specifically, the role can be described as assisting — and in some cases, coordinating — industry efforts to:

- Develop the means to facilitate U.S. shipyards’ transformation to Lean practices across their entire enterprise
- Educate shipyards and other organizational entities associated with U.S. shipbuilding and repair about Lean
- Promote and facilitate communication about Lean activities to enhance technology transfer within the industry
- Assess the industry’s progress along the Lean journey

Lean Implementers Group functions within these four categories are envisioned to be as follows:

Facilitate

- Participate in NSRP projects aimed at furthering Lean in the industry. This participation could range from individuals working on own-yard projects to the entire Group acting in an advisory/review capacity for Lean-oriented projects.
- Provide Lean-oriented input to key program documents, including the Strategic Investment Plan and Research Announcements.
- Upon request, act in an advisory capacity for the Executive Control Board on Lean matters.

Educate

- Share acquired Lean expertise within own yards and throughout the industry.
- Promote understanding of the enterprise-wide nature of Lean implementation, including above the shop floor and the supply chain
- Promote understanding of the nature and benefits of Lean transformation to entities outside the immediate organization—e.g., customers, labor unions.
- Provide spokespersons for industry-related events at which Lean shipbuilding and repair are logical topics of interest.

Communicate / Technology Transfer

- Maintain contact with other Group members to give and receive information (status, successes, lessons learned) on Lean implementation at individual shipyards.
- Contribute information to a centrally-administered repository of Lean educational/training materials, opportunities, resources and events.
- Participate in exchanging information on the NSRP-established Lean Shipbuilding bulletin board and other on-line resources.
- Identify the need for additional centralized Lean resources, on-line and otherwise.
- Identify the Lean needs of the industry. When needed, initiate the planning and approval process for Lean-oriented forums and conferences. Staff steering committees for these events from within LIG membership.
- Maintain regular contact with established NSRP entities, particularly Major Initiative Teams and Ship Production Panels, to preclude gaps and overlaps in Lean shipbuilding and repair implementation activities.
- As needed and desired, plan for and execute periodic site visits for LIG members at shipyards and other appropriate locations.

Assess

- At such time as the industry undertakes a project to develop and implement one or more systems to measure and/or assess Lean implementation in shipbuilding and ship repair, the LIG should participate in developing assessment tools and metrics, and contributing to assessment team membership.

Mode of Operations

The Lean Implementers Group will function for the most part in a distributed fashion. Communications in support of fulfilling the above-listed functions will generally be event-driven, initiated by any Group member using telephone, e-mail or other appropriate means. An e-mail exploder list which includes the entire Group is available to each member.

On an as-needed basis to collectively discuss specific topics, a phone conference will be conducted. ATI will coordinate.

As need and opportunity dictate, the group will physically meet, the preference being to conduct such meetings in conjunction with other events at which most LIG members would be in attendance. ATI will coordinate.

As desired by the group, there may be gatherings at a member's shipyard for the purpose of first-hand observation of Lean implementation and general sharing of lessons learned and best practices. The host organization will coordinate, with NSRP Program Administrator support as appropriate.

Recently, the group expanded to include members from NAVSEA's Task Force Lean, an effort by them to coordinate Lean activities throughout their organization.

Lean Implementers Group (as of December 2004)

Paul Albert	VT Halter Inc.	p.albert@vthm.com
Camilla DiBarra	Todd Pacific SY	camilla.dibarra@toddpacific.com
Kurt Doehnert	NAVSEA	DoehnertKC@navsea.navy.mil
Lisa Hepinstall	Atlantic Marine	lhepinstall@atlanticmarine.com
Dale Jermyn	Bender Shipyard	jerm@bendership.com
Charles LaRue	NGSS Ingalls	charles.larue@ngc.com
Bob Leber	NGNN-Crosscut Panel	robert_leber@ngc.com
Glenn Marshall	NGNN	Glenn.Marshall@ngc.com
Bob McDonough	Bollinger Shipyards	bobm@bollingershipyards.com
Dick Palmieri	EB	dpalmier@ebmail.gdeb.com
Eric Suehrstedt	BIW	eric.suehrstedt@biw.com
Shawn Wilkerson	NGSS Avondale	shawn.wilkerson@ngc.com
Mike Desjardins	PNSY	DesjardinsMP@mail.ports.navy.mil
Randy Gandy	NNSY	GandyR@nnsy.navy.mil
Ron Rabago	Coast Guard SY	RRabago@cgyard.uscg.mil
Chuck Radvansky	PHNSY	RadvanskyCS@phnsy.navy.mil
Michelle Tibke	PSNSY	tibkem@psns.navy.mil
Rick Alston	SUPSHIP NGNN	alstonrw@supship.navy.mil
Brad Asbury	SUPSHIP NGSS	asburyba2@supship.navy.mil
Walt Borkowski	SUPSHIP EB	borkowskiwm@supship.navy.mil
Bill Budd	PEO Ships	buddwj@navsea.navy.mil
Robert Cameron	SUPSHIP BIW	cameronrd@supship.navy.mil
Mary Grandgeorge	SUPSHIP HQ	GrandgeorgeMK@navsea.navy.mil
Paul Hagan	PEO LMW	haganfp@navsea.navy.mil
Kevin Kenney	PEO IWS	kenneykj@navsea.navy.mil
John Nunnery	PEO Carriers	nunneryjs@navsea.navy.mil
Brian Osgood	PEO Subs	OsgoodDB@navsea.navy.mil



NSRP Ties to Lean in Naval Shipyards



Background

Success has many fathers. NSRP has played some constructive role in the adoption of Lean/Six Sigma in both the private and public shipyards. To the degree that SECNAV will be looking at lean implementations at PNS with SEA 00, some data might be useful to have in making a connection.

Time Line

<i>Date</i>	<i>Event</i>	<i>NSRP/ NAVSEA Connection</i>
Oct-99	NSRP selects NASSCO's "World Class Manufacturing" Project	Introduction of Jeffrey Liker (Optiprise) to the US Navy ship building and ship repair industry
Apr-00	NSRP selects "5S" Project for funding – Todd Pacific Shipyards (TPSC) prime, Atlantic Marine Inc. (AMI), partner.	Introduction of Michael Boyer to the ship building and ship repair industry
November 9-10, 2000	NSRP "World Class Manufacturing Project" hosts a Lean Manufacturing Workshop in Georgetown, KY – includes a tour of the Toyota Facility	ADM Nanos and Baugh attend NSRP workshop and tour; opportunity for NAVSEA to see Optiprise
2000-2001	TPSC and PSNS&IMF negotiate a benchmarking agreement	First PSNS&IMF/ Todd connection to cooperate on process improvement
Mar-01	AMI invites Optiprise to become a partner in the Lean Enterprise Project proposal	NSRP funding utilized to augment and speed up program started by NAVSEA 04
Spring 2001	TPSC and AMI. Invite PSNS&IMF to become a partner in the NSRP Lean Enterprise Project proposal	NAVSEA and NSRP agree to jointly implement lean processes
Jul-01	NSRP selects AMI's "Lean Enterprise" Project	Official partnership between NSRP partner yards and PSNS&IMF to implement Lean begins
Sep-01	Jeffrey Liker's Consulting Co. "Optiprise" hired by NAVSEA 04 to conduct pilot Lean Workshops at the 4 Naval Shipyards	NAVSEA utilizes consultant introduced by NSRP "World Class Manufacturing Project"
Oct-01	Optiprise conducts pilot workshop at PSNS&IMF through NAVSEA funding	Start of Lean at PSNS&IMF
Oct-01	NAVSEA provides block of funding to PSNS&IMF for Process Improvement	Serendipitous – Can use funding to pay for internal cost of Optiprise workshops and lean changes
Oct 2001- Jan 2002	Optiprise conducts one week Kaizen event at each Naval shipyard	Firmly entrenched Naval shipyards in Lean manufacturing
2001-2003	Optiprise conducts 5 lean workshops at PSNS&IMF through NSRP funding	NSRP funding utilized to augment and speed up program started by NAVSEA 04
June 4-6, 2002	Lean Shipbuilding and Ship Repair Forum #1, Lexington KY	Naval Shipyards and NSRP/ Private Shipyards network and share ideas
Aug-02	TPSC, AMI, & PSNS&IMF jointly tour and study Japanese Ship Repair Best Practices	Study trip includes Japanese private yards and SRP Yokosuka
Oct-02	Todd and SUPSHIP Puget Sound (SSPS) agree to embark on joint lean events and training	Continued sharing of information and materials with NAVSEA as a result of NSRP funding
Mar-03	Michael Boyer hired by PSNS&IMF to conduct 2 sessions of Executive Level Training	PSNS&IMF utilize consultant introduced by NSRP "5S" and "Lean Enterprise" projects
April 1-3, 2003	Lean Shipbuilding and Ship Repair Forum #2, Seattle, WA	Naval Shipyards and NSRP/ Private Shipyards network and share ideas
Apr-03	PSNS&IMF, TPSC, AMI, and SSPS agree to partner on NSRP project proposal (Extended Lean Enterprise Project), COMNAVAIRPAC agrees to participate in the project	Direct examination of Lean applications in public/ private partnerships
May-03	Michael Boyer hired to facilitate Naval Shipyards Corporate Lean Group on aligning Lean Implementation Strategies	NAVSEA utilizes consultant introduced by NSRP "5S" and "Lean Enterprise" projects
Jul-03	NSRP selects the Extended Lean Enterprise Project for funding	Official partnership between NSRP partner yards, PSNS&IMF to use Lean to examine transaction between them begins
Oct-03	TPSC and PSNS&IMF host Lean Enterprise Model Workshop for Ship Repair	Highly attended by Naval Shipyard and SUPSHIP representatives
May 11-13, 2004	Lean Shipbuilding and Ship Repair Forum #3, Norfolk, VA	Naval Shipyards and NSRP/ Private Shipyards network and share ideas; tour of NNSY's Lean areas

Background to Date

The NSRP ASE World Class Manufacturing Project in 1999 introduced Lean concepts to the shipyards; it also introduced Jeff Liker (Optiprise) to the US Navy Shipbuilding and Ship Repair Industry.

An NSRP Lean Manufacturing Workshop was held November 9-10, 2000 at the Toyota Production Plant in Georgetown, Ky. The workshop was attended by 13 shipyards, as well as NAVSEA and ONR executives. Highlights included a presentation of Lean principles and a tour of the Toyota facility there.

- Jeff Liker (a Lean consultant of renown in the auto industry) presented “A Guide to Lean Shipbuilding”. His talk raised quite a stir of what might be possible – whereas conventional wisdom held that Lean did not fit the low production rate shipbuilding industry.
- Admirals Nanos (SEA 00) and Baugh (SEA 04) were both in attendance. Pete Jacquith distinctly remembers talking to both admirals, who he said were “impressed by the presentations such that they had enthusiastically reiterated their decision to implement Lean in the public yards.”
- Concurrently, Todd Pacific and Atlantic Marine Shipyards began collaborating on the 5S Project via NSRP. Of note, Michael Boyer was hired as a consultant: his introduction to the Shipbuilding and Ship Repair industry.
- Not too long after the meeting at Toyota, NAVSEA had extra program money at the end of their fiscal cycle; this was used to hire Jeff Liker, who spoke at the meeting at Toyota, to work with Puget Sound Naval Shipyard on their Lean efforts. Liker tells us that he was later hired by NAVSEA to conduct Lean training at naval shipyards through this introduction.

In the following Spring of 2001, PSNS&IMF teamed with Todd Pacific and Atlantic Marine in the NSRP ASE Lean Enterprise project. In the project proposal, the Lean Workshop in November 2000 and VADM Nanos and RADM Baugh’s attendance was specifically referenced as a catalyst for increased Naval shipyard lean implementation.

Moving forward, the four Naval shipyards have embarked on their own Lean implementation programs. They have attended a significant number of NSRP ASE Lean conferences, seminars, and forums in addition to their own work. They have used some of the consultants introduced to them by NSRP Lean efforts; they have also participated in technology transfer with the NSRP shipyards.