NSRP
National Shipbuilding Research Program

Organization & Operations Manual

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 shipbuilding-related technical and business processes.

March 2013
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## 1. RECORD OF CHANGES

<table>
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<th>Date</th>
<th>Sections</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original</td>
<td>August 14, 1998</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change 1</td>
<td>January 14, 2000</td>
<td>Major Initiatives</td>
<td>Clarified the technical issues discussed in the Major Initiatives sections based on comments received from the U.S. shipbuilding industry as the Plan was being implemented.</td>
</tr>
<tr>
<td>Change 2</td>
<td>September 11, 2001</td>
<td>All</td>
<td>The Strategic Investment Plan has been updated to reflect the needs and requirements of the U.S. shipbuilding industry. The changes made are summarized below:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The Plan was updated to reflect new information from benchmarking, project results, the state-of-the-art report, and changes in technology</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• The roadmaps for R&amp;D investment in each major initiative area were revised based on reprioritization of sub-initiatives, updated sub-initiative cost estimates, extension of the program funding profile through 2008, and funds spent or committed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Discussion was added on progress to date, sequence, and interdependencies.</td>
</tr>
<tr>
<td>Change 3</td>
<td>December 9, 2002</td>
<td>Foreword, Operations and Organization, Lean Shipbuilding and Repair</td>
<td>The Plan was updated to reflect new information from project results and industry’s fundamental process and cultural shifts due to the adoption of Lean principles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• A section on Lean Shipbuilding and Ship Repair was added to address industry’s transformation towards “Lean” and to define NSRP’s support role in these changes</td>
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<td></td>
<td></td>
<td></td>
<td>• The Foreword was revised to define NSRP’s value proposition to the Navy and include the latest program and project developments.</td>
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<td></td>
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<td></td>
<td>(Due to the fact this was a relatively minor update,</td>
</tr>
<tr>
<td>Version</td>
<td>Date</td>
<td>Sections</td>
<td>Description</td>
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<td></td>
<td>June 8, 2005</td>
<td>All</td>
<td>The Strategic Plan has been updated as a result of rigorous analysis and reflects progress to date and changes in the business environment with consideration given to the recent benchmarking of major U.S. shipyards. Changes include:</td>
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<tr>
<td></td>
<td></td>
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<td>• Added emphasis to three major topic areas: Lean/Six Sigma, Interoperability and Ship Repair</td>
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<td></td>
<td></td>
<td></td>
<td>• The composition of sub-initiatives has changed to: 1) remove those where requirements have been successfully met, 2) capture new requirements (common needs, such as RFID), and 3) repackage some as needed to reflect changes in execution of strategies</td>
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<tr>
<td></td>
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<td></td>
<td>• Highlighted efforts made by industry to measure NSRP effectiveness through cost reduction and implementation tracking and reporting</td>
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<td></td>
<td></td>
<td></td>
<td>• Funding estimates and relative benefit weighting for sub-initiatives were updated to reflect current industry priorities, experience to date, and recent benchmarking</td>
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<td></td>
<td></td>
<td></td>
<td>• Market segments: increased emphasis on government vessels, small vessels and repair; realigned Offshore Oil and Gas relative to commercial ships</td>
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<td></td>
<td>• Removed Appendix on NSRP History</td>
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<td>• Note: In developing this update, all available benchmarking data was considered, including preliminary results from the recent Defense Department-directed Global Shipbuilding Industrial Base Benchmarking Study. The detailed benchmarking scores reported in Part 1 of the OSD study (First Tier Shipyards) were released in late May 2005, after the update analysis was complete, and Part 2 (Second Tier shipyards) is scheduled to complete in late 2005. Accordingly, the details of this study will be more explicitly included in a future Strategic</td>
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<tr>
<td>Version</td>
<td>Date</td>
<td>Sections</td>
<td>Description</td>
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<td></td>
<td></td>
<td></td>
<td>Plan update.</td>
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<td>Change 5</td>
<td>Nov 30, 2010</td>
<td>All</td>
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<td></td>
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<td></td>
<td>- There was a five-year gap between SIP updates, partially due to uncertain funding picture during that time.</td>
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<td></td>
<td></td>
<td></td>
<td>- The lengthy gap between updates resulted in an outdated plan.</td>
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<td></td>
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<td></td>
<td>- Upon further review of the SIP 2005, both ECB and Navy considered the existing SIP to be too cumbersome, making it difficult to use, update and disseminate.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- As a result, the Strategic Investment Plan was entirely restructured and reformatted:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- A concise and focused Strategic Investment Plan as a stand-alone document</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Program Organization and Operations as a stand-alone document</td>
</tr>
<tr>
<td>Change 6</td>
<td>March 14, 2013</td>
<td>2, 3, 6, 6.1, 7, 7.1-7.4</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Inclusion of new program sponsors</td>
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<td>- Inclusion of new Ship Warfare Systems Integration Panel</td>
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<td></td>
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<td>- Updated R&amp;D interest areas</td>
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<td></td>
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<td>- New Benchmarking report</td>
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<tr>
<td></td>
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<td>- Administrative updates, including:</td>
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<td></td>
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<td>- Updated graphics</td>
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<td></td>
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<td>- Updates to date references</td>
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</table>
2. INTRODUCTION

The Organization and Operations Manual contains detailed information on the National Shipbuilding Research Program, including the evolution of the Program, the organizational structure, the Research & Development project selection process and other background information. It is intended to be a background companion document to the NSRP Strategic Investment Plan dated March 14, 2013.

As the Strategic Investment Plan states, the National Shipbuilding Research Program Advanced Shipbuilding Enterprise (NSRP ASE) is a collaboration of U.S. shipyards working together to reduce the cost of building, operating and repairing Navy ships. The shipbuilding industry will achieve this by improving productivity and quality through advanced technology and processes. NSRP ASE leverages public/private cooperation to manage cost-shared R&D based on a consensus Strategic Investment Plan.

At its core, the program is built upon the following elements, all of which are critical to the continued success of the NSRP ASE:

- **Breakthrough technologies and processes** -- the catalyst for innovation and cost reduction
- **Collaboration** – creating a neutral climate for R&D teams to share ideas with their peers and support emerging technologies
- **Implementation Solutions** -- creating a sound plan that allows technologies to be easily transferred and implemented across the industry
- **Human and capital investment** -- the more capital and human investment that is allocated for R&D at the outset, proportionally greater are the long-term results.

The unique framework of NSRP has earned support from industry and Navy over the life of the program: efficiently coordinating collaborative R&D among all segments of the ship construction and repair enterprise with the goal of reducing the cost and time required for both Navy and commercial ship construction, conversion, and repair.

NSRP’s hallmark is the rapid, widespread implementation of R&D results on Navy programs: cross-yard and cross-tier, across varied technology areas, and at times before projects complete – even at yards that were not on the project team.
FOCUS AREAS

The current Navy priorities, which the Program’s industry board concurred with, are woven into the mission, strategy and objectives of the Program:

- Improved first-time quality
- Reduction in Total Ownership Cost
- Improved energy efficiency and/or environmental impact in shipyards and/or ships
- Reduced cost associated with integration of Naval warfare systems during ship construction, modernization and maintenance
- Reduced cost associated with integration of Naval Warfare Systems during ship construction, modernization and maintenance

These core priorities form the basis for the ten focus areas listed below, which provide a roadmap for the program and the industry teams proposing R&D solutions through the program’s project solicitation processes:

<table>
<thead>
<tr>
<th>Major Focus Areas</th>
<th>Areas of Concentration</th>
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<tbody>
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<td>Improving Production Planning</td>
<td>• Optimized Work Packages</td>
</tr>
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<td></td>
<td>• Work Package Development Tools</td>
</tr>
<tr>
<td></td>
<td>• Capacity Planning Analysis</td>
</tr>
<tr>
<td></td>
<td>• Optimized Sequencing of Work</td>
</tr>
<tr>
<td>Improving Integration of Shipboard Warfare Systems</td>
<td>• Reduction of warfare system integration costs across new construction and modernization (in-service) platforms</td>
</tr>
<tr>
<td></td>
<td>• Analysis of past cost drivers and best practices between ship classes and shipyard activities for warfare system installation, ship integration and test...identification of investment areas to improve affordability</td>
</tr>
<tr>
<td></td>
<td>• Resolution of alteration maturity, scheduling, installation, test, evaluation and certification issues associated with warfare system installation efforts during in-service fleet availabilities</td>
</tr>
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<td></td>
<td>• Accelerated use of automated manufacturing and installation techniques for warfare system installation and testing, in the shipyard industrial environment</td>
</tr>
<tr>
<td></td>
<td>• Standardization of combat system interfaces with shipboard hull, mechanical and electrical systems</td>
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</tbody>
</table>

Table 1 - Major Focus Areas
<table>
<thead>
<tr>
<th>Major Focus Area</th>
<th>Areas of Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving Data Exchange</td>
<td>• Integrating internal systems (ERP, estimating, planning, scheduling, procurement, etc.)</td>
</tr>
<tr>
<td></td>
<td>• External Exchange (Navy-Industry)</td>
</tr>
<tr>
<td>Improving Safety &amp; Health / Reducing Environmental</td>
<td>• Reducing Injuries</td>
</tr>
<tr>
<td>Impacts</td>
<td>• Increasing tool ergonomic features</td>
</tr>
<tr>
<td></td>
<td>• Reducing shipbuilding and repair energy consumption</td>
</tr>
<tr>
<td></td>
<td>• Ensuring environmental compliance in the shipbuilding/repair industry</td>
</tr>
<tr>
<td>Improving Education and Training</td>
<td>• Improved Processes</td>
</tr>
<tr>
<td></td>
<td>• Standardization across Industry</td>
</tr>
<tr>
<td>Total Ownership Cost</td>
<td>• Increased Use of Composites and other Advanced Materials that Reduce Ship Operating and/or Maintenance Costs</td>
</tr>
<tr>
<td></td>
<td>• Design for Maintenance and Repair</td>
</tr>
<tr>
<td></td>
<td>• Parts Commonality and re-use across platforms</td>
</tr>
<tr>
<td></td>
<td>• Any other area in which ship total ownership costs can be reduced</td>
</tr>
</tbody>
</table>

Table 2 - Major Focus Areas (cont.)
3. OPERATIONS

3.1 CONCEPT OF OPERATIONS

The NSRP concept of operations is a proven, successful method for soliciting, selecting, and managing R&D projects. The NSRP organization has been adept at managing and focusing program research and development funding on technologies and processes that will reduce the cost of warships to the U.S. Navy.

*Figure 1* illustrates the logic stream used to develop the concept of operations and organizational model for NSRP from which the original Strategic Investment Plan was developed.

![Diagram of Concept of Operations](image_url)
3.2 PROGRAM OPERATIONS

As shown in Figure 2, Program Operations originate with Industry and Navy stakeholders providing recommendations on consensus priority issues, as related to the program’s mission and objectives; those recommendations provide the basis for the Strategic Investment Plan (SIP), which forms the program framework. The SIP then directs the project selection process and also defines relevant ad hoc initiatives (further details in Section 3.3). These projects and special initiatives are carried out within the industry through the execution of projects, panel meetings and conferences, dissemination of project results and the implementation of technologies and processes. This output is then relayed to Navy and industry stakeholders, who incorporate the results with their recommendations.
3.3 KEY ACTIVITIES

**Technology Transfer and Industry Networking:** One of the goals of NSRP is the sharing of project results to the maximum extent practicable to the U.S. shipbuilding industry, both throughout the project lifecycle as well as after project completion. This is achieved through Panel meetings, which serve a crucial role within the Program by providing a neutral, public forum for industry-wide networking, technology transfer and discussion of current Navy and industry areas of interest. Panels typically meet three times a year across the U.S. held throughout the country. Other opportunities for transferring the technologies developed under NSRP are industry conference, project demonstrations and training.

**Projects:** The greatest portion of industry and government funding for this Program is invested in R&D projects. Projects selected and executed fall into two categories: Panel Projects and Research Announcement (RA) projects. Panel projects are lower cost and shorter duration ($150K, 12 months or less). RA projects can run into the millions of dollars, last up to three years, and involve much more stringent cost share requirements for project participants. A key aspect of NSRP is the collaborative framework and proactive distribution of knowledge gained through projects and studies throughout the industry. Teams consisting of multiple shipyards, suppliers, academia, and other supporting industries are encouraged.

**Ad Hoc Groups:** Periodically, at the request of Navy or industry, ad hoc groups are established to focus efforts on specific target areas in the shipbuilding and ship repair industry. These ad hoc groups are quickly instituted to include key stakeholders of the focus area, carry out their task and are disbanded when required actions are complete.
4. ORGANIZATION

**Figure 4 - Program Organization**

**Major Initiatives**: The Strategic Investment Plan defines four Major Initiatives (previously six). In general, the Initiatives align with enterprise activities as described in Table 1. Similar to the business enterprise, none of the Major Initiative teams function alone, they collaborate with each other.

<table>
<thead>
<tr>
<th>Major Initiative</th>
<th>Correlation to Shipbuilding Enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ship Design &amp; Material Technologies</td>
<td>Naval Architecture, Ship Specifications, Preliminary Design, Material Development</td>
</tr>
<tr>
<td>Ship Production Technologies</td>
<td>Fabrication, Assembly, Outfitting, Production Facilities, Production Planning</td>
</tr>
<tr>
<td>Business Processes and Information Technologies</td>
<td>Business Support, i.e., data exchange, shipyard integration</td>
</tr>
<tr>
<td>Infrastructure &amp; Support</td>
<td>Health and Safety, Environmental Issues, Workforce Issues (training, workers compensation), overhead costs</td>
</tr>
</tbody>
</table>

Table 2 - Major Initiatives Alignment to Shipbuilding Enterprise
Panels: The eleven panels are the working groups of the Program. However, the core focus of the Panels is open interaction with the industry at large, as well as with government representatives and members of academia engaged in their respective functional areas. This interaction is accomplished primarily through two to four open meetings per panel per year. These meetings serve a critical role within the program by providing a public forum for industry-wide networking, technology transfer and discussion of current Navy and industry areas of interest. They also offer an opportunity to share program- and panel-specific information and other applicable topics.

4.1 LEADERSHIP, MANAGEMENT AND EXTENDED TEAM

4.1.1 EXECUTIVE CONTROL BOARD

NSRP is governed by an Executive Control Board (ECB) that consists of a senior management representative from each of the member shipyards.

4.1.2 EXECUTIVE DIRECTOR

The ECB has selected SCRA Applied R&D as Program Administrator, who, acting with guidance from the ECB, is responsible for the overall management of the Collaboration, including technical, programmatic, contracting, reporting, financial and administrative matters. The Program Administrator employs the program’s Executive Director, who provides a single point of contact for the Collaboration, the Government and the respective designees.

4.1.3 EXTENDED TEAM

Major Initiative Teams: Major Initiative Team Leaders act as technical managers, are assisted by the other Major Initiative team members, and report to the ECB via the Executive Director. They are the 'technical area' managers of the NSRP, each providing leadership of a key component of the shipbuilding enterprise as identified in the Strategic Investment Plan. Each MI Team, led by the Team Lead, has demonstrated expertise in the assigned technical area (see Table 2 in Section 4), synthesizes industry input to develop Research Announcements, provides technical oversight for both panel and Research Announcement projects, tracks project execution and provides input to the ECB during discussions about the NSRP's goals and direction. The MI Team Leads are nominated and selected by the ECB.

Panel Chairs/Vice Chairs: Each panel elects a chair and vice-chair who lead and coordinate the panel activities, which include open industry meetings and execution of smaller-scale projects. As with the Major Initiative Team Leaders, the Panel Chairs also provide input and recommendations on key elements of the program. Each panel is self-governed with established bylaws voted on by the panel members. The panel officers are selected by the panel membership, with the only restriction being the ECB requirement that the Panel Chairperson be employed by a private sector U.S. shipyard. Each Panel Chair is a member of the Major Initiative Team to which the panel is mapped.
4.2 PROGRAM SPONSORS

As a joint industry/government program, the U.S. Navy is actively engaged with NSRP. Naval Sea Systems Command, with the Program Executive Offices, and the U.S. Coast Guard are key stakeholders.

- Naval Sea Systems Command (NAVSEA):
- Program Executive Offices:
- Carriers
- Integrated Warfare Systems (IWS)
- Littoral Combat Ships (LCS)
- Ships
- Subs
- U.S. Coast Guard

Figure 5- NSRP Sponsors
5. PROJECT SELECTION PROCESS

As previously, the greatest portion of industry and government funding for this program is invested in R&D projects, and the process for identifying, selecting and funding projects is described in this section.

The two types of project selected and executed under NSRP are outlined in the following sections.

Funds are distributed to NSRP participants through contract awards managed by the Program Administrator. Contract awards are made to those activities submitting the best value proposals, emphasizing benefits to the industry and conformance with the strategic direction of the industry.

5.1 RESEARCH ANNOUNCEMENT (RA) PROJECTS

NSRP annually solicits proposals for applied research and technology development to meet the goals outlined in the Strategic Investment Plan. Solicitations are announced both on the NSRP website (www.nsrp.org) and the Federal Business Opportunities “FedBizOpps” website (www.fbo.gov). Specifics on technical and cost proposal requirements are available in the Proposal Preparation Kit. The graphic below outlines the submission and selection process for RA projects:

Figure 6 - RA Project Selection Process
5.2 PANEL PROJECTS

The NSRP Executive Control Board (ECB) allocates funds on an approximately annual basis to fund a portfolio of relatively focused, short timeframe projects, solicited, reviewed and down-selected through the panels, with final selection and award by the ECB.

Additional details on R&D project solicitations can be found on the Solicitations page on the NSRP website.
6. METRICS

A robust metrics methodology is employed to provide feedback on the Strategic Investment Plan and its execution by the ECB. This feedback is used to identify appropriate changes to the plan and/or program execution methods. The Navy also uses this information to gauge NSRP’s value. A number of leading and lagging indicators are used to provide a stream of metrics that suit the maturity of the associated R&D.

6.1 LEADING INDICATORS

From the proposal stage to post-execution, NSRP has developed a comprehensive set of criteria evaluation factors to ensure consistent and level evaluation for R&D projects and that projects are awarded based on responses to Research Announcements aligning with the Strategic Investment Plan.

6.1.1 PROPOSAL EVALUATION / AWARD PHASE

**Business case analysis** of each prospective investment is required during the proposal evaluation stage. Each must satisfy three levels of proposal reviewers, including a Blue Ribbon panel and the Executive Board.

**Before-and-after project-specific metrics** are also required of each proposal to demonstrate what aspects of shipyard operations will be affected and by what margin. These metrics are specific to the nature of the project, such as process cycle time, cost-per-process-step, etc.

**Indirect indicators** are viewed by those involved in the process as being particularly useful -- for example, the degree of shipyard involvement for long-term value/effectiveness.

6.1.2 PROJECT EXECUTION PHASE

**Project-specific metrics** measure real-time effectiveness in achieving the stated project goals. Each project is subject to early termination if progress is not convincing.

**Implementation tracking** is also required to conduct ongoing implementation tracking and periodic reporting that reveals how many yards have implemented (or have concrete plans to do so in the near-term) each project and to what degree.

While such tracking was conducted informally in a variety of ways since the Program began, a formal Implementation Study was produced in 2004 and can be found on the NSRP website. The extent of deployment at shipyards across the country is a clear measure of effectiveness. During the project phase, shipyard implementations often occur to varying degrees. On several past projects, shipyards rapidly accelerated deployment of project innovations, while shipyards not on the project team joined the race to deploy.

**Cost, Schedule, Deliverables and Technology Transfer activities** are discussed in detail in Research Announcements and the Proposal Preparation Kit.
6.2 LAGGING INDICATORS

Three lagging indicators are used after projects complete and are in the implementation phase – further implementation tracking, cost reduction reporting, and benchmarking.

**Implementation Tracking** of all projects across the NSRP shipyards provides a running tally of deployments that can then be used to infer program effectiveness. In addition to implementations that occur during project execution, implementation in production often occurs after the project is complete and at yards who were not on the project team.

**Cost Reduction Reporting** has been used to quantify NSRP’s impact in dollars on specific Navy contracts. While this measure is time late by nature and counted only those benefits that could be cleanly isolated and quantified (approx 15% of projects in 2004), it provided a bottom line financial figure that was routed through the Navy Program managers for validation.

**Benchmarking** U.S. shipyards against the most efficient international shipyards is another tool for objective analysis of NSRP’s effectiveness. Please see Section 8 for further details.

7. AD HOC INITIATIVES

7.1 DOCUMENTS FOR SHIP COST REDUCTION (DSCR)

This ongoing effort began in 2008, at the request of NAVSEA, who asked NSRP to oversee the dual process for both the shipbuilding industry to analyze and respond to NAVSEA’s draft specification changes and for the Navy to respond to industry’s request for specific changes:

**NAVSEA-Initiated Process:**

After completing data collection, risk analysis and revision, NAVSEA forwards the draft specification to the NSRP Executive Director.

The NSRP Executive Director forwards the draft specification for shipyards’ review through the most appropriate entity for analysis. Depending on the specification, the receiving entity may be one of the Ship Production Panels or an ad hoc group established specifically for the Documents for Ship Cost Reduction (DSCR) effort.

The Panel or Ad Hoc Group analyzes the draft specification for its Cost Savings/Avoidance Potential as compared to its original form and, using a standard formatted template, submit a draft report of impact to the NSRP Executive Director.
This three-part assessment examines:

1. **Specification Content** – How the altered content of the new/revised specification impacts cost? What the Navy is seeking from industry through the NSRP ECB is concurrence that the proposed change is an appropriate measure to realize future cost savings, not a measure of savings. This will be bounded as “High Value” or “Nominal Value”.

2. **Specification Application/Invocation** – Independent of content, how invocation impacts costs? (E.g., a less burdensome shock spec will not save money if it is invoked where shock specifications are not needed or used to be exempt.)

3. Potential risks are also examined and mitigating factors suggested. Results are documented on an NSRP-provided template.

The NSRP Executive Director forwards the draft analysis report to the ECB for approval, thence to NAVSEA for disposition.

**Industry-Initiated Process:**

One or more yards identifies a specification considered to be worthy of analysis and potential revision but not yet selected by NAVSEA; completes the NSRP standard formatted template; forwards to NSRP Executive Director.

1. The NSRP Executive Director vets the recommendation through the ECB, and with ECB concurrence, transmit the recommendation to NAVSEA.

2. NAVSEA conducts a technical review and forwards a written assessment report to the NSRP Executive Director.

3. The NSRP Executive Director notifies the ECB of NAVSEA disposition.

### 7.2 BENCHMARKING

During the development of the Strategic Investment Plan in 1998, the NSRP Executive Control Board concluded that a baseline was needed in order to measure performance of the U.S. shipbuilding industry during the period of the program. To establish the baseline, benchmarking of shipyards in the U.S., Europe, Japan and South Korea was conducted. The Defense Department sponsored the 2004-2005 benchmarking of first- and mid-tier U.S. shipyards and other international shipyards. The proven benchmarking method that was used established each shipyard’s current competitive position along with an evaluation of the applied technology and practices in key areas against peers in the shipbuilding industry, both foreign and domestic.

To complement the Shipbuilding Technology benchmarking program, the ECB commissioned other industry-wide benchmarking in the fields of purchasing practices and surface preparation and coatings.
7.2.1 2011 INTERNATIONAL SHIPYARD STUDY

At the direction of the NSRP Executive Control Board, two teams of shipyard and Navy representatives were formed for the purpose of visiting shipyards in Asia and Europe to gain insight into efficiencies associated with products and practices that may help U.S. yards. Through discussions with key foreign shipyard managers and tours of their shipyards, the U.S. teams were tasked to observe and record processes, practices and technologies employed in shipbuilding.

In advance of the visits four focus areas were provided to the shipyards along with related questions to help guide the discussions and maximize the benefit of the visits. These focus areas along with sub-areas were developed from the 2005 benchmarking of the U.S. first-tier and mid-tier shipyards and were the areas that provided the greatest opportunity for improvement in U.S. shipbuilding efficiency. The focus areas targeted included:

- Ship Design and Design for Production
- Production Engineering and Planning
- Purchasing and Material Management
- Organization and Structure

The Asian shipyard visits took place during the week of April 18, 2011, and included Sembcorp (Jurong Shipyard) and ST Marine (Tuas and Benoi shipyards) in Singapore, and DSME (Okpo Shipyard) in Busan, South Korea. The European shipyard visits took place during the week of May 9, 2011, and included Fincantieri (Muggiano and Riva Trigoso Shipyards) in Italy, and Navantia Fene-Ferrol (Ferrol Shipyard) in Spain.

In the view of team members, the shipyards visited went out of their way to provide the right level of senior management and support managers to address the focus areas and questions provided by the NSRP team in advance of the visits as well as questions asked at the time of the visits. The tour of ST Marine Benoi shipyard was reduced to a bus tour because of inclement weather; however, the tours of DSME, the two Fincantieri shipyards and Navantia Fene-Ferrol shipyard were in-depth and very informative.

The following are the general observations from all the shipyards visited:

- The Fincantieri Riva Trigoso and Navantia Fene-Ferrol shipyards both have significant machinery manufacturing facilities within their shipyards. These facilities provide shipboard as well as other industry products. Some examples include: diesel engines, reduction gears, shafting, turbine generators, thrusters, fin stabilizers and wind mill blades.
- Personnel safety was very strongly stressed and enforced in the Asian shipyards to the point where annual bonuses would be lost for a significant safety violation even though other factors were also considered in determining the bonus. The European shipyards did not appear to stress or enforce strict safety standards (e.g., hard hats in shops and in the shipyard).
- All the Asian and European shipyards visited maintain a small core workforce and use substantial percentages of contracted labor, in some cases up to 60 - 70% contracted labor.
- All of the surface warships observed being built used bulb flats for stiffeners that met the government/international build specifications directed and some also used corrugated bulkheads.
• The Navantia Fene-Ferrol shipyard visited is owned by the Spanish Government as are all of Navantia shipyards. Of interest the Ferrol shipyard was started in 1726 and delivered its first ship in 1740.
• The European shipyards visited have several multi-trade labor unions all affiliated with political parties. This provides for more flexibility in the use of the workforce.
• The market downturn has impacted many of the shipyards visited, but more so in Europe to the point where reorganization was mentioned as a possibility by one shipyard.
• The two Fincantieri shipyards visited work together to build ships greater than 100 meters. The Riva Trigoso shipyard builds the ship with all blocks from its shipyard or with some blocks provided by Muggiano shipyard. The ship is then transported via barge to the floating dry dock at the Muggiano shipyard where the ship is launched and final outfitting and testing completed.
• DSME shipyard workers start each day by cleaning the shipyard and conducting stretching exercises. It was obvious from the appearance of the shipyard that the cleaning was effective.
• Navantia Fene-Ferrol shipyard effectively used natural light through skylights in its shops to brighten the work environment. This was very noticeable.
• Navantia Ferrol shipyard pipe shop uses a Bose noise cancellation system to reduce the noise level in the shop.
• Rotating flanges (Van Stone flanges) were used to ease alignment and connection of pipes on blocks and on board.
• The Fincantieri shipyards visited seem to be moving to modular weapons and sensor installation more so than the U.S.
• All steel is bought pre-blasted and primed. There is typically only 3-4 months supply of steel in the shipyard. The 3-4 month buffer seems to be tied to the life of the primer.

The following are the key observations relating to the four focus areas:

Asian Shipyards

1) Ship Design and Design for Production:
   a. The extensive use of standard components and interim products used across platforms.
   b. A part numbering system that reflects a standard build strategy for all ship types. Most U.S. shipyards already have an established numbering system which would be hard to change.
   c. Detailed design phase (our contract design phase) is completed prior to start of construction. This locks in all technical requirements before work begins.
   d. The ratio of Engineers to Production workers varies by ship type. It is very low for Very Large Crude Carriers (VLCCs) and very high for Floating Production Storage and Offloading Ships (FPSOs). Further investigation is warranted on the different ratios by ship type and the rationale behind the ratios.

2) Production Engineering and Planning
   a. The importance of driving down the size of work packages and sizing them according to time to perform rather than number of man-hours
b. The importance of continuous measurement of assemblies, analysis of the data and feedback to design and/or production planning to continually improve designs and procedures to minimize distortion
c. The establishment of multi-disciplinary teams to develop detailed assembly and outfitting procedures.

3) **Organization and Structure**
   
a. The commitment to quality fostered throughout the yard resulting in a much smaller Q/A department while still achieving required quality.

4) **Purchasing and Material Management**
   
a. The formation of a separate division for planning, procuring and managing all major equipment to provide better support for production.

**European Shipyards**

1) **Ship Design and Design for Production:**
   
a. Fincantieri’s use of Tecnomatics software for over-all planning of the build strategy and for shipyard resource planning.
   
b. Navantia Fene-Ferrol’s use of FORAN v70 which is a totally integrated design system linked to Windchill PLM system.
   
c. Navantia Fene-Ferrol’s many standards that are used across ship designs. These include standard structural details, outfit steel standards, standard pipe hangers, wireways, HVAC hangers and numerous standard components like communication panels and sprinkler actuation panels and where possible standard outfit modules and accommodation modules.
   
d. Using the best people on the functional design team and making sure that the functional design is as complete as possible prior to starting production design.
   
e. Ensuring that ship designs are producible because all designs are based on a build strategy that is developed prior to beginning of design.

2) **Production Engineering and Planning**
   
a. Fincantieri’s standard, best practice procedures for minimizing distortion in typical structural assemblies. The procedures provide the recommended weld procedures and the best weld sequences.
   
b. Fincantieri’s and Navantia Fene-Ferrol’s company standards which document acceptable tolerance levels for all phases of steel fabrication and assembly.
   
c. Navantia Fene-Ferrol’s book of standard tolerances for all steelwork including deformation standards
   
d. Navantia Fene-Ferrol’s robust, block-centric planning strategy.
   
e. The significant role that Production Planning and Production Engineering play in defining production requirements to engineering for production drawings.

3) **Organization and Structure**
   
a. Navantia Fene-Ferrol’s subcontracting of their engineering by design zone, (e.g. engine room, bow, stern, superstructure, etc).
b. The role of Production Planning and Production Engineering at Navantia Fene-Ferrol and how they work together and with engineering.
c. Navantia Fene-Ferrol’s Module Shop organization into three product areas; multi system pipe racks, multi system equipment modules and accommodation modules.

4) Purchasing and Material Management

a. A Central Procurement Department in Trieste, Italy that is responsible for ordering all common material and equipment, such as steel, pipe, valves, cable, etc. for all the Fincantieri shipyards.
b. Fincantieri’s supplier evaluation process.
c. Navantia Fene-Ferrol’s scheduling for receipt of VFI in stages, as needed, to support the detailed design and construction process. VFI schedule stages include: Foundations and mechanical information, electrical information, automation and control information, factory acceptance testing (FAT), logistics.
d. Initial procurement of material and components based on estimates during the functional design phase. As detail design progresses and material and equipment by zone are developed the procurement schedule and material requirements are refined and submitted to procurement.

Recommendations

It was recognized by the various team members on both the Asian and European NSRP teams that not all observations captured by the teams would necessarily provide improvement opportunities for every U.S. shipyard. However, some opportunities did present themselves for individual shipyard improvement while others seem appropriate for broader application across the U.S. Naval shipbuilding and repair industry. The following, for consideration, is a listing of recommendations, broken down by: Potential Opportunities for Near-Term Adoption, NSRP Investment Opportunities and Areas for Further Investigation.

Potential Opportunities for Near-term Adoption

- Use of shipside material and personnel elevators-- (Riva Trigoso)
- Non-painted cables for Navy ships (Navantia)
- Shrink-wrapped stainless steel pipe (Navantia)
- Numbered and color-coded cable ways for cable installation (Navantia)
- Peel-off paint protection used on Mega-yacht (Muggiano)
- Holding unit for neat storage of used weld wire reels (Navantia)
- Covered, painted, and organized 5S shadow boards for select working locations (Navantia)
- Use of black zip ties on temporary services to decrease cycle time for installation and cleanliness (Muggiano)
- Metal vs. Wood Scaffolding applications (All)
- Detail design drawings for structure and outfitting are scheduled to support block erection sequence. Total system arrangement plans do not have to be completed first; rather they are completed block by block.
- High level of influence that production planning and production engineering have over engineering.
- Development of build strategy prior to design. Build strategy drives design and procurement schedule.
**NSRP Investment Opportunities**
- Use of bulb-flats in lieu of built-up T's for U.S. Navy ships -- (all 3 yards)
- Compare U.S. Military Standards (ABS Navy Vessel Rules) to Lloyds military standards, / RINA (Italian Navy standards, DNV military standards, ROK (Korean) etc.) to identify opportunities for reducing some of the current U.S. Navy specifications to the more commercial-like requirements now used by foreign Navies.
- Use of slip flanges on U.S. Navy ships – (all 3 yards)
- Use of corrugated bulkheads on Naval Ships? (Navantia?)
- Tank coating system? They do not use high solids (Navantia)
- Modular weapons systems

**Areas for Further Investigation**
- ROI for covered facilities?
- Use of “labor standards” for creating Work package budgets?
- Meeting/Reviews/Collaboration structure (Duration limits? Ad-hoc? Re-occurring or standard meetings, both internally and w/ the customer?)
- Use of standardized weld procedures including weld sequences for reducing weld distortion on all typical structural sub-assemblies and assemblies ( all 3 yards)
- Comparison of Navantia’s company dimensional tolerance standards, including deformation standards vs. customer required standards.

The full benchmarking report is available on the NSRP website.

### 7.2.2 PAST BENCHMARKING STUDIES
- Benchmarking of Mid-Tier U. S. Shipyards
- Global Shipbuilding Industrial Base Benchmarking Study
- First Marine International Benchmarking Study
- Shipbuilding Industrial Base Investment Fund
- U. S. Shipbuilding Technology Benchmarking
APPENDIX A  BACKGROUND

The NSRP ASE began in late 1999 based on a Navy-approved Requirements Document - a discrete, bounded statement of work that is defined by consensus national priorities of the platform-independent manufacturing cost drivers. NSRP’s annual seed funding, legal provisions and vast knowledge network act as a catalyst to accelerate cost-effective, reduced-risk R&D. In the aggregate, industry investment more than doubles the federal funds because large teams share in the initial costs of joint evaluation and experimentation. Each yard pays the more substantial costs of implementation and capital investment after the risk is reduced. Detailed accounting of payback proves that this investment saves Federal money on Navy acquisition and repair contracts while improving the infrastructure. Reporting by shipyards to Navy PEOs in 2004 disclosed that annual cost reductions attributable to just a limited subset of NSRP projects totaled more than four times the annual investment—allowing the Navy to reach the break-even point on its investment in 2002.

2000 STRATEGIC PLAN AND PROCESS UPDATE

After the first solicitation cycle in 1999, the MI Team leaders, several of which were also first time proposers, expressed concern that some of the proposal requirements imposed were too difficult or unnecessary. After requesting specific issues the MI Team leaders analyzed each item to determine what, if any, changes should be made to the process. In most cases the MI Team leaders found that they were able to trace each requirement back to the reason it was imposed to begin with - to ensure quality proposals that address industry needs as identified in the SIP.

Key changes to the project requirements that evolved from this review included mandatory Technology Transfer Plans and Software Development Plans. To assist proposers in meeting these requirements, a guide of best practices for each was developed using the collective knowledge of the MI Team leaders.

2001 STRATEGIC PLAN AND PROCESS UPDATE

In 2001, a more thorough review if the SIP and program operations was conducted. New information was available from U.S., European, and Asian benchmarking studies and a state-of-the-art analysis. At that time 23 projects had been funded and project accomplishments were prevalent and implementation of technology was now underway. Based on all these sources of new information, the Major Initiative teams updated the sub-initiatives and cost estimates and reprioritized the sub-initiatives using the same analytical portfolio planning
tools as were used in the original prioritizations. Information on progress to date and implementations was added for each MI section.

The MI Team leaders also examined the Technology Transfer/Implementation process through a series of brainstorming sessions and follow-up conference calls. One key result was a Project Book that provides descriptions of each NSRP project at multiple levels of detail to facilitate different communication channels and different layers of shipyard management. This document is maintained current on the NSRP website and frequent feedback validates its utility as a mass-media tool for awareness and interest generation.

2002 STRATEGIC PLAN AND PROCESS UPDATE

The 2002 review of the SIP and processes was less rigorous based on a comprehensive 2001 update. The most significant changes resulted from the continued, widespread implementation of Lean principles across industry. In response to this movement and in an effort to further implementation, NSRP added a chapter on Lean in the SIP, sponsored an industry forum on Lean, and launched the Lean Shipbuilding Initiative (including the Lean Implementer’s Group) to answer the shipyards’ demand to expand NSRP’s role as a tool to facilitate rapid implementation of lean projects and other related knowledge across the industry.

Again the MI Team leaders assessed ideas for process improvements. Similar to the 2000 review, several issues were raised regarding the value of some proposal requirements (since they add burden to proposal preparation), but these were again found to be necessary. A sub-set of the MI Team leaders took action to develop a tool that would aid technology transfer to other shipyards after the project was completed in an effort to increase technology implementations. The result was a “Project Results Template” which offers a brief, executive overview of the entire project in a standard format and provides enough information to encourage those interested to seek further details. This template, intended to be publicly available, was incorporated as a contractual requirement for subsequent projects as an attachment to the project’s Final Report. Another change that evolved from this review was the addition of a customer representative (PEO Ships Deputy) to the Blue Ribbon Panel and invitation of a Fleet Maintenance Representative in the subsequent solicitation review process.

2003 STRATEGIC PLAN AND PROCESS UPDATE

MI Team leaders, PTRs, and project leads were asked to conduct reviews on 18 completed or nearly completed projects and provide input into the following areas for their respective projects:

- Evidence of Industry Benefit / Implementations (full or partial)
- Factors that Limited the Project’s Benefit to Industry
- Recommended changes to solicitation/selection process to increase industry benefit.

On the topic of implementation, MI Team leaders pointed out that a portfolio of projects that include high, medium and low risk projects may result in a project selected and executed that after completion is not well suited to implementation. Sharing project results information in this case is also valuable as a means of
preventing having to reinvent the wheel. This was acknowledged in the subsequent discussion, but it was pointed out that since the industry and the customer are most interested in realizing lower costs and greater efficiencies through actual implementation of new technology, these “lessons learned” or non-implementable types of projects should represent only a small percentage of the overall research portfolio.

Projects were reviewed to determine their benefit to the industry and to develop recommendations for potential improvements to the solicitation/selection processes with the goal of improving technology transfer and implementation. A series of recommendations were developed in a brainstorming session. After a close review of existing requirements, the few ideas that were not already incorporated in the process were subsequently implemented:

- Require Letter of Commitment signed by a senior official who can commit resources (PPK requirement)
- For projects requiring post-completion maintenance, proposals should include plans/structure for that maintenance
- Add wording (include in Tech Transfer Plan) to technical approach to discuss connection to ongoing projects
- Continue emphasis on having shipyards lead projects
- Require that proposals include identification and timing of deliverables to be shared with US shipbuilding industry...make this an element of the evaluation process (required in technology transfer plan)
- After award (1st quarterly review) put more emphasis on Technology Transfer plan (Project Lead, PTR, ATI) to ensure key deliverables are incorporated and the Technology Transfer plan as proposed is in fact implemented
- Require final documentation for later sharing of information after project participants are no longer available as sources of information.

2004/5 STRATEGIC PLAN AND PROCESS UPDATE

This most recent update was the most extensive to date. In addition to updating the written sections, a prioritization effort was conducted, which required establishing a baseline for funds spent to date, and the Plan duration was extended three years through 2011. The process used to account for the $182M in Navy and industry investment and to determine the cost of going forward comprised of two major steps:

1. Assessing where the Program was relative to the most current SIP (at the time Rev. 3) - analyzing past efforts and establishing a baseline for the current requirements which included allocating past/current investments by sub-initiative, while making adjustments for “ineffective investments”, and
2. Using this assessment and other input to develop a plan going forward - using the MI teams’ collective judgment to estimate future funding levels for existing sub-initiatives, add any new sub-initiatives or “zero out” those that no longer applied.

The end product was determining the Total Remaining Investment for 2005 through 2011 (reflects a three year Program extension) and documenting the changes to the baseline and why they were necessary. The Core team had the advantage of using the data gathered during the 2001 prioritization effort, which catalogued investments made from 1998-2001. The Team validated this information as well as allocated investments made
since the last update. While the 2001 prioritization accounted for all research announcement projects and a several ONR projects, this 2004 effort took into account all ONR Leverage projects and NSRP panel projects funded since 2000.

During this time period, the NSRP contract with Navy was renewed and included several changes that impacted project execution. The most significant of these was requiring proposers to include before-and-after project metrics in support of their business case and requiring project leads to report periodically on these metrics. Because of this added requirement, proposers were no longer required to develop a quantified Return on Investment worksheet. There were also changes to how project cost share was categorized and reported.

APPENDIX B  RESOURCES

Strategic Investment Plan

NSRP website

Project Portfolio

Technology Transfer Guide

Solicitations

Naval Sea Systems Command (NAVSEA)
### APPENDIX C  GLOSSARY

**ABS** – American Bureau of Shipping  
**A/C** – Accuracy Control  
**ADM** – Admiral (4 star)  
**APT** – Automatically Programmed Tools  
**ASE** – Advanced Shipbuilding Enterprise; the name given to the virtual organization involved in developing and executing the follow-on program to MARITECH  
**ASN** – Assistant Secretary of the Navy  
**ASN RDA** – Assistant Secretary of the Navy - Research, Development & Acquisition  
**ASNE** – American Society of Naval Engineers  
**ASSA** – American Shipbuilding Suppliers Association (ASSA)  
**ATI** – Advanced Technology International  
**BAA** – Broad Agency Announcement  
**BIW** – General Dynamics Bath Iron Works  
**BOM** – Bill of Material -- is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, components, parts and the quantities of each needed to manufacture an end product.  
**BRP** – Blue Ribbon Panel  
**CAD/CAM** – Computer-Aided Design/Computer-Aided Manufacturing; computerized design and production systems.  
**CAPS** – Center for Advanced Purchasing Studies  
**CGT** – Compensated Gross Ton; calculated measure of a ship’s gross tonnage that accounts for density and complexity of the ship. Man-hours per CGT are frequently used as a metric to compare shipyards building dissimilar ships.  
**CM** – Computer-Integrated Manufacturing (or Management) -- computerized production of parts, or management of production.  
**COTS** – Commercial Off-The-Shelf
**CPG** – Core Planning Group; the team of shipyard experts who worked closely over several months to obtain and integrate industry input into a synthesized strategic investment plan.

**Cycle Time** – Time from starting to cut steel to delivery.

**DARPA** – Defense Advanced Research Projects Agency

**DASN** – Deputy Assistant Secretary of the Navy

**DFP** – Design for Production

**DHS** – Department of Homeland Security

**DLA** – Defense Logistics Agency

**DoD** – Department of Defense

**DoT** – Department of Transportation

**DWT** – Dead Weight Tonnage; the maximum weight of cargo and stores that a ship can carry.

**EB** – General Dynamics Electric Boat Corporation

**ECB** – Executive Control Board; the governing body of the NSRP drawn from senior executives in U.S. shipyards.

**EDI** – Electronic Data Interchange

**EPA** – Environmental Protection Agency

**ERP** – Enterprise Resource Planning

**ESTEP** – Evolution of STEP

**EWI** – Edison Welding Institute

**FAR** – Federal Acquisition Regulations

**FMI** – First Marine International (subsidiary of Royal Haskoning)

**FY** – Fiscal Year

**GD** – General Dynamics

**GDP** – Gross Domestic Product

**GFE** – Government-Furnished Equipment

**GSIBBS** – Global Shipbuilding Industrial Base Benchmarking Study
**GT** – Gross Tonnage; the total volume of a vessel, expressed in units of 100 cubic feet (gross ton), with certain open structures, deckhouses, tanks, etc., exempted.

**HII** – Huntington Ingalls Industries

**HM & E** – Hull Mechanical and Electrical

**HTML** – Hypertext Markup Language is the predominant markup language for WebPages

**HVAC** – Heating, Ventilation & Air Conditioning

**ILE** – Integrated Logistics Environment

**INDUSTRIAL RESEARCH** – Goal is knowledge applicable to a company’s business needs that will enable the company to participate in the forefront of new technology or lay the scientific foundation for the development of new products or processes.

**ISE** – Integrated Shipbuilding Environment

**ISO** – International Standards Organization

**IT** – Information Technology

**ITAR** – International Traffic in Arms Regulation

**JIT** – Just-in-Time

**LCS** – Littoral Combat Ship

**Lean Manufacturing** - An advance manufacturing system focused on reducing cycle time and improving overall productivity through the elimination of waste. Documentation of Lean manufacturing principles is generally attributed to the Toyota Production System (TPS) of Toyota Motors.

**Legacy systems** - Existing computer systems that typically are stand-alone applications that are critical to the business processes of the shipyard. These systems are often too large and too important to be replaced in the short term, and as a result new technology must accommodate these systems for some period of time.

**LNG** – Liquefied Natural Gas; generic reference to ships specifically designed to transport gases under pressure.

**Logically Integrated Databases** - A system that enables a user to get and put information from a number of standalone databases. The purpose of the system is to provide a single interface, which shields the user from the peculiarities of each database. The logically integrated database must support the requirement that there will be multiple users accessing the data at the same time, and it must protect the databases from data corruption based on users’ overwriting each other’s data.

**LSI** – Lean Shipbuilding Initiative
MAAST – Maritime Agile Shipbuilding Toolkit

MACOSH -- Maritime Advisory Committee for Occupational Safety and Health

MAG – Maritime Agility Group

Man-Hr/C GT – Man-hours per Compensated Gross Ton is frequently used as a metric to compare shipyards building dissimilar ships.

ManTech – Navy Manufacturing Technology program

MARAD – Maritime Administration, part of Department of Transportation

MARITECH – Maritime Systems Technology program; precursor to NSRP ASE

MASTER – Machine Tool Advanced Skills Educational Resources

MIT – Massachusetts Institute of Technology

MMA – Marine Machinery Association

MMC – Marinette Marine Corporation

MSB – Major Shipbuilding Base

NA & ME – Naval Architecture, Marine Engineering, and Ocean Engineering

NASSCO – General Dynamics National Steel and Shipbuilding Company

NBEW – National Brotherhood of Electrical Workers

NAVSEA – Naval Sea Systems Command

NESHAP – National Emission Standards for Hazardous Air Pollutants

NC – Numerically Controlled

NGSB – Northrop Grumman Shipbuilding

NGSB-GC – Northrop Grumman Shipbuilding Gulf Coat

NGSB-NN – Northrop Grumman Shipbuilding Newport News

NIDDESC – Navy Industry Digital Data Exchange Steering Committee

NOAA – National Oceanic and Atmospheric Administration

NPDI – Navy Product Data Initiative
NRC – National Research Council
NSRP – National Shipbuilding Research Program
NSWCC – Naval Surface Warfare Center-Carderock Division
NSWCD – Naval Surface Warfare Center-Dahlgren Division
NVR – The American Bureau of Shipping establishes Naval Vessel Rules (NVR) for NAVSEA. Naval Vessel Rules are enacted into U.S. Code.
OEM – Original Equipment Manufacturer
OMB – Office of Management and Budget
ONR – Office of Naval Research
OPA – Oil Pollution Act
OSD – Office of the Secretary of Defense
OSHA – Occupational Safety and Health Administration – division of the Department of Labor
OSV – Offshore Supply Vessel; vessels that support offshore drilling rigs.
PDM – Product Data Management software
PTR – Program Technical Representative
RA – Research Announcement
RADM – Rear Admiral (2 star)
RDML – Rear Admiral (1 star)
R&D – Research and Development
ROI – Return on investment
SBIR – Small Business Innovative Research
SCA – Shipbuilders Council of America
SHAC – Safety/Health Action Committee
SHIIP – Shipbuilding Information Infrastructure Program
SIBIF – Shipbuilding Industrial Base Investment Fund
SIC – Standard Industrial Classification (used by the Department of Labor)

SIP – Strategic Investment Plan

SNAME – Society of Naval Architects and Marine Engineers

SOA – State of the Art Report

STEP – STandard for the Exchange of Product Model Data

STTR – Small Business Technology Transfer

SWOT – Strengths, Weaknesses, Opportunities, and Threats

TAF – Technology Advisory Forum

T-AKE – Auxiliary Cargo and Ammunition Ship

TERP – Technical Evaluation Review Panel

TEU – Twenty-foot Equivalent Unit; the carrying capacity of a container ship is expressed in the number of TEU’s it can carry. A standard container, or TEU, is 20 ft. x 8 ft. x 8 ft.

Title XI – Established pursuant to Title XI of the Merchant Marine Act, 1936, as amended (Act), provides for a full faith and credit guarantee by the U.S. Government of debt obligations issued by (1) U.S. or foreign ship owners for the purpose of financing or refinancing either U.S. flag vessels or eligible export vessels constructed, reconstructed or reconditioned in U.S. shipyards and (2) U.S. shipyards for the purpose of financing advanced shipbuilding technology and modern shipbuilding technology (Technology) of a privately owned general shipyard facility located in the U.S.

TQM – Total Quality Management

TDWT – Total Dead Weight Tonnage

USAF – United States Air Force

USCG – United States Coast Guard

USN – United States Navy

VADM – Vice Admiral (3 star)

VLCC – Very Large Crude Carrier; crude oil tankers with a carrying capacity greater than 70,000 DWT.

WBS – Work Breakdown Structure

WIP – Work In Process
XML – eXtensible Mark-up Language. A web-based language for describing data.