NSRP PDMT Panel Project
Shipbuilding Opportunities in Short Sea Shipping (S3):
Reducing U.S. Shipbuilding Cost for S3

Rick Thorpe
CCDoTT Technology Transition Project

TRB Summer Meeting
June 20, 2008
An Identified Barrier to S3/AMHs is the High Cost of US Built Ships

- The National Shipbuilding Research Program (NSRP) has a program of Workshops and Roadmap planning studies to Address this barrier.

- The Center for the Commercial Deployment of Transportation Technologies (CCDoTT) is supporting the implementation of this NSRP S3 Program.
CCDoTT Concentrates on Agile Sea Port and High Speed Ship Technologies

Funding for this project provided by Congress through the Office of Naval Research under Cooperative Agreement Number N00014-04-2-0003
CCDoTT’s Role

- Conduct multi-year project planning.
- Coordinate research for commercial and military transport.
- Develop enabling technologies for both.
- Demonstrate programs that validate effectiveness of technologies.
- Work with stakeholders to find end users for the technologies.
- Hand-off technology for exploitation by end-users and/or military (Technology Transition).
CCDoTT R&D Program is:
Compatible with TRB Initiatives

Selected Focus Areas:
- Seabasing
- Inland Ports
- High-Speed Ships
- Port Security
- Environment

- Intermodal Cargo Movement
- Development of Multi-hull Optimization Tools
- Advanced Cargo Transportation Technologies

World’s First Container Moved on a Maglev
June 15, 2006, La Jolla, CA
2006 Projects Addressing SSS Issues Shown in Green

Continuing Projects:
- Multi Disciplinary Design Optimization
- Waterjet Inlet Design and Hull Integration Optimization
- HALSS Heavy Air Lift Seabasing Ship
- Rational Structural Dynamic Loads
- ECCO System Definition and Implementation (Maglev)
- Pacific Northwest Agile Port System Demonstration
- Development of Short Sea Shipping (SSS) to Serve the Pacific Coast
- Alternate Shipboard Powering Systems for Commercial Ships
- Technology Transition and Technical Coordination

New Initiatives that Support CCDoTT and Sponsor Objectives:
- Planning to Support New Legislation SSS R&D Initiatives
- Port Disruption Model – Program Definition
- Seabased Logistics Optimization
- Simulated Seabase Ship System Selective Port Access and Operational Performance Assessment
CCDoTT Short Sea Shipping R&D Initiative

- Respond to HR6/110-140 Energy Independence and Security Authorization Act

- Prepare a R&D Program Plan to Support SSS R&D Administered by the DoT
  - Provide R&D Ideas to Support HR6 General Goals
  - Define and Propose R&D Tasks
  - Form a Team of R&D Providers and Users
CCDoTT’s Specific Support to the NSRP SSS Workshop

- Advise on the overall structure of the workshop

- Organize and oversee European Shipyard input
  - Dutch Approach – Damen Shipyards
  - Finnish Shipbuilding Model – Deltamarin
  - Germany and SSS vessel construction:
    » Aker Yards
    » Flensburger (FSG)

- Guide the “Virtual Shipbuilding” sessions
Results of the Successful NSRP SSS Workshop

First NSRP Short Sea Project

Part of the Product Design & Materials Technology Panel work

Held in April, 2007
Consensus Summary from April 2007 Workshop

- **Ship construction costs are perceived to be a significant roadblock for S3 in the U.S.**

- **Promising markets are most characterized by:**
  - land-mode (congestion, lack of capacity)
  - Land rates that permit S3 to be price competitive

- **East coast and West coast are perceived to be the best domestic targets for S3 with the East Coast perceived as more likely in the near term**
  - Primarily driven by lack of port availability on the West Coast and the perception that congestion and lack of capacity is worse on the East Coast

- **General consensus that “one size will not fit all”**
  - However, there are significant series production opportunities for a number of vessel types and designs in a number of markets

- **General consensus that Ro-Ro’s and Ro-Ro barges will be most prevalent for S3**
Also from April 2007 Workshop

- Speeds from 20 to 30 knots are believed to be required, except in short routes where feeder vessels may operate at slower speeds below 15 knots

- Survey respondents are optimistic about opportunities for series construction
  - Series up to 30 vessels for long routes
  - Series up to 20 vessels for moderate routes
  - Series up to 10 vessels for shorter routes which may be more “niche”

- Vessel construction, vessel operating, and port infrastructure costs are perceived to be the most significant cost contributors to S3 required rates

- Strong consensus that Federal action is required for S3
  - Revitalized Title XI, application of CCF to contiguous trades, elimination of HMT

- Role for State and Local Government is facilitating availability of ports and landside infrastructure
Observations from April 2007 Workshop, Cont.

- Congestion relief, road infrastructure cost mitigation, and air pollution reduction are believed to be the most compelling public benefits
  - Congestion relief is perceived to be the most certain benefit
- Broad support for follow-on NSRP investment in S3, including:
  - Analysis of application of “Virtual Shipyard” partnering and construction methods
  - Development of S3 designs applicable to multiple markets
  - Leveraging of foreign designs for S3
  - Leveraging of foreign case studies for construction methods, supply chain management for S3, and partnership with foreign shipyards
  - Analysis of power and propulsion options for S3, means to mitigate fuel costs and vessel emissions
### Recommendations from April 2007 Workshop Survey

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Percent of Respondents</th>
<th>Percent of Points Allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary design of candidate SSS vessel(s) including development of...</td>
<td>18%</td>
<td>58%</td>
</tr>
<tr>
<td>Analysis of “Virtual Shipyards” practices including lessons learned...</td>
<td>17%</td>
<td>50%</td>
</tr>
<tr>
<td>Analysis of U.S. SSS markets and sub-markets and their associated...</td>
<td>7%</td>
<td>25%</td>
</tr>
<tr>
<td>Benchmarking and evaluation of international designs for SSS in the US...</td>
<td>5%</td>
<td>25%</td>
</tr>
<tr>
<td>Improve sourcing of overseas equipment. Work with suppliers and...</td>
<td>5%</td>
<td>25%</td>
</tr>
<tr>
<td>Benchmark ship construction practices and processes overseas for SSS...</td>
<td>5%</td>
<td>25%</td>
</tr>
<tr>
<td>Power/Propulsion and Emissions study addressing alternative plant...</td>
<td>4%</td>
<td>25%</td>
</tr>
<tr>
<td>Follow-on RA Proposal</td>
<td>13%</td>
<td>17%</td>
</tr>
<tr>
<td>Booklet on benefits of SSS. Market SSS to the public. Refine/revis...</td>
<td>5%</td>
<td>17%</td>
</tr>
<tr>
<td>Facilitate partnership between Navy, MARAD, Operators, and...</td>
<td>4%</td>
<td>17%</td>
</tr>
<tr>
<td>Assess land-side cargo handling and load discharge...</td>
<td>3%</td>
<td>17%</td>
</tr>
<tr>
<td>Lobby MARAD and Government for revitalization of Title XI. Advocate for...</td>
<td>3%</td>
<td>17%</td>
</tr>
<tr>
<td>Movie on SSS to help educate public on benefits of SSS...</td>
<td>3%</td>
<td>8%</td>
</tr>
<tr>
<td>Identify potential ports and terminals to serve SSS markets, determine...</td>
<td>2%</td>
<td>8%</td>
</tr>
<tr>
<td>Economic and environmental impact studies</td>
<td>2%</td>
<td>8%</td>
</tr>
<tr>
<td>Follow-on workshop based on results of this workshop</td>
<td>2%</td>
<td>8%</td>
</tr>
<tr>
<td>NSRP partner with SCOOP to leverage SCOOP funds as cost share for...</td>
<td>2%</td>
<td>8%</td>
</tr>
<tr>
<td>Identify and achieve early success with a service that could be built upon...</td>
<td>2%</td>
<td>8%</td>
</tr>
<tr>
<td>Identify private financing opportunities</td>
<td>0%</td>
<td>8%</td>
</tr>
</tbody>
</table>

- **Recommendations made by workshop participants when asked to propose up to ten follow-on actions for the NSRP**
- **Not all are within NSRP scope or charter**
Roadmap Focus Areas

Recommendations suggest nine major focus areas:

<table>
<thead>
<tr>
<th>Focus Area</th>
<th>Within NSRP Scope</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ship Production</td>
<td>Strong</td>
<td>Primary scope of the NSRP</td>
</tr>
<tr>
<td>Ship Design</td>
<td>Strong</td>
<td>Primary scope of the NSRP</td>
</tr>
<tr>
<td>Facilitating Partnerships</td>
<td>Strong</td>
<td>Facilitating partnerships would be a desired outcome of any S3 activity sponsored by the NSRP.</td>
</tr>
<tr>
<td>Business Case, Economics, and Systems Modeling</td>
<td>Strong</td>
<td>Tasks addressing the business case, the economics, and door to door systems modeling for S3 are necessary to verify ship design alternatives for potential S3 markets</td>
</tr>
<tr>
<td>Landside and Port Infrastructure</td>
<td>Moderate</td>
<td>While not directly in the scope of the NSRP, understanding landside infrastructure requirements will influence vessel designs and the business case.</td>
</tr>
<tr>
<td>Public Benefits and Awareness</td>
<td>Moderate</td>
<td>While not directly in the scope of the NSRP, data generated by other tasks may be used to help demonstrate public benefits.</td>
</tr>
<tr>
<td>Lobbying and Government Support</td>
<td>No</td>
<td>While important, this is not deemed to be within the scope of the NSRP.</td>
</tr>
<tr>
<td>Pilot Projects</td>
<td>No</td>
<td>A pilot project might evolve out of an NSRP activity, but it would not be within the NSRP scope to develop a pilot project.</td>
</tr>
<tr>
<td>Financing</td>
<td>No</td>
<td>While important, this is not deemed to be within the scope of the NSRP.</td>
</tr>
</tbody>
</table>
Focus Area Weighting

- Based on mapping of recommendations to focus areas and respondents allocation of points to recommendations.
- Strong preference for NSRP S3 activity addressing ship design, ship production, demonstrating the business case and S3 system models, and facilitating partnerships.
**Investment Plan**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td></td>
</tr>
</tbody>
</table>

- **Extend ECB initiative with a second workshop**
  - Address ship cost challenge and ship production focus area
  - Serve as a bridge to a broader RA project addressing remaining tasks and focus areas
- **Recommend NSRP support major RA initiative addressing economics, operational modeling and ship design tasks**
- **Roadmap further details the sequence of tasks within each major element of the investment plan**
Recommended S3 Investment Portfolio: Best Practices S3 Workshop

- Evaluate ship construction practices and processes overseas, including supply chain management, for S3 vessels
  - Assess the application of the “international model” to U.S. yards.
  - Conduct workshop bringing in foreign yards
  - Assess potential to reduce ship construction costs

- Benchmarking and evaluation of proven international designs

- Analysis of “virtual shipyard” or collaborative construction as an approach for S3 vessels
Initial List of Workshop Invitees

<table>
<thead>
<tr>
<th>Group</th>
<th>Quantity</th>
<th>Potential Attendees</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S Shipyards</td>
<td>10</td>
<td>NASSCO, Aker Philadelphia, Bender (2), Atlantic Marine, VT Halter, Bollinger, Manitowoc, NGS</td>
</tr>
<tr>
<td>International Participants</td>
<td>8</td>
<td>Fincantieri, Delta Marin, Aker Germany, Flensburger, Damen, Stena, possibly Daewoo/DESEC or Hyundai, Odense</td>
</tr>
<tr>
<td>Operators</td>
<td>8</td>
<td>Crowley, Horizon, TOTE, SeaBridge, Westar, TrailerBridge, National Shipping, International Shipholding Corp and Coastal Connect, Matson</td>
</tr>
<tr>
<td>Government &amp; NGO</td>
<td>4</td>
<td>Navy, MARAD, Congressional Staff, ATI</td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td><strong>41</strong></td>
<td></td>
</tr>
</tbody>
</table>
Goal & Objectives

Goal:

To accelerate the shipbuilding opportunities associated with potential U.S.-based Short Sea Shipping (S3) operations

Objectives:

- To continue the NSRP engagement with S3, and serve as a bridge to a broader effort that may be undertaken as an NSRP RA project
- To focus on reducing the costs of constructing S3 vessels in the U.S. with concentration on Ro-Ro vessels of varying size and configuration
- To facilitate forming consortia (owners, operators, U.S. shipyards, partnered foreign shipyards, suppliers and technical support companies)
Principal Outcomes

- Identification of best in class practices applicable to S3 vessel designs, construction methods (including virtual shipyard approach), project management, design for production challenges (e.g., collaborative multi-yard environment, foreign designs, etc.), and supplier management

- Facilitation of partnerships between U.S. and foreign shipyards to reduce U.S. ship construction costs

- Facilitation of partnerships between U.S. shipyards and potential owners

- Development of generic design, business practice, and build strategies for S3 resulting in reduced U.S. ship construction costs

- Improved understanding of U.S. shipbuilding costs and cost drivers for S3 vessels
Questions or Comments?
Back-up Slides
Recommended S3 Investment Portfolio: Ship Design

- Development of vessel requirements and preliminary design of candidate S3 vessels for representative markets with sufficient fidelity for ROM cost estimating
- Assessment of power and propulsion alternatives and the means to reduce fuel consumption
  - Fuel costs are the predominant driver of S3 costs
- Assessment of S3 emissions and the means to mitigate vessel emissions
- Continue to engage the Navy in S3 to leverage common interests at the technology level
  - E.g.; hull form, power and propulsion
Recommended S3 Investment Portfolio: Economic and Operational Modeling

- **Document market estimates and assumptions for use in developing candidate designs**
  - Draw on existing work in this area to document assumptions for volumes and commodity mix

- **Development of economic and door to door service models for S3 in representative markets**
  - Economic assessment of candidate designs in representative markets to assess price competitiveness
  - Throughput modeling and simulation to assess service time competitiveness

- **Document port and terminal restrictions and throughput capabilities in representative markets and their impact upon vessel requirements**
The project addresses four of the top six recommendations that were outputs of the NSRP-sponsored S3 Workshop in Orlando, FL on April 19-20, 2007:

- Analysis and application of the “Virtual Shipyard” concept, including lessons learned overseas
- Leverage partnerships between U.S. and foreign shipyards
- Leverage examples of success in overseas construction methods and supply chain business practices applicable to S3
- Leverage examples of success in overseas designs applicable to S3
Key Aspects of Approach

- **Identify “case studies” of efforts to reduce ship construction costs through:**
  - “Virtual Shipyard” collaborative approach to ship construction and project management
  - Lessons learned overseas in areas of ship designs, construction methods, project management and supply chain management
  - Opportunities and approaches for partnership between U.S. and foreign shipyards

- **Identify experts associated with each of the case studies, and engage them to participate in an NSRP-sponsored workshop. The experts may include:**
  - Representatives of foreign shipyards and ship owner/operators
  - U.S. shipyard reps with experience in partnering with foreign yards
  - U.S. shipyard representatives with experience in collaborative construction
Key Aspects of Approach (cont’d)

- Plan and conduct a workshop to discuss the advantages and disadvantages of alternative ship design concepts, shipbuilding strategies, partnering arrangements, project management and supply chain approaches.
  - Attendance at the workshop will be by invitation only
  - Target of 35-40 participants
  - Anticipated invitees / participants include:
    » U.S. shipyards (those that attended the previous NSRP-sponsored S3 workshop, and those that did not)
    » Foreign shipyards
    » U.S. & foreign owner/operators
    » Design agents / consultants engaged with shipyards and owners and operators
    » U.S. Navy representatives involved in Ro-Ro / Auxiliary ship design and construction programs

- Prepare preliminary and final reports documenting workshop outputs / results
Framework of Workshop Agenda

- **Day 1:** Primarily presentations. Introductions, recap of prior workshop, overview of virtual shipbuilding and overview of foreign partnerships with contemporary examples. Lessons learned and best practices from overseas. Foreign participants review successful approaches to construction of SSS vessels and identify lessons learned.

- **Day 2:** Complete presentations by international participants. Discussion and prep for break-outs following day. Introduce survey and talking points for final session of day 3.

- **Day 3:** Breakout Sessions with specific focus on case studies and final session to document major takeaways.
**Workshop Agenda, October 20-21**

**Monday 10/20/08:** No sessions. Rooms are set-up and workbooks readied for distribution. No host bar reception TBD.

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30 – 08:00</td>
<td>Registration and Breakfast</td>
</tr>
<tr>
<td>08:00 – 08:30</td>
<td>Introduction &amp; Overview</td>
</tr>
<tr>
<td>08:30 – 09:00</td>
<td>Retrospective</td>
</tr>
<tr>
<td>09:00 – 09:45</td>
<td>Operator Panel Discussion</td>
</tr>
<tr>
<td>09:45 – 10:15</td>
<td>BREAK &amp; NETWORKING</td>
</tr>
<tr>
<td>10:15 – 11:00</td>
<td>Shipbuilder Panel Discussion</td>
</tr>
<tr>
<td>11:00 – 12:00</td>
<td>Virtual Shipbuilding</td>
</tr>
<tr>
<td>12:00 – 13:15</td>
<td>LUNCH &amp; MARAD SPEAKER</td>
</tr>
<tr>
<td>13:15 – 14:15</td>
<td>International Partnerships</td>
</tr>
<tr>
<td>14:15 – 14:30</td>
<td>BREAK &amp; NETWORKING</td>
</tr>
<tr>
<td>14:30 – 16:45</td>
<td>Presentations from International Shipyards</td>
</tr>
<tr>
<td>16:45 – 17:00</td>
<td>Wrap Up</td>
</tr>
</tbody>
</table>
### Workshop Agenda, October 22

#### Wednesday 10/22/08

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30 – 08:00</td>
<td>Breakfast</td>
<td></td>
</tr>
<tr>
<td>08:00 – 08:15</td>
<td>Introduction &amp; Overview</td>
<td>Re-Cap prior day and overview of days objectives</td>
</tr>
<tr>
<td>08:15 – 09:45</td>
<td>Presentations from International Shipyards, Continued</td>
<td></td>
</tr>
<tr>
<td>09:45 – 10:15</td>
<td>BREAK &amp; NETWORKING</td>
<td></td>
</tr>
<tr>
<td>10:15 – 12:00</td>
<td>Virtual Shipbuilding Facilitated Discussion</td>
<td></td>
</tr>
<tr>
<td>12:00 – 13:15</td>
<td>LUNCH &amp; SPEAKER TBD</td>
<td></td>
</tr>
<tr>
<td>13:15 – 15:00</td>
<td>International Partnership Facilitated Discussion</td>
<td></td>
</tr>
<tr>
<td>15:00 – 15:30</td>
<td>BREAK &amp; NETWORKING</td>
<td></td>
</tr>
<tr>
<td>15:30 – 16:30</td>
<td>Overview of case studies for use in break-out sessions</td>
<td></td>
</tr>
<tr>
<td>16:30 – 17:00</td>
<td>Wrap-Up, distribute surveys, and Plan for next day</td>
<td>Assign people to break-outs that will start the next day</td>
</tr>
</tbody>
</table>
# Workshop Agenda, October 23

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:30 – 08:00</td>
<td>Breakfast</td>
<td></td>
</tr>
<tr>
<td>08:00 – 10:00</td>
<td>Break-Out Sessions</td>
<td>Case study oriented – application of VS or IP to case studies</td>
</tr>
<tr>
<td>10:00 – 10:30</td>
<td>BREAK &amp; NETWORKING</td>
<td></td>
</tr>
<tr>
<td>10:30 – 11:30</td>
<td>Break-Out Briefs and Discussion</td>
<td></td>
</tr>
<tr>
<td>11:30 – 12:30</td>
<td>LUNCH</td>
<td></td>
</tr>
<tr>
<td>12:30 – 14:30</td>
<td>Facilitated Discussion and Survey</td>
<td></td>
</tr>
<tr>
<td>14:30 – 1500</td>
<td>Wrap - Up</td>
<td></td>
</tr>
</tbody>
</table>
Virtual Shipbuilding

- **Definition**: A combination of two or more ship construction entities with capable management & technical staff to organize the planning, scheduling, budgeting, design & engineering, procurement, production control, testing and program management for the design & construction of ships.

- **Key elements of a suggested VS approach for S3**:
  - Good business relationship between ship owner/operator & the shipper customer
  - Significant participation by the ship owner/operator in the program planning and ship design process
  - Program Management Organization (PMO) staffed by experienced commercial shipbuilders, designers/engineers, planners & managers
  - Technically sound contract design developed specifically for Virtual Shipbuilding
  - Experienced commercial vessel detail design organization (in-house or outsourced)
  - Well conceived outsourcing plan utilizing high labor productivity and low overhead mid-tier yards and proven marine contractors (system suppliers and fabricators)
Virtual Shipbuilding

● **Strengths**
  – Cost reduction by using more labor productive and lower overhead fabrication & sub-assembly facilities than fully integrated traditional shipyards
  – Accelerated production schedule by distributing the production work

● **Weaknesses**
  – Additional layer of contracting
  – Requires greater program management attention & expertise
  – Added cost of transporting interim products from fab sites to assembly facility

● **Risks**
  – Poor management, planning and/or technical direction
  – Subcontractors not meeting schedule or technical requirements
  – Misunderstanding between ship buyer and shipbuilder, i.e., poor quality contract design, which can result in error-prone and/or late detail design (PI)

● **Benefits**
  – 15-30% cost reduction over large commercial U.S. yards, and much more over naval combatant yards
  – Cost reduction benefit shared by buyer, shipbuilder & other VS team members
  – Shorter delivery time
  – Shipbuilder has better understanding of buyer’s needs, and buyer has better understanding of shipbuilder’s constraints & issues
Virtual Shipbuilding Examples

**Commercial**
- U.S. Shipping Partners LP ATB Barge
- Heavy Airlifter Seabasing Ship (HALSS)
- AHL Shipping Co. Chemical/Product Tanker

**Navy**
- Northrop Grumman Ship Systems (NGSS) DDG 103 Deckhouse
- Lockheed Martin Co. (LMCO) Littoral Combat Ship (LCS 1)