Building and Modernizing Affordable Warships with Standard Modular Compartments

"Sea Power to the Hands of Our Sailors"

Nilo Maniquis
PEO IWS D - Ship Systems Engineer

March 15, 2016

Leadership/Stakeholders Briefed On Modular Combat System Approach

Organization	Date	Comments
PEO IWS Senior Advisory Team (SAT) Bob Nagle, Larry Rogers, Mickey Bourne, Fred Parker, Dub Summerall, Brian Eckerle	21 Jul 15	Supports the Concept Programmatic Challenges Distribution of Funds
PEO IWS Front Office RDML Jon Hill, Mr. Bill Bray Ms. Karen Davis	22 Jul 15	PEO Approved for External Communications and Move Forward with Developing the Solution
PEO SHIPS AM Bill Budd	29 Jul 15	"We should have done this sooner."
PEO SHIPS PMS400D8 R. Sturges	30 Jul 15	"We should pursue as an alternative to the path we're on."
PEO SHIPS Director of Science & Technology G. Sturtevant	31 Jul 15	Support concept and offered to champion Raised Concerns with Flexible Infrastructure vs Studs
OPNAV N96F CAPT Halvorson	12 Aug 15	Understood concept "What's the Payback?"
SEA 05H Mr. Bill Williford	31 Aug 15	"This is exactly what we need." Scheduling a meeting with Admiral Fuller and Mr. Kistler
SEA 21 (PMS 407) AEGIS SPM CAPT Ted Zobel, Evan Littig	8 Sep 15	"Must be in synch with PMS400D DDG 51 AEGIS New Construction." May implement Hybrid solution as applicable to Modernization. Schedule meeting with Randy Bennett and Dale Davis.
PEO IWS SAT Randy Fortune	8 Sep 15	"The concept is absolutely in line with the Design Budgeting (DB) strategy successfully employed in Combatant Shipbuilding over the last 35 years and was employed on CG 47 Class"
ASNE/SNAME SD-8 Panel and Ship Design Committee	10 Sep 15	Admiral Eccles "This concept is a great idea and very similar to submarine building." Jack Abbott "I've been waiting 40 years for this."
NAWC AD Tim Hickey, Bernie Dombrosky	11 Sep 15	We will support consideration for SESS and Radio Room Similar to Radio Equip Unified foundations used on CG 47 Class"

Leadership/Stakeholders Briefed On Modular Combat System Approach

Organization	Date	Comments
PEO SHIPS PMS 400D5/D7/D8 Cliff Rader, Katie Connelly, Rich Sturges	17 Sep 15	There is no way we can stay the course considering AMDR and the restricted/limited change budget of 3%. Agreed to develop a Modularity Management Plan and engage LYS, FYS and Shipbuilders to develop a Tasking Instruction to aid in developing Shipbuilder ROMs for this effort.
SEA 21 (PMS 407) Randy Bennett	23 Sep 15	"This concept makes sense, is a good approach to do as an alternate to our usual Shipbuilding approach and can leverage lessons learned from AMOD" Agreed to engage the Planning Yard to develop Modernization approach and add to MADWG tasking.
NAVSEA 05 RDML Fuller, Mr. Mike Kitsler, Mr. Bill Williford, Ms. Robyn White, Eric Duncan, Shelly Yost, Timothy Barnard	25 Sep 15	RDML Fuller and Mr. Kitsler stated "We will do everything we can to assist IWS in the development of a NAVSEA Specification to include the SMI solution in support of Shipbuilding. We should push to implement this solution on LXR." Mr. Williford "This is the way we should go." Ms. Robyn White "I love the Modular concept."
DASN Ships, DASN Air, and DASN RDT&E Mr. Vance Brahowsky, Mr. Ed Jackonowski, Mr. Nick Guertin, Mr. Mike Boland, CAPT(sel) Jon Garcia, Ms. Dawn Doebel, Ms. Cathy Spencer, and Mr. Derrick Lewis	19 Oct 15	"Why did it take us this long [15 years, to catch up to Subs]?" "This solution is feasible but make sure to look at the ROI, the savings are clear from ECP elimination but there will be a cost for the CM, facility, and government resources needed to support this approach."
PEO Ships and PEO IWS D Ms. Bilyana Anderson and Ms. Karen Davis	05 Nov 15	"We [PEO Ships] will help you with whatever shipbuilding has to offer." "We need to tread carefully; invoke change where we can as this involves a lot of coordination and management including maintaining business rules." "It [this concept] could be powerful."

Leadership/Stakeholders Briefed On Modular Combat System Approach

Organization	Date	Comments
Self Defense Test Ship Demonstration PEO Ships- Cliff Rader, Zack Dixon, Glen Sturtevant, DASN Ships-Vance Brahowsky, ATO ATT- LCDR Eid Fakhouri, SEA05D-Jacob Trithart	17-18 FEB 16	Demonstrated the Modularity Decking System (MDS) concepts to stakeholder NAVSEA personnel on the SDTS. Actions were taken to create an Modularity IPT and next steps forward the FLT III RFP.
PEO IWS RDML Hill	29 Feb 16	"We need to make sure this is in the war room, modularity is an enabler." Task: show fielding and procurement plans for each ship class/platfrom that modularity is applicable to and map out targets for insertion.
SEA05 Mr**.** Williford	1 MAR 16	"We need to take the steps toward this becoming a NAVSEA standard, please brief my Ship Design managers and
ShipTech- RDML Hill briefed	1 MAR 16	Conference sponsored by the Office of Naval Research's Manufacturing Technology (ManTech. Audience included Industry and Shipbuilders as well as DoD contractors.
Aegis Readiness Working Group	2 MAR 16	Brief at the LM sponsored Aegis Readiness Day. Audience included Aegis personnel from LM, Aegis Test Team, PARMS, and Field Activities.
Global ShipBuilding Executive Summit-ASNE Panelist: RADM J. Kamerman(ret.), SVP, TKMS, Dr. C.H. Chung, Chairman, Dr. Christiansen, CEO OMT, Glen Sturtevant, PEO Ships, and Nilo Maniquis, PEO IWS	2 MAR 16	This invite only session included an international panel to talk about Flexible War ships during ASNE. "You are describing the MEKO ship concept." -RADM J. Kamerman(ret.), SVP, TKMS
SEA 05 Ms. Robin White, Carey Filling James Harrison	11 MAR 16	" I am all in, in fact, I am going to build my next house this way!" Ms. Robin White exclaimed as she expressed that this is a significant move toward commonality.

Engagement Briefing Plan Forward

Scheduled:

- OPNAV N96- CDR Gantt and Mr. Earl Bowers- 17 MAR
- PEO Tech Council-18 MAR
- Aegis Focus Day- 18 MAR, CAPT Druggan (PEO IW 1.0) CAPT Vandroff (PMS 400), and CAPT Zobel (PMS 407)

Upcoming:

- Mr. Shevock & Christy Goeff, SEA 06- TBD
- Update to: RDML Fuller, SEA 05- TBD
- Ms. Valdez, DASN Ships- TBD

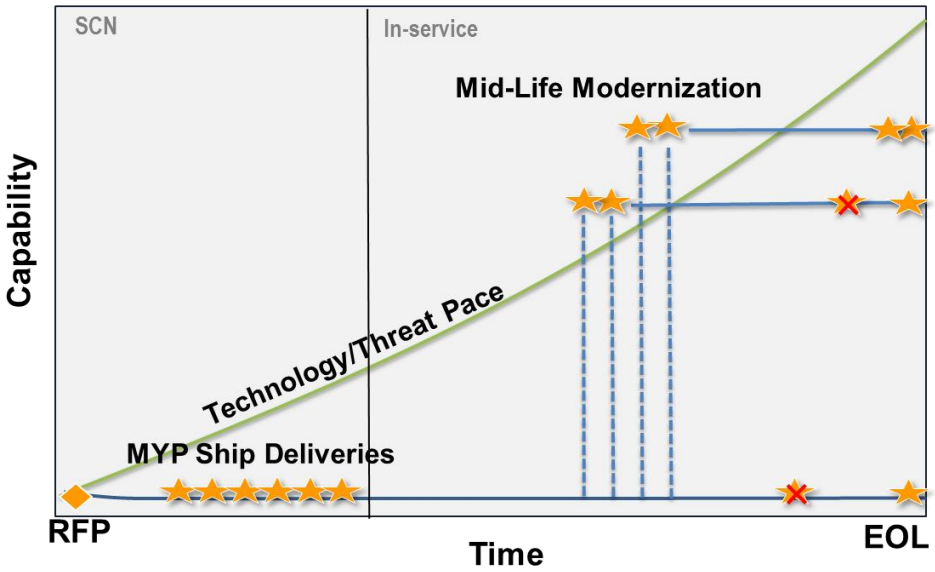
Future Meetings:

- RADM Gale & Jay Stefany, PEO Ships
- RDML Antonio, PEO LCS
- RDML Galinis & Ms. Davis, SEA 21

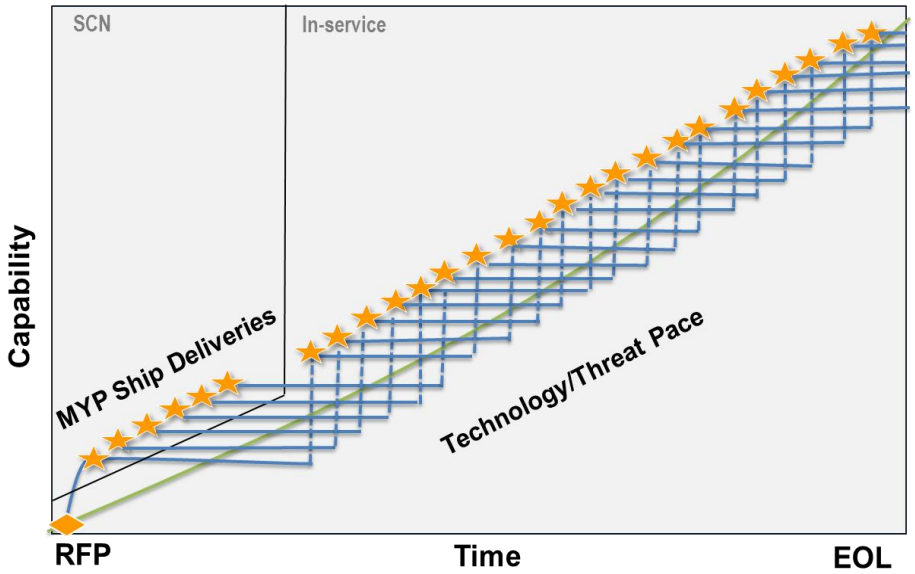
BLUF

- ***Traditional Shipbuilding and Modernization***
  - *Systems are Selected and "Locked" Prior to New Construction Ship's RFP*
  - *MYP Exacerbates Older Technology for Each Ship Delivered*
  - *"Stick Built" Construction and Costly to Change*
  - *Modernization Reduced to Costly Mid-Life or Ship Does Not Meet Expected EOL*
- ***Modular Shipbuilding and Modernization***
  - *Latest Systems Installed for Each Ship Built*
  - *MYP Ships are Built to a Single Design But Will Receive Latest Systems*
  - *More Efficient and Affordable to Build Modular Designed Ships*
  - *Modernization is Less Costly with More Intervals for Upgrades Throughout Ship's Life*

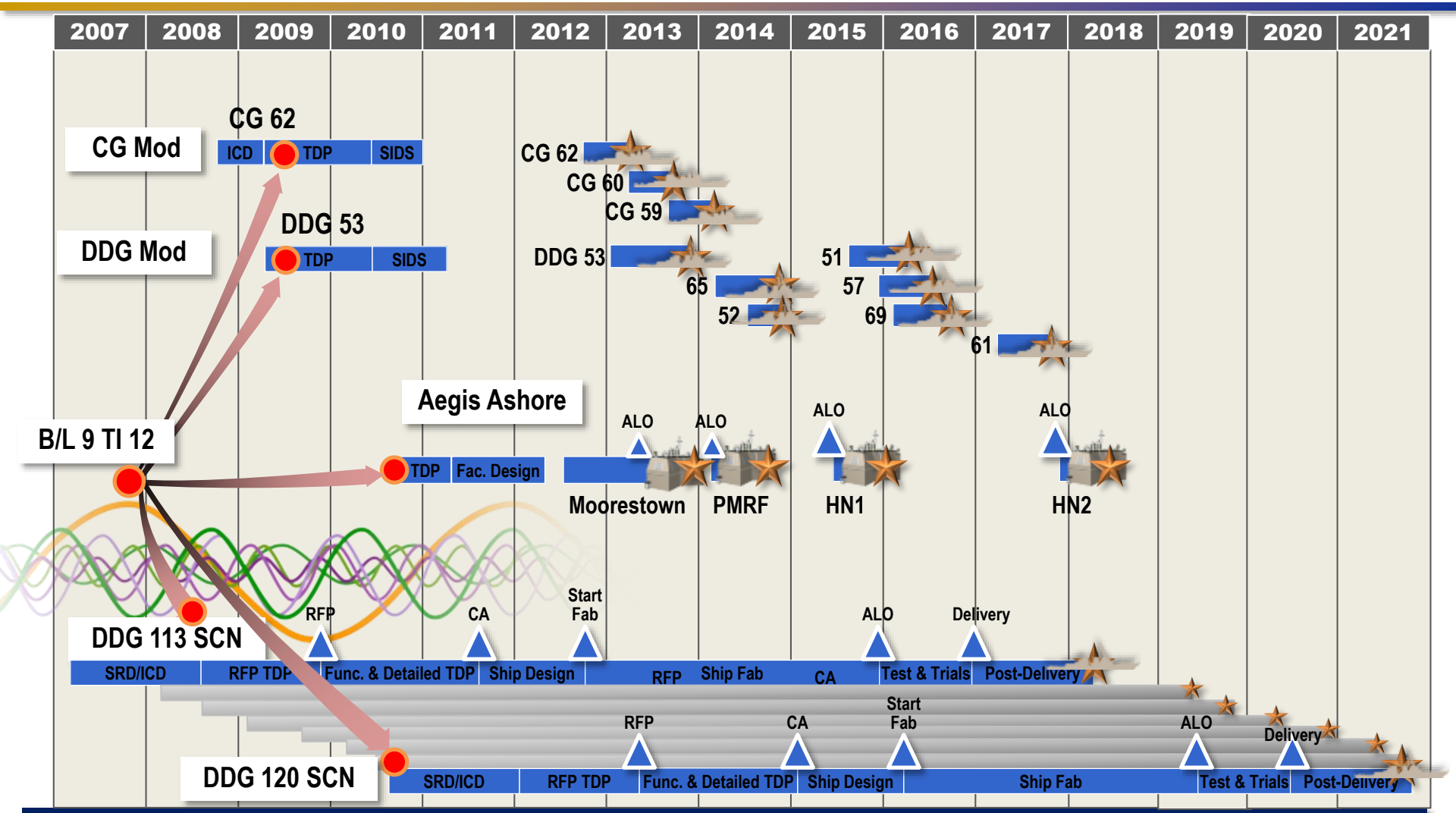
Traditional



Modular



AEGIS Baseline 9 Fielding

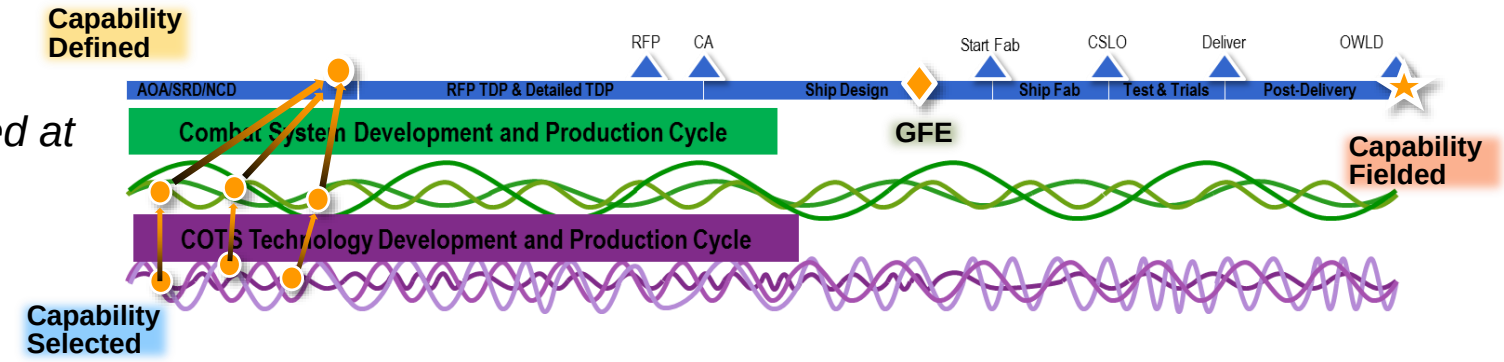


Opportunities Exist in New Construction to Deliver More Capable and Affordable Warships

Speed to Capability

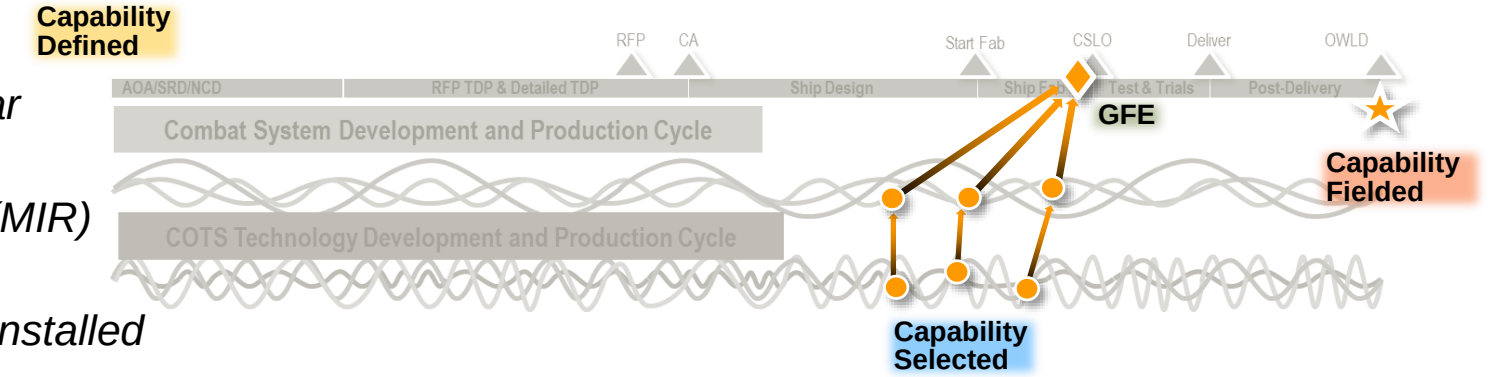
Traditional: 11-16 Years Technology for All Ships Fleet Delivered in the MYP

- *Stick Built Construction*
- *Systems Locked at Ship's RFP*
- *High Costs for Changes*



Modular: 3-4 Years Technology for Each Fleet Ship Delivered

- *Standard Modular Compartments*
- *Move-In-Ready (MIR) Compartments*
- *Latest Systems Installed*



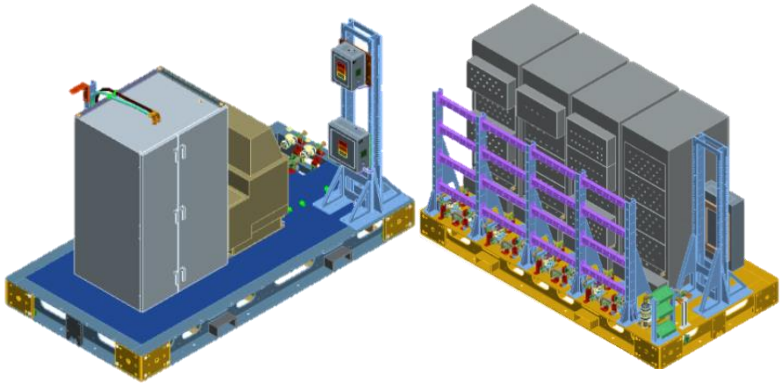
Proven Best Practices

DDG 51 Modernization

- *Six Months Production*
- *Pre-fabricated Foundations*
- *Cabling Mock-ups*
- *Just-in-Time Delivery*

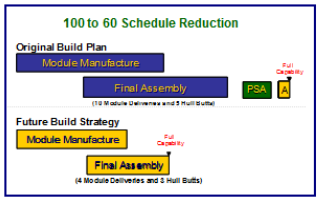
AEGIS Ashore

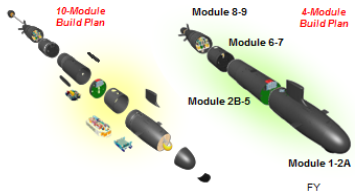
- *120 Days Relocatable*
- *Modular Design to Final Assembly*
- *Kitted Equipment & Pre-Fabricated Deck House*
- *Value Streamed Construction Processes*

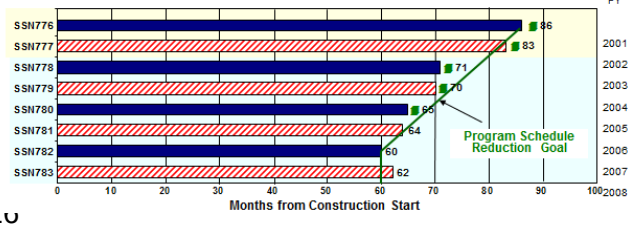


Virginia Class Submarine

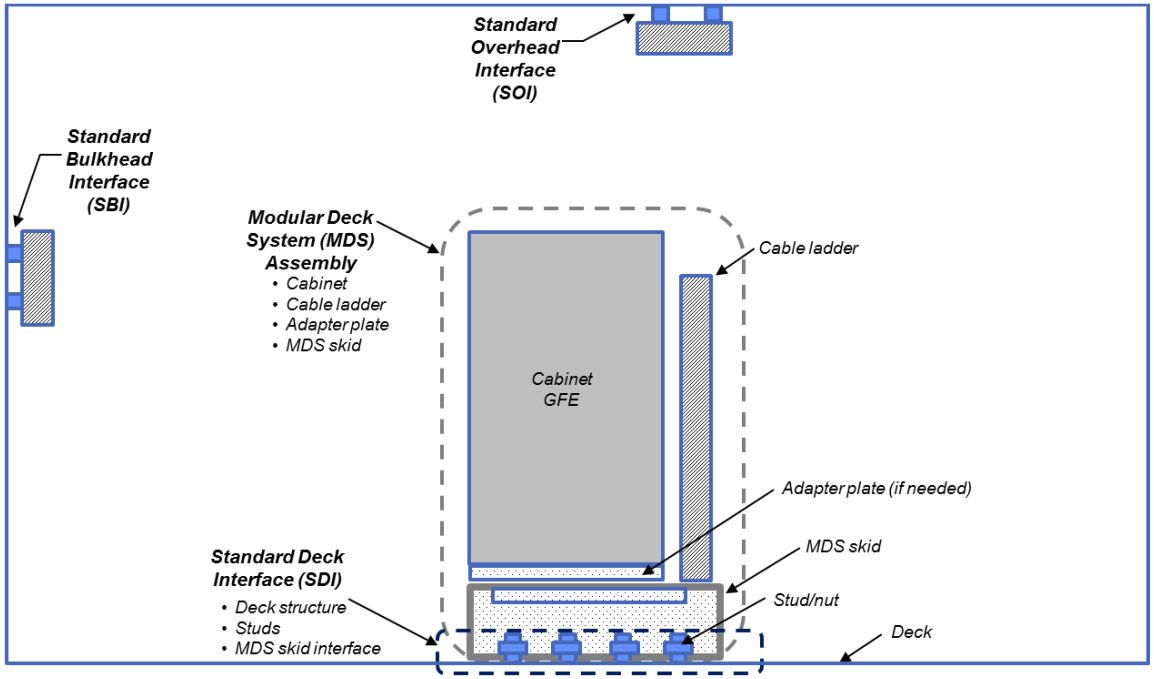
- *84 Months to 60 Months Reduction for Ship Delivery*
- *Modular Production: Manufacturing to Final Assembly, "1-3-8" Rule*
- *Design for Affordability*
- *CCSM Off-Hull Assembly and Test Site (COATS)*







Standard Modular Compartment and Equipment Modularity Assembly

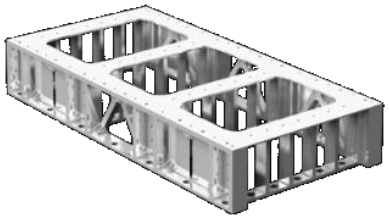


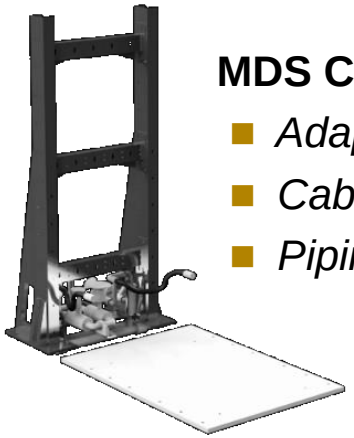
Standard Modular Interface (SMI)

- *Standard Overhead Interface (SOI)*
- *Standard Bulkhead Interface (SBI)*
- *Standard Deck Interface (SDI)*

MDS GFE Assembly

MDS Skid



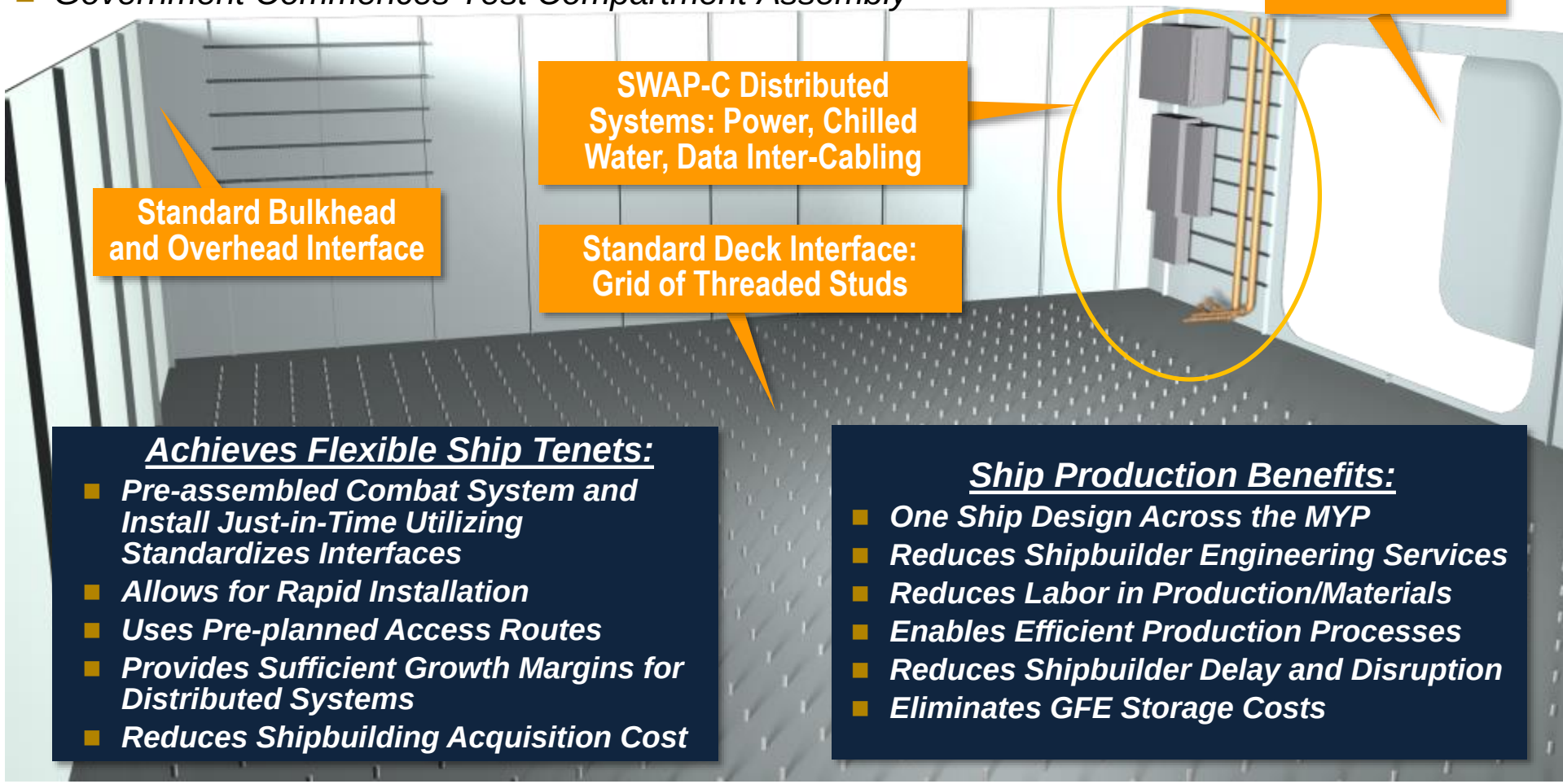


MDS Components

- *Adapter Plate*
- *Cable Ladder*
- *Piping Assembly*

Standard Modular Compartment

- *Government Provides in Ship's RFP SMC with NTE SWAP-C Requirements*
- *Shipbuilder Delivers SMC with NTE SWAP-C Services Prior to Ship's Delivery*
- *Shipbuilder Assembles Modular Equipment with Government Oversight*
- *Government Commences Test Compartment Assembly*



Achieves Flexible Ship Tenets:

- *Pre-assembled Combat System and Install Just-in-Time Utilizing Standardizes Interfaces*
- *Allows for Rapid Installation*
- *Uses Pre-planned Access Routes*
- *Provides Sufficient Growth Margins for Distributed Systems*
- *Reduces Shipbuilding Acquisition Cost*

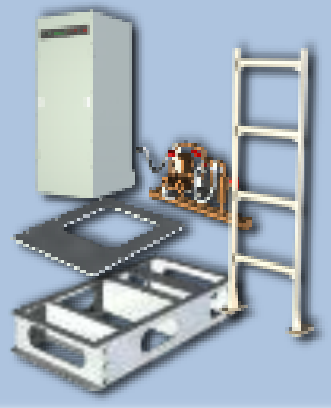
Ship Production Benefits:

- *One Ship Design Across the MYP*
- *Reduces Shipbuilder Engineering Services*
- *Reduces Labor in Production/Materials*
- *Enables Efficient Production Processes*
- *Reduces Shipbuilder Delay and Disruption*
- *Eliminates GFE Storage Costs*

Equipment Modularity Process

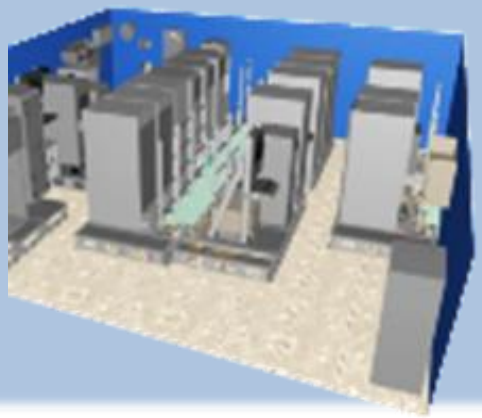
- ***Pre-fabricate/Pre-Outfitting Facility (Secured/Environmental Controlled)***

1. Kit Equipment



2. Assemble Equipment

3. Pre-Fabricate Compartments



- ***Shipboard (Secured/Environmental Controlled)***

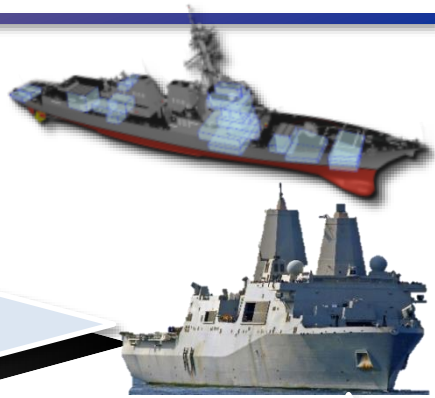
4. MIR Compartments

5. Final Assembly

6. Shipboard Testing

Shipbuilder Modularity Process

- *Ship Designed With SMCs, Pre-fabrication to Final Assembly*
- *Environmental Controlled and Secured Facility*
- *Accommodates Technology Upgrades Affordably*
- *Innovative, Repetitive, Producible, Efficient, and Affordable*



Single Ship Class Design

Milestones

RFP | Start Fab | Lay Keel | Assembly | Outfitting | Launch | MIR | CSLO | Shipboard Testing | A/B/C | Delivery

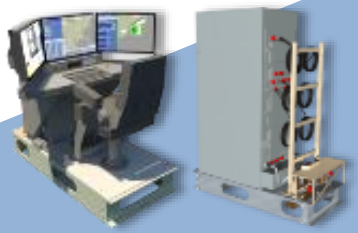
Shipyard Facility

Sea Trials

Kit Equipment

GFE

Assemble Equipment



Pre Fabricated Compartments

Assembly and Test Facility

Move-in-Ready Compartments

Final Assembly

Shipboard

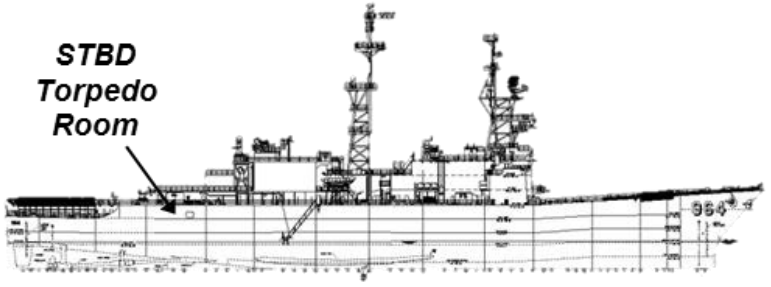
Drive Innovation and Affordability into our Ship Building Processes!

USS Paul F. Foster (EDD 964)
Self Defense Test Ship (SDTS) Demonstration

- *Evaluated Producibility of Stud and Skid and the Installation Process*
- *Demonstrated Feasibility and Qualified Stud Welding Process*
- *Demonstrated Assembly to Stud Installation Process*

Stud Welding

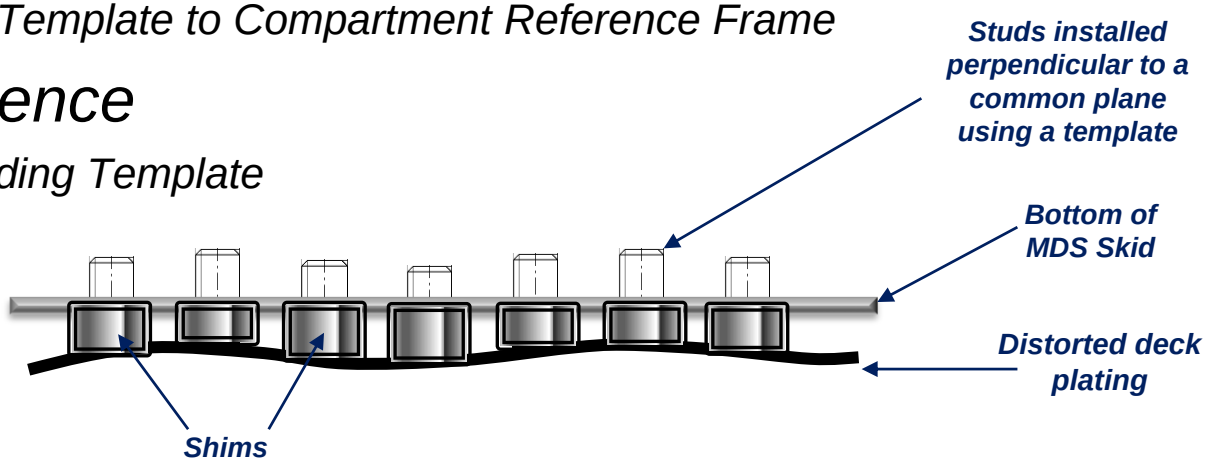
Assembly Installed



EDM1 Location on SDTS

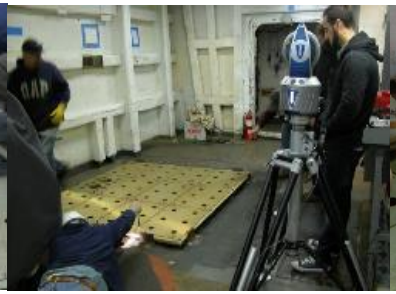
Template & Stud Installation Sequence

- *Template Installation Sequence*
  - *Digitally Establish Compartment Reference Frame (Horizontal Plane and Fore-aft Line) for Cabinet Leveling*
  - *Assemble Template Frame Members and Plates*
  - *Digitally Level and Align Template to Compartment Reference Frame*
- *Stud Welding Sequence*
  - *Assemble and Align Welding Template*
  - *Grind Surface*
  - *Weld Studs*
  - *Clean-up Welds*
  - *Move Welding Template*
  - *Repeat*




Digitally Surveyed Compartment

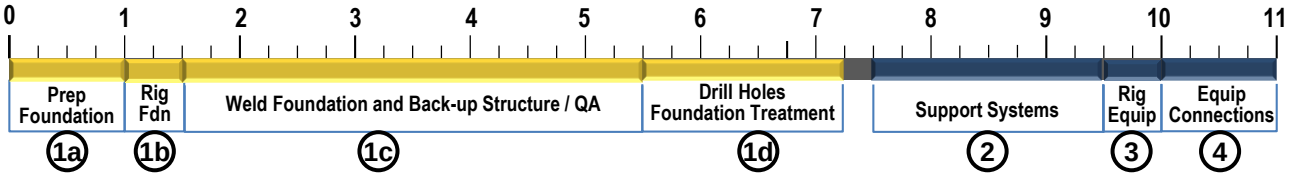

Assembled Template


Template Leveled

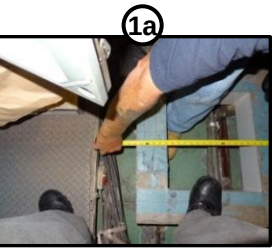

Welded Studs


Final Stud Configuration

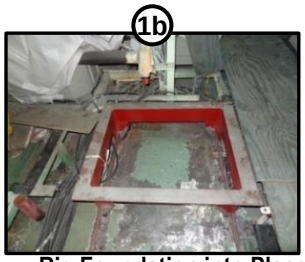
Notional Traditional Shipyard Foundation and Cabinet Installation



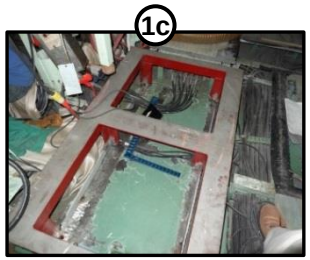
11 Work Days For Single Foundation



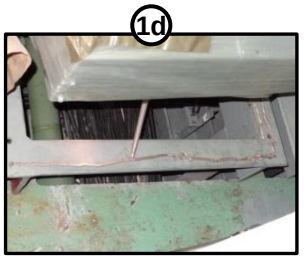
Prep Foundation Area/ Measure and Scribe



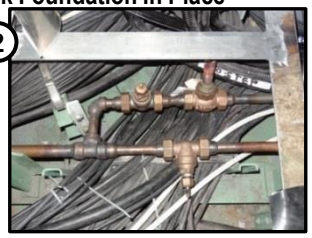
Rig Foundation into Place, Protect Adjacent Areas for Welding Operations, and Tack Foundation in Place



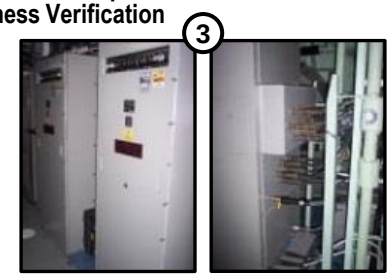
Weld Foundation and Back-up Structure / QA Inspection / Flatness Verification



Drill Holes / Foundation Bond Surface Treatment



Prepare and Install Support Systems e.g. Cable Ladders, Cooling Piping, HVAC Pick-ups

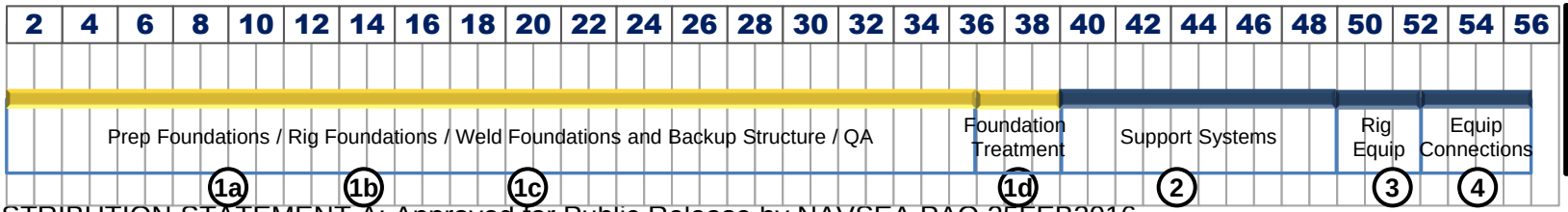


H/W Installation / Torque Connect Support Systems

Foundation Installation Trades Required

Step	Mechanical	Welder	Firewatch	Painter	QA Rep	Ship Fitter	Fitter Helper	Riggers	Pipe Fitter	Sheet Metal	TOTAL
1a/b/c/d	1	1	4	1	1	1	1	2			12
2	2		1						2	2	7
3	2								1	2	5
TOTAL	5	1	5	1	1	1	1	2	3	4	24

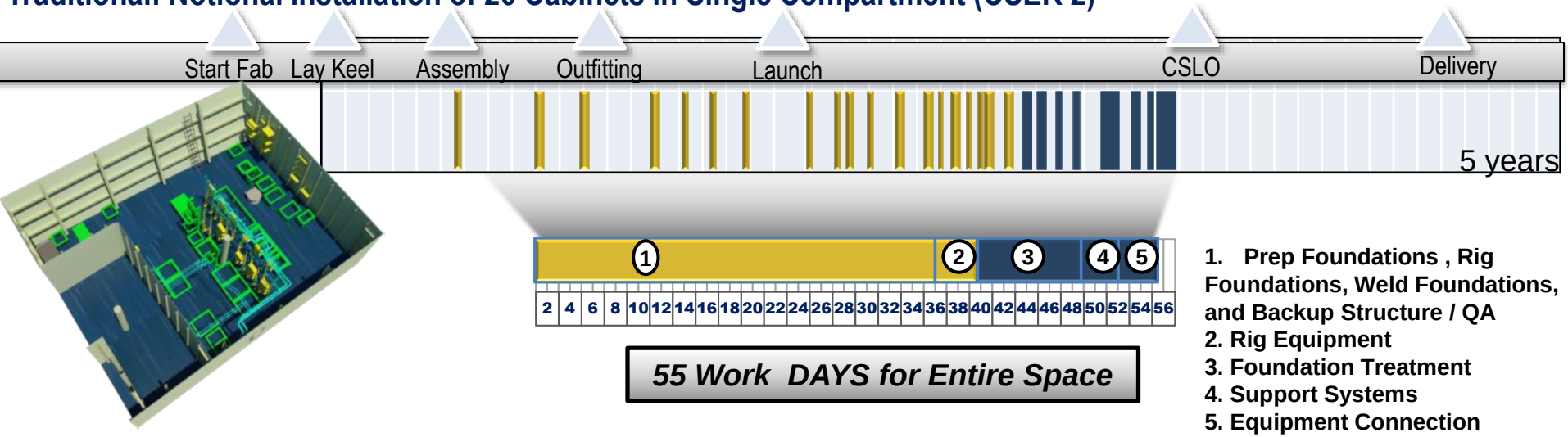
26 Cabinets in Single Compartment (CSER 2)



55 Work Days For Entire Space

Traditional vs. Modular Approach

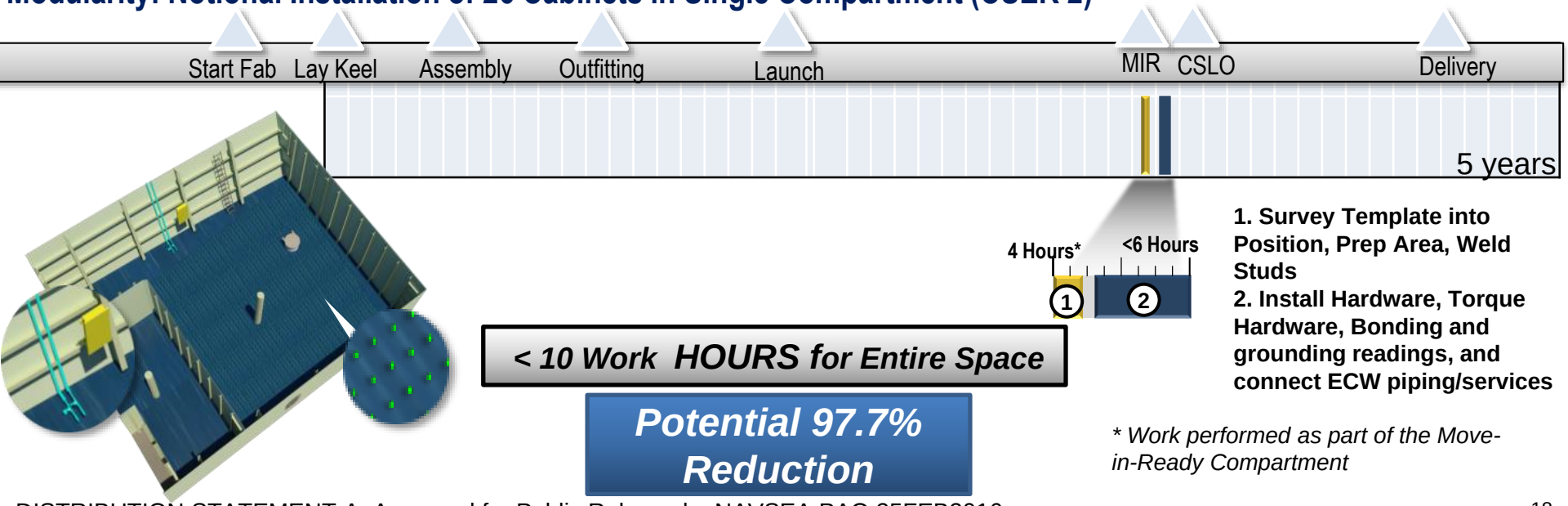
Traditional: Notional Installation of 26 Cabinets in Single Compartment (CSER 2)



55 Work DAYS for Entire Space

1. **Prep Foundations , Rig Foundations, Weld Foundations, and Backup Structure / QA**
2. **Rig Equipment**
3. **Foundation Treatment**
4. **Support Systems**
5. **Equipment Connection**

Modularity: Notional Installation of 26 Cabinets in Single Compartment (CSER 2)



< 10 Work HOURS for Entire Space

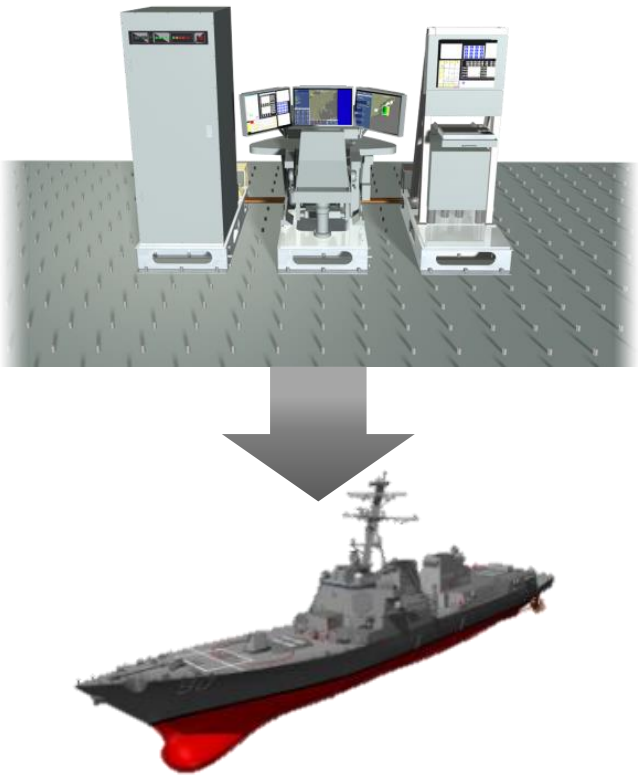
Potential 97.7% Reduction

1. **Survey Template into Position, Prep Area, Weld Studs**
2. **Install Hardware, Torque Hardware, Bonding and grounding readings, and connect ECW piping/services**

** Work performed as part of the Move-in-Ready Compartment*

Moving Forward

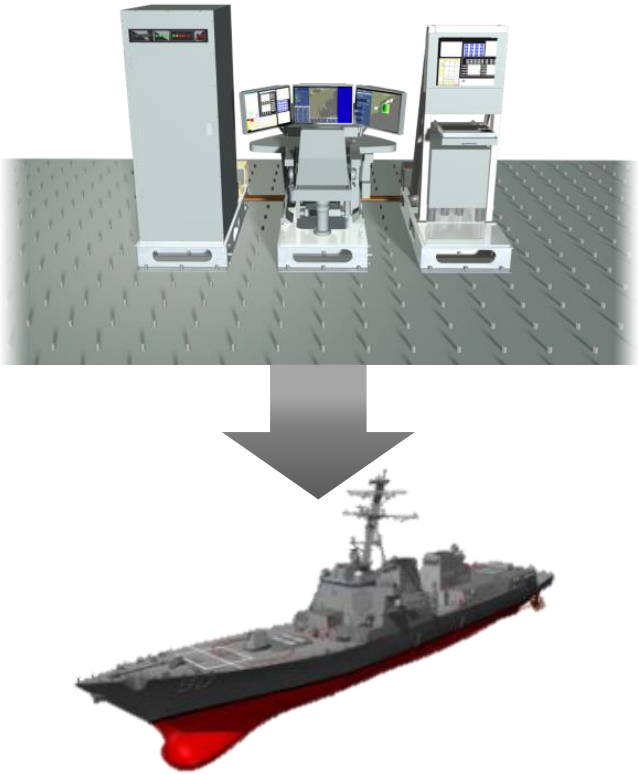
- *Qualify Modular Interfaces to a NAVSEA Standard*
- *Transition Modularity from Engineering Development Models (EDMs) to Program of Record*
- *Incorporate Modularity, Pre Fabrication and Final Assembly Approaches into Future Shipbuilding RFP and Modernization Programs*



Challenge Status Quo to Ensure Affordability!

Summary

- *Modularity must be designed at all levels (Component, Enclosure, System, Ship)*
- *Utilize Value Stream eliminating "wait time", convert manual labor to innovation, automation and new techniques*
- *Institute a Culture of Affordability*



Combat Systems and Shipbuilders Delivering Sea Power to the Hands of our Sailors

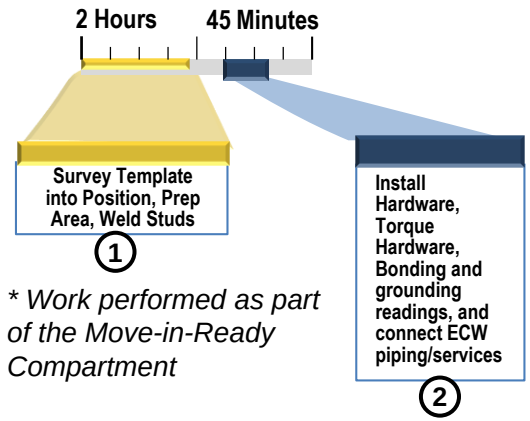
$E^2 = R^2$

Evolutionary Effort = Revolutionary Results

"Sea Power to the Hands of Our Sailors"

Notional Modular Deck System (MDS) Shipyard Cabinet Installation

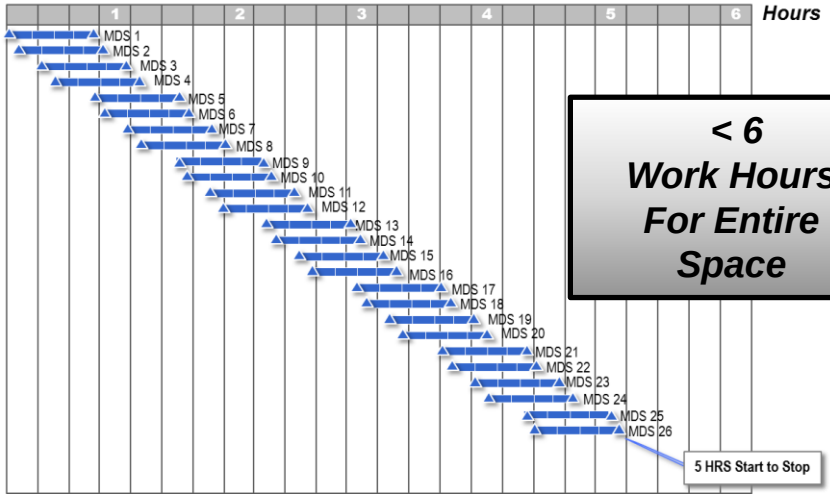
Single Cabinet (CSER 2)



** Work performed as part of the Move-in-Ready Compartment*

45 Minutes for Single Foundation

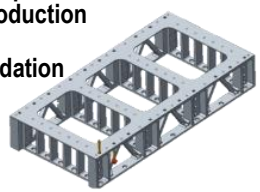
26 Cabinets in Single Compartment (CSER 2)



< 6 Work Hours For Entire Space

Standard MDS Skid (common design)

- Precise Hole Mounting Pattern
- Adapter Plates for various equipment mounting options
- Economy of Scale Production
- Eliminates Recurring Engineering for Foundation Design



MDS Assembly

- Assembled at Off Ship Location
- Includes Ancillary Items (cable ladders, pipe support, etc.)
- Full Assembly Ready for Transport to Ship

1

2

Step	Surveyor	Mechanical	Welder	Firewatch	Painter	Pipe Fitter	Sheet Metal	TOTAL
1	1	2	1	2	1			7
2		2				1	2	5
TOTAL	1	4	1	2	1	1	2	12

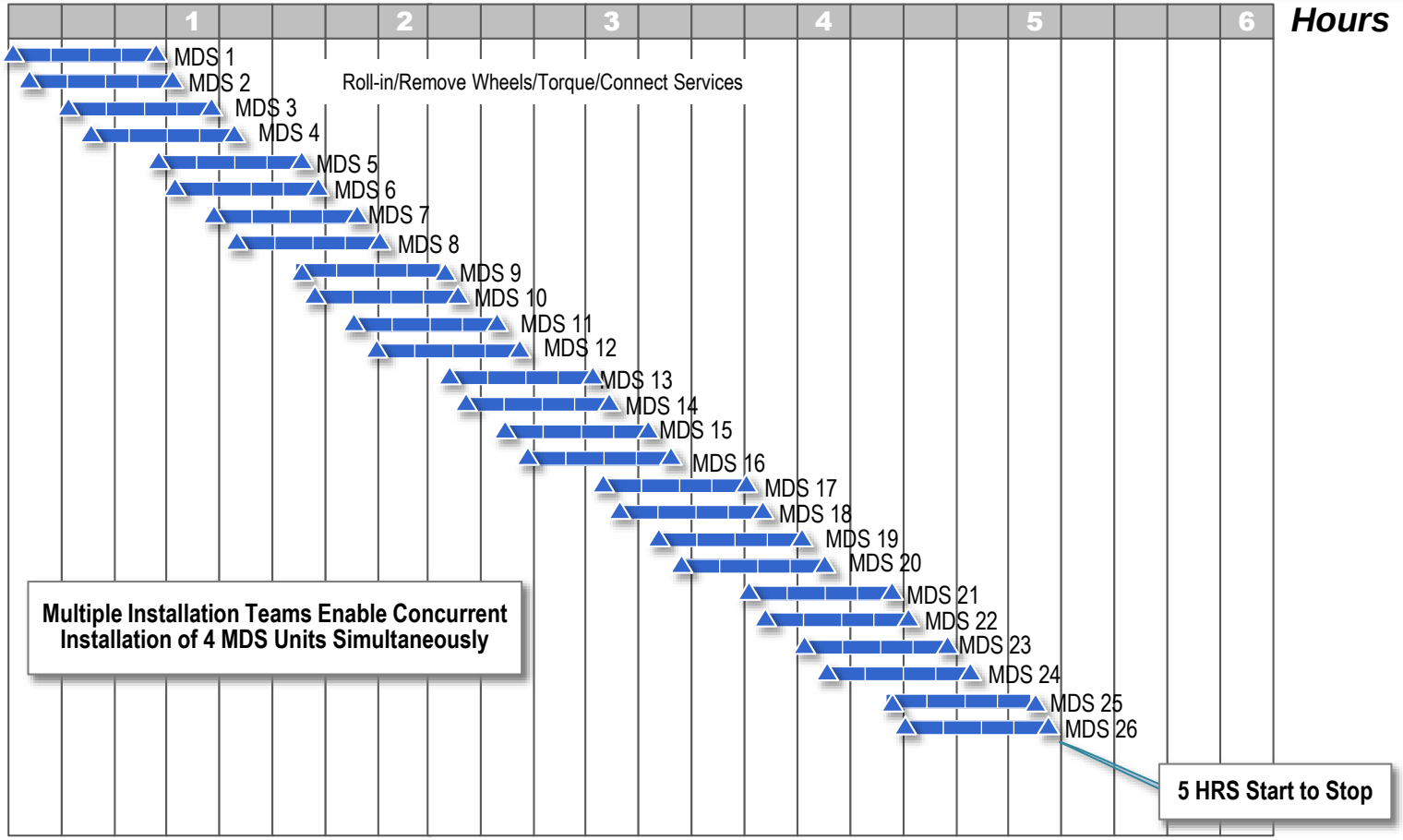
MDS installation Trades Required

Roles and Responsibilities

- ***Government to Shipbuilder***
  - *Provide Modular SWAP-C Requirements ISO Ship's RFP*
  - *Provide Modular Skid and Components "Build to Print" Drawings ISO Modular Component Production, Kitting and Assembly of GFE Equipment*
  - *Provide Shipyard Facility Modular Compartment Arrangement Drawings ISO Pre-fabrication of Modular SWAP-C Compartments*
  - *Provide Shipboard Installation and Detail Instruction ISO Ship's Move-In-Ready Modular SWAP-C Compartments*

- ***Shipbuilder to Government***
  - *Deliver Modular SWAP-C Compartments*
  - *Produce Modular Skids and Components*
  - *Perform GFE Kitting and Assembly*
  - *Build Pre-Fabricated Modular Compartments in an Environmentally Controlled and Secured Shipyard Facility*
  - *Disassemble and Transport Pre-Fabricated Compartments to Ship*
  - *Install Pre-Fabricated Compartments into Ship's Modular SWAP-C Compartments during MIR Milestone*

Notional MDS Compartmentalized Installation



MDS Compartmentalized Installation is Significantly Quicker than Traditional Installation Approach (Hours vs. Months)

MDS Compartmentalized Installation Conditions and Assumptions

- Assumes CSER 2 onboard DDG with a 26 cabinet/equipment layout
- "Installation" is defined as the moment the MDS assembly enters compartment until it is landed, torqued, and services are hooked up
- Adequate Access Cut with sufficient landing area to pre-stage all cabinets in optimum installation sequence
- Level path for MDS Units to transition from exterior landing area to within compartment
- All Studs and necessary support structure (SDI) has been installed, surveyed, and prepped
- Assumes 4 rows of cabinets within compartment to allow for nearly simultaneous installation of four MDS Assemblies
- Shim kit calculations completed, kitted, and pre-installed on studs
- All MDS Assemblies are pre-assembled including wheels/castors to facilitate loadout
- Adequate overhead clearance to roll MDS without requiring tilting or rigging using chainfalls, slings, etc.
- No Deck mounted obstacles that would prohibit loadout (e.g. cableways, piping, etc.)
- Runway plates installed ahead of MDS Assembly installation to facilitate multiple row loadout
- Four teams (minimum) to move and install MDS Assemblies onto Studs within compartment
- Hardware and tools pre-staged in compartment
- Additional staging team outside compartment maneuvering MDS Units into CSER 2 Access Cut Opening to meet installation demand
- Assumes water connections and simple HVAC connections (No Direct Air Pick-ups)