Affordable Future Surface Combatants

DDG 51 Class
DETAIL DESIGN

HST-1 USNS GUAM Conversion
Military Sealift Command (MSC)

MSS AMP 145 Coastal Security Craft
Delivered to Lebanese Navy via FMS

AIR & MISSILE DEFENSE RADAR (AMDR)
PEO Ships and PEO IWS

AEGIS ASHORE DESIGN INTEGRATION
Missile Defense Agency (MDA)

LCS FREEDOM CLASS
DESIGN
Introduction to Gibbs & Cox

Quality; Excellence in execution

Integrity; Devotion to high ethical standards

Customers; Commitment to customer success

Employees; Respect for our most valued asset

Teamwork; Cooperation with stakeholders

Innovation; For customers and employees

Corporate Values

History

- ~7,000 ships built to G&C designs
- 70+ in-service U.S. Navy ships
- 60+ naval ships in 15 international countries
- High speed/high performance craft
- High end pleasure craft
- 50+ government & commercial customers in last year

Capabilities

- All phases of ship design and systems engineering
- Modernization and upgrades to parent designs
- Shipyard industrial capability assessments
- 3-D CAD/CAE including laser scanning
- On-site support/staff augmentation
- Program Management support

Independent and privately held since 1929

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The Challenge

• “Challenge the paradigm that it takes 2-3 years to design a ship, and then 3-5 years to build it.”
  – CNO remarks to Congressional Shipbuilding Caucus, June 14, 2016

• ”Time is our enemy”
  – Acting SECNAV Stackley remarks at Sea Air Space luncheon, April 5, 2017
Challenge the paradigm that it takes 2-3 years to design a ship, and then 3-5 years to build it

- **Maximize Re-use of Design Elements**
  - Shorten program definition phase by leveraging existing designs
  - Lower acquisition and training costs by reusing retiring systems

- **Establish FSC Design Boundaries Early via Open Architectures**
  - The design challenge: Standardizing Interfaces
  - Modularity is a common practice throughout the industry
  - Expands competitive sourcing
  - Enables distributed lethality

- **Employ Flexible Warship Features for Technology Insertion**
  - The design challenge: Early Definition of Margins and Capacity
  - Employing this across multiple platforms multiplies the benefits
  - Pre-planned compartments and accesses

These are principles for the future of Naval shipbuilding – not just the next platform
Time is Our Enemy

- **Shorten program definition phase by leveraging existing program(s)**
  - Rapid AoA possible using library of existing point designs
- **Shorten detail design phase by leveraging existing design elements**
  - Publish interfaces and design basis for common modules
  - Adapt as needed to FSC requirements
  - Integrated, Navy-led design team allows detailed, informed tradeoffs
- **Shorten construction by using Common Modules and Standardized Interfaces**
  - Module construction competed and distributed across a wider industrial base
  - Shipbuilder integrates and tests HM&E modules...like we have for 20 years
- **Shorten Warfare System integration and test by working parallel with construction**
  - Integrate on land, install pierside
  - Final testing and certification after delivery

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<table>
<thead>
<tr>
<th>FSC Challenge</th>
<th>Duration</th>
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</thead>
<tbody>
<tr>
<td>Studies &amp; Early Design</td>
<td>3 years</td>
</tr>
<tr>
<td>Detail Design</td>
<td>2 years</td>
</tr>
<tr>
<td>Construction</td>
<td>2-3 years</td>
</tr>
<tr>
<td>Integration &amp; Test</td>
<td>1 year</td>
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*Early validation of common modules and standard interfaces reduces timeline and risk*
Re-use leverages a generation of Naval Engineering

- Proven, adaptable hullform
- Established production line
- Flight Upgrade process
- AEGIS OA
- AMDR integration

- Performance-based Spec
- Design Adaptation
- Modular Architecture
- Standard Interfaces

- Integrated Power
- AGS
- Modular Deckhouse

- Flexible Infrastructure
- Reconfigurable spaces

- Distributed construction
- Land Based Integration & Test
- Shock isolated decks for COTS electronics

Flexible Warships for FSCs

- C4ISR Integrated Topside
- Sensors
  - Scalable AMDR
  - SEWIP
- Flexible Infrastructure
- Reconfigurable spaces
- Distributed construction
- Land Based Integration & Test
- Shock isolated decks for COTS electronics

Common modules and interfaces support a range of FSC Options and shorten program timeline
Establish FSC Design Boundaries Early via Open Architectures

- **Warfare Systems** ship design drivers
  - VLS cells and other weapons mounts
  - Modular integrated deckhouse dimensions & required height
  - Vehicles (helos, UxVs, boats)
  - Manning
  - Time required for technology refresh

- **Ship performance** design drivers
  - Speed (sprint and endurance) and range
  - Margins

- Define a balanced and affordable survivability baseline
  - Susceptibility, vulnerability and recoverability

- **Common Modules and Standard, Flexible Interfaces**
  - Warfare Systems/Integrated Deckhouse
  - Naval Power & Energy Systems (NPES)
  - Habitability

Define boundaries based on capability and capacity needs – combine via open architectures
## Employ Flexible Warship Tenets

<table>
<thead>
<tr>
<th>Flexible Ships Tenets</th>
<th>Features/Advantages</th>
<th>FSC Considerations</th>
</tr>
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<tbody>
<tr>
<td>De-Coupled Payloads (Capabilities) from Platforms (Ships)</td>
<td>Independent development of mission systems and ship design and defines interfaces for future capability upgrades</td>
<td>Overall schedule compression and just-in-time integration</td>
</tr>
<tr>
<td>Common Platform-to-Payload Interfaces</td>
<td>Allows capabilities to be fielded across different ship classes without major redesign</td>
<td>Allows payload application on more than just FSC</td>
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<tr>
<td>Compartment and System Reconfiguration</td>
<td>Integrated deck systems designs for equipment installation, removal and rearrangement without hot work</td>
<td>Facilitates affordable upgrades</td>
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<tr>
<td>Pre-Planned Equipment Access Routes</td>
<td>Access hatches, passageways, handling systems, soft patches for easy access to high-turnover spaces and major equipment</td>
<td>Facilitates upgrades and later installation of mission systems during construction</td>
</tr>
<tr>
<td>Sufficient Growth Margins for Modernization (SWaP-C*)</td>
<td>Installed capacity (or the ability to easily add in the future) to support future increased requirements</td>
<td>Provides foundation for the future force</td>
</tr>
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*Space, Weight, Power and Cooling

### Applying Flexible Ship Tenets to FSC makes future upgrades affordable
Create One Operational Requirement... Change the Future of Combatant Ship Design

“Mission Systems must be reconfigured pier side and tested in 60 days”

- Aligns New Construction and Modernization
- Allows for the most capable war fighting systems at sea
- Makes Modernization an operational requirement AND a design constraint
- AEGIS Ashore is the Precedent: ”The deckhouse must be relocatable in 120 days”

Enhances Economic Order buying power and enabling a more modern and capable fleet
Technology Development in Parallel with Platform

- Pre-engineered ship interfaces enable parallel development
- Pre-planned access and installation/removal routes support “just-in-time” delivery
- Off-ship integration and testing reduces risk to on-time ship delivery

Interface definition and management is key to schedule and cost performance
Life Cycle Acquisition Benefits

**Competition**
- Steepens learning curves by introducing competition
- Lengthens learning curves and reduces cost by limiting redesign
- Lowers first unit cost of new systems by leveraging industry IRAD
- Allows a larger role for smaller yards and equipment suppliers

**Innovation**
- Inspires third party innovation in ship design
- Equipment suppliers can embed their systems into integrated deck deliverables
- Isolates high risk work outside of ship production contracts
- FMS opportunities

**Modernization**
- Re-use of legacy systems reduces design risk, training and overall costs
- Nurtures a competitive industrial base throughout ship life by increasing quantity
- Reduces modernization and redesign cost over the 30-50 year service life

Expanding this concept across multiple ship classes multiplies these acquisition benefits

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Summary

Keys to Affordable Future Surface Combatants

- Maximize Re-use of existing designs
- Establish FSC design boundaries early via Open Architectures
- Employ Flexible Warship tenets

FSCs are an opportunity to translate 30 years of lessons learned into an affordable design baseline for the 21st century
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