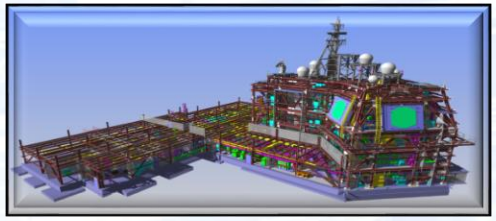
Affordable Future Surface Combatants

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

Corporate Values

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*

Locations

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

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

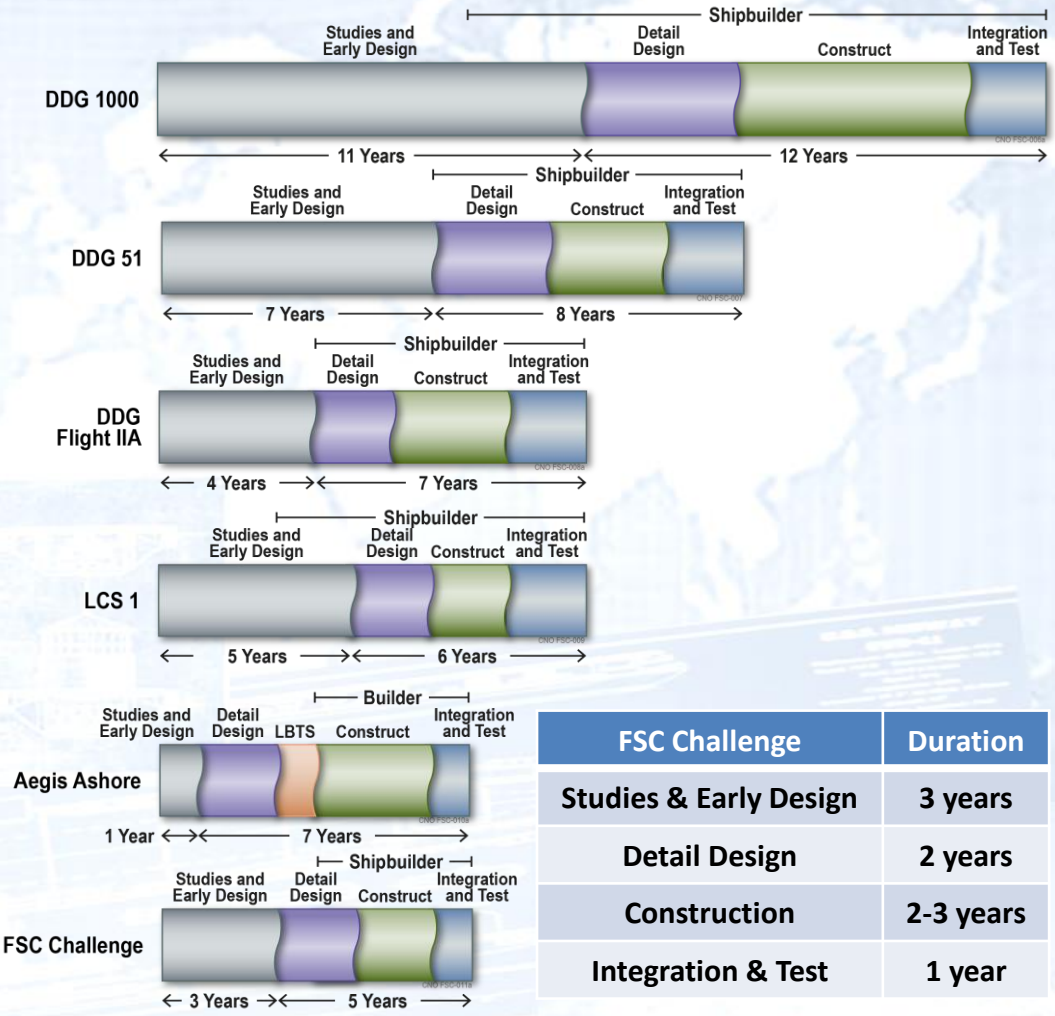
	FY27-45
Future Surface Combatants	

- **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



FSC Challenge	Duration
Studies & Early Design	3 years
Detail Design	2 years
Construction	2-3 years
Integration & Test	1 year

Early validation of common modules and standard interfaces reduces timeline and risk

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Re-use leverages a generation of Naval Engineering

- Decoupled payload/platform
- Mission modules/UxVs

DDG 51

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

AEGIS Ashore

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

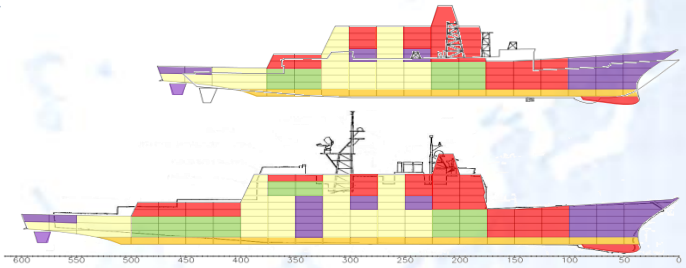
- Integrated Power
- AGS
- Modular Deckhouse

- Flexible Infrastructure
- Reconfigurable spaces

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

C4ISR
Integrated Topside

Sensors
Scalable AMDR **SEWIP**

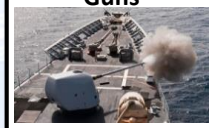


Warfighting Systems Machinery Spaces
Living Spaces Ship Support Fuel/Ballast

Flexible Warships for FSCs

Combat System
Open Architecture
CDS **EME**

Weapons
Guns **Laser/EM**



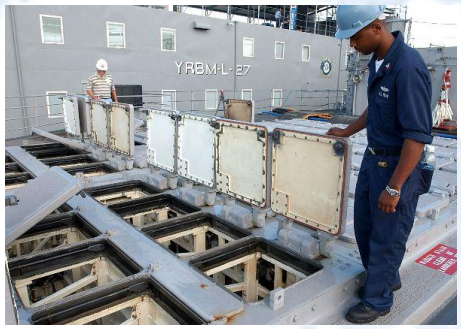
Missiles **Rail Gun**

Common modules and interfaces support a range of FSC Options and shorten program timeline

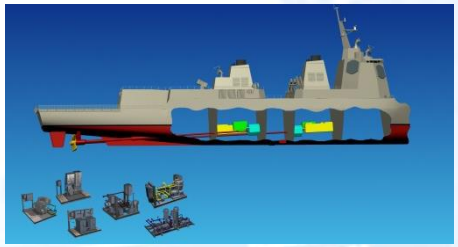
GIBBS & COX
Maritime Solutions

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



VLS Module



Survivable separation of machinery systems (Gibbs & Cox image)

Removable Equipment Unit (AEGIS Ashore)

Define boundaries based on capability and capacity needs – combine via open architectures

Employ Flexible Warship Tenets

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

*Space, Weight, Power and Cooling

Applying Flexible Ship Tenets to FSC makes future upgrades affordable

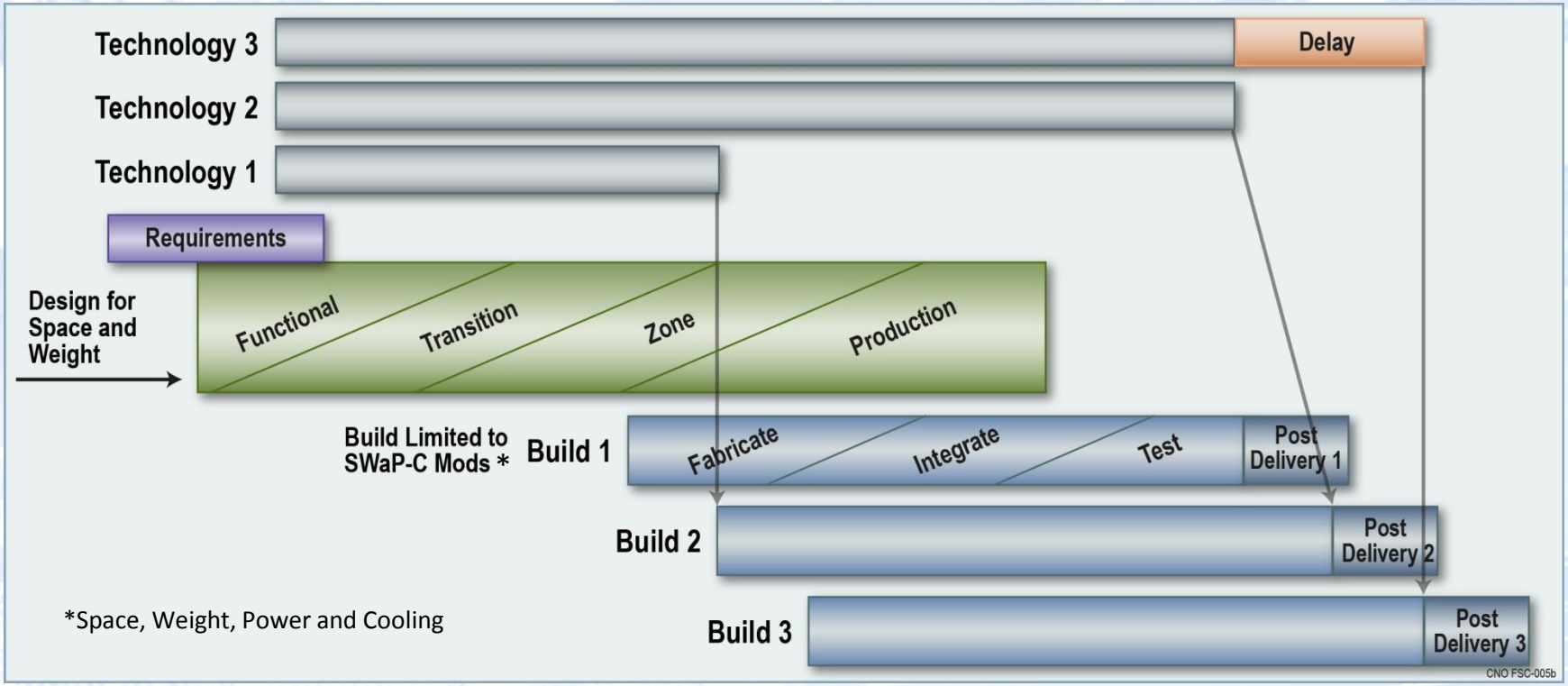
Create One Operational Requirement…
Change the Future of Combatant Ship Design

"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

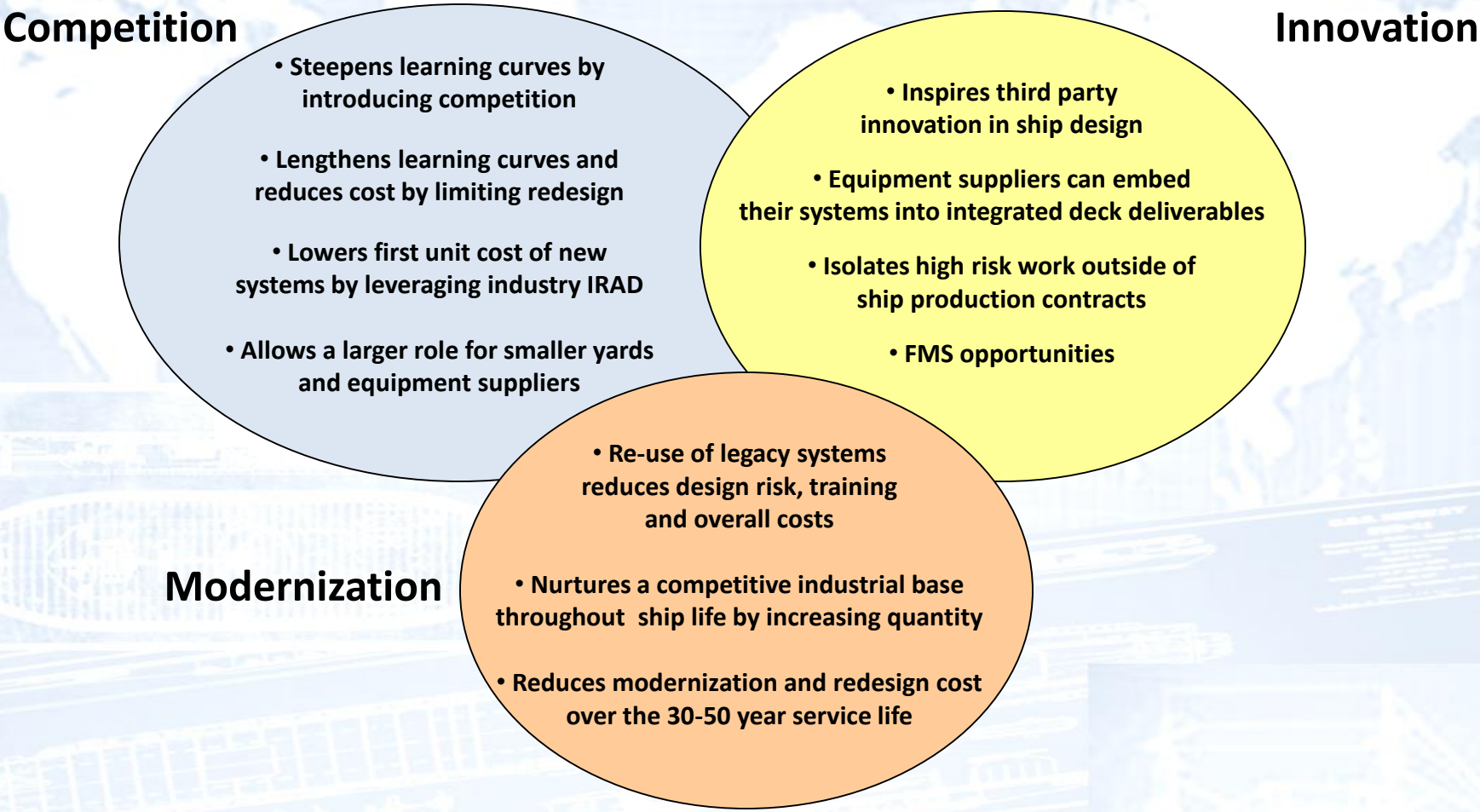
Technology Development in Parallel with Platform



- 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



Expanding this concept across multiple ship classes multiplies these acquisition benefits

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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