

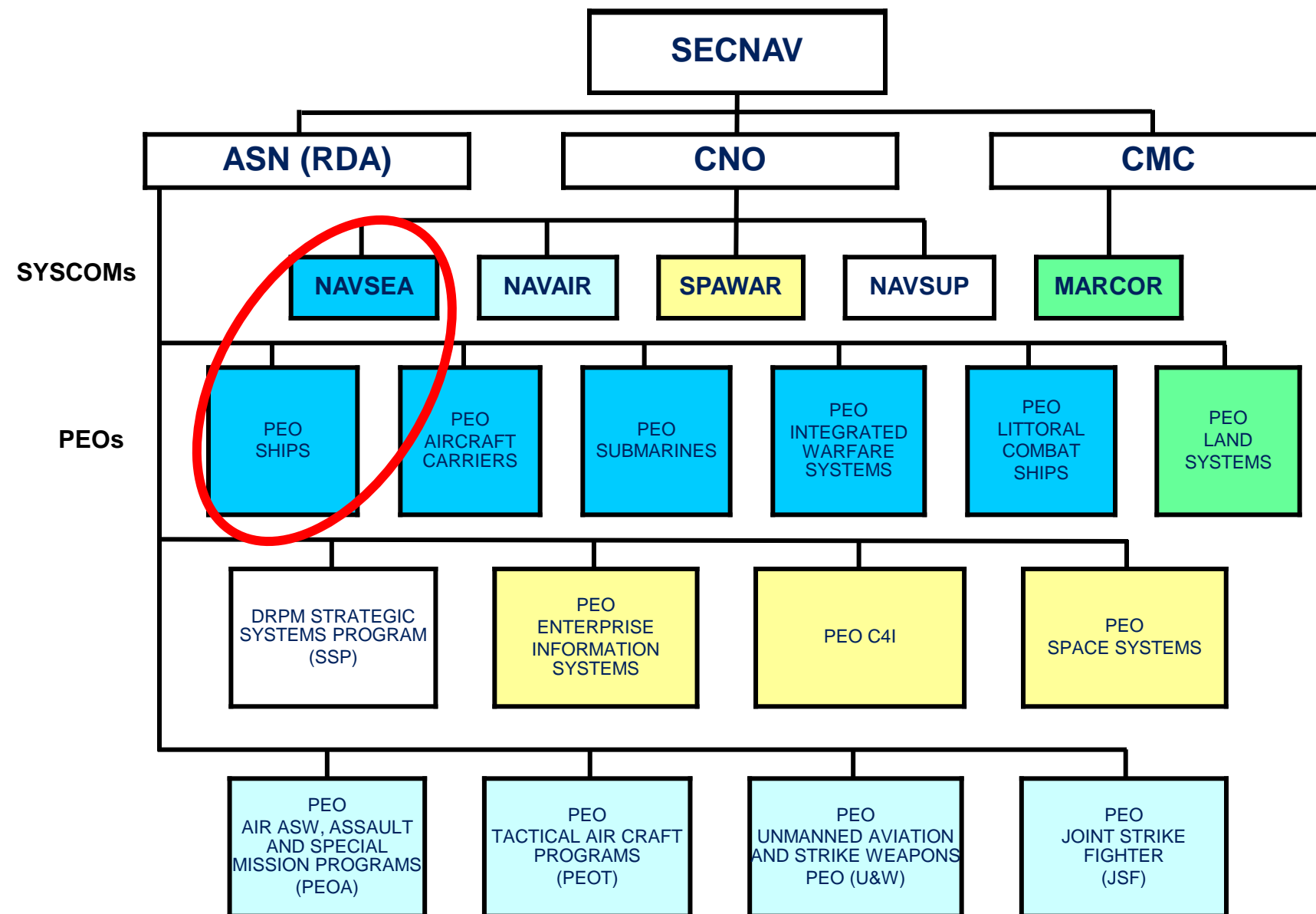
Flexible Ships:

Affordable Relevance Over the Ship's Life Cycle



Glen Sturtevant
Director for Science & Technology
21 January 2015

- **Backdrop**
- **Implementing the Flexible Ships Concept**
- **Key Enablers**



MILESTONES

A

B

Pre-AoA	Materiel Solution Analysis	Technology Development	Engineering and Manufacturing Development	Production and Deployment	Operations and Support	
FSC	LX(R)		SSC	JHSV	LPD 17	CG
				MLP	T-AKE 1	LCAC
SC(X)(R)	T-AO(X)	DDG 51 FLT III		DDG 51	FFG 7	Boats
			LHA(R) FLT I LHA 8/9/10	DDG 1000	LHD / LSD / LPD	MCM 1
			AGOR	LHA(R) FLT 0 LHA 6/7	LCC 19	
				T-AGS 66	LHA	PC 1
				T-AGM 25		



Evolving Threats



Accelerating Pace of Technological Change



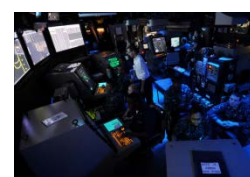
Declining Budgets



Rising Costs

Imperative for Change

- Ships cost too much to build and sustain
- Payloads (capabilities) are strongly coupled to platforms (ships)
- Legacy ship design margins limit growth for capability upgrades
- Inflexible architectures result in lengthy and costly upgrades to ships
- Ships need to stay relevant over their *entire* service life
- The future is uncertain and the pace of changing threats is increasing



1960s

1970s

1980s

1990s

2000s

2010s

PAYLOADS



Surface Combatant Platforms (Destroyer example)

DDG 37



DD 963



CG 47



DDG 51



DDG 79



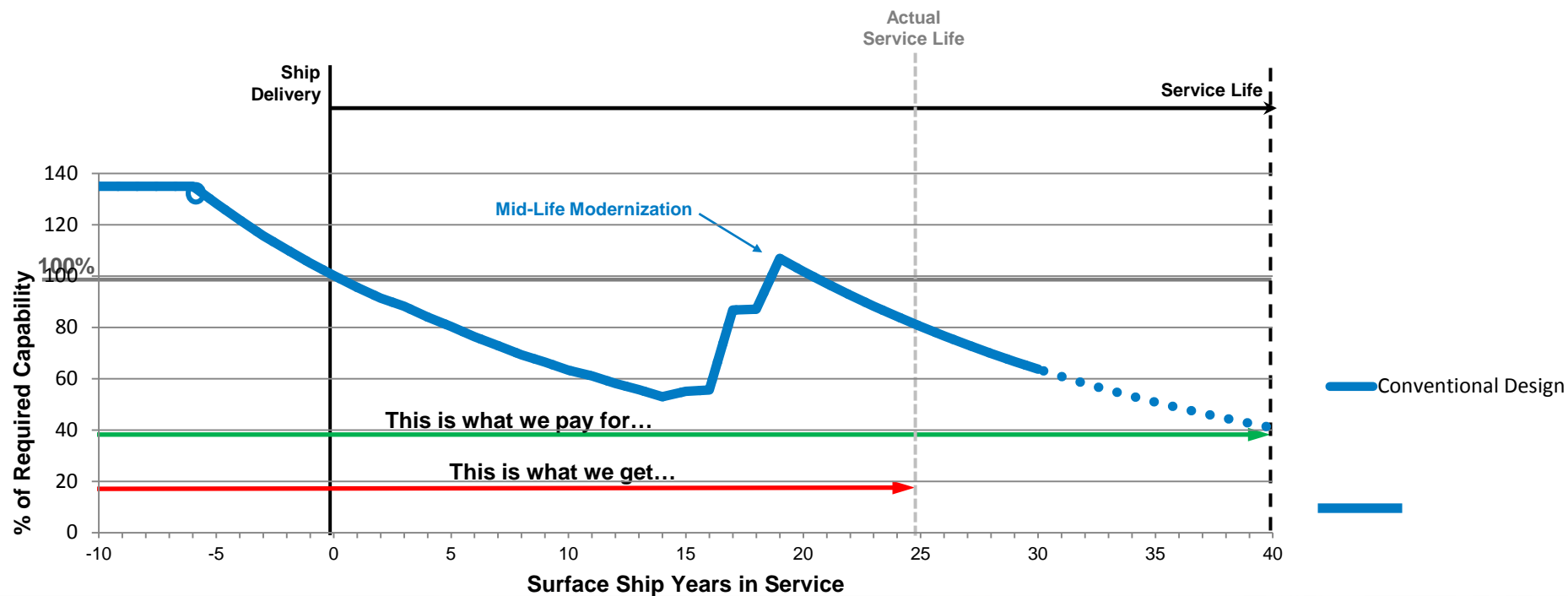
DDG 1000

DDG 124

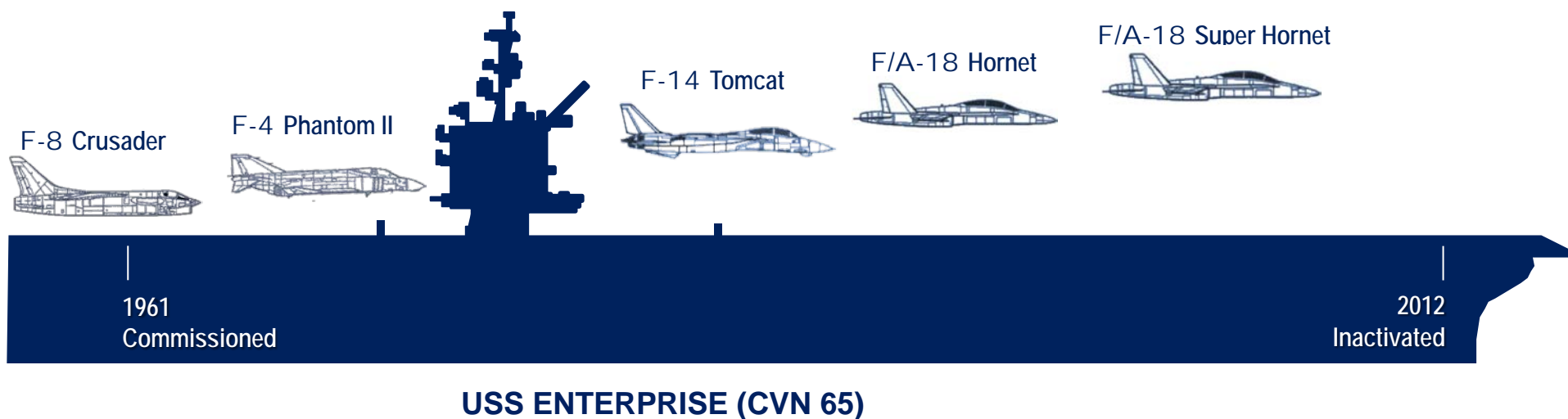


1961-2012 Surface Navy introduced 16 different Surface Combatant platform types

What is the Problem?

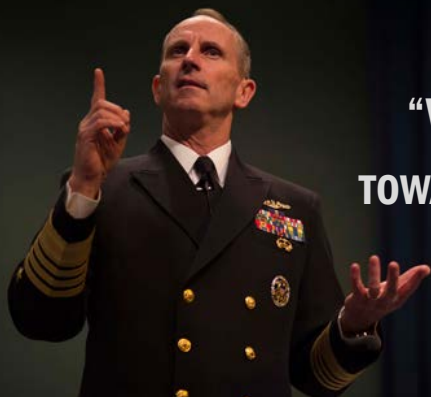


Payloads over Platforms



1961-2012

16 different Surface Combatant platform types introduced over the life of 1 Aircraft Carrier



**“WE NEED TO MOVE FROM LUXURY CAR PLATFORMS WITH BUILT IN CAPABILITIES
TOWARD DEPENDABLE TRUCKS THAT CAN HANDLE A CHANGING PAYLOAD SECTION.”**

ADM Jonathan Greenert
Chief of Naval Operations
Jul 2012 Vol 138/7/1,313

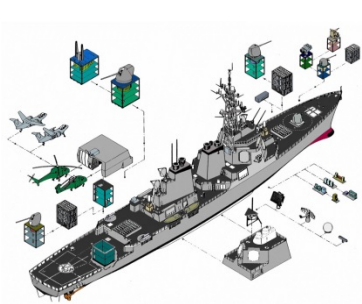
PROCEEDINGS
U.S. NAVAL INSTITUTE | The Independent Forum of the Sea Service

**“MAKING THE MOVE TO MODULARITY WILL FURTHER ALLOW US TO MAXIMIZE THE SERVICE
LIFE OF OUR SHIPS AS WE WILL BE ABLE TO UPGRADE THE COMBAT SYSTEMS EQUIPMENT
TO MORE EASILY AND AFFORDABLY KEEP PACE WITH RAPIDLY ADVANCING TECHNOLOGY.”**

VADM Thomas Rowden
Commander Naval Surface Forces
Jan 2014 Vol 140/1/1,331

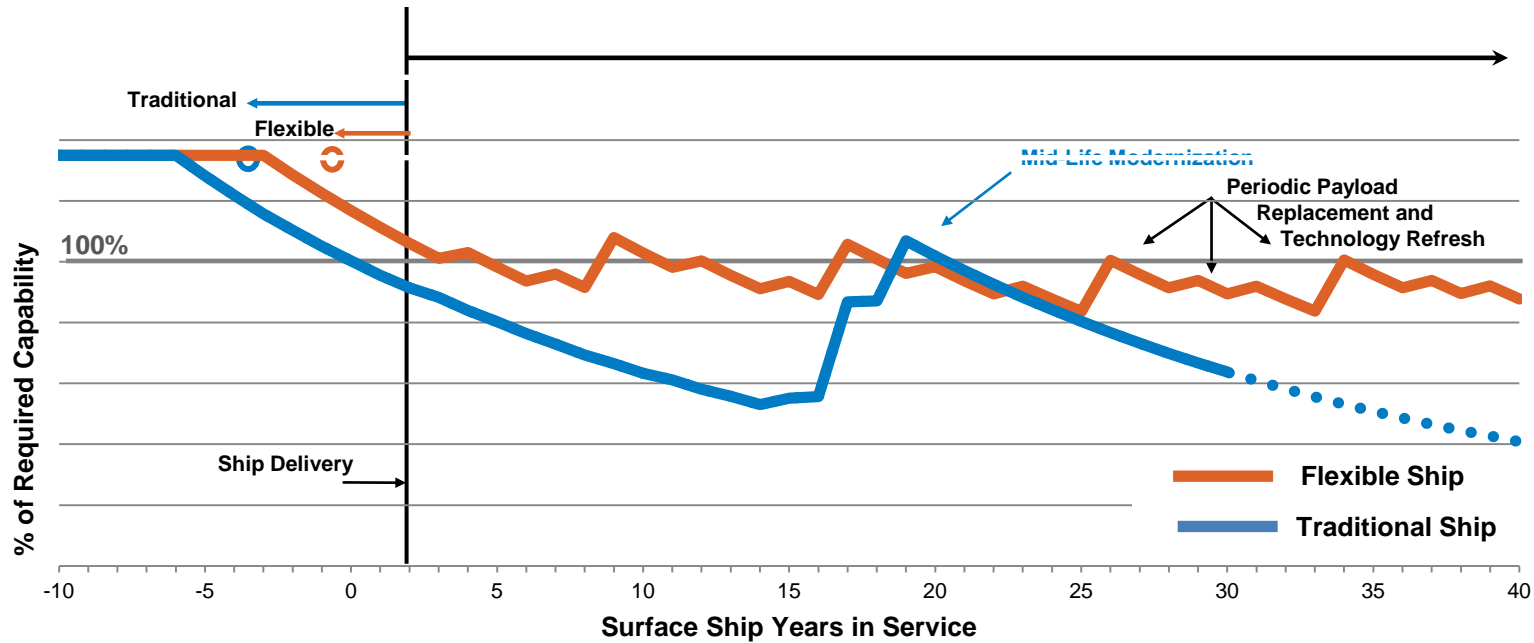


- De-Coupled Payloads (capabilities) from Platforms (ships)
- Standard Platform-to-Payload Interfaces
- Rapid Re-Configuration
- Pre-Planned Access Routes
- Sufficient Service Life Allowance Growth Margins



Delivering Affordable Relevance Over the Entire Ship's Life Cycle

Potential Benefits of Flexible Ships



Decoupling Payloads from Platforms Where It Makes Sense

Stable



Hull



Propulsion



Distributed Systems



Damage Control



Habitability

Dynamic



Weapons, Sensors, & Aircraft

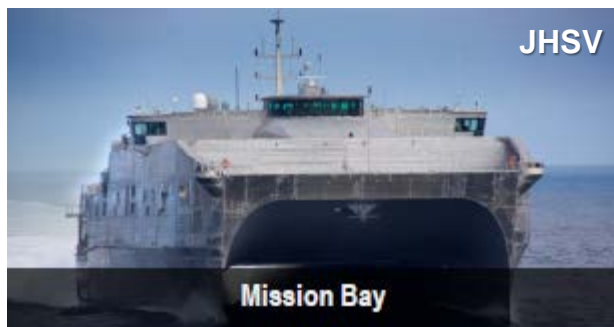


Unmanned Vehicles



Combat Systems
& C4I

Examples of Platforms with Flexible Ships Features





ROYAL DANISH NAVY FLEXIBLE SHIPS

MODULAR DESIGN: *Rapid Reconfiguration for Mission Adaptability*



PAYLOADS



Modular Payloads

- Anti-Submarine Warfare
- Special Operations
- Mine Warfare
- Intel
- Close-In Weapon System
- Harpoon Launchers
- Sea Sparrow Launchers
- Rigid Hull Inflatable Boat
- Gun

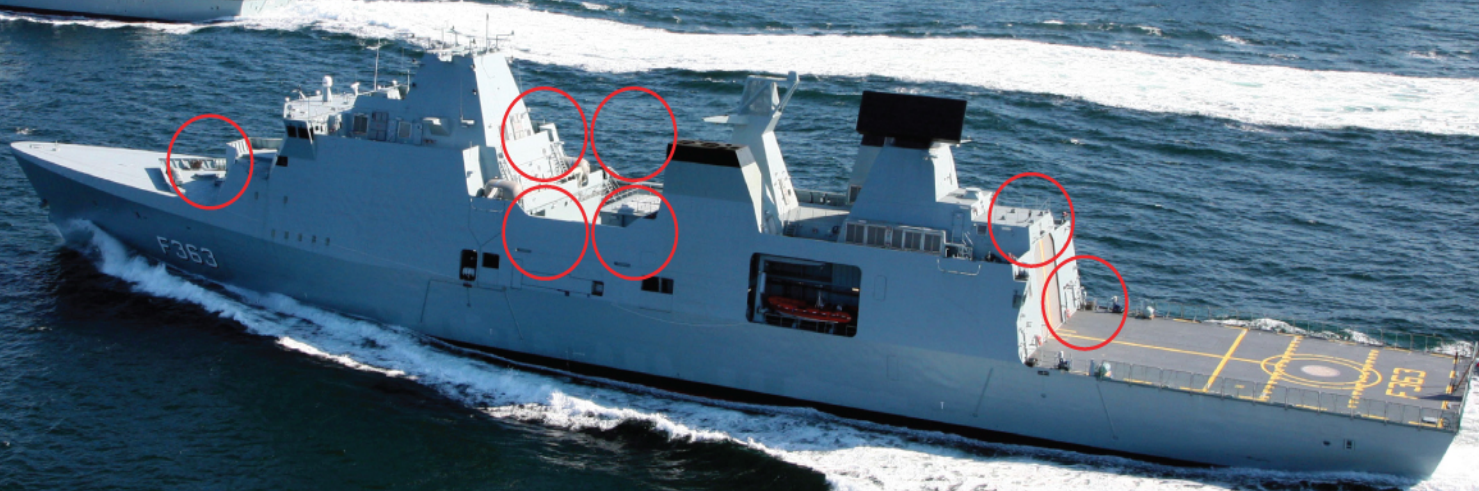
PLATFORMS



Frigates



Combat Support Ships

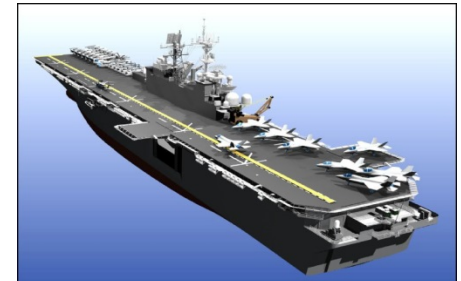
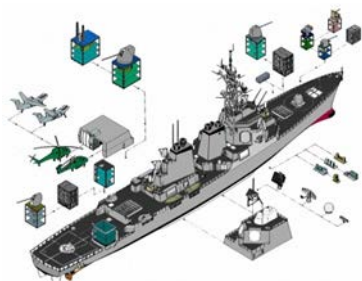


30 Year Shipbuilding Plan

Fiscal Year	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Large Surface Combatant	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Small Surface Combatant	3	3	3	3	2	3	3	3	3	3	3							1		1	1		4	4	4	4	4	4	4	2
Amphibious Warfare Ships			1			1		1		2		1		2	1	1	1	2	1	1		1				2		1		2
Combat Logistics Force		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1		1	1	1	1		1	
Support Vessels			3	1	1	2		2	3	2	1			1	1	2	2	3	2	2			2	2	2	2	2			2

In FY2030, the DON plans to start building an affordable follow-on, multi-mission, mid-sized future surface combatant to replace the Flight IIA DDG 51s that will begin reaching the ESLs in FY2040... These ships will incorporate space, weight, power and cooling margins into their designs and have the flexibility and modularity to host new technologies

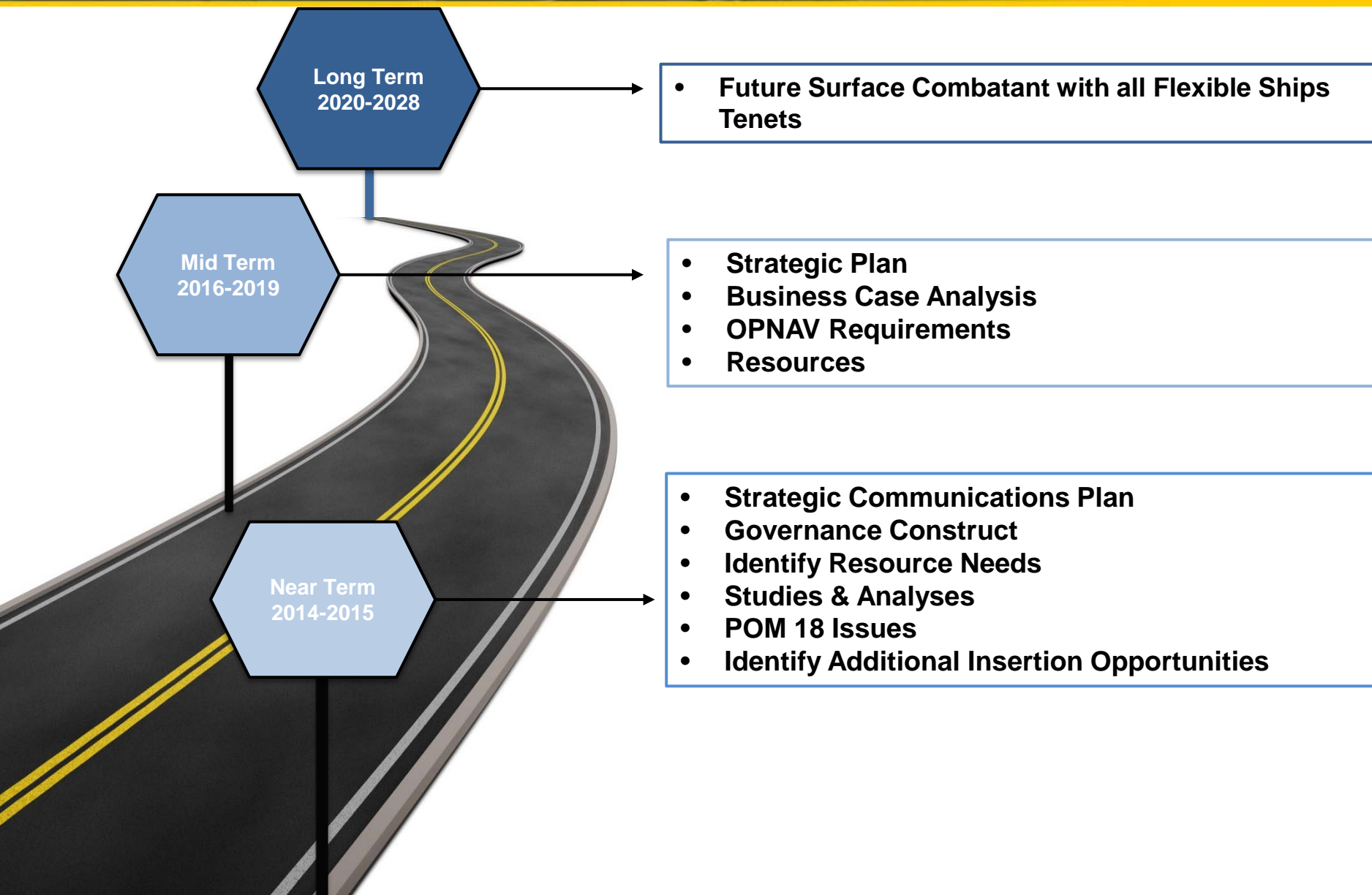
- DDG 51 Flight III
- Mobile Landing Platform (MLP) 3-4 Afloat Forward Staging Base
- LHA(R)
- LXR
- Future Surface Combatant (FSC)



- Ensure **strong central leadership** and form a powerful **coalition**
- **Roadmap** our existing plans and future opportunities
- Provide the warfighting **requirements** that will drive flexible, common, and open architectures into our ship designs and acquisitions
- Establish a **business model** that supports Flexible Ships
- Navy standardize, define, and manage **modular interface standards** and engineering practices
- Invest in **technology advancements** that support flexibility
- Conduct **risk reduction** prototyping, at-sea tests and demos



- ***Requirements***
- ***Business Model***
- ***Interface Standards***
- ***Governance***
- ***Metrics***
- ***Threats***
- ***Opportunities***
- ***Strategic Communications***
- ***Strategic Plan***



- ➊ ASNE Fleet Maintenance & Modernization Symposium 2012
- ➋ ASNE Day 2013 Panel
 - *Modularity: Benefits of Modular Adaptable Ships*
- ➌ ASNE Day 2014 Panel (February)
 - *Flexible & Common Warships*
- ➍ ASNE Fleet Maintenance & Modernization Symposium 2014 (September)
- ➎ ASNE Flexible Ships Workshop 2014 (November)
- ➏ ASNE Day 2015 (4 March)
 - *Flexible Ships Flag Panel*
 - *Global Shipbuilding Executive Summit- Flexible Ships*

- **Backdrop**
 - Major Challenges Confronting Surface Navy
 - Imperative for Change
- **Flexible Ships Key Enablers**
 - Requirements
 - Business Model
 - Interface Standards
- **Implementing the Flexible Ships Concept**
 - Incremental Insertion of Tenets
 - Future Surface Combatant

Navy STEM Education Outreach Priorities:

- Inspire future Naval Engineers and Scientists
- Engage students at ALL levels with skill-building activities with Naval- relevant content
- Help prepare students for STEM careers with the Navy Department
- Collaborate with other organizations on STEM activities
- Develop and retain a workforce of STEM professionals



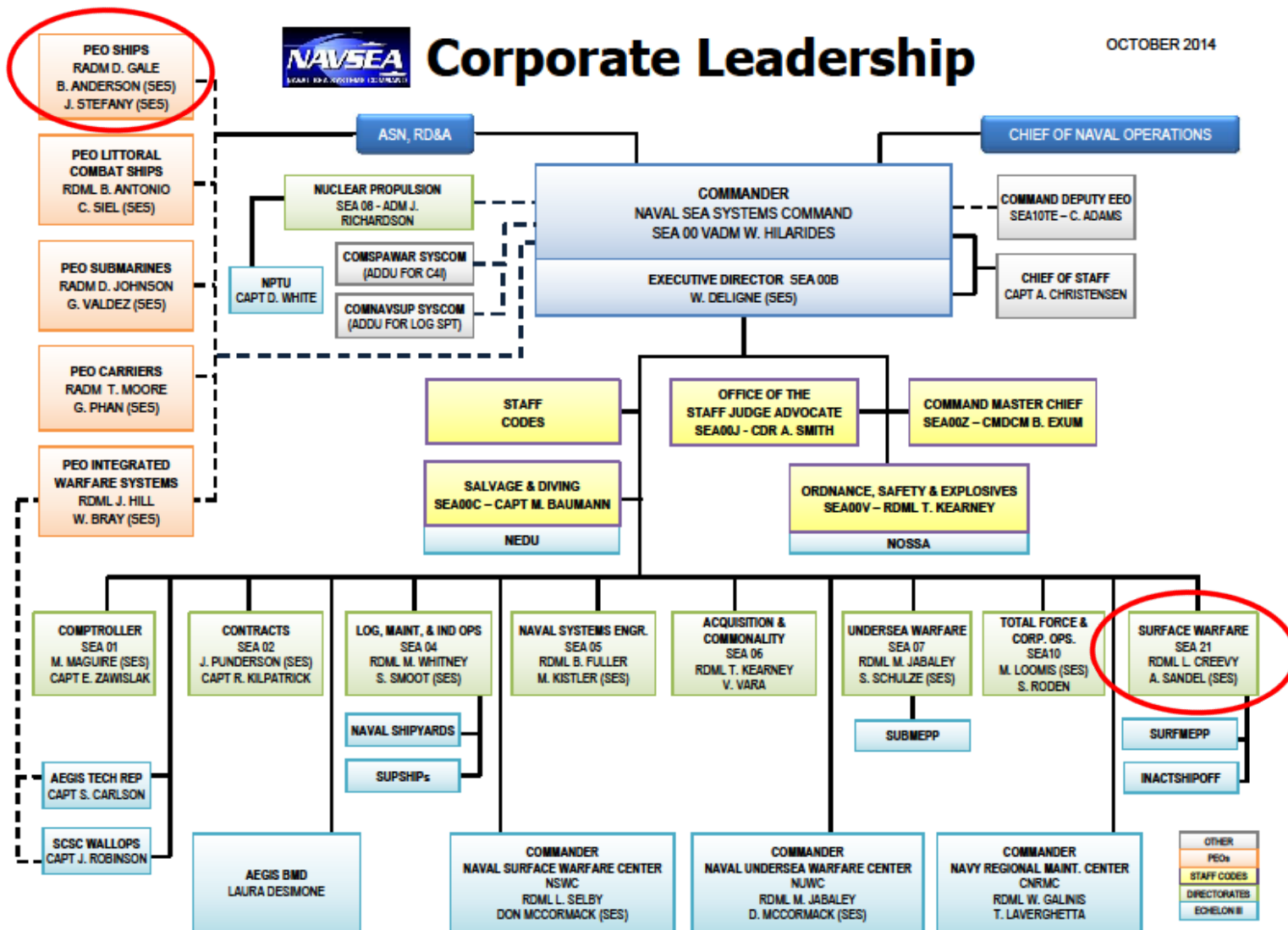
Questions ?





Corporate Leadership

OCTOBER 2014

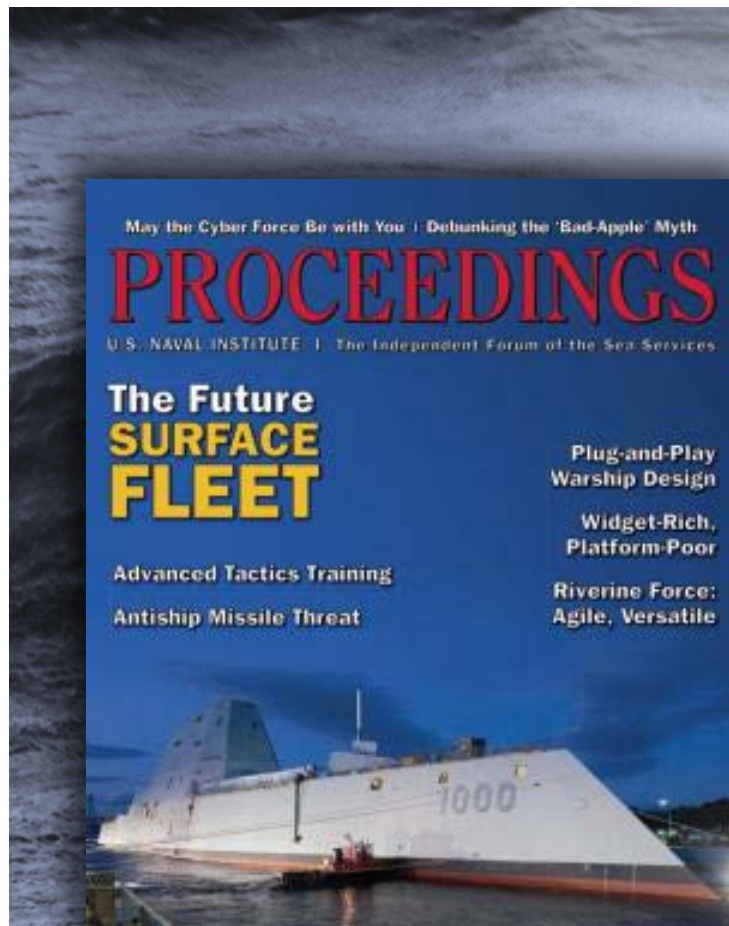


Flexible Ships Tenets

The goal of the Flexible Ships initiative is to deliver affordable relevance to Navy ships over their entire life cycle. It consists of the following 5 attributes:

- **De-coupled Payloads (capabilities) from Platforms (ships)** - Traditionally, Navy ships have been tightly coupled to weapons and sensors and as such, require lengthy and costly ship overhauls to rip-out and modernize their systems. The Flexible Ships concept treats weapons and sensors as modular payloads that can be easily replaced for ship mission adaptability and new capabilities.
- **Standard Platform-to-Payload Interfaces** - Well defined, common interfaces for distributed ship services that are prescribed and managed by the Navy.
- **Rapid Re-configuration** - Specific C5I compartments that can be easily re-configured with upgraded equipment or new systems.
- **Pre-planned Access Routes** - Used for the easy removal and replacement of interior equipment or systems.
- **Sufficient service life allowance growth margins:** Space and weight for future capabilities, and provision for projected demand for distributed systems such as electric power, cooling and network bandwidth.

- **Moderator: VADM Paul Sullivan, USN (Ret)**
- **Assistant Moderator: Glen Sturtevant, PEO Ships-NAVSEA 21**
- **Panelists:**
 - **VADM Thomas Rowden (SURFOR)**
 - **VADM William Hilarides (NAVSEA)**
 - **RADM David Gale (PEO Ships)**
 - **RADM Peter Fanta (OP N96)**
 - **RDML John Ailes (SPAWAR)**
 - **RDML Brian Antonio (PEO LCS)**
 - **RDML Jon Hill (PEO IWS)**



Naval Institute Proceedings, January 2014

Adaptability (Flexibility): Ships built with the ability to accept mission systems/equipment that can be removed and replaced pier-side, in a short period, to adapt a ship's capabilities to a specific mission

Modularity: Ships built with common design interfaces and modular components that reduce the complexity of adding, adapting, and modernizing capabilities

Commonality: Ability of hardware/software combinations to be increased or decreased in size to match the capability requirements of different sized ship platforms without sacrificing performance

Scalability: Capabilities developed independently of ships using standardized design specifications which allow the same systems, at various scales, to be applied across multiple ship platforms

Fundamental change in the way we do business



VADM Thomas Rowden

Commander Naval Surface Forces

Naval Institute Proceedings
Jan 2014 Vol 140/1/1,331

MAINTENANCE & MODERNIZATION

“

THE INTRUSIVE NATURE OF CURRENT MODERNIZATION EFFORTS COSTS TOO MUCH AND TAKES TOO LONG TO COMPLETE. THE EXTENSIVE CUTTING OF BULKHEADS, THE MOVEMENT OF MAJOR EQUIPMENT BOLTED AND WELDED TO DECKS, OVERHEADS, BULKHEADS, AND THE CREATION OF HOLES IN THE SKIN OF THE SHIP TO ENABLE SUCH EFFORTS WILL BE LARGELY REPLACED BY SHIPS DESIGNED WITH MOVABLE AND RECONFIGURABLE SPACES, PLANNED AND EFFICIENT PATHS FOR THE MOVEMENT OF EQUIPMENT, AND STRATEGICALLY PLACED HULL PORTALS WHICH ENABLE EQUIPMENT REMOVAL AND INSERTION.

”





WHY ARE FLEXIBLE SHIPS IMPORTANT?



DECOUPLING PAYLOADS FROM PLATFORMS



- Rising Costs
- Declining Budgets
- Accelerating Pace of Technological Change
- Evolving Threats

AFFORDABLE RELEVANCE OVER THE ENTIRE SHIP LIFE CYCLE