

# Setting the Stage: Modular Adaptable Ship Imperative

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# Introduction

- The post-Cold War “Peace Dividend” era is over
- “Overt challenges to the free and open international order and the re-emergence of long-term, strategic competition between nations.”

*DOD: Summary of the 2018 National Defense Strategy of the United States of America*

- Possibility of non-nuclear, industrial-scale war has re-emerged.
  - We have not experienced since World War II



People's Liberation Army (Navy) Haikou (DD 171): U.S. Coast Guard photo by Petty Officer 3<sup>rd</sup> Class Manda M. Emery

# Setting the Scene

“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 their ESLs [Estimated Service Life] in FY2040.”

*Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for FY2015*

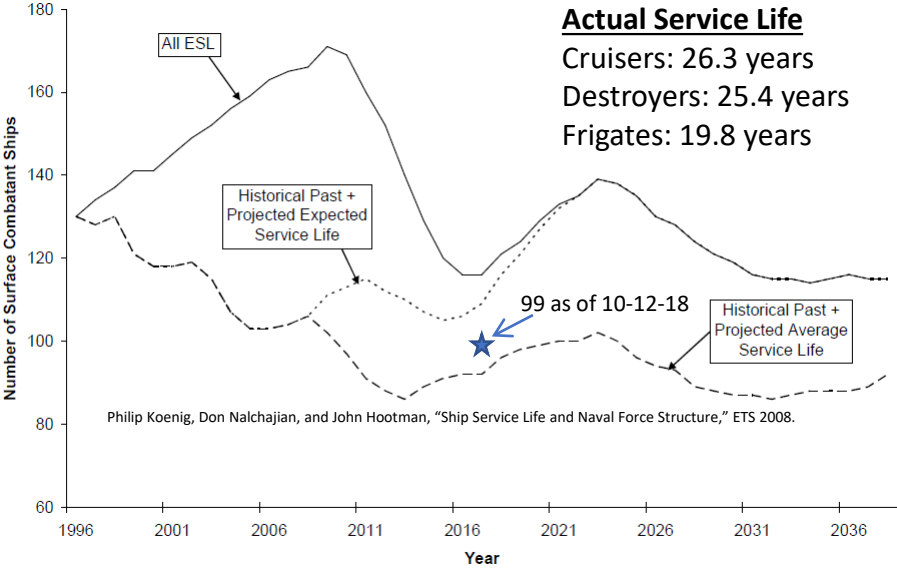
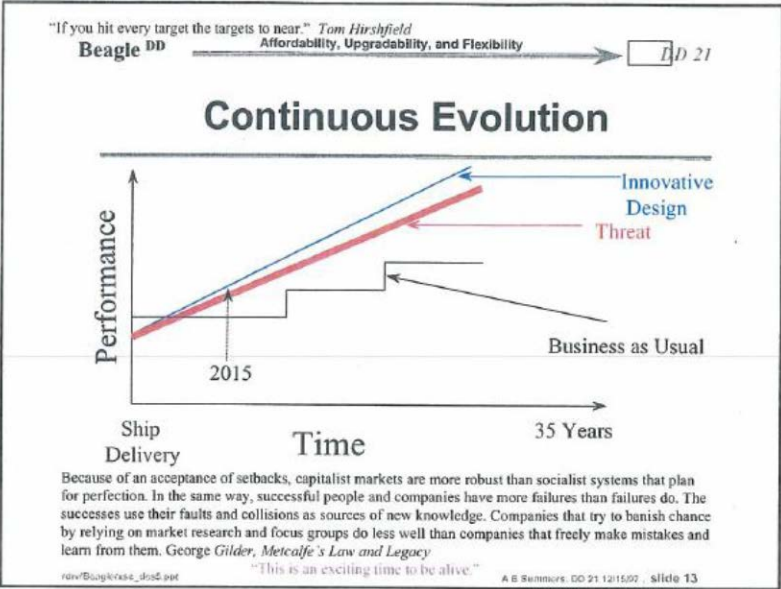
Big differences from DDG 51:

- High-energy weapons and sensors
- Flexibility for affordable capability updates



Photo by CAPT Robert Lang, USN (Ret), from site <http://www.public.navy.mil/surfor/swmag/Pages/2014-SNA-Photo-Contest-Winners.aspx>

# Motivation



Since World War II, the Navy has not been successful in keeping surface combatants operationally relevant for their design service life.

Modularity and Flexibility technologies that can help keep ships operationally relevant have been well known since mid 70's, but have not been systematically adopted

Current requirements and decision processes do not inherently consider the value of modularity and flexibility in keeping ships operationally relevant

# What about DDG 1000?

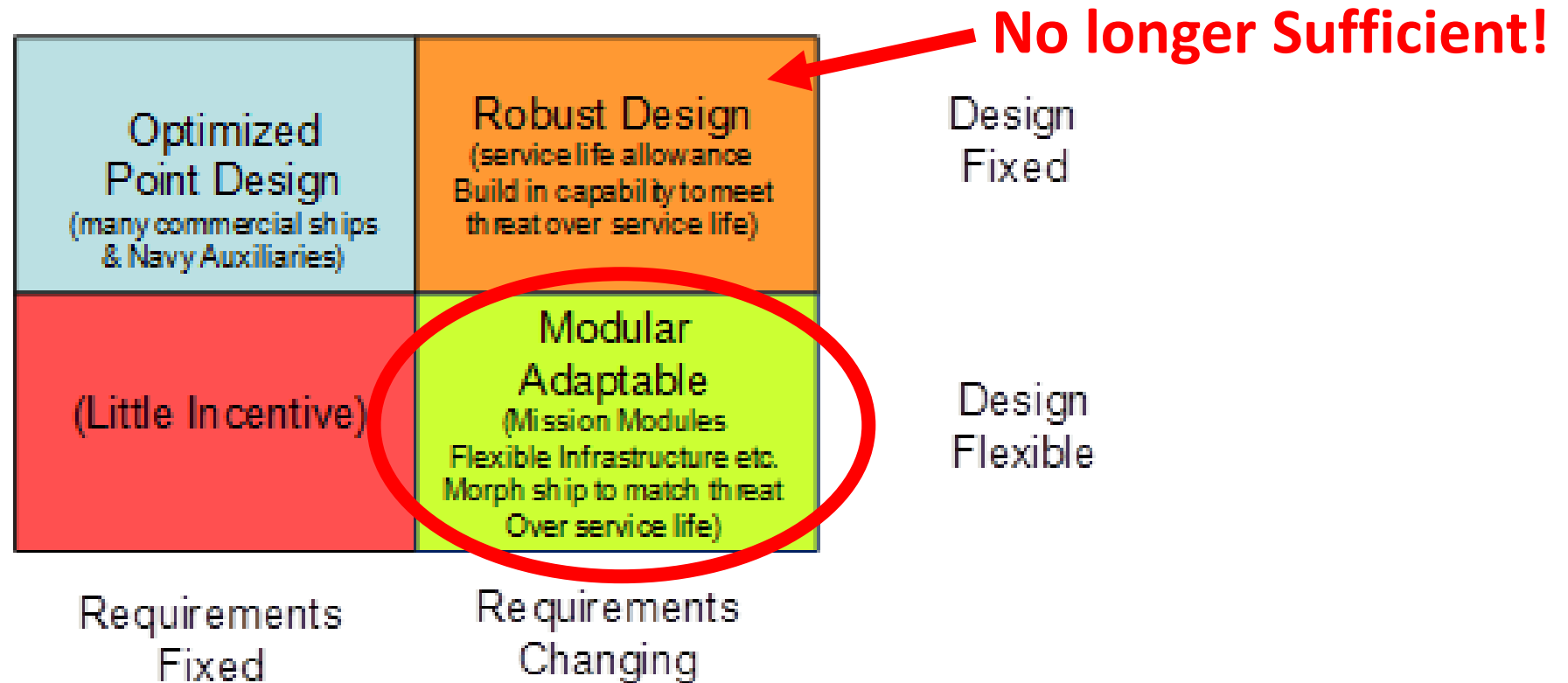
“In retrospect, the Navy’s 2008 reversal in its destroyer procurement plans can be viewed as an early indication of the ending of the post-Cold War era (during which the Navy focused its planning on operating in littoral waters against the land- and sea-based forces of countries such as Iran and North Korea) and the shift in the international security environment to a new situation featuring renewed great power competition (during which the Navy is now focusing its planning more on being able to operate in mid-ocean waters against capable naval forces from near-peer competitors such as China and Russia).” - Ronald O’Rourke, CRS 2018.



PHIPPSBURG, Maine (Sep. 7, 2016) The future guided-missile destroyer USS Zumwalt (DDG 1000) departs Bath Iron Works: US Navy Photo 160907-N-DM751-010

**A victim of Market Risk (aka Requirements Risk)?**

# How can we change design so ships can remain operationally relevant over their service lives?



# Open-Loop vs Closed-Loop Systems

- Current Acquisition System acts like an open-loop system
  - Command = Requirements
  - Must get the requirements (aim point) nearly perfect for good outcome (but the target is moving fast and changing directions)
- Flexible-Adaptable Acquisition allows in-service course correction
  - “Control authority” becomes a more important attribute
  - System is corrected in-service to respond to changing needs.
    - Aim point is automatically corrected by feedback to hit the target
  - Real Options Analysis provides guidance for designing the “Controller” and the “System”



Open Loop

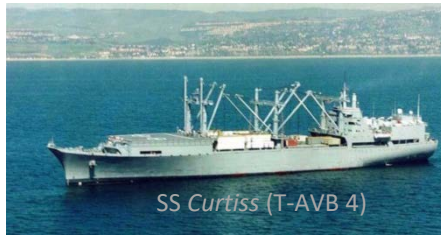


Closed Loop

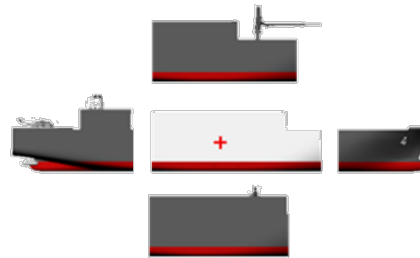


# Modular, Adaptable, Flexible Ship Technologies

Container Stacks



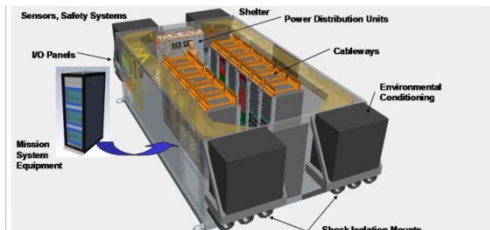
Modular Hull Ship



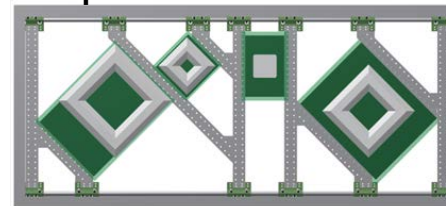
Off-Board Vehicles



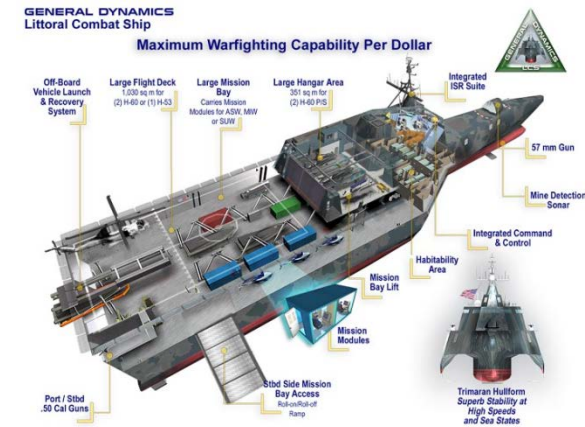
Electronic Modular Enclosures



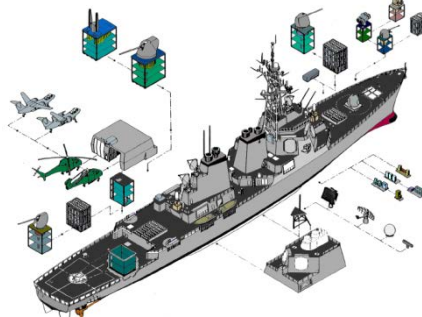
Aperture Stations



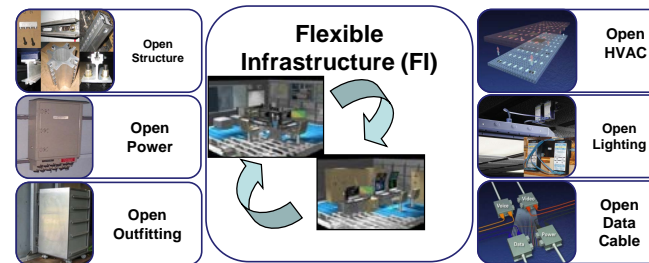
Mission Bay



Weapons Modules

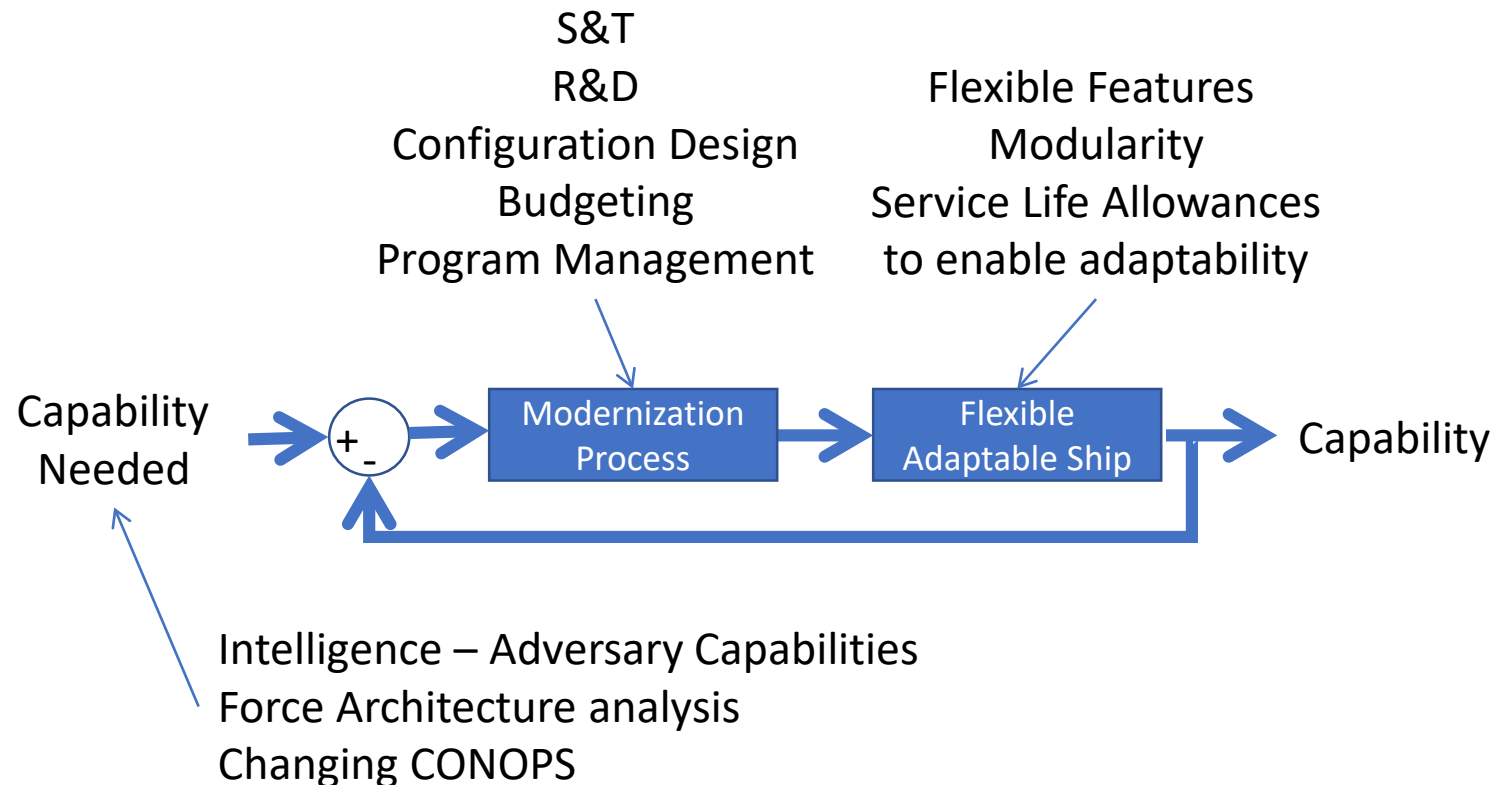


Flexible Infrastructure





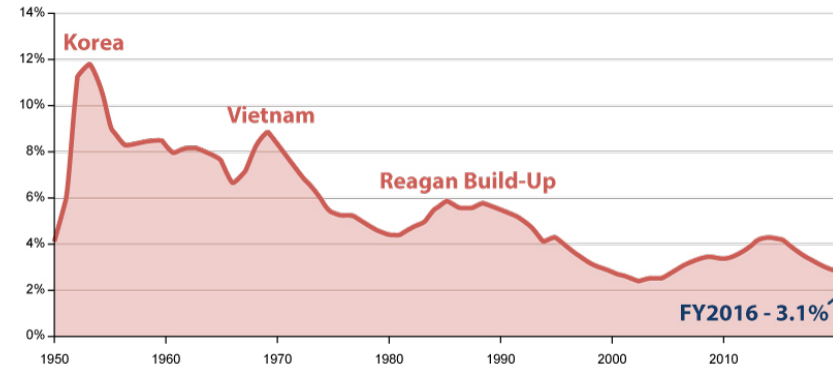
# Need to rapidly evolve a ship over its service life to reflect evolving needs



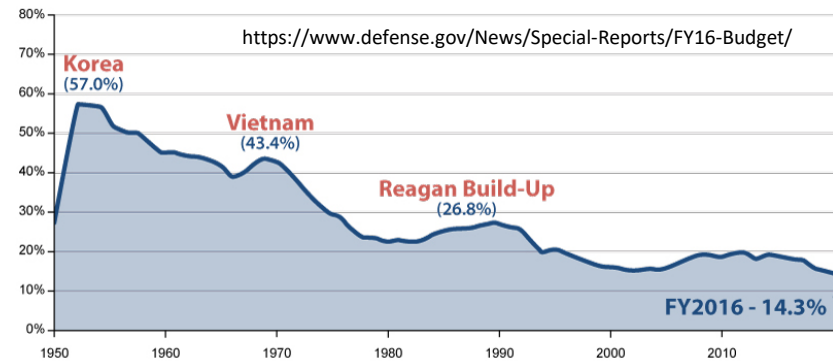
# Affordability

- Affordability is the willingness to spend budget authority on a system.
- Depends on
  - Relative value with respect to other investments
  - Geopolitical Threat
  - Fiscal Environment
  - Industrial Base

Can modularity, flexibility, and adaptability help maximize effectiveness in a changing affordability environment?



Defense Spending as a Share of the Economy (GDP)



Defense Spending as a Share of Total Federal Spending

# Challenge

- How should the requirements development process change to take advantage of modularity, flexibility and adaptability?
- How should one determine how much of what type of modularity, flexibility and adaptability to incorporate into a ship design?
- What new tools and methods should be incorporated into the design process?
- What changes to the ship modernization process are needed to take advantage of modularity, flexibility and adaptability?
- How can modularity, flexibility, and adaptability maximize effectiveness in a changing affordability environment?
- How do we properly estimate costs for a modular, flexible and adaptable warship to facilitate making good investment decisions?