Challenges for the Naval Ship Design Community

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Topics

• Background and Motivation
• Producibility from DAY ONE
• Design for Maintainability and Upgrade
• The Ship Designer as an Integrator
• The Ship Designer as a C4ISR Expert
• Reducing Type/Model Series
• Community Demographics
Background and Motivation
Ship Design State Today

• The “logjam” of lead ship designs is dissipating
  – LPD-17 on hull 6
  – LCS on hulls 3 to 10+
  – CVN-78 still to deliver but design effort is past peak
  – DDG-1000 still to deliver but design effort is past peak
  – MLP starting production but a simpler ship than most
  – LHA/LHD design work is past peak

• Our decade plus of lead ship issues has provided many lessons learned – will we use them?

• What can our community do to apply the hard lessons learned to the next round?

• We will experience a “lull” in early stage design of surface ships and a ramp of submarine design needs

• We have had our share of problems, but the Design Community can be justifiably proud of keeping our Navy at the forefront of superiority
Background and Motivation

• We have the best Navy in the world
  – Most technologically advanced
  – Most lethal
  – Most reliable
  – Forward-deployed day in and day out
  – Multi-mission
  – Able to affect the political landscape as an instrument of National Policy

• So, what’s the problem?
Background and Motivation

*Cost is threatening our future*

- The Navy today
  - Approximately 280 ships
  - Approximately 3500 airplanes
  - 325,000 people
  - 50 plus percent underway
  - 35 percent forward deployed

- CNO stated requirement – 313 to 330 battle force ships

- 30-year shipbuilding plan can’t get us there on current SCN plan

- Budget cuts are coming – SCN is $13-17 Billion per year, what will it be in the future?

**We cannot continue to run our Navy at current rates, and we cannot recapitalize it without action now on affordable ships**
Background and Motivation
Major Shipbuilding needs – next 30 years

- Continuous construction of Aircraft Carriers (and their air wings)
- OHIO-class replacement
- Missile defense
- Surface combatant renewal/expansion
  - Aegis fleet
  - FFG/Corvette
  - LCS build out, including mission modules
- Amphibious Lift recapitalization
- Command Ships
- Missions we have not thought of yet
Background and Motivation

Needed – pervasive cost reduction strategies for acquisition and life-cycle cost

• Cultural changes
  – Mission Performance Requirements streamlining
  – Design philosophy – production is king
  – Challenging our own specification requirements
  – Design for ease of Maintenance and Upgrade

• Process changes
  – Design tools
  – Collaboration
  – Cost modeling
  – Physics Modeling

• Technology improvements
  – Steer $$ toward cost reduction

The Ship Design Community “owns” the ability of the Navy to invest in the Future Fleet!
Producibility from Day One

• Shipbuilders onboard early!!!
  – Before the Ship Spec is developed
  – During requirements tradeoffs
  – Require pervasive commonality

• Systems Simplification – ship structure and ship systems
  – Piping Systems
  – Common, repeatable structural elements
  – Standardized machinery and electrical components
  – Commercial where it makes sense

• Systems Simplification – combat systems
  – Common computing environment
  – Common software development
  – Common hardware sourcing

• Finish the design before construction

• Invest in Modular Outfitting and separate construction of payloads
  – LCS did not go far enough!

We pay lip service to all this – when will we actually execute???
Design for Maintainability and Upgrade

- The problem:
  - It is very expensive to rip up systems to upgrade them
  - We lose valuable service time to the warfighters when we take our systems offline to overhaul and upgrade
  - Unless the program funds the logistics plan, it doesn’t really exist
  - Make use of the Design Products from acquisition to facilitate maintenance and modernization throughout the life-cycle

- The Reality of a ship life-cycle
  - Concept Design to Lead Ship Delivery – 8 to 15 years
  - Delivery to first deployment – 2 years
  - Construction project duration – 10 to 15 years (longer for DDG)
  - Individual Service Life of 30-35 years (50 for CVN)

- We can’t know what the warships will carry in the future, so we must be smart about the design now

For the last ship of the class to be combat effective on decommissioning date – we must plan for 60 to 75 years in the ship design
Design for Maintainability *and* Upgrade

- Warfare Systems Upgrade is prime consideration over life cycle
- Logisticians/Maintainers must be on Integrated Product Teams
- Warfighting systems upgrades are unknown and must be given ample margin for lifetime upgrade
- Steel is cheap, relatively
- LRU/Sparing philosophy upfront
- Develop Logistics Technical Data up front
- Develop Training and maintenance strategy up front

Source: GD and Defense News Daily
The Ship Designer as Integrator

- Ship Design and Construction – OF COURSE
- BUT . . . . . . .
  - Sensors and weapons impact every aspect of the design
  - Stealth and Shock implications continue to challenge us
  - Producible ship considerations must be driven into design from the start
  - Software Development and Maturation is part of our job
  - 3-D Product Environment is our toolset
  - Cost Engineering is not optional or add-on
  - Power Distribution Systems are evolving rapidly
  - Information Technology Systems are exploding and will drive us for a long time to come
- Our environment is far more complex than even 15 years ago
  - Interface Control and understanding is paramount
  - Mission Modules
  - Subsystem Shipboard “services” requirements
    - HAVAC
    - Water
    - Power
- We must truly ramp up our game if we expect to stay on top of the Total Warship design
The Ship Designer as C4I Design Expert

• 50 percent of the cost for combatants is the weapon/combat systems suite

• Integration and testing of this suite takes at least 20 percent of construction time during the most expensive part of construction

• We continue to carry 16 surface ship combat systems hardware/software baselines

• We are integrating and testing upwards of 20 million SLOC on combatants

• We will be integrating CANES into all ships

• We must track
  – Software progress, including manning
  – Trouble reports
  – Completion of CSCI’s
  – Certification of initial testing
  – Certification of regression testing

• Sensor/shooter integration into the basic ship
  – Driving for submarines
  – Evolving toward driving for surface ships

Source: Navy.mil
Reducing Type/Model/Series
Building on Naval Aviation Enterprise Model?

- We have 19-20 “Type/Model/Series” of ships
- Modified repeats are cheaper to design and execute than full-up designs
- We continue to carry 16 surface ship combat systems hardware/software baselines, which account for up to 50 percent of the cost of combatant design and production
- We must both reduce cost of new designs and make maximum use of existing platforms
  - Modeling environment
  - Rolling combat system baselines – submarine model
- This requires discipline – we love new ship designs but our Navy can’t afford the crushing non-recurring costs of new classes of ship unless absolutely necessary
- Suggested Approach
  - Involve Shipbuilders – again
  - Use the modularity and commonality approach
  - Discipline of “cleverness” – can we fit new missions into existing platforms??

Source: Navy.mil
Our Ship Design Community - Demographics

• Where is the design workforce?
  – Government – NAVSEA/PEO’s
  – Shipbuilders – General Dynamics and Huntington Ingalls Industries
  – Shipbuilders – “Second Tier”
  – Combat Systems Houses – LM, Raytheon, GDAIS, L3, etc
  – M Street
  – Independents

• Proposition
  – There are enough Naval Ship Design people in the USA, but we are not employing them correctly
  – The Navy CANNOT afford to keep each individual shipbuilder design workforce completely independent
  – Our needs are cyclical
  – The basics of the Naval Ship Design business are portable
  – The specifics of specialized ships can be preserved
    • Nuclear Power
    • Submarines
    • Aircraft Carriers

• We as a community need to think about combining forces and finding a way to preserve the total good, while recognizing that multiple standalone design workforces are not sustainable
Conclusions

• We need more ships and aircraft to accomplish our mission, not less

• Our nation won’t increase our budget
  – 11 years of war
  – Fiscal pressure-sequestration
  – Other National priorities

• We can’t achieve the numbers unless we get substantially cheaper – quickly

• Pervasive Cost Reduction is a priority

• Our warfighters can’t perform if they do not have the platforms to deliver weapons on target

• There cannot be networked capabilities across platforms if there are not enough platforms

• We are in charge of the solution