SHARPENING THE SPEAR

The Carrier, the Joint Force, and High-End Conflict

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EXECUTIVE SUMMARY

- The CVN—and sea-based air power—are central to deterring, conducting, and winning high-end conflict.

- The Carrier Strike Group (CSG), with the large, nuclear-powered aircraft carrier (CVN) at its core, remains the most effective and efficient means of providing these capabilities across the range of military options.

- In order to provide these required capabilities, the Navy must pursue a series of conceptual, capability, and capacity improvements to the CVN, the Carrier Air Wing (CVW), and the CSG.
THE EVOLUTION OF THE AIRCRAFT CARRIER

**Key Points**

- The perceived value of the large-deck carrier has significantly fluctuated throughout its history.
- The perceived value of the large-deck carrier is currently largely declining in light of A2/AD threats and cost considerations.
- New concepts and capabilities could “bend the curve” upward against A2/AD threats.
## The Evolution of the Aircraft Carrier

### Alternative Carrier Design Characteristics

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Displacement (full load in tons)</td>
<td>13,735</td>
<td>29,130</td>
<td>59,800</td>
</tr>
<tr>
<td>Length (feet)</td>
<td>610</td>
<td>717</td>
<td>912</td>
</tr>
<tr>
<td>Speed (Maximum in knots)</td>
<td>26</td>
<td>30</td>
<td>27.8</td>
</tr>
<tr>
<td>Manning (Including Air Wing)</td>
<td>700</td>
<td>1,600</td>
<td>4,025</td>
</tr>
<tr>
<td>Aircraft</td>
<td>3 AV-8B, 17 SH-3</td>
<td>4 AV-8B, 6 SH-2, 16 SH-3D</td>
<td>24 F-14A, 10 S-3A, 4 EA-6B, 6 SH-3H, 4 KA-6E, 8 E-2C, 2 RA-7</td>
</tr>
</tbody>
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### The Evolution of the Aircraft Carrier

<table>
<thead>
<tr>
<th>75 Concept Designs Analyzed in DoD’s CVX Study Analysis of Alternates 1996-2000</th>
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</thead>
<tbody>
<tr>
<td><strong>PT-1 SMALL AIRWING (10 Studies)</strong></td>
</tr>
<tr>
<td>4- CONV-CTOL/STOVL</td>
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<tr>
<td>4A- CONV-CTOL/STOVL</td>
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<tr>
<td>4B- CONV-CTOL/STOVL</td>
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<td>4C- NUC-CTOL/STOVL</td>
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<tr>
<td>4D- CONV-CTOL/STOVL</td>
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<tr>
<td>5- CONV-STOVL</td>
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<tr>
<td>5A- CONV-STOVL</td>
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<tr>
<td>5A1- CONV-STOVL</td>
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<tr>
<td>5A2- CONV-STOVL</td>
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<tr>
<td>5B- NUC-STOVL</td>
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<tr>
<td><strong>PT-1 MEDIUM AIRWING (6 Studies)</strong></td>
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<tr>
<td>2- NUC-CTOL/STOVL</td>
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<tr>
<td>2A- NUC-CTOL/STOVL</td>
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<td>2B- CONV-CTOL/STOVL</td>
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<tr>
<td>2B1- CONV-CTOL/STOVL</td>
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<tr>
<td>2C- NUC-STOVL</td>
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<tr>
<td>2C1- CONV-STOVL</td>
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<tr>
<td><strong>PT-1 LARGE AIRWING (6 Studies)</strong></td>
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<tr>
<td><strong>PT-2 CONVENTIONAL PROPULSION (18 Studies)</strong></td>
</tr>
<tr>
<td>NH 5- EXP CAP BL(ECBL)</td>
</tr>
<tr>
<td>NH 7- ECBL w/ LOW PROTECT</td>
</tr>
<tr>
<td>NH 9- NH 6 w/ ++ R&amp;D ITEMS</td>
</tr>
<tr>
<td>5- NUC-STEALTH- 65 CTOL</td>
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<tr>
<td><strong>PT-2 STEALTH HULL FORM (5 Studies)</strong></td>
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<tr>
<td>5- NUC-STEALTH- 65 CTOL</td>
</tr>
<tr>
<td>S1- NUC-STEALTH- 55 CTOL</td>
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<tr>
<td>S4- CONV-STEALTH- 65 CTOL</td>
</tr>
<tr>
<td><strong>PT-3 NEW HULL FORM (6 Studies)</strong></td>
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<td>5- NUC-STEALTH- 65 CTOL</td>
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<tr>
<td>S1- NUC-STEALTH- 55 CTOL</td>
</tr>
<tr>
<td>S4- CONV-STEALTH- 65 CTOL</td>
</tr>
<tr>
<td><strong>PT-3 MODIFIED REPEAT NIMITZ (8 Studies)</strong></td>
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<tr>
<td>5- NUC-STEALTH- 65 CTOL</td>
</tr>
<tr>
<td>S1- NUC-STEALTH- 55 CTOL</td>
</tr>
<tr>
<td>S4- CONV-STEALTH- 65 CTOL</td>
</tr>
<tr>
<td><strong>PT-4 NUCLEAR PROPULSION (14 Studies)</strong></td>
</tr>
<tr>
<td>MR 1- CVN 76 BASELINE</td>
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<tr>
<td>MR 2- MR1 w/ AVN IMPROV</td>
</tr>
<tr>
<td>MR 3- MR2 w/ + PROTECT</td>
</tr>
<tr>
<td>MR 4- MR3 w/ BLUSTER</td>
</tr>
<tr>
<td>MR A- MR2 w/ + AVN IMPROV</td>
</tr>
<tr>
<td>MR AA- MRA w/ ++ AVN IMPROV</td>
</tr>
<tr>
<td>MR B- MR1 w/ ++ PROTECT</td>
</tr>
<tr>
<td>MR C- MR1 w/ KG SL MAX</td>
</tr>
<tr>
<td><strong>Pt-1,2,3 CVN 76 COST BASELINE STUDY</strong></td>
</tr>
</tbody>
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**Legend:**
- **CTOL:** Catapult and Recovery System (Cat and Rec)
- **STOVL:** Short Take-Off and Vertical Landing
- **NUC:** Nuclear
- **ECBL:** Enhanced Capability for Battle Line
- **PROTF:** Protective Hull Form
- **STEALTH:** Stealth Technology
The CSG is operates and fights as a system.
- Key roles in providing presence, deterrence, and warfighting capabilities to the country.
- Carrier operations on recent display.

2014 Quadrennial Defense Review called for the Joint Force to “project power and win decisively” in spite of “increasingly sophisticated adversaries who could employ advanced warfighting capabilities.”
- The most challenging scenarios for the Joint Force—military operations against the peer or near-peer threat of China—merit examination in evaluating the role of the CSG.

Defense of Taiwan rises to the top in terms of its utility in force planning.
- Prevent a PRC invasion of Taiwan
- Counter compellent forces
- Support Taiwanese survival
- Apply direct pressure against PRC power projection forces and indirect pressure via extended blockade and other elements of U.S. national capability.
ASSESSMENT OF THE FUTURE FORCE: Challenges

- Challenges to the future Joint Force
  - A2/AD systems will likely proliferate
  - A2/AD systems will mature and improve in sophistication and coverage, and will feature improved sensors, networks, and weapons
  - China’s “Anti-Access Enabled Power Projection Force”
Current CONOPS are:

- Relatively brittle and vulnerable to enemy disruption and deception.
- Highly dependent on air forces.
- Threat of structured attacks of missiles and aircraft
- Threat of advanced IADS

Perceived U.S. advantages in military competitions, such as Undersea Warfare, Air Superiority, and Secure C4ISR, are eroding.
The Joint Force will require carriers to execute power projection, sea control, and surveillance missions.

Sea control requirements will rise
- Enemy threat capabilities will continue to rise.

Critical warfighting requirements that would go unmet or at least be dramatically under-resourced without aircraft carriers.
In a conflict with China, the importance of carrier-based naval air forces would increase.

- **AAW:** Independent OCA missions, escort support of Air Force units (such as bombers), supporting OCA missions to dislocate enemy SUW and ASW operations, and selective DCA for Second and Third Island Chain bases.

- **Strike:** Support to other naval forces, engaging enemy naval forces, limited strikes against land-based operational nodes

- **ISR:** Enemy forces at sea, in the air, and on land

At the earlier stages of a conflict, CSGs focus on sea control and Joint Force enabler missions, before increasing proportion of effort dedicated to power project as gains are made against the adversary ISR complex.
CONSTRUCTION
- HII Newport News only shipyard capable

PORT STAY
- Can be attacked or surveilled in port

C2 AND NAVIGATION
- Threats from RF/DF systems
- Threats SATCOM, GPS, all satellites

SECURING OPERATING AREAS
- CSG complicates enemy kill chain
- However, plentiful and persistent enemy ISR and strike.
- U.S. land/space-based ISR degraded.

STRIKE
- CSG restraint, LR ops or “stand-in”
- Challenges due to CVW, weapons mix, and air threats

AIR WARFARE
- Reduction in land-based TACAIR places a premium on CVW AAW
- Potential qualitative and quantitative inferiority

UNDERWAY REPLENISHMENT
- Potential capacity shortfall during a major conflict
- Threats against CLF
- Lack of VLS Reload
- Threats against land-based logistics system

ATTRITION AND REPAIRS
- Damage and losses
- Recoverability
- Long range CSAR
In spite of threats and limitations, current CVW strike capability and capacity is significant, even at extended ranges.

However, current CVW capability highly dependent on tanking.
CVW crucial for AAW, yet limited in size compared to force generation by continental enemy. Consequently,

- CVW should be husbanded for pulse operations
- Tanking vulnerable to disruption, so organic LR important
- Degrading enemy broad-area ISR important
- Maximize number of embarked aircraft on carriers
- Continued importance of integration with the Joint Force
Likely CLF capacity shortfall during a major conflict.

<table>
<thead>
<tr>
<th>CLF Ships</th>
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<tbody>
<tr>
<td>Ship Class</td>
<td>Number</td>
<td>Fuel Storage (barrels)</td>
<td>Ordnance Storage (tons)</td>
<td>Speed (knots)</td>
</tr>
<tr>
<td>T-AO 187</td>
<td>15</td>
<td>180,000</td>
<td>N/A</td>
<td>20</td>
</tr>
<tr>
<td>T-AOE 6</td>
<td>3</td>
<td>156,000</td>
<td>1,800</td>
<td>26</td>
</tr>
<tr>
<td>T-AKE 1</td>
<td>12</td>
<td>18,000</td>
<td>5,900</td>
<td>20</td>
</tr>
</tbody>
</table>

CLF Capacity and Demand for Refueling CSGs 2,000 and 3,000 NM from Advanced Bases

- **Demand for Oilers and Fast Combat Support Ships at 2,000 NM**
- **Demand for Oilers and Fast Combat Support Ships at 3,000 NM**
- **Number of Oilers and Fast Combat Support Ships**
CSG EFFECTS CHAIN ANALYSIS: Summary

- CSGs would face major, multifaceted threats in operations against a mature A2/AD threat, such as China.
- Although many of these threats could affect units other than the CSG, the CSG’s important role in power projection operations makes it a valuable target and the carrier’s large signature makes it relatively vulnerable to detection.
- Despite these threats, assessment of the role of CSGs in counter-A2/AD operations demonstrates both significant utility and significant weaknesses in the near term.
- Using a combination of novel defensive capabilities and astute tactics, vulnerabilities can be mitigated.
IMPROVING THE CSG AS A SYSTEM
CSG Concepts of Employment: Power Pulse

Persistent Support

Power Pulse
IMPROVING THE CSG AS A SYSTEM

CSG Concepts of Employment: Integrated, Multi-CSG Ops

Cooperative Multi-CSG Operations

Integrated, Multi-CSG Operations
IMPROVING THE CSG AS A SYSTEM

CSG Concepts of Employment: Develop Single Naval Battle

Red Forces Expand Defensive Perimeter

Employ Single Naval Battle

Novel CSG Capabilities: AIRCRAFT CARRIER

- EMCON
- Ship Self-Defense Systems: Surface Ship Torpedo Defense, directed energy
- Improving recoverability
Novel CSG Capabilities: CARRIER AIR WING

- Address capability gaps:
  - Increase Striking Range: LR aircraft, weapons, and tanking
  - Develop Sea Control Aircraft: organic, persistent ISR and targeting, LR strike, air superiority, ASW, SAR
  - Develop New Munitions and Sensors: ASCM, LR AAM, IRST, ASW, jammers
Novel CSG Capabilities:
CARRIER AIR WING

- Address capacity gaps:
  - Over 100 aircraft fighter shortfall
IMPROVING THE CSG AS A SYSTEM

Novel CSG Capabilities: OTHER SHIPS IN CSG

- Cruisers and Destroyers
  - Improve surface combatant airborne ISR capabilities
  - VLS reload underway or at dispersed locations
- CLF and Supporting Logistics Force
  - Critically appraise sufficiency of CLF
  - Active or high Reduced Operating Status T-AOE force
  - Defensive armament to CLF ships
  - Exercise convoy operations for CLF, MSC, and comm. ships
  - Distribute and harden land-based logistics infrastructure
FLEET DESIGN OPTIONS

- The Current Fleet
- Alternative Fleet Design Options
  - Existing Fleet Design, Except with More Numerous, Smaller Aircraft Carriers
  - Moving to a Navy with No Carriers
  - Improving the CSG as a System

Comparison of FORD Class (CVN 80) with Alternate Ship Designs

<table>
<thead>
<tr>
<th></th>
<th>% Increase in Cost for Single Ship</th>
<th>% Increase in Cost for Three Ships</th>
<th>% Increase in Aircraft Capacity</th>
<th>% Increase in Aviation Fuel Storage</th>
<th>% Increase in Munitions Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>USS AMERICA (LHA 6)</td>
<td>132%</td>
<td>132%</td>
<td>264%</td>
<td>164%</td>
<td></td>
</tr>
<tr>
<td>FS CHARLES DE GAULLE (R 91)</td>
<td>22%</td>
<td>64%</td>
<td>53%</td>
<td>225%</td>
<td></td>
</tr>
<tr>
<td>HMS QUEEN ELIZABETH (R08)</td>
<td>10%</td>
<td>42%</td>
<td>50%</td>
<td>247%</td>
<td>480%</td>
</tr>
</tbody>
</table>
How many carriers does the United States need and why?

- Legislation: 11 carriers, waived to 10
- 2007 two-hub, 11 carrier requirement
- In 2015 with rising major threats? China, Russia, Iran, ISIS
- Rule-of-thumb for calculating required carrier Fleet size: \(5 \times (\text{Number of Hubs}) + 1\)
  - Two hubs: 11 carriers
  - Three hubs: 16 carriers
Periodic assessment of CVN utility, design, and CONOPS is important.

No other element of our military is as extensible across ROMO.

The Chinese A2/AD complex represents the greatest threat to the aircraft carrier; paradoxically, the implications of this high-end threat argue strongly for the CVN.
IMPROVING THE CSG AS A SYSTEM

CSG Concepts of Employment: Distributed Basing Dynamics

Current Shuttle Model of Nearby Logistics

**CLF ships provide a "Shuttle Model" of logistics to the CSG from a select number of vulnerable nearby bases.**

Distributed Basing Dynamics

**CLF ships operate from a large number of nearby, geographically distributed bases.**

If necessary, CLF ships operate from Main Operating Bases at extended range.

Surface combatants reload LCS cells underway, in anchorages and atolls, and in small ports.

CLF ships conduct at-sea fuel and cargo/munitions transfers from tanker and cargo ships in anchorages or atolls.
IMPROVING THE CSG AS A SYSTEM

CSG Concepts of Employment: Air Force-Navy Theater Strike

Potential Threats

Red missiles strike nearby Blue airbases and Army Air and Missile Defenses with missiles, suppressing flight operations, while Red bombers threaten to launch cruise missiles against Blue forces.

Employment of Air Force-Navy Theater Strike

Blue CVW intercepts Red bomber force and provides temporary Combat Air Patrols over Blue airbases.

Operates at distance from dispersed airfields, Blue Air Force tanking maximizes Blue CVW combat potential.

Blue CVW low-observable UAV targets Red Amphibious Force, while DVL AEA jams enemy radars. Blue CVWs escort Air Force bombers against Red OCA.
REPRESENTATIVE CLF FORCE OPTIONS FOR ADVANCED BASES IN THE ASIA-PACIFIC

2,000 NM Straight-Line Distance from CSG to Advanced Bases in Japan, Korea, Philippines, Singapore, Marianas, and Northern Australia.

3,900 NM to Hawaii.

4,500 NM to Diego Garcia.
CVX STUDY METHODOLOGY TO MEET CRITICAL CAPABILITY

Air plan CVX deck
Reliability

Strike sorties

Aircraft for strike

Aircraft on deck

Aircraft in Airwing

BSD sorties

High BSD
2 CAP stations (4 a/c)
4 alerts + 4 tankers
2 a/c on other tasks
Requires 22 F/A over 12 hrs.

Moderate BSD
1 CAP station (2 a/c)
2 alerts + 2 tankers
2 a/c on other tasks
Requires 14 F/A over 12 hrs.

Low BSD
4 alerts + 2 tankers
(alerts are spares)

Plus 13 support a/c,
3 Jammers, 6 Support, 4 helos.
Because most of their strike/fighters are engaged in the defensive Fighter role with few or no strike/fighters to do Strike, small carriers do not meet the Critical Capability.
NIMITZ CLASS KEY DATE SCHEDULE

CVN 68 – USS NIMITZ
CVN 69 – USS EISENHOWER
CVN 70 – USS VINSON
CVN 71 – USS ROOSEVELT
CVN 72 – USS LINCOLN
CVN 73 – USS WASHINGTON
CVN 74 – USS STENNIS
CVN 75 – USS TRUMAN
CVN 76 – USS REAGAN
CVN 77 – USS BUSH

Nimitz Class
Avg Interval = 3 Yrs 9 Mos
Avg Duration = 7 Yrs 10 Mos

Two Ship Procurements
Avg Interval = 2 Yrs 11 Mos
Avg Duration = 6 Yrs 11 Mo
GERALD R. FORD CLASS KEY DATE SCHEDULE
(PLAN OF RECORD, AS OF 2013)

CVN 78 – Gerald R. Ford

CVN 79 – John F. Kennedy

CVN 80 - Enterprise

Navy Can Reduce Intervals Between Ships to <4 Years and Reduce Build Durations Closer to those of Nimitz Class
PERCENTAGE CHANGE IN SCN COST COMPARED TO PREVIOUS CVN (LESS DESIGN)
DF-21D Coverage from Three Launch Sites
(~2,000 km range)
DF-26 Coverage from Three Launch Sites
(~4,000 km range)