# Rebooting The “Jeep” Carrier: When Less Is More In A “Big” Deck

**Major John Kelly, USMC**

**USMC School of Advanced Warfighting**
Marine Corps University
3070 Moreell Avenue
Quantico, VA 22134-5068

**Abstract**
The advance of technology in ship design and operations now allows a single ship to do more with fewer personnel – modern ship designs such as the Gerald Ford class CVN exemplify this development. Additionally, advances in aircraft design, such as tilt rotor technology and fifth generation fighters have increased the range and effectiveness of sea-based aviation, reducing the number of aircraft needed to accomplish the same missions as legacy aircraft. A modern variant of the “light” or “escort” carrier would provide a low cost and versatile alternative to current aircraft carrier designs. Rather than consolidate a large number of assets in a capital ship, multiple smaller aircraft carriers could achieve the same effect at less cost, while providing wider coverage overseas. Whether adapted from a commercial merchant design or designed from the keel up, a “jeep” carrier has a place in the anticipated future operating environment combatant and non-combatant roles.

**Subject Terms**
FUTURE WAR PAPER

Rebooting The “Jeep” Carrier: When Less Is More In A “Big” Deck

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AUTHOR: Major John Kelly
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Mentor: Dr. Wray Johnson
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EXECUTIVE SUMMARY

The outlook of the National Security Strategy anticipates increased US commitments overseas, while the Department of Defense expects a smaller military with which to operate due to reduced budget authorizations, translating to a fewer number of ships, aircraft, and personnel with which to fulfill its mission. The ability of the US to operate for sustained periods of time from the sea remains a vital capability that must be maintained if it is to maintain its influence among allies, partners, and adversaries alike.

The advance of technology in ship design and operations now allows a single ship to do more with fewer personnel - modern ship designs such as the Gerald Ford class CVN exemplify this development. Additionally, advances in aircraft design, such as tilt rotor technology and fifth generation fighters have increased the range and effectiveness of sea-based aviation, reducing the number of aircraft needed to accomplish the same missions as legacy aircraft.

A modern variant of the “light” or “escort” carrier would provide a low cost and versatile alternative to current aircraft carrier designs. Rather than consolidate a large number of assets in a capital ship, multiple smaller aircraft carriers could achieve the same effect at less cost, while providing wider coverage overseas. Whether adapted from a commercial merchant design or designed from the keel up, a “jeep” carrier has a place in the anticipated future operating environment combatant and non-combatant roles.
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I. Introduction

Presently, the US government anticipates an "increasingly complex set of challenges" in the future operating environment. While still striving to take an "active approach" to worldwide concerns, the US Department of Defense is experiencing fiscal limitations that have emerged within recent years. The reduced availability of naval shipping resulting from increased mission requirements and obligations have stretched US naval presence extremely thin. Additionally, advanced technologies are becoming available that are changing the nature and reach of naval operations. Within this context, the capabilities and role of the aircraft carrier must adapt to the future operating environment. Given the future military and political environments and commitments anticipated, a modern variant of the "light" or "escort" carrier would provide a lower cost and more versatile solution to US naval power projection requirements across the range of military operations.

II. The Problem and Its Context

In the view of the US Department of Defense, the future poses "an increasingly complex set of challenges" requiring the US to "continue to take an active approach to countering emergent threats by monitoring the activities of non-state threats worldwide, working with allies and partners to establish control over ungoverned territories, and directly striking the most dangerous groups and individuals when necessary." In the ten missions that the 2012 Defense Strategic Guidance outlines, all require potential support from the sea for execution.

However, a stagnant economy and a shrinking defense budget may not support this scheme; the number of naval assets capable of providing options for power projection will fluctuate over the next 30 years. Concerns over a "hollow force" - a military overcommitted relative to the resources available
- have been raised as the US enters a second round of sequestration and a downward trend in military funding. The FY2013 Defense Budget requested funding for 11 nuclear aircraft carriers (CVNs) to cover the deployment, training, and maintenance requirements for the aircraft carrier fleet, but this level of funding may not continue into FY2014. The Navy’s ten “big deck” amphibious assault ships (LHD/LHA) are in a similar situation. The result of funding cuts will be reduced availability of ships with fixed-wing capable flight decks operationally deployed.

With a higher operational tempo and a reduced number of ships comes a penalty. The availability of naval shipping is influenced by the maintenance, training, and deployment cycles of the ships themselves, as well as that of their crews. There is a continuous balancing act between operational requirements, shipyard availability, light and heavy maintenance cycles, and training periods. Any interruption to this cycle can have a ripple effect, especially with a decreased pool of assets to draw from. As the Chief of Naval Operations, Admiral Gary Roughhead, testified in 2010, “In the last decade, the Navy fleet has decreased by 30 ships, or about 10 percent, and active duty end strength dropped 13 percent, while operational demands have grown...we are consuming the service life our fleet at a higher than expected rate...” Further, the Navy’s 30 year shipbuilding plan expects to maintain a target number of 306 ships per fiscal year, which includes 10-12 CVNs and 29-34 amphibious ships (of all classes). This plan assumes that “all battle force ships serve to the end of the planned or extended lives.” Casualties to shipping, which can take some time to repair, immediately strain this number.

Since its beginnings in the US Navy, the aircraft carrier has filled six roles throughout the years. In recent years, especially following the end of the Cold War, two roles have persisted: the carrier as a mobile platform for aircraft projection (“Airfield At Sea”) and as an element of
diplomatic strategy ("Geopolitical chess piece"). In the ten-year period from 1998 to 2008, even while supporting combat operations in two countries, CVNs have dedicated most of their effort in support of peace operations, shows of force, and Humanitarian Assistance/Direct Relief (HA/DR) missions, and since 2008 little has changed. These roles have applied highly capable assets – CVNs – against missions for which they are overmatched. While the CVN provides “power projection, forward presence, humanitarian assistance, deterrence, sea control and maritime security” the reality is that this large, capable asset is designed for one thing: striking power that cannot maintain a presence on a hostile shore. It is an inefficient use of a CVN (and its attendant strike group) to support smaller scale operations such as anti-piracy, maritime interdiction, and other missions. The CVN should be assigned to only major operations of national importance. Similarly, the LHD/LHA, which has the capability to project and maintain power ashore, is a large and expensive multi-role platform that should be available for missions of vital national interest. While CVNs and LHDs/LHAs are conducting support to minor operations they are not available for larger missions, reducing their potential strategic impact and creating gaps in US presence worldwide.

If sea control of whatever duration requires physical presence, the US Navy will lag behind in this responsibility, and the nation will accept risk with the forces it deploys forward. Ship availability directly impacts the US’s ability to maintain presence and project power from the sea. Most visibly, US power projection is in the form of a carrier strike group (CSG) and/or an Amphibious Ready Group (ARG) with a Marine Expeditionary Unit (MEU) positioned off the shores of a potentially hostile area. Both assets are centered on a flight deck capable of fixed-wing operations, providing “sovereign” US territory from which the US can operate from the sea. This sovereign territory, however, is limited due to ship availability and operational factors such as deck cycles an the number of aircraft available.
To offset this limitation, the US has relied on basing assets in countries; however, this option is becoming increasingly degraded. For political, legal, and other reasons, allies and friends have become reluctant to allow the US basing or over flight rights. Such restrictions have degraded operational reach. US allies remain wary of indirectly supporting military action against adjacent or regional neighbors. Without land-based options (especially if the US undertakes unilateral action), operational reach is further limited by the number of flight decks on station from which to operate.

Advances in the technologies for ship construction, ship operations, and the aircraft that operate from ships have also made a significant impact on the calculus of the role and capability of naval power projection. In shipbuilding improved technologies allow ship designs that require fewer personnel, such as in the latest designs of the Fast Sea Frame (FSF), Gerald Ford Class CVN, the San Antonio Class LPD, and DDG-1000 series.

Most strikingly, the fifth generation fighter, due to replace fixed wing “legacy” aircraft presently aboard CVNs and LHA/LHDs, promise to deliver a significant increase in capability operating from ships.\textsuperscript{12} The Joint Strike Fighter (JSF) best illustrates the potential of fifth generation capability and the asymmetric advantage it maintains.\textsuperscript{13} The JSF, and presumably other fifth (and beyond) generation fighters, will bring improved sortie generation rates, improved range and fuel consumption, quicker maintenance turnaround time an reduced maintenance levels, and a smaller logistics footprint (for both personnel and equipment) requiring fewer and smaller facilities. With this leap ahead in technology and operations, the requirement to build a large ship to house and maintain large numbers of aircraft is no longer valid.\textsuperscript{14} Similarly, the tilt rotor technology has greatly increased the range of aircraft performing the assault support role. As illustrated by the now operational V-22 Osprey, the tilt rotor can fly much faster and further than
“legacy” helicopters. The operational possibilities of tilt rotor technologies are just beginning to be explored.\textsuperscript{15}

\textbf{III. Recommendation}

Based on this discussion, the possibility to revive the escort or light carrier design emerges as a practical option for future US power projection. The “jeep” carrier, as it was colloquially known, traces its roots to World War II, when the requirement for additional flight decks was quickly required. The jeep carrier was produced in two variants: the CVE (Aircraft Carrier, Escort) and CVL (Aircraft Carrier, Light).\textsuperscript{16} Though smaller in size from than a “fleet” carrier and not as capable, they could be produced quickly and at low cost.\textsuperscript{17} The original impetus behind their development was to provide air cover for the defense of transatlantic convoys against German U-Boat attacks. As the ship’s design matured and more operational requirements were identified, they were used to provide air defense for convoys, air support to amphibious assaults, to move equipment, supplies, and personnel, and other miscellaneous tasks. Considered austere living by their crews and much more susceptible to catastrophic damage, they nonetheless augmented Allied naval aviation capability, providing flexibility and the availability of air power to missions at sea and ashore through the increase of additional flight decks.

For the purpose of this discussion and within the current naming convention, this paper will discuss two potential platforms.\textsuperscript{18} The first would be the CVE(A): CVE to designate its role capability as a “true” escort carrier and (A) to denote its ability to project and sustain forces ashore. The CVE(A) would be designed to support missions in high-risk areas with peer or near-peer threats, such as anti-ship cruise missiles, and would be designed to operate as a true aircraft carrier, only smaller in size and complement. These ships would be commissioned and operated by the US Navy.
The second variant would be the ACV(A): ACV to designate its role as an auxiliary platform from which aircraft can operate, and (A) to denote its ability to project and sustain landing forces ashore. The ACV(A) would be designed to support missions in permissive or semi-permissive threat environments and would also be designed to operate as a platform capable of supporting fixed and rotary-wing flight operations. The key difference between the ACV(A) and the CVE(A) would be the design characteristics that the CVE(A) would require, especially in terms of damage control and survivability, self-defense, and command and control. Another difference is that the ACV(A) could be operated wholly or in part by military sealift command, carrying the “USNS” prefix.

Both of these platforms would be designed to support an operational niche somewhere between a “baby carrier” and “amphib light” option. Their key feature would be the flight deck, able to accommodate both manned and unmanned fixed and rotary-wing aircraft. As a “baby carrier,” the CVE(A) would have more facilities available for sustained air operations. The ACV(A) would be more akin to an austere airfield, with limited to no maintenance capability, but with the ability to refuel and rearm aircraft.

In addition to a V/STOL capable flight deck, both ships would be able to embark and sustain a small landing force that could be projected and sustained ashore. A Company Landing Team (CoLT) would be the ideal size, with somewhere around 300 troops would be optimal. This would reduce the amount of life support services (berthing, food, sanitation, etc.) required aboard the ship to help keep its design small and simple. There should also be an element of modularity within the ship’s design to allow it for quick, in-stride upgrades. A modular design would also allow the ship to quickly reconfigure based on anticipated missions. Finally, the design must be able to support the five armed services and coalition partners. By viewing these ships not as a single platform, but as a platform for other platforms to
integrate with or operate from, the ship becomes truly a “joint” and “coalition” asset.

IV. Potential Sources For A CVE(A)/ACV(A)

There are two main approaches to realizing the CVE(A)/ACV(A) concept: designing a ship from the keel up or adapting an existing ship’s design to meet flight deck and life support requirements.

The first method, most appropriate to a CVE(A), would result in a purpose-built vessel, specifically designed as a smaller aircraft carrier than the Nimitz or Gerald Ford classes. It would be based on the specific design requirements an aircraft carrier would require. The USS Gerald R. Ford (CVN-78) is the first updated aircraft carrier design in 40 years and is based on an improved Nimitz class hull. During World War II six CVE and two CVL designs were developed; in the postwar period and following the development of the “supercarrier” the US Navy routinely paired “big” carriers and “small” carriers to operate together.

The USS America (LHA 6), christened in October 2012, might provide the strongest indication of what a modern, purpose-built “baby carrier” would look like. Designed to be the primary aviation platform of an Expeditionary Strike Group (ESG), America is based on the Makin Island (LHD 8) design. America has no well deck and its hangar and maintenance areas are modified to better accommodate the V-22 and F-35B. There are some drawbacks to this design. Without a well deck, the ship’s ability to rapidly project troops and material ashore is limited to aerial (or pier side operations). Criticism of America has included the labels “escort carrier” and “jeep carrier,” recognizing its departure from an “amphibious assault ship” because of its inability to accommodate surface connectors.

The second method, more appropriate to an ACV(A), would be to modify an existing commercial design to create a ship capable of supporting fixed-wing
flight operations, an idea not without precedent. The earliest aircraft carriers began their service as modified merchant vessels. The US Navy’s CVEs and CVLs of World War II were the younger American cousin of the British “merchant ship carrier,” which were merchant ships converted to support flight operations for anti-submarine operations. They were a stopgap measure until the “keel up” designs became available.\textsuperscript{24}

During the 1982 Falklands War between Argentina and the United Kingdom a variant of the merchant ship carrier was put into service. Faced with a requirement to operate more than 7,800 miles from England and 3,900 miles from Ascension Island (its next nearest forward base), the Royal Navy (RN) used a fleet of hastily modified merchant vessels to rapidly augment its warship inventory under a contingency plan known as STUFT (Ships Taken Up From Trade). Notably, two Roll-On/Roll-Off (RoRo) container ships, Cunard Line’s Atlantic Conveyor and Atlantic Causeway, were used as expedient flight decks to ferry aircraft and support flight operations, augmenting two RN fleet carriers. Though officially designated auxiliary ships, both saw action (Atlantic Conveyor was attacked and sunk) and supported flight operations (Atlantic Causeway actively supported helicopter operations) to sustain the RN task force operating around the Falkland Islands.

The US Navy experimented with a similar program in the early 1980s with the ARAPAHO program.\textsuperscript{25} Much like the original purpose of the escort carrier, ARAPAHO was a research and development program conducted by the US Navy to install aircraft facilities, sensors, personnel, and support equipment aboard a merchant container ship to rapidly create an anti-submarine warfare platform for V/STOL aircraft. ARAPAHO was to enable merchant vessels to protect themselves in the case of wartime emergency, freeing US Navy warships (destroyers, frigates, submarines) from convoy escort duties. The US Army examined ARAPAHO as a potential method to create a mobile aircraft
maintenance facility that could be moved into a combat theater to sustain aviation operations.

Commercial industry has also explored converting its designs to accommodate military aircraft. Maersk Lines Limited proposed an Afloat Forward Staging Base (AFSB) that could accommodate Marine Corps rotary-wing aircraft as well as the AV-8B, and was based on a modification of the Maersk S-class container ship. The ship was intended to support the Seabasing concept and not as a primary combatant ship. The Marine Corps did not select the Maersk option in favor of one proposed by General Dynamics - the Mobile Landing Platform (MLP). There are presently three MLPs programmed for construction, the first, the USNS Lewis B. Puller, is a design that originated from a US Central Command requirement. Puller is intended to provide “a low cost option to deploy forces for low-intensity operations without tying up the resources of an asset that costs more to operate.” The MLP’s design is primarily for surface “connectors” (small boats, etc.) and has limited flight deck space: two CH-53s at a time with room to stow two more. The Puller’s flight deck was intended to enable counter-mine missions for the MH-53. Because the F-35 cannot take off vertically, it cannot be launched from the MLP.

V. Implications And Potential Missions for the Jeep Carrier

Whether designed or converted, the availability of a CVE(A)/ACV(A) provides options for the US military around the globe, increasing US forward deployed presence and better supporting the ability to command the sea.

Foremost, these platforms would provide additional flight decks from which to operate fixed wing aircraft, providing sea based assets when land-based assets are limited or not available. This would address the shortage of deck space that air planners are constantly and creatively finding ways to overcome. Limited flight deck space is one of the chief limitations of a
ship’s ability to rapidly project combat power, whether in support of air to air or air to surface missions. The CVE(A)/ACV(A) could significantly enhance capability by providing additional aircraft to a formation. Incorporated into a CSG it could supplement a CVN, or form the centerpiece of an expeditionary strike group. Paired with another platform, it provides a fixed-wing capable flight deck.

The ship could also be prepositioned as a dedicated recovery asset, providing ready quick reaction force (QRF) or tactical recovery of personnel/aircraft (TRAP) force in support of operations ashore. The 26th MEU aboard the USS Kearsarge provided the TRAP force that recovered a US F-15 pilot in Libya in 2011 whose aircraft suffered mechanical problems. While tasked with the TRAP mission, Kearsarge was not available other tasks. Similarly, in a naval task force, the ship could be designated the search and rescue (SAR) platform to perform lifeguarding duties, freeing DDGs for other purposes.

The CVE(A)/ACV(A) could also perform the traditional “lily pad” mission of ships with flight decks, but with the capability to support fixed-wing fighters instead of just rotary-wing assets. This is nothing more than providing a place to land and refuel while an aircraft transits long distances or conducts longer duration missions. A CVE(A)/ACV(A) could easily be positioned at the limits of an aircraft’s range; it could also be used to position less capable aircraft closer to an objective area, such as the escorts (i.e. AH1W/Z or UH1N/Y) for an air assault force. The ship could also be used to provide fuel in lieu of (or in addition to) aerial tanker support, or for transiting aircraft (such as the V-22) that do not have the ability to refuel in flight. As a corollary to this role, the CVE(A)/ACV(A) could also be used as a forward arming/refueling point (FARP), to cut down the transit time for aircraft running multiple sorties against an objective. Stocked with fuel and ammunition, a CVE(A)/ACV(A) operating closer to an
objective assumes more risk than a CVN, but would provide a shorter
turnaround time between aircraft sorties. As a “divert” airfield, the ship
would provide a flight deck positioned to recover and stage aircraft, freeing
flight decks for higher priority missions. The ship could also be staged to
provide support to potential emergencies. Modern aircraft are very expensive
and any opportunity to recover rather than lose a aircraft is a sound
investment.

Additional flight decks would offer multiple threat axes to attack an
adversary. A single aircraft carrier at the center of a formation provides a
predicable threat axis. The CVN can be easily identified and the geometries
of its offensive actions can be determined with ease. Multiple flight decks
would complicate the enemy’s calculations. Rather than have one flight deck
to operate from, multiple flight decks massing their aircraft on an
objective, coordinated independently, would undoubtedly disrupt enemy
defensive actions. Additional decks would also enable naval forces to
overcome anti-access/area denial (A2AD) capabilities. One or more
CVE(A)/ACV(A)s could concentrate or disperse at or within the envelope of an
adversary’s A2AD assets, enabling friendly aircraft to reduce, neutralize, or
control areas on sea or land by extending their range.

The CVE(A)/ACV(A) would spread load combat power. Several ships could
aggregate to equal or exceed the aircraft capacity of a single CVN, then
disperse to confuse enemy retaliatory action. As the centerpiece of a
carrier strike group, the CVN provides a large, capable asset, but also a
highly lucrative target. The ability to spread load expensive aircraft
across multiple flight decks will provide for security and will reduce the
impact of a ship rendered incapable due to enemy action. Aircraft carriers
have not faced a direct attack in over 50 years, but they remain vulnerable
despite the protection they are provided.30
The modularity of the CVE(A)/ACV(A) would result in quicker turnaround for maintenance and technology upgrades. A CVN spends between 19 and 31 percent of its time deployed, all other times are spent in various stages of maintenance. The result of this is a shell game of maintenance cycles and planning that leaves little room for error or disruption. The modular design of the CVE(A)/ACV(A) would permit rapid modification. Moreover, when a CVN or LHD/LHA is unavailable for maintenance, the CVE(A)/ACV(A) can fill the gap. Modularity would also allow the CVE(A)/ACV(A) to provide a tailored capability based on mission requirements. The ship could be configured to support specific missions such as mine sweeping, anti-submarine warfare, intelligence collection, surveillance, information operations, communications, bulk cargo/transshipment, etc.

The CVE(A)/ACV(A) would be an ideal platform to support UAS operations. The US Navy recently launched and recovered the X-47B UCAV (Unmanned Combat Air Vehicle) on the USS George H.W. Bush to demonstrate the feasibility of launching and recovering UAS platforms. This opens up a range of possibilities for UASs operating from a dedicated naval platform. A ship dedicated to UAS operations would require less space because of the smaller size of the airframes and the reduced number of personnel needed to operate the ship, maintain the aircraft, and conduct flight operations. The UAS flight complement could be shaped to fit assigned tasks. In an offensive role the UASs could be employed in a variety of ways - as a SIGINT platform (in electronic attack and electronic support roles), augmenting fire support (in a general or direct support), swarms against A2AD capabilities, sensor operations, to provide “on call” logistics packages via the K-MAX or similar UAS, or casualty reception and handling.

The CVE(A)/ACV(A) is also ideal for sustained presence. The presence of CVE(A)/ACV(A)s would free larger, more capable assets for other missions that require their advanced capabilities, or to cover gaps between
operational cycles of other forces. For example, the ship could support special operations forces (SOF) as an intermediate support base (ISB). SOF forces are by nature light and mobile and a CVE(A)/ACV(A) could provide the space required to prepare and conduct a mission or series of missions, especially those of a time sensitive nature, by providing proximity to an objective. In a more benign scenario, a CVE(A)/ACV(A) could support humanitarian assistance or direct relief operations, with the ability to remain on station for an extended period of time and working closely with allies or partners. In a similar vein, the ship could be used to support theater security cooperation and assistance by supporting coalition partners who cannot afford to maintain their own large scale naval platforms.

The CVE(A)/ACV(A) manifests the whole idea of economy of force. The USS George Washington was dispatched to the Philippine Islands to support the humanitarian response to Typhoon Haiyan in November 2013. Although a valuable humanitarian and diplomatic gesture, the George Washington was for all intents and purposes “off line” for the missions it was designed for. A CVE(A)/ACV(A) could have fulfilled this role at much lower cost.\(^{34}\)

Finally, the CVE(A)/ACV(A) provides scalability. Where an Arleigh Burke Class (DDG) or the oncoming Zumwalt Class (DDG-1000) overmatches most of our adversaries, they are also limited in their ability to scale back their offensive capability. For small scale or low-intensity operations, the CVE(A)/ACV(A) could be configured with a range of lethal or non-lethal systems.

VI. Conclusion

In the end, the CVE(A)/ACV(A) would prove a more versatile and cost-effective means to realize US strategy for the future. As a primary warfighting or auxiliary platform it can provide a lower-cost, flexible solution
to US security and defense requirements across the range of military operations.
To protect U.S. national interests and achieve the objectives of the 2010 National Security Strategy in this environment, the Joint Force will need to recalibrate its capabilities and make selective additional investments to succeed in the following missions:

Counter Terrorism and Irregular Warfare

Deter and Defeat Aggression

Project Power Despite Anti-Access/Area Denial Challenges

Counter Weapons of Mass Destruction

Operate Effectively in Cyberspace and Space

Maintain a Safe, Secure, and Effective Nuclear Deterrent

Defend the Homeland and Provide Support to Civil Authorities

Provide a Stabilizing Presence

Conduct Stability and Counterinsurgency Operations

Conduct Humanitarian, Disaster Relief, and Other Operations
Table 2: Missions of the Carrier Air Wing

**Fighter escort**: providing fighter protection and escort to airborne platforms in an offensive or defensive role.

**Offensive and defensive counter-air operations**: neutralizing or destroying enemy air and missile capabilities, and defending the battle group against attack by hostile aircraft and missiles.

**Day and night precision strike**: attacking enemy targets at sea and ashore under all conditions of visibility.

**Suppression and destruction of enemy air defenses**: disrupting, destroying or degrading enemy air defense systems through kinetic or non-kinetic means.

**Intelligence, surveillance and reconnaissance**: acquiring and integrating timely intelligence and information from sensors, assets, and processing, exploitation and dissemination systems to support the battle group’s needs.

**Other specialized fleet missions**, including antisubmarine warfare, anti-surface warfare, combat search and rescue, and logistics support.
Table 3: Construction Costs And Times Of Select Aircraft Carrier & Amphibious Ship Classes

<table>
<thead>
<tr>
<th>Class</th>
<th>Type</th>
<th>Cost</th>
<th>Approx Time to construct (in months)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midway</td>
<td>CV</td>
<td>$90 mil (1944)</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td>Essex</td>
<td>CV</td>
<td>$68.9 mil (1941-1944)</td>
<td>18.0</td>
<td>Cost is averaged among 24 ships constructed Essex (CV-9) took 20 months to build in 1941-42; Philippine Sea (CV-47) took 12 months to build in 1944-45</td>
</tr>
<tr>
<td>Enterprise</td>
<td>CV</td>
<td>$25 mil (1938)</td>
<td>46.0</td>
<td>Construction postponed due to difficulties</td>
</tr>
<tr>
<td>Ranger</td>
<td>CV</td>
<td>$20 (1931)</td>
<td>33.0</td>
<td>First US aircraft carrier design (not converted from another design)</td>
</tr>
<tr>
<td>Saratoga</td>
<td>CV</td>
<td>$45 mil (1945)</td>
<td>86.0</td>
<td>Cost includes aircraft</td>
</tr>
<tr>
<td>Commencement Bay</td>
<td>CVE</td>
<td>$11 mil (1944)</td>
<td></td>
<td>Purpose-built escort carrier, time to construct not available</td>
</tr>
<tr>
<td>Sangamon</td>
<td>CVE</td>
<td></td>
<td></td>
<td>Converted Oiler, construction cost not available. Independence class CVE based on this design.</td>
</tr>
<tr>
<td>Casablanca</td>
<td>CVE</td>
<td></td>
<td>76 Days</td>
<td>Purpose-built escort carrier, construction cost not available</td>
</tr>
<tr>
<td>Bogue</td>
<td>CVE</td>
<td></td>
<td>77 Days</td>
<td>Converted merchant vessel</td>
</tr>
<tr>
<td>Independence</td>
<td>CVL</td>
<td>$31 (1940) - $42 mil (1941)</td>
<td>16.3</td>
<td>Laid down as Cleveland class cruisers, converted to aircraft carriers mid-construction. Cost reflects construction as a cruiser</td>
</tr>
<tr>
<td>Nimitz</td>
<td>CVN</td>
<td>$4.5 bil (1998)</td>
<td>67.7</td>
<td>Cost provided for USS Ronald Reagan</td>
</tr>
<tr>
<td>Enterprise</td>
<td>CVN</td>
<td>$451.3 mil (1957)</td>
<td>45.0</td>
<td>Only ship in class</td>
</tr>
<tr>
<td>Gerald Ford</td>
<td>CVN</td>
<td>$12.9 bil (2008)</td>
<td>53+</td>
<td>Launched, not yet commissioned</td>
</tr>
<tr>
<td>Tarawa</td>
<td>LHA</td>
<td></td>
<td>57.5</td>
<td>Construction cost not available</td>
</tr>
<tr>
<td>America</td>
<td>LHA</td>
<td>$3.4 bil (2013)</td>
<td>57+</td>
<td>Launched, not yet commissioned</td>
</tr>
<tr>
<td>Wasp</td>
<td>LHD</td>
<td>$750 mil (average)</td>
<td>44.3</td>
<td></td>
</tr>
<tr>
<td>Class</td>
<td>Year First Introduced</td>
<td>Type</td>
<td>Full Displacement (tons)</td>
<td>Dimensions (feet) Overall x Beam</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------------------</td>
<td>--------</td>
<td>--------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Sangamon/Chenango</td>
<td>1942</td>
<td>CVE</td>
<td>12,000</td>
<td>546 x 75</td>
</tr>
<tr>
<td>Bogue</td>
<td>1942</td>
<td>CVE</td>
<td>7,300</td>
<td>494 x 69.5</td>
</tr>
<tr>
<td>Essex</td>
<td>1943</td>
<td>CV</td>
<td>33,000</td>
<td>874 x 93</td>
</tr>
<tr>
<td>Independence</td>
<td>1943</td>
<td>CVL</td>
<td>13,000</td>
<td>618 x 71.5</td>
</tr>
<tr>
<td>Commencement Bay</td>
<td>1944</td>
<td>CVE</td>
<td>12,000</td>
<td>553 x 75</td>
</tr>
<tr>
<td>Casablanca</td>
<td>1944</td>
<td>CVE</td>
<td>10,200</td>
<td>499 x 80</td>
</tr>
<tr>
<td>Midway</td>
<td>1945</td>
<td>CV</td>
<td>55,000</td>
<td>968 x 136</td>
</tr>
<tr>
<td>Enterprise</td>
<td>1961</td>
<td>CVN</td>
<td>88,600</td>
<td>1123 x 133</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nimitz</td>
<td>1975</td>
<td>CVN</td>
<td>100,200</td>
<td>1030 x 134</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tarawa</td>
<td>1976</td>
<td>LHA</td>
<td>39,967</td>
<td>834 x 111.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wasp</td>
<td>1989</td>
<td>LHD</td>
<td>40,358</td>
<td>847 x 140.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gerald Ford</td>
<td>2013</td>
<td>CVN</td>
<td>100,000</td>
<td>1030 x 134</td>
</tr>
<tr>
<td>America</td>
<td>2013</td>
<td>LHA</td>
<td>44,971</td>
<td>844 x 106</td>
</tr>
</tbody>
</table>

*Notes:* Armored flight deck

*Fixed Wing* refers to aircraft that are fixed-wing, while *Rotary Wing* refers to aircraft that are rotary-wing or helicopter-based.
<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Fuselage Length (feet)</th>
<th>Wingspan (feet)</th>
<th>Speed</th>
<th>Radius of Operation (nm)</th>
<th>Max Takeoff Weight (lbs)</th>
<th>Max Payload (lbs)</th>
<th>Max Fuel Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-35B</td>
<td>51.2</td>
<td>35</td>
<td>Mach 1.6 (max)</td>
<td>450</td>
<td>60,000</td>
<td>15,000 (fuel only)</td>
<td>13,000 (internal)</td>
</tr>
<tr>
<td>F/A-18C</td>
<td>56</td>
<td>37.5</td>
<td>Mach 1.8 (est max)</td>
<td>290</td>
<td>36,700 lb (fighter mission)</td>
<td>51,900 lb (attack mission)</td>
<td>15,500</td>
</tr>
<tr>
<td>AV-8B</td>
<td>46.3</td>
<td>30.3</td>
<td>Mach 0.87 (max)</td>
<td>90 (short takeoff, 12 Mk 82 Snakeye bombs, internal fuel, 1 hour loiter)</td>
<td>31,000 lb (short take off)</td>
<td>17,000 lb (est useful load, inc fuel, stores, weapons, ammunition, and water injection for engine, short take off)</td>
<td>44,500</td>
</tr>
<tr>
<td>MV-22B</td>
<td>60 (wings stowed, blades folded)</td>
<td>51 (incl nacelles)</td>
<td>257 kts (cruising)</td>
<td>52,600 lb (vertical take off)</td>
<td>20,000 lb (internal, cargo)</td>
<td>10,000 lb (underslung, single hook)</td>
<td>7,700 (internal)</td>
</tr>
<tr>
<td>CH-53E</td>
<td>60.5 (rotors folded, tail folded)</td>
<td>79 (rotors extended)</td>
<td>150 kts (cruising)</td>
<td>69,754 (internal load), 73,502 (external load)</td>
<td>29,918 lb (Internal, 100 nm)</td>
<td>32,000 lb (external, 50 nm)</td>
<td>unavailable</td>
</tr>
<tr>
<td>AH-1Z</td>
<td>45.5 (rotors folded)</td>
<td>14.5 (rotors folded)</td>
<td>160 kts (cruising)</td>
<td>370</td>
<td>16,500</td>
<td>2,812 (fuel &amp; ordnance)</td>
<td>2,768 (internal)</td>
</tr>
<tr>
<td>UH-1Y</td>
<td>48 (rotors folded)</td>
<td>15.3 (rotors folded)</td>
<td>153 kts (cruising)</td>
<td>129</td>
<td>18,500</td>
<td>5,000 (underslung)</td>
<td>2,584 (internal)</td>
</tr>
</tbody>
</table>
Endnotes

3 See Table 1 for the list of missions and Table 2 for the list of carrier air wing missions.
7 Two examples: In December 2013 USS Chancellorsville (CG-62) collided with a 13 foot BGM-74 target drone, damaging on its most sensitive compartments. Repairs are expected to take six months. In May 2008, the USS George Washington (CVN-73) experienced a fire onboard that required four months of repairs.
12 The exact definition of "Fifth Generation Fighter" is still undetermined, however, Lockheed-Martin, builder of the JSF, defines a 5th Generation Fighter as one that has "all aspect, advanced stealth," "next generation avionics and sensor fusion," and "embedded, network-enabled capability."
13 While controversial, the focus should be on fifth generation capability, not the specific platforms.
14 The Nimitz class CVN can carry 60+ aircraft, the Gerald Ford class CVN is designed to carry 75+ aircraft, and the America class LHA can carry up to 20 F-35B’s.
15 See Table 5 for a comparison of the current and "new" aircraft.
16 A "light" carrier was designed to be able to go faster to maintain the pace of a fleet carrier; an "escort" carrier was slower, but intended to support convoys and slower ships.
17 See Table 3 for a comparison of costs and construction times for various aircraft carriers and amphibious ships.
20 Long Island, Avenger, Sangamon, Bogue, Casablanca, and Commencement Bay Class.
21 Independence and Saipan Class.
23 the LCAC, LCU, and AAV.
24 The Independence class CVL was based on a modified Cleveland class cruiser hull, the Bogue class CVE was based on a modified C3 merchant hull.


30 The last aircraft carrier sunk was the USS Bismarck Sea (CVE-95), lost off Iwo Jima from kamikaze attack in February 1945. In May 1964 while docked, USNS Card (ex-CVE-11) was attacked and sunk by Vietnamese commandos.


34 In 2013 a carrier strike group cost about $6.5 million per day to operate.


Gordon IV, John, Peter A. Wilson, John Birkler, Steven Boraz, Gordon T. Lee. Leveraging America’s Aircraft Carrier Capabilities: Exploring New


O'Rourke, Ronald. Navy Role in Global War on Terrorism (GWOT) – Background and Issues for Congress. Washington, DC: Congressional Research Service


