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THE ADVANCED SURFACE FORCE FLEET: A PROPOSAL FOR AN ALTERNATE SURFACE FORCE STRUCTURE AND ITS IMPACT IN THE ASIAN PACIFIC THEATER

by

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December 2015

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This thesis addresses how an alternate surface fleet comprised of aircraft carriers (CVNs), guided missile destroyers (DDGs), and enhanced San Antonio class amphibious transport dock ships (eLPD 17s) of an "equal replacement procurement cost" compare in 14 measures of capabilities to the planned 2040 U.S. fleet, and how the two fleets compare in Asian Pacific Theater operations. The estimated procurement costs for the proposed eLPD 17 class ship and for the Navy's planned 2040 fleet, and the composition of the equal procurement cost alternate fleet, *The Advanced Surface Force Fleet*, are determined. The two fleets are then compared using three different matrices: 14 measures of capabilities, the capability to conduct humanitarian assistance and disaster relief operations, and the capability to defeat an adversary in a maritime conflict. *The Advanced Surface Force Fleet* has more offensive capability than the Navy's planned 2040 fleet. Furthermore, the eLPD 17 provides the Navy with an amphibious ship that can act autonomously in contested environments, with more surface ships that have offensive capability, and with a warship that can perform conventional surface combatant roles while maintaining the ability to perform traditional amphibious lift capabilities.

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ABSTRACT

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LIST OF ACRONYMS AND ABBREVIATIONS

AAW	antiair warfare
AD	air defense
AMDR	air and missile defense radar
ARG	amphibious ready group
ASCM	anti-ship cruise missile
ASROC	antisubmarine rocket
ASUW	anti-surface warfare
ASW	antisubmarine warfare
C2	command and control
CCDR	combatant commander
CG 47	Ticonderoga class guided missile cruisers
CIWS	close-in weapon system
CSBA	Center for Strategic Budgetary Assessments
CVL	light aircraft carrier
CVN	aircraft carrier, nuclear
DDG	guided missile destroyer
DDG 51	Arleigh Burke class guided missile destroyer
eLPD 17	enhanced San Antonio class amphibious transport dock ship
ESSM	evolved sea sparrow missile
FSA	force structure assessment
FY	fiscal year
GMVLS	guided missile vertical launching system
HADR	humanitarian assistance and disaster relief
INS	inertial navigation system
ISR	intelligence, surveillance, reconnaissance
LCAC	landing craft air cushion
LCS	littoral combat ship
LCU	landing craft utility
LHA 6	America class amphibious assault ship
LPD 17	San Antonio class amphibious transport dock ship
LSD 41	Whidbey Island class dock landing ship
LSD 49	Harpers Ferry class dock landing ship
LX(R)	dock landing ship

MEB	Marine expeditionary brigade
MSC	Military Sealift Command
NNFM	New Navy Fighting Machine
ONI	Office of Naval Intelligence
OTH-T	over-the-horizon targeting
PLAN	People's Liberation Army Navy
RAM	rolling airframe missile
R&D	research and development
RORO	roll on roll off
SAG	surface action group
SAM	surface-to-air missile
SAR	search and rescue
SLOC	sea lines of communication
SM	standard missile
SSBN	ballistic missile submarines, nuclear
SUW	surface warfare
TLAM	Tomahawk land-attack missile
USMC	United States Marine Corps
USN	United Stated Navy
VADM	Vice Admiral
VDS	variable depth sonar
VLS	vertical launch system

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I. INTRODUCTION

A. MAJOR RESEARCH QUESTION

Within any fiscal environment, political and naval leaders have the obligation to ensure taxpayers' dollars are being spent efficiently. As defense leaders prepare for future challenges and threats, they assess the ability of current and future planned naval forces to execute required and potential missions. These assessments lead to programs that support platform acquisition plans, modify them, or add new ones. Force structure is created in this manner, with the naval vessel construction plan being a central pillar. Naval leaders have provided Congress with their naval vessel construction plan; however, as is seen later in this chapter, others have suggested alternative solutions.[1] Several have proposed alternative naval force structures, but none have suggested simplifying the surface combatant and amphibious forces to only three ship classes. This thesis focuses on a new alternative force structure that does just that. Specifically, it addresses how an alternative surface fleet comprised of aircraft carriers (CVNs), guided missile destroyers (DDGs), and enhanced San Antonio class amphibious transport dock ships (eLPD 17s) of an "equal replacement procurement cost" compare in 14 measures of capabilities—to include offensive capability, U.S. Navy (USN) and Marine Corps (USMC) integration, and operating costs—to the planned 2040 United States (U.S.) fleet, and how the proposed fleet may fare in East Asia naval operations.

B. SIGNIFICANCE OF THE RESEARCH QUESTION

This study offers an alternative naval force structure to increase the surface fleet's offensive capabilities and enhance an underutilized naval asset, the San Antonio class amphibious transport dock ship (LPD 17), at no cost over the planned fleet.

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[1] Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2016* (Washington, DC: Office of the Chief of Naval Operations, 2015), http://news.usni.org/wp-content/uploads/2015/04/FY16-30-Year-Shipbuilding-Plan.pdf; Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for FY2015* (Washington, DC: Office of the Chief of Naval Operations, 2014), http://navylive.dodlive.mil/files/2014/07/30-year-shipbuilding-plan1.pdf.

In *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, Ronald O'Rourke writes, "The planned size of the Navy, the rate of Navy ship procurement, and the prospective affordability of the Navy's shipbuilding plans have been matters of concern for the congressional defense committees for the past several years."[2] Under the current fiscally constrained environment, the U.S. Navy is considering the current and future force structure that will best execute the uncertain missions that lie ahead. Currently, the planned 2040 Navy consists of 302 naval vessels; however, "it requires funding that exceeds levels the Navy has historically been able to commit to new ship construction."[3] While naval leadership considers several competing budget concerns—large surface combatant modernization, small surface combatants procurement, amphibious ship replacements, aviation components, etc.—replacing the Ohio Class ballistic missile submarines (SSBNs) is one of the most substantial. The Navy has taken action to offset the projected high costs of replacing the Ohio Class SSBNs. In July 2014, the Navy announced "the cancellation of a fourth flight of Arleigh Burke destroyers (DDG 51s) as well as the controversial plan to layup 11 Ticonderoga-class guided missile cruisers (CG 47s)," and in March 2015, delayed five guided missile destroyers (DDGs) from receiving their combat system upgrade for ballistic missile defense.[4] If additional funding is not secured, the Navy may dwindle from its current level of approximately 280 ships to 240.[5] While efforts to replace the Ohio Class SSBN have been sizable, budget constraints have also affected the Navy's amphibious fleet. Only 33 amphibious ships—of the 38 required for U.S. Marine Corps 2.0 Marine

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[2] Ronald O'Rourke, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress* (CRS Report No. RL32665) (Washington, DC: Congressional Research Service, 2015), i, http://fas.org/sgp/crs/weapons/RL32665.pdf.

[3] Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2016*, 6.

[4] Sam LaGrone, "Navy Cancelled New Destroyer Flight Due to Ohio Replacement Submarine Costs," *USNI News,* July 14, 2014, http://news.usni.org/2014/07/14/navy-cancelled-new-destroyer-flight-due-ohio-replacement-submarine-costs; Sam LaGrone, "Navy Again Reduces Scope of Destroyer Modernization, 5 Ships Won't Receive Any Ballistic Missile Defense Upgrades," *USNI News*, March 3, 2015, http://news.usni.org/2015/03/03/navy-again-reduces-scope-of-destroyer-modernization-5-ships-wont-receive-any-ballistic-missile-defense-upgrades.

[5] John Grady, "Navy Leaders: Fleet Size Could Fall to 240 Ships without Budget Relief," *USNI News*, April 11, 2014, http://news.usni.org/2014/04/11/navy-leaders-fleet-size-fall-240-ships-without-budget-relief.

expeditionary brigade (MEB) lift capabilities—are scheduled to be part of the 2040 Naval Battle Force.[6] Additionally, U.S. Combatant Commanders (CCDRs) feel the burden of budget constraints. In a hearing before the House Armed Services Committee, Commander of U.S. Pacific Command, Admiral Samuel J. Locklear, III said:

> Due to continued budget uncertainty, we were forced to make difficult short-term choices and scale back or cancel valuable training exercises, negatively impacting both the multinational training needed to strengthen our alliances and build partner capacities as well as some unilateral training necessary to maintain our high end warfighting capabilities.[7]

In the 2015 *National Security Strategy*, President Barack Obama notes that while the military may be smaller, he still expects "a versatile and responsive force prepared for a more diverse set of contingencies."[8]

As naval leaders continue to face current and future budget concerns, they are reorienting U.S. naval strategy. Chief of Naval Operations, Admiral Jonathan Greenert has called for further joint force interdependence.[9] While the Navy and Marine Corps have worked interdependently for over 200 years, Admiral Greenert indicates the sister services—and other services—can expand their efforts further via "innovative employment of ships," "tightly knitted ISR [intelligence, surveillance, reconnaissance]," and "truly interoperable combat and information systems."[10] In June 2014, now Commander of Naval Surface Forces, Vice Admiral (VADM) Thomas Rowden suggested the "mastery of the fundamentals of sea control" have atrophied as the surface

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[6] Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2016*; 6; Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for FY2015*, 24.

[7] *Senate Armed Services Committee Statement of Admiral Samuel J. Locklear, U.S. Navy Commander, U.S. Pacific Command Before the Senate Committee on Armed Services on U.S. Pacific Command Posture* (2014), 18, http://www.armed-services.senate.gov/imo/media/doc/Locklear_03-25-14.pdf.

[8] The White House, *National Security Strategy* (Washington, DC: The White House, 2015), 8, https://www.whitehouse.gov/sites/default/files/docs/2015_national_security_strategy.pdf.

[9] Jonathan Greenert, "Navy Perspective on Joint Force Interdependence," *Joint Force Quarterly*, 11, January 2015, http://www.dtic.mil/doctrine/jfq/jfq-76.pdf.

[10] Ibid., 12–3.

navy has not recently been contested, and that it is time to "go on the offensive."[11] To further emphasize the offensive strategy, VADM Rowden, Commander of Naval Surface Force Atlantic, Rear Admiral Peter Gumataotao, and Director of Surface Warfare (N96), Rear Admiral Peter Fanta published "Distributed Lethality."[12] In "Distributed Lethality," the admirals call for increased offensive capabilities aboard surface vessels, further integration with Marine Corps, and new ship employment, "Distributed lethality combines more powerful ships with innovative methods for employing them."[13] While the surface Navy shifts to the offensive mindset in the constrained fiscal environment, naval leaders must exploit current technologies and assets.[14]

Most alternative fleet structures simply suggest increasing or decreasing the number of current naval assets, but a few offer new ship classes in addition to current U.S. naval assets; all fail to exploit the unique opportunity the surface navy has by enhancing the LPD 17. The research for this thesis examines the prospects for decreasing naval operating costs, enabling a stronger integration between Navy-USMC services, and providing naval leaders with a more offensive capable surface fleet comprised of only CVNs, DDGs, and eLPD 17s.

C. LITERATURE REVIEW

This literature review examines recently proposed alternative force structures, costing methods, and comparative performance models.

1. Alternative Forces

The U.S. Navy's programmed force structure provides the baselines from which alternative force literature derives and diverges. This literature review examines eight

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[11] Thomas S. Rowden, "Surface Warfare Must Take the Offensive: In an A2AD World, Surface Warfare Must 'Go on the Offensive' to Enable Future Power Projection," *The Diplomat*, June 28, 2014, http://thediplomat.com/2014/06/surface-warfare-must-take-the-offensive/.

[12] Thomas Rowden, Peter Gumataotao, and Peter Fanta, "Distributed Lethality," Proceedings, January 2015, http://www.usni.org/magazines/proceedings/2015-01/distributed-lethality.

[13] Ibid.

[14] Rowden, "Surface Warfare Must Take the Offensive: In an A2AD World, Surface Warfare Must 'Go on the Offensive' to Enable Future Power Projection."

recently proposed alternative force structures. Alternative force literature cultivates two primary concepts, traditional naval forces, but with different numbers, and traditional naval forces with additional new ship classes. Although each structure considers aircraft carriers, surface combatants, subsurface combatants, amphibious ships, logistical ships, and support vessels in varying degrees, this analysis focuses primarily on aircraft carriers, surface combatants, and amphibious ships.

The current Navy's force structure plan is found in the *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2016*.[15] Based on finite resources, naval leaders have balanced the missions the Navy is expected to execute with the amount of acceptable risk they deemed necessary. The Force Structure Assessment (FSA) provides the *Long-Range Naval Battle Force Construction Plan* and the *Baseline Naval Battle Force Inventory* to promulgate the force required to adequately complete the requirements established in the Quadrennial Defense Review.[16] The FY2016 plan shows the 2040 Navy is comprised of 10 aircraft carriers, 85 large surface combatants, 56 small surface combatants, and 33 amphibious warfare ships.[17] Within the fiscally constrained environment, the Navy has provided the force structure plan that it believes best executes future missions; however, others have not accepted the Navy's plan as the best to meet future challenges.

Most alternative force structures are principled around traditional naval force components with varying combinations of surface ships. Two recently proposed alternative forces suggest the Navy's planned size is adequate or needs to be increased. The one alternative fleet that generally concurs with the Navy's surface asset plan is the Center for Strategic and Budgetary Assessments (CSBA) 2008 report, *The U.S. Navy: Charting a Course for Tomorrow's Fleet*.[18] To confront the robust set of challenges the

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[15] Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2016*.

[16] Ibid., 5–6.

[17] Ibid., 6.

[18] Robert O. Work, The U.S. Navy: Charting a Course for Tomorrow's Fleet," Center for Strategic and Budgetary Assessments, 2008, 81, February 17, 2009, http://csbaonline.org/publications/2009/02/us-navy-charting-a-course-for-tomorrows-fleet/.

United States faces, *The QDR in Perspective: Meeting America's National Security Needs in the 21st Century* recommends increasing the total number of naval assets to 346; however, specific numbers per ship class are not offered, besides the 11 recommended carriers.[19] Four other recent reports suggest the number of surface assets can be the same or reduced. In *A Strong National Defense: The Armed Forces America Needs and What They Will Cost*, The Heritage Foundation recommends a fleet comprised of more amphibious ships (37), but only 88 large surface combatants and 28 small combatant ships.[20] Having a navy designed on surge capability—rather than forward-deployed units—is the driving force behind the CATO Institute, Sustainable Defense Task Force, and the Project on Defense Alternatives recommendation for fewer ships.[21] Although most alternative force structures simply vary numbers of traditional naval forces, some have suggested a need for new ship designs in addition to traditional platforms.

Two recent alternative force structures propose the creation of new small combatants ships, *The New Navy Fighting Machine: A Study of the Connections Between Contemporary Policy, Strategy, Sea Power, Naval Operations, and the Composition of the United States Fleet* and *From Preponderance to Partnership: American Maritime Power in the 21st Century*.[22] Both recommend a larger navy with considerably more small combatants. The most radical proposal is from the *New Navy Fighting Machine*

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[19] Stephen J. Hadley and William J. Perry, *The QDR in Perspective: Meeting America's National Security Needs In the 21st Century, The Final Report of the Quadrennial Defense Review Independent Panel* (Washington, DC: United States Institute of Peace, 2010), 58, http://www.usip.org/sites/default/files/qdr/qdrreport.pdf.

[20] The Heritage Foundation, A *Strong National Defense: The Armed Forces America Needs and What They Will Cost* (Washington, DC: The Heritage Foundation, 2011), 25, http://www.heritage.org/research/reports/2011/04/a-strong-national-defense-the-armed-forces-america-needs-and-what-they-will-cost.

[21] Benjamin H. Friedman and Christopher Preble, *Budgetary Savings from Military Restraint* (Washington, DC: CATO Institute, 2010), http://object.cato.org/sites/cato.org/files/pubs/pdf/PA667.pdf, 6–9; The Sustainable Defense Task Force, *Debt, Deficits, & Defense: A Way Forward* (Cambridge, MA: The Project on Defense Alternatives, The Commonwealth Institute, 2010), 19, http://www.comw.org/pda/fulltext/1006SDTFreport.pdf; Carl Conetta, *Reasonable Defense: A Sustainable Approach to Securing the Nation* (Cambridge, MA: The Project on Defense Alternatives, The Commonwealth Institute, 2012), 11–2, http://comw.org/pda/fulltext/121114-Reasonable-Defense.pdf.

[22] Wayne P. Hughes Jr., ed., "The New Navy Fighting Machine: A Study of the Connections Between Contemporary Policy, Strategy, Sea Power, Naval Operations, and the Composition of the United States Fleet" (NPS research paper, Naval Postgraduate School, Monterey, CA, 2009); Frank Hoffman, *From Preponderance to Partnership: American Maritime Power in the 21st Century* (Washington, DC: Center for a New American Security, 2008), http://www.cnas.org/publications/reports/from-preponderance-to-partnership-american-maritime-power-in-the-21st-century#.VQT7usahhUQ.

(NNFM). The NNFM is concentrated on increasing the size of the Navy's green water force by procuring hundreds of different small combatant ships, but the NNFM also revamps the entire surface Navy with an emphasis on more single-mission warships.[23] The NNFM recommends a green water navy comprised of 160 offshore patrol craft, 12 fleet station ships, 400 inshore patrol craft, 12 gunfire support ships, 12 antisubmarine warfare (ASW) ships, eight light aircraft carriers (CVLs), and 30 coastal combatants.[24] Additionally, the NNFM alters the blue water Navy to be represented by six aircraft carriers (CVNs), 10 CVLs, 20 arsenal ships, 30 destroyers, and 90 frigates.[25] Collectively, these recommendations offer a substantially different perspective than normally addressed; however, naval leaders have adopted none of these alternative proposals.

Several alternative force structures have been forwarded, but none have changed the Navy's plans: "All have had significant flaws," said a lead naval force structure planner in Ronald O'Rourke's *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress,* "so they have not received serious consideration."[26] With the exception of the two alternative force structures that offer new ship designs, all other alternative force recommendations use traditional naval ships with varying numbers. Generally, the disagreement between the literatures is on the need for more ships for the ability to have forward presence, or fewer ships focusing on surging the assets when needed; however, none discuss decreasing the total number of ship types and enhancing a current platform. This thesis proposes an alternate 2040 fleet—at an equal procurement cost—that costs less to operate, is more integrated, and has increased offensive capability to meet the objective of distributed lethality.

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[23] Hughes, "New Navy Fighting Machine," vii.

[24] Ibid., 23–4.

[25] Ibid., 50.

[26] O'Rourke, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, 24–5.

2. Costing Methods and Comparative Performance Models

Generally, alternative force structure literature suggests the Navy should be bigger or smaller, and makes recommendations about how the Navy should spend or save money; this thesis advocates a more capable surface navy at an equal procurement cost. Comparing capabilities at equal cost will demonstrate the different performance potential of the two navies. The significance of comparing costs and performance is captured in *Analysis for Military Decisions*:

> In choosing among alternative military systems or force structures, why do we make cost estimates? The short answer is that cost is an element of choice we cannot ignore. To choose wisely, we must know the cost of the proposal and be able to compare it with the cost of the other proposals. We must also know the benefits of the choice, and be able to compare them with the benefits of the alternative possibilities. The intelligent weighing of costs and benefits is at least as important in military management and decision making as in any other sector of government activity or in private business enterprise.[27]

Research and development, procurement, and operating costs are three of the primary costs associated with the building and operation of a naval vessel. Research and development (R&D) costs are, "all costs necessary to bring a system to a point where it is available for introduction into the active inventory."[28] "Procurement costs," Richard L. Kugler states in his book, *Policy Analysis in National Security Affairs: New Methods for a New Era*, "include the costs not only for the weapon, but also for initial spares, testing equipment, and contractor maintenance."[29] After a ship has been delivered to the Navy, the recurring costs to operate, maintain, and support the vessel are known as operating costs.[30] This thesis does not compare R&D costs because the proposed navy is composed of current naval platforms and technologies and has no significant R&D costs. The proposed navy will be of equal procurement costs because the Navy has proposed the

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[27] E. S. Quade, ed., *Analysis for Military Decisions, Mors Heritage Series* (Alexandria, VA: Military Operations Research Society, 1964), 264.

[28] Ibid., 281.

[29] Richard L. Kugler, *Policy Analysis in National Security Affairs: New Methods for a New Era* (Washington, DC: National Defense University Press, 2006), 587.

[30] Quade, *Analysis for Military Decisions, Mors Heritage Series*, 280–81.

2040 fleet it needs to execute the missions it is expected to perform satisfactorily, and data is available for each ship class's procurement costs. The study may have used the operating costs of the Navy's planned 2040 fleet to establish the size of the proposed navy; however, operating costs will be used as a measure of capability to compare the equal procurement costs of surface fleets. Finally, an equal capabilities assessment was not conducted because naval leaders have not stated one variable is more important than the other; moreover, the 14 capabilities selected as comparison metrics offer a better holistic comparison between the two fleets. As is shown, the alternative surface navy proposed in this thesis is better than the planned 2040 navy in most of the measures of capabilities.

D. POTENTIAL EXPLANATIONS AND HYPOTHESES

The U.S. Navy can reduce operating costs, further integrate with the U.S. Marine Corps, and distribute offensive lethality on its surface ships by enhancing the LPD 17 class ship. The LPD 17 class ships are used to transport Marines and their equipment from sea to shore. The current LPD 17 is a diesel-operated, 684-foot-long amphibious ship capable of embarking 800 marines, launching and landing two MV-22 or four CH-46 helicopters, and holding two landing craft air cushions (LCAC) or one landing craft utility (LCU).[31] It is armed with two 30mm guns and two rolling airframe missile (RAMs) launchers.[32] The proposed enhancements for the LPD 17 (eLPD 17) class add two close-in weapon system (CIWS) mounts, 16 vertical launch system (VLS) cells, 16 anti-ship cruise missiles, a variable depth sonar, and a combat system suite upgrade that would integrate the weapon systems. While the enhancements significantly upgrade the LPD 17 class ships' ability to take part in traditional naval warfare areas, no significant ship alterations would be needed to accommodate the changes. By enhancing the LPD 17 class ship with more weapon systems, a ship that is traditionally and predominantly used for Marine transport can be employed as a potent surface combatant. The added weaponry significantly increases the offensive capabilities of the fleet.

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[31] U.S. Navy, "United States Navy Fact File: Amphibious Transport Dock—LPD," America's Navy, accessed January 31, 2015, http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=600&ct=4.

[32] Ibid.

This thesis shows that a surface combatant fleet composed solely of CVNs, DDGs, and eLPD 17s—subsequently referred to as *The Advanced Surface Force Fleet*—will have more offensive capacity than the Navy's currently planned 2040 navy. While *The Advanced Surface Force Fleet* will have significantly more offensive capabilities, it will have fewer total ships. One potential remedy for the smaller navy is for more ships to be forward deployed, as already recommended by naval leaders in *A Cooperative Strategy for 21st Century Seapower*.[33] Also, while the proposed navy will be able to meet the Marine Corps 2.0 MEB lift requirement, fewer vertical take-off spots for USMC will occur than on traditional amphibious platforms. However, further integration between the USMC and the U.S. Navy's carrier air wing would offset the difference in vertical takeoff spots, the Ford Class aircraft carriers have space for 75 aircraft compared to the 60 of Nimitz Class aircraft carriers.[34]

In the East Asia region, the ability to execute soft power and hard power simultaneously is important. In some cases, soft power is equally as important as hard power, so the ability to conduct humanitarian assistance and disaster relief (HADR) operations is essential. On average, *The Advanced Surface Force Fleet* will be better equipped to execute HADR missions because it will have more amphibious ships, medical operating rooms, and medical beds. If a maritime conflict occurs in the region, *The Advanced Surface Force Fleet* would be better armed, integrated, and offensively capable to deal with the situation.

E. RESEARCH DESIGN

Most recent literature on alternative force structures suggest increased or decreased naval ships based purely on ship numbers. While they are implicitly discussing the capabilities of the fleet that they recommend—based on their recommended number of ships per class—none explicitly define the specific capabilities needed to execute the required and expected future missions. Through the Navy's proposed 2040 fleet, naval

[33] U.S. Navy, *A Cooperative Strategy for 21st Century Seapower* (Washington, DC: U.S. Navy, 2015), 2, http://www.navy.mil/local/maritime/150227-CS21R-Final.pdf, 2.

[34] U.S. Navy, "United States Navy Fact File: Aircraft Carriers—CVN," America's Navy, accessed January 20, 2015, http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=200&ct=4.

leaders are implicitly suggesting what capabilities are needed to execute the required missions most efficiently. Fourteen measures of capabilities to see how *The Advanced Surface Force Fleet* compares to the planned 2040 Navy are explicitly compared. To accomplish this task, the thesis is divided into the following chapters.

Chapter II determines all the costs associated with the proposed changes for the eLPD 17-class ship: two CIWS mounts, 16 vertical launch system (VLS) cells, 16 anti-ship cruise missiles, a variable depth sonar, and a combat system suite upgrade that would integrate the new weapon systems on the eLPD 17 platform. All upgrades come from other current naval platforms; therefore, the costs of each upgrade are based on previously procured amounts, all in fiscal year (FY)15 dollars. The total ship procurement cost are computed by adding each of the enhancement costs to the LPD 17 procurement costs, and then 10% is added to plan for additional costs associated with the slight modifications to the ship's design. After Chapter II discusses the procurement cost for each eLPD 17, Chapter III finds the Navy's 2040 planned surface combatant fleet's procurement costs.

From the Navy's planned 2040 fleet, only changes to the large surface combatants, small surface combatants, and amphibious ships are considered. Only altering the composition of the surface fleet is considered; keeping plans for aircraft carriers, submarines, logistical ships, and support ships unchanged. In FY2015 dollars, the procurement costs for each surface combatant and amphibious ship are gathered to provide the procurement costs for the planned 2040 Navy. As this thesis is not altering the destroyer design, the individual ship procurement costs for each DDG will be the same for each navy; the only difference is the cost of the eLPD 17. At an equal procurement cost to the Navy's planned 2040 fleet, the best combination of DDGs and eLPD 17 is developed. After the total number of ships for each navy is compiled, 14 measures of capabilities are used to compare the two navies in Chapter III.

The 14 measures of capabilities are the number of vertical launch cells, number of anti-ship cruise missiles (ASCM), number of ASW capable ships, number of 60 Romeo helicopters embarked, number of sailors, number of landing craft air cushion (LCAC) spots, amount of USMC vehicle storage available, amount of USMC cargo storage

available, number of Marines carried, number of USMC CH-53 helicopter spots, number of medical operating rooms, number of medical ward beds, number of ships, and operating and support costs. Each ship's respective capabilities are compiled using only unclassified material.

The capability of *The Advanced Surface Force Fleet* and the Navy's planned 2040 surface fleet to conduct HADR operations and to defeat an adversary in a maritime conflict are examined in Chapter IV and Chapter V, respectively. Chapter IV uses Cullen M. Greenfield and Cameron A. Ingram's research from their thesis, "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief," to determine the HADR capabilities of each fleet.[35] In Chapter V, Wayne Hughes's "Salvo Model" equation is used to illustrate how an amphibious ready group (ARG) from *The Advanced Surface Force Fleet* and from the planned 2040 surface fleet may fare in a theoretical conflict against a Chinese surface action group (SAG).[36]

Chapter VI offers a summary of key findings, and then provides recommendations for future research.

[35] Cullen M. Greenfield and Cameron A. Ingram, "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief Operations" (acquisition research report, Naval Postgraduate School, 2011), accessed March 1, 2015, http://www.dtic.mil/dtic/tr/fulltext/u2/a545858.pdf.

[36] Wayne P. Hughes Jr., *Fleet Tactics and Coastal Combat*, 2nd ed. (Annapolis, MD: Naval Institute Press, 2000), 268.

II. THE ENHANCED SAN ANTONIO CLASS AMPHIBIOUS TRANSPORT DOCK SHIP (ELPD 17)

A. BACKGROUND

The San Antonio class amphibious transport dock ship (LPD 17) is used to transport Marines and their equipment across the globe. Currently, the LPD 17 is a diesel-operated, 684-foot-long amphibious ship capable of embarking 800 marines, launching and landing two MV-22 or four CH-46 helicopters, and holding two landing craft air-cushions (LCAC) or one landing craft utility (LCU).[37] Additionally, it is armed with two 30mm guns and two rolling airframe missile (RAMs) launchers.[38] Figure 1 is a picture of the USS San Antonio, the first LPD 17 class ship.

Figure 1. USS San Antonio (LPD 17)

Source: "The USS San Antonio LPD 17," *San Antonio Class Landing Platform Dock, United States of America*, accessed October 21, 2015, http://www.naval-technology.com/projects/lpd17/lpd171.html.

[37] U.S. Navy, "United States Navy Fact File: Amphibious Transport Dock—LPD."

[38] Ibid.

To compare measures of capabilities of equivalent costs fleets, a rough assessment on the costs to create an eLPD 17 must first be gained. The following section provides a breakdown of each proposed enhancement's cost, which is then totaled for the eLPD procurement cost. Follow on research may conduct more detailed cost estimates.

B. ENHANCEMENTS AND COSTS

The proposed upgrades to the enhanced LPD 17 (eLPD 17) class are two CIWS mounts, 16 VLS cells, 16 ASCMs, a variable depth sonar, and a combat system suite upgrade that would integrate the added weaponry. While the upgrades enhance the LPD 17 class ships' ability to take part in traditional naval warfare areas, no significant ship alterations will be needed to accommodate the changes. By enhancing the LPD 17 class ship with more weapon systems, a ship that is traditionally and predominantly used for Marine transport can be employed as a potent surface combatant. All costs estimates for the proposed upgrades are in FY15 dollars.

1. Close-In Weapon System

The current LPD 17 relies on two RAM launchers for air defense and two 30mm guns for surface defense; however, the installation of two CIWS mounts provides the LPD 17 with further air and surface defense capabilities. Originally, the Mk 15 CIWS was developed to provide U.S. Navy surface ships with the means to defend themselves against incoming enemy missiles.[39] The latest model, Block 1B, allows CIWS to engage surface targets along with aerial targets.[40] The two CIWS mounts will be placed symmetrically on the bridge wings aboard the eLPD 17. Specifically, one will be located on the port bridge wing and the other located on the starboard bridge wing.

The procurement costs of two CIWS mounts for each eLPD 17 are estimated to be approximately $16 million. In FY15, the U.S. Navy purchased two CIWS mounts for the

[39] IHS Jane's, "Mk 15 Close-In Weapon System, Phalanx," Jane's Naval Weapon Systems, September 30, 2014, https-//janes.ihs.com.libproxy.nps.edu/CustomPages/Janes/DisplayPage.aspx?DocType=Reference&ItemId=+++1495993.

[40] Ibid.

DDG 51 AEGIS Destroyer platform at a cost of $15.9 million.[41] Since no modifications are to be made to the Mk 15 weapon system, the cost of each CIWS mount is estimated to be approximately $8 million.

2. Vertical Launch System

The addition of 16 Mk 41 VLS cells provides the eLPD 17 with long-range strike capability and increased air defense capability. Jane's describes the Mk 41 as:

> The Mk 41 GMVLS [Guided Missile Vertical Launching System] is an unmanned multirole vertical missile launching system based upon pre-assembled launcher modules each of a structure containing eight missile cells, independently operating armoured [sic] hatch covers, a gas-management system and requisite electronics, power supplies, and support equipment. The GMVLS can interface with any combat or weapon control system.[42]

The original LPD 17 blueprints included space for 16 VLS cells on the foc'sle; as initially designed, the eLPD 17 will have 16 VLS cells on the ship's foc'sle.[43]

Each set of 16 VLS cells is estimated to cost roughly $9.1 million. In FY15, the Navy purchased two sets of VLS launchers—96 cells each—at a cost of $109.2 million.[44] Since the Navy will purchase more VLS modules annually, the procurement costs are projected to be linear. The average cost of each VLS set of 96 cells was $54.6 million. The eLPD 17 will have one-sixth of the VLS cells of a destroyer. Therefore, the procurement costs for the 16 eLPD VLS cells are estimated to be one-sixth of the $54.6 million.

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[41] AEROWEB, "U.S. Department of Defense (DoD) Budget Data, 2016," DDG 51 AEGIS Destroyer, February 2015, 8–8, http://www.bga-aeroweb.com/Defense/Budget-Data/FY2016/DDG-51-NAVY-SHIP-FY2016.pdf.

[42] IHS Jane's, "GMLVS Mk 41/Mk 57," Jane's Naval Weapon Systems, December 31, 2014, https-//janes.ihs.com.libproxy.nps.edu/CustomPages/Janes/DisplayPage.aspx?DocType=Reference&ItemId=+++1499634.

[43] "LPD-17 San Antonio Class," LPD 17 Specifications, July 7, 2011, http://www.globalsecurity.org/military/systems/ship/lpd-17-specs.htm.

[44] AEROWEB, "U.S. Department of Defense (DoD) Budget Data, 2016," 8–8.

3. Anti-Ship Cruise Missiles

By having 16 ASCMs aboard the eLPD 17, Naval leaders will have another offensively capable surface platform. Currently, the only anti-ship cruise missile aboard any surface ship is the RGM-84 Harpoon. Jane's describes the RGM-84A Block IA Harpoon as "an inertial navigation system (INS) and radar guided, turbojet-powered, rocket boosted, fitted with a high-explosive warhead."[45] The Harpoon can travel at a max range of 50 nautical miles, reach a max speed of .85 Mach, and deliver a 488-pound warhead.[46] Sixteen anti-ship cruise missiles—harpoon missiles or a future designed ASCM—will be placed near the aft radar enclosure, which houses the AN/SPS-48E.

The cost of the launchers from which the 16 ASCMs will be fired is estimated to be no more than $9.1 million. The cost of each missile is not considered. No information has been found that directly discusses the costs of the Harpoon launchers and supporting infrastructure; however, it is assumed that the launchers, canisters, and supporting systems will not cost more than the previously discussed VLS cells. One option for significantly decreasing the cost of the launchers is to take the launchers from decommissioning cruisers and destroyers and place them aboard the eLPD 17. For cost estimating purposes, however, it is assumed that 16 ASCM launchers will be less than or equal to the cost of 16 VLS cells.

4. Variable Depth Sonar

The addition of the variable depth sonar (VDS) and applicable littoral combat ship (LCS) ASW mission package provides the eLPD 17 with cutting-edge ASW capabilities. The torpedo countermeasures presently installed aboard the LPD 17 class ship will remain in place if compatible with the LCS ASW mission package. The requisite LCS ASW mission package components are the ASW Escort Module, Torpedo defense module, and ASW mission management/command and control (C2) center; the best

[45] IHS Jane's, "RGM-84/UGM-84 Harpoon (GWS 60)," Jane's Naval Weapon Systems, December 12, 2014, https-//janes.ihs.com.libproxy.nps.edu/CustomPages/Janes/DisplayPage.aspx?DocType=Reference&ItemId=+++1495985.

[46] Ibid.

combination of ASW components will be installed aboard the eLPD 17 platform.[47] The exact combination of components is beyond the scope of this research; however, the eLPD 17 will have ASW capabilities equal to those of a LCS ASW mission module. The ASW components will be installed on the aft end of the ship, on both port and starboard sides. To further enhance the eLPD 17 ASW capabilities, two 60 Romeo helicopters and applicable crew will be embarked aboard the ship.

The cost of the ASW suite is estimated to be $22.7 million, not including the cost of the helicopters. Since multiple portions of the LCS ASW module will be used aboard the eLPD 17, the entire cost of the ASW Module—$22.7 million—is used for estimating the procurement costs.[48]

5. Combat System Suite Upgrade

The combat system suite upgrade will integrate the currently installed radars, fire control radars, and weapon systems with the previously discussed eLPD 17 enhancements. In addition to the LPD 17's current combat suite capabilities, the upgrade will allow the eLPD 17 to employ CIWS in its fullest capacity; fire various standard missiles (SMs), evolved sea sparrow missiles (ESSMs), vertical launch antisubmarine rockets (ASROCs), and the Tomahawk land attack missile (TLAM) from VLS; fire the ASCMs, and fully integrate the ASW suite. In addition to the applicable hardware and software required for integrating all the weapon systems, three illuminators will also be installed aboard the eLPD 17.

The cost of the combat system suite upgrade is estimated to be less than $179 million. The first assumption is that the upgrade will cost less than the Mk 7 AEGIS weapon system. Three Mk 7s were purchased in FY13 for $610 million, one in FY14 for

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[47] "United States Navy: Fact File, Littoral Combat Ship—Anti-Submarine Warfare (ASW) Mission Package," May 19, 2015, http-//www.navy.mil/navydata/fact_display.asp?cid=2100&tid=412&ct=2.

[48] Ronald O'Rourke, *Navy Littoral Combat Ship (LCS)/Frigate Program: Background and Issues for Congress* (CRS Report No. RL33741) (Washington, DC: Congressional Research Service, 2015), 8, https://www.fas.org/sgp/crs/weapons/RL33741.pdf.

$231.3 million, and two in FY15 for $444.8 million.[49] Looking at the quantity and costs of Mk 7 purchases between FY13 and FY15, and assuming a 90% learning curve, the combat system suite upgrade is estimated to cost no more than $179 million.

C. SUMMARY OF COSTS AND CONCLUSION

The total procurement cost of each eLPD 17 class ship is estimated to be approximately $2.6 billion. Currently, in FY15 dollars, the procurement cost for each LPD 17 is approximately $2.1 billion.[50] To determine the estimated procurement cost of each eLPD 17, as seen in Table 1, all the enhancement costs are first added to the procurement costs of an LPD 17 to provide the total enhancement cost. To account for ship alteration costs and other additional costs, 10% is added to the total enhancement cost to arrive at the total procurement cost of each eLPD 17 (see Table 1).

Table 1. Estimated Procurement Cost of Each eLPD 17
(in Millions of FY15 Dollars)

Enhancements for LPD 17	Estimated Unit Cost	Quantity	Estimated Enhancement Costs	Estimated Enhancement Cost	Estimated Procurement Cost of eLPD 17
CIWS	8.0	2	16.0	2,335.9	2,569.5
VLS	9.1	1	9.1		
ASCM	9.1	1	9.1		
Variable Depth Sonar	22.7	1	22.7		
Combat System Suite Upgrade	179.0	1	179.0		
Procurement Cost of an LPD 17	2,100.0	1	N/A		

The first four columns break down the individual enhancement costs for the eLPD 17. The fifth column, Total Enhancement Cost, adds the individual Enhancement Costs to the Procurement Cost of an LPD 17 class ship. The last column, Total Procurement Cost of Enhanced LPD 17, is determined by adding 10%—to account for the additional costs of changing the LPD 17 ship design—to the Total Enhancement Cost.

[49] AEROWEB, "U.S. Department of Defense (DoD) Budget Data, 2015," DDG 51 AEGIS Destroyer, March 2014, 7–8, https://www.bga-aeroweb.com/Defense/Budget-Data/FY2015/DDG-51-NAVY-PROC-FY2015.pdf.

[50] Ronald O'Rourke, *Navy LPD-17 Amphibious Ship Procurement: Background, Issues, and Options for Congress* (CRS Report No. RL34476) (Washington, DC: Congressional Research Service, 2011), 7, https://www.fas.org/sgp/crs/weapons/RL34476.pdf.

The eLPD 17 provides the Navy with an amphibious ship that can act autonomously in contested environments, and with a warship that will be able to perform traditional surface combatant roles while maintaining the ability to perform traditional amphibious lift capabilities.

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III. CONSTRUCTING AND COMPARING THE FLEETS

A. BACKGROUND

This chapter demonstrates an analytical process to gauge the utility of introducing the eLPD 17 into the fleet. The procurement cost of the planned 2040 fleet is first estimated in FY15 dollars, and then this value is used to "buy" *The Advanced Surface Force Fleet* to achieve an "equal cost" fleet. Subsequently, the two fleets are compared by 14 measures of capability. While acknowledging that this method is somewhat artificial since some "sunk costs" for ships already procured in the programmed fleet are included, this first-order gross level comparison is conducted to see if a more detailed fleet transition analysis is warranted for future studies.

These cost estimates come only from open sources. Specifically, these estimates come from Naval and Congressional Budget Office material. Yet, it is acknowledged that further research into this concept should include sensitivity analysis for the cost estimation.

B. THE NAVY'S PLANNED 2040 SURFACE FLEET

The planned 2040 Navy will be comprised of 85 large surface combatants, 56 small surface combatants, and 33 amphibious warfare ships.[51] Since all the cruisers will be decommissioned by 2040, the service life of destroyers will be extended to 40 years, and the first flight IIA Arleigh Burke Class Destroyer was commissioned in 2000, the large surface combatants are assumed to be comprised of 46 flight IIA destroyers and 39 flight III destroyers.[52] The Navy will procure 32 LCSs and plans to build "modified

[51] Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2016*, 6.

[52] Ibid., 11; Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2016 Shipbuilding Plan* (Washington, DC: Congress of the United States, October 2015), 10, https://www.cbo.gov/publication/50926.

versions of the current LCS providing greater lethality and survivability."[53] Therefore, the assessment is that the small surface combatants will be comprised of 16 Freedom class LCSs, 16 Independence class LCSs, and 24 LCS follow-on class of Frigate designation. Based on the Navy's amphibious class warship construction plan and the 12th LPD 17 class ship purchase, it is assumed that the 2040 amphibious force will include two America class (LHA 6) amphibious assault ships, eight flight I LHA 6 amphibious assault ships, 12 LPD 17s, and 11 LX(R) dock landing ships.[54]

The total procurement cost of the planned 2040 surface fleet, in FY15 dollars, is estimated to be $254 billion. The Congressional Budget Office's estimated procurement costs (instead of those estimated by the Navy) were used for each ship class to arrive at the estimated 2040 fleet procurement cost. The estimated procurement cost of large surface combatants is $1.4 billion for flight IIA destroyers and $1.9 billion for flight III destroyers.[55] On average, the estimated cost for the small surface combatant is expected to be $0.5 billion for each LCS—which does not include the cost of the mission packages—and $0.6 billion for each frigate.[56] Each LHA 6 class ship and subsequent flight I LHA 6 ship is estimated to cost approximately $3.9 billion.[57] Additionally, the estimated procurement cost for each LPD 17 class ship and LX(R) is $2.1 billion and $1.9 billion, respectively.[58] Table 2 summarizes the composition and estimated procurement costs of the Navy's planned 2040 surface fleet.

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[53] Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for FY2015*, 15; Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2016*, 11–2.

[54] Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for FY2015*, 24–7; Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2016*, 5.

[55] Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2015 Shipbuilding Plan* (Washington, DC: Congress of the United States, 2014), 27, http://www.cbo.gov/sites/default/files/cbofiles/attachments/49818-Shipbuilding.pdf, 27; Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2016 Shipbuilding Plan*, 27.

[56] Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2016 Shipbuilding Plan*, 28.

[57] Ibid., 29.

[58] Ibid.

Table 2. The Composition and Procurement Cost (in Billions of FY15 Dollars) of the Navy's Planned 2040 Surface Fleet

Ship Class	Number of Ships	Estimated Procurement Cost Per Ship	Estimated Procurement Cost of Each Ship Class	Estimated Procurement Cost of Navy's Planned 2040 Surface Fleet
Flight IIA Destroyer	46	1.4	64.4	254
Flight III Destroyer	39	1.9	74.1	
Freedom Class LCS	16	0.5	8	
Independence Class LCS	16	.5	8	
Frigates	24	.6	14.4	
LHA 6	2	3.9	7.8	
Flight I LHA 6	8	3.9	31.2	
LPD 17	12	2.1	25.2	
LX(R)	11	1.9	20.9	

C. THE ADVANCED SURFACE FORCE FLEET

The cost-equivalent *Advanced Surface Force Fleet* is comprised of 91 large surface combatants and 40 amphibious warfare ships; specifically, 46 flight IIA destroyers, 45 flight III destroyers, and 40 eLPD 17s. As previously discussed, the estimated procurement cost for each destroyer is $1.4 billion for each flight IIA destroyer and $1.9 billion for each flight III destroyer. Additionally, as shown in Chapter II, the estimated procurement cost for each eLPD 17 is $2.6 billion. To establish the composition of *The Advanced Surface Force Fleet*, the fleet's total procurement costs, capabilities of each platform, and the ability of the Navy and Marine Corps to further integrate is considered. Table 3 summarizes the composition and procurement costs of *The Advanced Surface Force Fleet*.

Table 3. The Composition and Procurement Cost (in Billions of FY15 Dollars) of *The Advanced Surface Force Fleet*

Ship Class	Number of Ships	Estimated Procurement Cost Per Ship	Estimated Procurement Cost of Each Ship Class	Estimated Procurement Cost of *The Advanced Surface Force Fleet*
Flight IIA Destroyer	46	1.4	64.4	253.9
Flight III Destroyer	45	1.9	85.5	
eLPD 17	40	2.6	104	

D. INDIVIDUAL SHIP CLASS CAPABILITIES

Before comparing the two fleets by 13 measures of capabilities, the respective capabilities of each ship class is discussed. Each ship class is assessed by its number of VLS cells, number of anti-ship cruise missiles (ASCM), ability to conduct ASW, number of 60 Romeo helicopters embarked, number of sailors, number of LCAC spots, amount of USMC vehicle storage available, amount of USMC cargo storage available, maximum number of Marines carried, number of USMC CH-53 helicopter spots, number of medical operating rooms, number of medical ward beds, and operating and support costs. All operating and support costs are presented in millions of FY15 dollars, and are based on class averages for FY14. Each ship's respective capabilities are compiled using only unclassified material.

1. Large Surface Combatants: Flight IIA and III Arleigh Burke Destroyers (DDG)

The flight III Arleigh Burke class destroyer has several internal modifications to incorporate the air and missile defense radar (AMDR), also known as AN/SPY-6; however, the flight III and IIA share many other capabilities.[59] Both flights of destroyers have 96 VLS cells, room to embark two 60 Romeo helicopters, room for approximately 308 crew members, and the ability to conduct ASW operations.[60] Currently, neither

[59] IHS Jane's, "Arleigh Burke (Flight III) Class," Destroyers, United States, September 7, 2015, https://janes.ihs.com.libproxy.nps.edu/Grid.aspx; Stephen Saunders, *IHS Jane's Fighting Ships: 2015–2016* (Coulsdon, England: IHS Jane's, 2015), 942.

[60] IHS Jane's, "Arleigh Burke (Flight III) Class"; Saunders, *IHS Jane's Fighting Ships: 2015–2016*, 942.

platform has any ASCM capability, and neither destroyer has any USMC or medical capability. In 2014, the average operating and support costs for each flight IIA was approximately $57 million; as a flight III destroyer has not been built, its operating and support costs are assumed to be the same as the flight IIA average.[61]

2. Small Surface Combatants: Littoral Combat Ships and Frigates

The Freedom Class LCS and Independence Class LCS may conduct similar missions, but they differ in their capabilities. The Freedom Class LCS is capable of conducting ASW operations, embarking one 60 Romero helicopter, and supporting a crew of 50.[62] In 2014, the average operating and support costs for the Freedom Class LCS were approximately $24 million.[63] The Independence Class LCS is capable of conducting ASW operations, embarking two 60 Romeo helicopters, and supporting a crew of 40.[64] In 2014, the average operating and support costs for the Independence Class were approximately $22 million.[65] While both ship classes are capable of conducting ASW operations, the Navy has planned to only purchase 16 ASW mission packages; therefore, when assessing the ASW capability of the Navy's planned 2040 surface fleet, it is assumed that only 16 of the 32 LCS class ships are ASW capable.[66] Currently, neither LCS class has VLS cells, ASCMs, USMC capabilities, or medical capabilities.[67]

Since limited information is available on the expected capabilities of the frigate, its capabilities are based off the two LCS class ships. All frigates are assumed to be able

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[61] Visibility and Management of Operating and Support Costs (VAMOSC), "Operating and Support Costs for CG-47CL, DDG-51CL/Flight IIA, LCS-1CL, LCS-2CL, LHD-1CL, and LPD-17CL," e-mail message to the author, February 18, 2015, https://www.vamosc.navy.mil.

[62] Saunders, *IHS Jane's Fighting Ships: 2015–2016*, 946.

[63] Visibility and Management of Operating and Support Costs (VAMOSC), "CG-47CL, DDG-51CL/Flight IIA, LCS-1CL, LCS-2CL, LHD-1CL, and LPD-17CL."

[64] Saunders, *IHS Jane's Fighting Ships: 2015–2016*, 948.

[65] Visibility and Management of Operating and Support Costs (VAMOSC), "CG-47CL, DDG-51CL/Flight IIA, LCS-1CL, LCS-2CL, LHD-1CL, and LPD-17CL."

[66] O'Rourke, *Navy Littoral Combat Ship (LCS)/Frigate Program: Background and Issues for Congress*, 5.

[67] Saunders, *IHS Jane's Fighting Ships: 2015–2016*, 946–48.

to conduct ASW operations, embark two Romeo helicopters, support a crew of 45, and have operating and support costs of approximately $23 million. Additionally, it is assumed all frigates will not have VLS cells, ASCMs, USMC capabilities, or medical capabilities.

3. Amphibious Warfare Ships: The America Class Amphibious Assault Ship, Flight I America Class Amphibious Assault Ship, San Antonio Class Amphibious Transport Dock, LX(R), and Enhanced San Antonio Class (eLPD 17) Transport Dock

The America Class (LHA 6) ship is different from traditional amphibious assault ships in that it does not have a well deck. While the LHA 6 class is not capable of carrying any LCAC, the flight I LHA 6 will have a well deck capable of holding two LCAC.[68] The America Class has a crew of 1,204, the capacity to carry a maximum of 1,871 Marines, 160,000 cubic feet of cargo storage space, 11,760 square feet for vehicle stowage, nine CH-53 helicopter spots, two medical operating rooms, and 26 medical ward beds; since limited information is available about the flight I LHA 6, it is assumed that it will have these same capabilities.[69] While data on the operating and support costs of the LHA 6 class or flight I are currently not available, it is assumed both will have operating and support costs similar to that of LHD 8, which in 2014, was approximately $145 million.[70] The LHA 6 class, and subsequent flight 1, does not have any VLS cells, ASCMs, 60 Romeos embarked, or ASW capabilities.

The San Antonio Class (LPD 17) ship is a versatile platform. It can support a crew of 403 sailors and carry a maximum of 800 Marines.[71] Additionally, it has a well deck that can hold two LCAC, 24,000 square feet of vehicle storage space, 34,000 cubic feet for cargo storage, two CH-53 helicopter spots, two medical operating rooms, and 24

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[68] Saunders, *IHS Jane's Fighting Ships: 2015–2016*, 960; Global Security, "LHA 6 Flight I/LHA 8 Class," accessed January 20, 2015, http://www.globalsecurity.org/military/systems/ship/lha-8.htm.

[69] Saunders, *IHS Jane's Fighting Ships: 2015–2016*, 960.

[70] Visibility and Management of Operating and Support Costs (VAMOSC), "Operating and Support Costs for LHD 8, LSD-41CL, and LSD-49CL," e-mail message to the author, February 23, 2015, https://www.vamosc.navy.mil.

[71] Saunders, *IHS Jane's Fighting Ships: 2015–2016*, 957.

medical ward beds.[72] In 2014, the average operating and support costs of each LPD 17 were approximately $60 million. The LPD 17 class does not have VLS, ASCMs, 60 Romeo helicopters embarked, or the ability to conduct ASW operations.

The replacement for the Landing Ship Dock 41 and 49 (LSD 41 and LSD 49) class ships is the LX(R). According to Huntington Ingalls, the LX(R) accommodates a crew of 396, a maximum of 506 Marines, and two LCAC.[73] It will also have 24,900 square feet for vehicle storage, 18,000 cubic feet of cargo storage, two CH-53 helicopter spots, one operating room, and eight medical ward beds.[74] While the LSD 49 class had an average operating and supports costs of approximately $101 million per ship in 2014, the LSD 41 class average was approximately $50 million.[75] Since the LX(R) is being built from a proven platform, the LPD 17 class, it is assumed the LX(R) will have an operating and support cost less than that of the LPD 17 class; thus, the operating and support costs of each LX(R) are estimated to be approximately $50 million. The LX(R) does not have VLS, ASCMs, 60 Romeo helicopters embarked, or ASW capabilities.

As discussed in Chapter II, the eLPD 17 has 16 VLS cells, 16 ASCMs, two 60 Romeo helicopters embarked, and the ability to conduct ASW operations. The eLPD 17 also retains the LPD 17's capability of carrying two LCAC, 24,000 square feet of vehicle storage, 34,000 cubic feet of cargo space, two CH-53 helicopter spots, two medical operating rooms, and 24 medical ward beds. To support all the enhanced capabilities of the eLPD 17, it is estimated an additional 42 sailors will be permanently assigned to the ship, 12 sailors for ASW operations, 15 sailors for air defense (AD) operations, and 15 sailors for surface warfare (SUW) operations. As a result, the eLPD 17 has a crew of 445. Also, it is estimated that approximately 30 sailors will embark in support of the two, 60 Romeo helicopters. Using the LPD 17's baseline Marine surge capability (800 Marines), and taking into account the eLPD 17's additional crew (42 Sailors) and helicopter

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[72] Ibid.

[73] "LPD Flight IIA Specifications," accessed February 14, 2015, http://www.huntingtoningalls.com/flight2/specs.

[74] Ibid.

[75] Visibility and Management of Operating and Support Costs (VAMOSC), "LHD 8, LSD-41CL, and LSD-49CL."

detachment (30 Sailors), it is estimated the eLPD 17 can support carrying a maximum of 728 Marines.

The eLPD 17's annual operating and support cost is estimated to be $77 million. To estimate the annual operating and support costs of the eLPD 17, the annual operating costs of a cruiser (CG 47) are analyzed. In 2014, the CG 47 class had an average operating and support costs of $68 million.[76] Since the eLPD 17 adds a fifth of a CG 47's crew, an eighth of its VLS cells, and four times the amount of ASCMs, the annual operating and support costs of the enhancements are estimated to be a fourth of the CG 47's annual operating and support cost ($17 million). The total operating and support estimation of $77 million is arrived at by adding the CG 47's $17 million to the LPD 17's annual operating and support costs of $60 million.

4. Summary of Individual Ship Class Capabilities

The summary of 13 measures of capabilities for the flight IIA DDG, flight III DDG, Freedom Class LCS, Independence Class LCS, Frigates, LHA 6, flight I LHA 6, LPD 17, LX(R), and eLPD 17 are shown in Table 4.

[76] Visibility and Management of Operating and Support Costs (VAMOSC), "CG-47CL, DDG-51CL/Flight IIA, LCS-1CL, LCS-2CL, LHD-1CL, and LPD-17CL."

Table 4. Summary of Individual Ship Class Capabilities

	Ship Classes									
Measures of Capabilities	Flight IIA DDG	Flight III DDG	Freedom Class LCS	Independence Class LCS	Frigates	LHA 6	Flight I LHA 6	LPD 17	LX(R)	eLPD 17
VLS Cells	96	96	0	0	0	0	0	0	0	16
ASCMs	TBD	TBD	TBD	TBD	TBD	0	0	0	0	16
ASW Capable	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes
60 Romeo Helicopters Embarked	2	2	1	2	2	0	0	0	0	2
Sailors	308	308	50	40	45	1,204	1,204	403	396	445
LCAC	0	0	0	0	0	0	2	2	2	2
USMC Vehicle Storage (Sq. Ft)	0	0	0	0	0	11,760	11,760	24,000	24,900	24,000
USMC Cargo Storage (Cubic Ft)	0	0	0	0	0	160,000	160,000	34,000	18,000	34,000
Marines (Surge)	0	0	0	0	0	1,871	1,871	800	506	728
USMC CH-53 Spots	0	0	0	0	0	9	9	2	2	2
Medical Operating Rooms	0	0	0	0	0	2	2	2	1	2
Medical Ward Beds	0	0	0	0	0	26	26	24	8	24
Annual Operating and Support Costs (in Millions of FY15 Dollars)	57	57	24	22	23	145	145	60	50	77

While the Flight IIA DDG, Flight III DDG, Freedom Class LCS, Independence Class LCS, and Frigates are not currently armed with any ASCMs, "TBD" is placed in their respective ASCM row because the current "Distributed Lethality" initiative in the surface force is determining capability and capacity requirements to arm current surface combatants with ASCM.

E. COMPARING THE FLEETS

Using the composition of each fleet, as previously displayed in Tables 2 and 3, and with the individual ship class capabilities shown in Table 4, it is possible to evaluate the two fleets via the 14 measures of capabilities, as seen in Table 5. The Navy's planned 2040 surface fleet shows higher capacity in five of the 14 categories; however, *The Advanced Surface Force Fleet* is better in nine of the 14 categories. The Navy's planned 2040 surface fleet has 2% more 60 Romero helicopters embarked aboard its fleet, 62% more USMC cargo storage area within its amphibious fleet, 16% more Marine surge capability, and 70% more USMC CH-53 helicopter spots aboard its amphibious fleet than *The Advanced Surface Force Fleet*.

Table 5. Comparing the Navy's Planned 2040 Surface Fleet to *The Advanced Surface Force Fleet*

Measures of Capabilities	Navy's Planned 2040 Surface Fleet	*The Advanced Surface Force Fleet*
VLS Cells	8,160	**9,376**
ASCMs	TBD	**640+**
ASW Capable	125	**131**
60 R Embarked	**266**	262
Sailors	49,932	**45,828**
LCAC	62	**80**
USMC Vehicle Storage (Sq. Ft)	679,500	**960,000**
USMC Cargo Storage (Cubic Ft)	**2,206,000**	1,360,000
Marines (Surge)	**33,876**	29,120
USMC CH-53 Spots	**136**	80
Medical Operating Rooms	55	**80**
Medical Ward Beds	636	**960**
Annual Operating and Support Costs (in Millions of FY15 Dollars)	8,853	**8,267**
Number of Ships	**174**	131

Each bolded and underlined number shows the fleet that "won" the respective category. "TBD" is in the Navy's Planned 2040 Surface Fleet's ASCM row because the current "Distributed Lethality" initiative in the surface force is determining capability and capacity requirements to arm current surface combatants with ASCM. "640+" is in *The Advanced Surface Force Fleet's* ASCM row because the eLPD 17 will add 640 ASCMs in addition to any changes made to destroyers based on the "Distributed Lethality" concept.

While *The Advanced Surface Force Fleet* has 25% fewer ships than the Navy's planned 2040 surface fleet, *The Advanced Surface Force Fleet* has 115% more VLS cells, 5% more ASW capable ships, 8% percent fewer Sailors, 123% more LCAC, 141% more USMC vehicle storage space, 145% more medical operating rooms, and 151% more medical ward beds. The two categories that *The Advanced Surface Force Fleet* trumps

the Navy's planned 2040 fleet are ASCMs and annual operating and support costs. With the 16 ASCMs on each eLPD 17, *The Advanced Surface Force Fleet* provides a significant addition to the surface force offensive capacity. Additionally, *The Advanced Surface Force Fleet's* annual operating and support costs are estimated to be $586 million less than that of the Navy's planned 2040 surface fleet.

F. CONCLUSION

The Advanced Surface Force Fleet is more offensively capable and distributable, comprised of ships that can self-escort in contested environments or integrate with any U.S. Navy platform, and it is estimated to operate at half a billion dollars less than the Navy's planned 2040 surface fleet. As the Navy and Marine Corps are currently structured, the Navy's planned 2040 surface fleet has generally more USMC lift capacity; however, *the Advanced Surface Force Fleet* distributes lethality across all its platforms and has more medical facilities.

Employing *The Advanced Surface Force Fleet* to its fullest capability requires further integration between the Marine Corps and Navy, and between the United States and its allies. Incorporating Marine assets aboard aircraft carriers, reducing the overlap of aircraft platforms between the two services, and shifting Marine cargo transportation to other platforms can mitigate the shortfalls of *The Advanced Surface Force Fleet*. Additionally, the Navy must rely further on its allies. *The Advanced Surface Force Fleet* provides the Navy with more large surface combatants and amphibious ships; however, its small combatant force is non-existent. By relying on regional allies to purchase, maintain, and provide small combatants—such as LCSs, frigates, and single-mission ships—for current and future missions, larger naval platforms can be maintained while having access to more small surface combatants through regional navies.

The Advanced Surface Force Fleet centers on the concept of maintaining large, multi-mission platforms. With 40 amphibious ships, the USMC will be better positioned to respond to various crises around the world. Moreover, with 91 large surface combatants, the Navy will be better equipped to execute various missions around the globe.

This first-order analysis provides sufficient evidence to support a more robust look at comparing the programmed fleet with an alternative ship building plan that includes the eLPD 17 and does not build frigates or other amphibious platforms. For this future study, it is suggested that logistics and maintenance issues be added, which for a less diverse fleet composition, may provide additional savings.

IV. HUMANITARIAN AID AND DISASTER RELIEF OPERATIONS IN THE EAST ASIAN REGION: AN APPLIED CASE STUDY FOR FLEET COMPARISON

A. BACKGROUND

On March 11, 2011 Japan experienced a 9.0 magnitude earthquake followed by a catastrophic tsunami wave. The earthquake was the fourth largest recorded since 1900, and "its occurrence shift[ed] the seafloor nearly eighty feet westwards above the quake center, moving Honshu [Japan's largest island] roughly 8 feet closer to California, and also shift[ed] the Earth on its axis by four inches."[77] The dual disaster caused significant damage: "With a population of 14.8 million people, the prefectures along the northeastern coast were the worst affected, with 129,500 houses destroyed and 265,324 severely damaged by the earthquake, tsunami, or ensuing fires."[78] The devastating disasters claimed the lives of more than 20,000 people, and led to more than $210 billion in damages.[79] Moreover, the earthquake and tsunami caused the Fukushima Daiichi Nuclear Power Plant to experience catastrophic failure—an event that only complicated relief efforts.

1. U.S. Response

The United States supported nearly all facets of Japanese relief efforts. The Japanese disaster was a unique experience for the United States because of its large concentration of naval forces in the region: "The U.S. Navy has approximately 70 ships, 300 various types of aircraft, and approximately 40,000 sailors and Marines operating in

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[77] Richard S. Ray, "Measured Maritime Responses to Disaster Relief Scenarios in the Pacific" (Naval Postgraduate School, 2012), 27, http://calhoun.nps.edu/bitstream/handle/10945/27894/12Dec_Ray_Richard.pdf?sequence=1.

[78] Jennifer D. P. Moroney et al., *Lessons from Department of Defense Disaster Relief Efforts in the Asia-Pacific Region* (Santa Monica, CA: RAND Corporation, 2013), 85, http://www.rand.org/content/dam/rand/pubs/research_reports/RR100/RR146/RAND_RR146.pdf.

[79] Ray, "Measured Maritime Responses to Disaster Relief Scenarios in the Pacific," 27.

the region on any given day."[80] At its peak, U.S. relief efforts employed 24 ships, 189 aircraft, and almost 24,000 personnel.[81] Specifically, the surface Navy provided "one Nimitz Class Aircraft carrier, one Wasp Class Amphibious Assault Ship, one Blue Ridge Class Command Ship, one Harper's Ferry Dock Landing Ship, two Whidbey Island Dock Landing Ships, several Guided Missile Cruisers, and several Flight I and II Guided Missile Destroyers."[82] The Japanese government requested "search and rescue teams, the use of U.S. military's lift capacity to transport supplies and personnel, and… nuclear expertise to help with the Fukushima nuclear crisis."[83] From conducting search and rescue missions, clearing debris, providing medical support, or delivering food supplies, the United States assisted Japan's relief efforts in every way possible.

In many respects, Operation Tomodachi—the U.S.-Japanese relief efforts in response to Japan's March 2011 earthquake and tsunami—was very successful. The response was rapid, joint, and thorough. In *Lessons from Department of Defense Disaster Relief Efforts in the Asia-Pacific Region*, the authors assert, "The utility and credibility of the U.S.-Japan alliance was strongly enhanced. Tomodachi, which means 'friend' in Japanese, was very well received on the Japanese side, and Tomodachi increased the popularity of the United States in Japan."[84]

2. HADR Capabilities of the 2040 Fleets

As Operation Tomodachi demonstrates the ability to conduct HADR operations is an important element of national security, and joint HADR operations provide a unique opportunity to build trust and cooperation among states. *A Cooperative Strategy for 21st*

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[80] Alexander Kaczur, Jayson Aurelio, and Edelio Joloya, "An Analysis of United States Naval Participation in Operation Tomodachi: Humanitarian and Disaster Relief in the Tsunami-Stricken Japanese Mainland" (MBA Professional Report, Naval Postgraduate School, 2012), https://calhoun.nps.edu/bitstream/handle/10945/7366/12Jun_Kaczur_Joloya_Aurelio_MBA.pdf?sequence=1.

[81] Moroney et al., *Lessons from Department of Defense Disaster Relief Efforts in the Asia-Pacific Region*, 86.

[82] Kaczur, Aurelio, and Joloya, "An Analysis of United States Naval Participation in Operation Tomodachi: Humanitarian and Disaster Relief in the Tsunami-Stricken Japanese Mainland," 12.

[83] Moroney et al., *Lessons from Department of Defense Disaster Relief Efforts in the Asia-Pacific Region*, 90–1.

[84] Ibid., 105.

Century Seapower, the Navy, Marine Corps, and Coast Guard's latest joint document states:

> Positioned to respond rapidly to disasters in key regions, forward naval forces working with allies and partners are ready to save lives, provide immediate relief, and set the conditions for effective civilian response without relying on damaged or inaccessible ports or airfields ashore. This function supports the naval missions of defending the homeland, responding to crises, deterring conflict, defeating aggression, and providing humanitarian assistance and disaster response.[85]

Using HADR as a mission case study, this chapter compares the HADR capabilities of the Navy's perspective 2040 7th Fleet and *The Advanced Surface Force Fleet's 7th Fleet*.

B. THE PROSPECTIVE 2040 7TH FLEET FORCES

Based on the current and planned naval forces allocated to 7th Fleet, it is assumed that the Navy's 2040 7th Fleet will have 11 destroyers, 11 LCSs, one LHA 6 flight I ship, one LPD 17, and two LX(R)s. As with previous chapters, changes are not being recommended for aircraft carriers, flagships, or other platforms; therefore, for comparison purposes, their HADR capabilities are not included in either fleet. In May 2015, the Navy had two cruisers and seven destroyers based in Japan, and announced plans for two additional destroyers to be forward deployed.[86] It is assumed two destroyers will replace the cruisers currently stationed in Japan because all the cruisers will be decommissioned by 2040.[87] Based on these details, it is assumed the Navy will have 11 destroyers stationed in Japan in 2040. Additionally, the Navy plans to have four LCSs in Singapore and seven LCSs stationed in Sasebo, Japan by 2022.[88] Therefore, it is

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[85] U.S. Navy, *A Cooperative Strategy for 21st Century Seapower* (Washington, DC: U.S. Navy, 2015), http://www.navy.mil/local/maritime/150227-CS21R-Final.pdf, 24.

[86] Kris Osborn, "Navy's New Maritime Strategy Includes More Destroyers to Pacific," accessed May 23, 2015, http://www.military.com/daily-news/2015/02/26/navys-new-maritime-strategy-includes-more-destroyers-to-pacific.html.

[87] Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2016*, 11.

[88] Zachary Keck, "U.S. Chief of Naval Operations: 11 Littoral Combat Ships to Asia by 2022," The Diplomat, May 17, 2013, http://thediplomat.com/2013/05/u-s-chief-of-naval-operations-11-littoral-combat-ships-to-asia-by-2022/.

assumed the Navy will have 11 LCSs deployed in 7th Fleet. Since the Navy currently has one LHD, one LPD 17, and two LSDs in Sasebo, it is assumed that it will have one LHA 6 flight I, one LPD 17, and two LX(R)s in Sasebo in 2040.

Based on the composition of the Navy's forward deployed assets, it is assessed that *The Advanced Surface Force Fleet's 7th Fleet* is comprised of 12 destroyers and eight eLPD 17s. Based on the previously discussed assumptions, the Navy's planned 2040 fleet will have 26 of its 174 total ships, or approximately 15% of its fleet stationed in 7th Fleet; additionally, 11 of its 85 destroyers, or approximately 13%, will be stationed in 7th Fleet. Therefore, approximately 15 percent of *The Advanced Surface Force Fleet*, or 20 ships, are allocated to 7th Fleet. Furthermore, 12 of *The Advanced Surface Force Fleet's* 91 destroyers, or approximately 13%, are assigned to 7th Fleet. Consequently, the remaining eight ships are eLPD 17s.

C. MEASURES OF HADR CAPABILITIES

In "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief," Greenfield and Ingram compiled typical mission requests that the USN and Military Sealift Command (MSC) were requested to conduct HADR operations.[89] They determined the two services were asked to conduct 14 critical missions in support of HADR operations: aircraft support capability, amphibious landing craft support, search and rescue (SAR), cargo capacity for dry goods, refrigerated goods, fresh water, for roll on roll off (RORO), for fuel and for self-sufficiency, personnel transfer, fresh water production, personnel support for cleanup and recovery efforts, berthing capability, and medical support.[90]

After determining the critical missions for conducting HADR operations, the authors determined each naval vessel's capability for conducting each specific mission: "Linking missions to specific USN and MSC platforms provides a comparison of

[89] Greenfield and Ingram, "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief Operations," 48.

[90] Ibid.

different vessels and their abilities to respond to disasters."[91] Having difficulty placing specific quantitative values for each ship, the authors chose to use qualitative descriptions; for each critical mission, a vessel was assigned one of three classifications, as seen in Table 6: little or no capability, some capability, and very capable.[92]

Table 6. Capability Label Classification

Empty Circle	○	The vessel has little no capability to conduct the specified mission
Half Filled Circle	◑	The vessel has some capability to conduct the specified mission
Filled Circle	●	The vessel is very capable of conducting the specified mission

Adapted from Cullen M. Greenfield and Cameron A. Ingram, "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief Operations" (acquisition research paper, Naval Postgraduate School, 2011), 59, http://www.dtic.mil/dtic/tr/fulltext/u2/a545858.pdf.

Considering each critical mission, the authors then determined the specific mission parameters that would be defined by each capability classification, as seen in Table 7.[93]

[91] Greenfield and Ingram, "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief Operations," 59.

[92] Ibid.

[93] Ibid., 60.

Table 7. Mission Capability Parameter Definitions

			Capability Defined	
Critical Mission Capabilities	Aircraft support		○	No embarked helo, unable to support helicopter operations
			◑	Single helo embarked, able to support a majority of helo platforms
			●	Multiple helos embarked, able to sustain multiple flight operations simultaneously
	Landing Craft support		○	No ability to support landing craft
			◑	Some ability to support landing craft
			●	Landing craft embarked, able to load / off load cargo and store amphibious vehicles
	Search and Rescue		○	No embarked helo, unable to efficiently conduct SAR missions
			◑	Single embarked helo with communication equipment and night vision
			●	Multiple helos embarked with communication equipment and night vision
	Dry goods	Cargo Capacity	○	No ability to store good beyond current ship use
	Refrigerated goods			
	Fresh water		◑	Ability to store some supplies beyond ship's use
	Roll On Roll Off			
	Fuel		●	Ability to store and transfer mass amount of supplies
	Self Sufficient			
	Personnel transfer		○	No ability to support personnel transfer, slow speed vessel with deep draft
			◑	Ability to support personnel transfer for 15+ personnel
			●	High speed, shallow draft vessel with ability to transport 30+ personnel per voyage
	Fresh water production		○	no ability to produce freshwater beyond shipboard usage
			◑	Ability to produce and transfer >2,000 gallons per day beyond shipboard usage
			●	Able to produce and transfer > 5,000 gpd beyond shipboard usage
	Personnel support		○	Low crew number to support HADR mission (< 50 personnel)
			◑	Medium size crew which can support HADR mission (51 - 200 personnel)
			●	Large crew with ability to support HADR mission (> 200 personnel)
	Berthing capability		○	Little to no excess berthing or facilities (< 30 racks)
			◑	some excess berthing and facilities (31-50 racks)
			●	large number of excess berthing and facilities (> 50)
	Medical support		○	No ability to conduct impatient medical treatments, no Medical officer embarked
			◑	Some medical support onboard, ability to support minor medical procedures
			●	Medical officer embarked, ability to perform surgeries and hold several patients

From Cullen M. Greenfield and Cameron A. Ingram, "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief Operations" (acquisition research paper, Naval Postgraduate School, 2011), 60, http://www.dtic.mil/dtic/tr/fulltext/u2/a545858.pdf.

Greenfield and Ingram then compiled the parameters against each ship's capabilities to establish the capability of each naval platform, as seen in Table 8.[94]

[94] Greenfield and Ingram, "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief Operations," 61.

Table 8. USN Platforms to Capability Comparison

Missions to Platforms			Mission / Ship Characteristic																	
						Cargo Capacity														
			Aircraft support	Landing Craft support	Search and Rescue	Dry goods	Refrigerated goods	Fresh water	Roll On Roll Off	Fuel	Self Sufficient	Personnel transfer	Freshwater Production	Personnel support	Berthing capability	Medical support	Transit speed	Hydrographic survey	Salvage Ops	Towing
U.S. Navy		CVN (Nimitz)	●	○	●	◑	◑	◑	○	◑	◑	●	◑	●	●	●	●	○	○	○
U.S. Navy		CVN (Enterprise)	●	○	●	◑	◑	◑	○	◑	◑	●	◑	●	●	●	●	○	○	○
U.S. Navy	Amphibious Ships	LHD	●	●	●	◑	◑	◑	○	◑	◑	●	◑	●	●	●	◑	○	○	○
U.S. Navy	Amphibious Ships	LHA	●	●	●	◑	◑	◑	○	◑	◑	●	◑	●	●	●	◑	○	○	○
U.S. Navy	Amphibious Ships	LCC	◑	○	◑	◑	○	○	○	○	○	◑	○	◑	◑	◑	◑	○	○	○
U.S. Navy	Amphibious Ships	LPD (San Antonio)	●	●	●	◑	○	○	○	○	◑	◑	○	◑	◑	◑	◑	○	○	○
U.S. Navy	Amphibious Ships	LPD (Austin)	●	●	●	◑	○	○	○	○	◑	◑	○	◑	◑	◑	◑	○	○	○
U.S. Navy	Amphibious Ships	LSD (Harpers Ferry)	●	●	●	◑	○	○	○	○	◑	◑	○	◑	◑	◑	◑	○	○	○
U.S. Navy	Amphibious Ships	LSD (Whidby Island)	●	●	●	◑	○	○	○	○	◑	◑	○	◑	◑	◑	◑	○	○	○
U.S. Navy	CRUDES	CG	◑	○	◑	○	○	○	○	○	○	◑	○	◑	○	○	●	○	○	◑
U.S. Navy	CRUDES	DDG (FLT I & II)	○	○	○	○	○	○	○	○	○	○	○	◑	○	○	●	○	○	◑
U.S. Navy	CRUDES	DDG (FLT IIA)	◑	○	◑	○	○	○	○	○	○	◑	○	◑	○	○	●	○	○	◑
U.S. Navy	CRUDES	Frigates	◑	○	◑	○	○	○	○	○	○	◑	○	◑	○	○	●	○	○	◑
U.S. Navy	Other	LCS (Freedom)	◑	○	◑	○	○	○	○	○	○	◑	○	○	○	○	●	○	○	◑
U.S. Navy	Other	LCS (Independence)	◑	○	◑	○	○	○	○	○	○	◑	○	○	○	○	●	○	○	◑
U.S. Navy	Other	PC	◑	○	◑	○	○	○	○	○	○	◑	○	○	○	○	●	○	○	◑
U.S. Navy	Other	MCM	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●

Source: Cullen M. Greenfield and Cameron A. Ingram, "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief Operations" (acquisition research paper, Naval Postgraduate School, 2011), 60, http://www.dtic.mil/dtic/tr/fulltext/u2/a545858.pdf.

For clarity, Greenfield and Ingram's work was simplified, as seen in Table 9, to capture only the naval platforms from the Navy's prospective 2040 7th Fleet and *The Advanced Surface Force Fleet's* 7th Fleet. A LHA 6 flight I is assumed to have the same HADR utility as its predecessors, the LHA and LHD. Since the LPD (San Antonio), LPD (Austin), LSD (Harper's Ferry), and LSD (Whidbey Island) all have the same HADR capabilities, it is assumed the LPD 17, eLPD 17, and LX(R) will have equivalent HADR capabilities. Furthermore, it is assumed the flight III DDG will have the same HADR capabilities as a flight IIA DDG. As future frigates are to be of a subsequent LCS design, it is assumed that frigates would have LCS HADR capabilities; unlike previous frigates, as seen in Table 8, it is assumed future frigate will not have "some capability" to conduct personnel support.

Table 9. Simplified USN Platforms to Capability Comparison

Missions to Platforms		Mission / Ship Characteristic													
					Cargo Capacity										
		Aircraft Support	Landing Craft Support	Search and Rescue	Dry Goods	Refrigerated Goods	Fresh Water	Roll On Roll Off	Fuel	Self Sufficient	Personnel Transfer	Freshwater Production	Personnel Support	Berthing Capability	Medical Support
U.S. Navy	**LHA 6 Flight I**	●	●	●	◑	◑	◑	○	◑	◑	●	◑	●	●	●
U.S. Navy	**LPD 17, eLPD 17, and LX(R)**	●	●	●	◑	○	○	○	○	◑	◑	○	◑	◑	◑
U.S. Navy	**Flight IIA and III DDG**	◑	○	◑	○	○	○	○	○	○	◑	○	◑	○	○
U.S. Navy	**LCS and Frigates**	◑	○	◑	○	○	○	○	○	○	◑	○	○	○	○

Adapted from Cullen M. Greenfield and Cameron A. Ingram, "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief Operations" (acquisition research paper, Naval Postgraduate School, 2011), 60, http://www.dtic.mil/dtic/tr/fulltext/u2/a545858.pdf.

D. COMPARING THE FLEETS

When comparing the two 7th Fleet Navies, as seen in Tables 10 and 11, *The Advanced Surface Force Fleet* has more "very capable" HADR assessments; however, Tables 12 and 13 show the Navy's prospective 2040 fleet has more "some ability" HADR assessments. *The Advanced Surface Force's* 7th Fleet has more aircraft support, landing craft support, and search and rescue capacity. The LHA 6 Flight I provides the planned Navy with an unparalleled ability to produce freshwater and hold refrigerated goods, fresh water, and fuel; moreover, the LHA 6 Flight I provides the prospective Navy's 7th fleet with the means to better execute personnel transfers, personnel support, berthing capability, and medical support. *The Advanced Surface Force Fleet's* 7th Fleet would

have to rely more heavily on MSC ships to offset the LHA 6 Flight I's superior HADR capabilities.[95]

Table 10. Navy's Prospective 2040 7th Fleet: "Very Capable" HADR Assessments

Ship Class	Number of Ships	Number of "Very Capable" HADR Assessments	Total Number of "Very Capable" HADR Assessments Per Ship Class	Total Number of "Very Capable" HADR Assessments for Fleet
LHA 6 Flight I	1	7	7	16
LPD 17	1	3	3	
LX(R)	2	3	6	
Flight IIA and III DDGs	11	0	0	
LCSs and Frigates	11	0	0	

Table 11. The Advanced Surface Force Fleet's 7th Fleet: "Very Capable" HADR Assessments

Ship Class	Number of Ships	Number of "Very Capable" HADR Assessments	Total Number of "Very Capable" HADR Assessments Per Ship Class	Total Number of "Very Capable" HADR Assessments for Fleet
eLPD 17	8	3	24	24
Flight IIA and III DDGs	12	0	0	

Table 12. Navy's Prospective 2040 7th Fleet: "Some Ability" HADR Assessments

Ship Class	Number of Ships	Number of "Some Ability" HADR Assessments	Total Number of "Some Ability" HADR Assessments Per Ship Class	Total Number of "Some Ability" HADR Assessments for Fleet
LHA 6 Flight I	1	6	6	101
LPD 17	1	6	6	
LX(R)	2	6	12	
Flight IIA and III DDGs	11	4	44	
LCSs and Frigates	11	3	33	

[95] Greenfield and Ingram, "An Analysis of U.S. Navy Humanitarian Assistance and Disaster Relief Operations," 62.

Table 13. The Advanced Surface Force Fleet's 7th Fleet: "Some Ability" HADR Assessments

Ship Class	Number of Ships	Number of "Some Ability" HADR Assessments	Total Number of "Some Ability" HADR Assessments Per Ship Class	Total Number of "Some Ability" HADR Assessments for Fleet
eLPD 17	8	6	6	96
Flight IIA and III DDGs	12	4	44	

E. CONCLUSION

One of the essential missions of the Navy is to execute HADR operations. The Navy's planned 2040 7th Fleet and *The Advanced Surface Force Fleet's* 7th Fleet provides leaders with distinctly different capabilities and limits. Destroyers and littoral combat ships, which comprise 22 of the Navy's 26 forward deployed ships, lack the ability to perform 10 of the 14 critical missions of HADR operations. Compared to amphibious ships, DDGs and LCSs are not being well employed if they are being used for HADR operations. *The Advanced Surface Force Fleet's* 7th Fleet has more HADR centered assets, and can overcome its limited HADR cargo capacity by further relying on MSC platforms.

V. A THEORETICAL CONFLICT IN THE SOUTH CHINA SEA: AN APPLIED CASE STUDY FOR FLEET COMPARISON

A. BACKGROUND

In "China's Military Strategy," the State Council Information Office of the People's Republic of China declares:

> The traditional mentality that land outweighs sea must be abandoned, and great importance has to be attached to managing the seas and oceans and protecting maritime rights and interests. It is necessary for China to develop a modern maritime military force structure commensurate with its national security and development interests, safeguard its national sovereignty and maritime rights and interests, protect the security of strategic SLOCs [sea lines of communication] and overseas interests, and participate in international maritime cooperation, so as to provide strategic support for building itself into a maritime power.[96]

As the People's Liberation Army Navy (PLAN) continues to grow, modernize, and expand its maritime interests, the U.S. Navy must consider the military forces it has allocated to the region.

This chapter examines the current PLAN force structure, considers a potential future PLAN force structure, and evaluates a theoretical naval conflict between a prospective 2040 Navy 7th Fleet ARG and a potential PLAN SAG, compared to an *Advanced Surface Force Fleet* 7th Fleet ARG and a potential PLAN SAG.

B. THE PLAN'S FORCE STRUCTURES

This section reviews the former surface fleet, assesses the current surface fleet, and proposes a prospective future fleet of the PLAN.

1. The PLAN's Former Fleet

Previously, the PLAN surface fleet was comprised of an "eclectic mix of vintage, modern, converted, imported, and domestic platforms, which utilized a variety of

[96] The State Council Information Office of the People's Republic of China, *China's Military Strategy* (Beijing: The State Council Information Office of the People's Republic of China, May 2015), http://news.usni.org/2015/05/26/document-chinas-military-strategy.

weapons and sensors with wide-ranging capabilities;" however, the PLAN's surface combatants have become large, modern, multi-mission capable, and produced indigenously.[97] The Office of Naval Intelligence (ONI) has acknowledged this shift in its most current report, saying "Although the overall order-of-battle has remained relatively constant in recent years, the PLA(N) is rapidly retiring legacy combatants in favor of larger, multi-mission ships, equipped with advanced antiship, antiair, and antisubmarine weapons and sensors."[98] During the 1990s and 2000s, China built 15 different classes of surface and subsurface combatants.[99] However, since the mid-2000s, China has produced fewer ship classes; specifically, "China is implementing much longer production runs of its domestically produced surface combatants…suggesting greater satisfaction with recent designs."[100] In 2006, China imported its last major surface combatant, the SOVREMENNYY II-class destroyer.[101] More recently, China has produced the JIANGKAI II class (Type 054A) frigate and the LUYANG class (Type 052B/C/D) destroyer.[102] In the near future, the PLAN will have a new cruiser, Type 055.[103] The Chinese have designed each of their new major surface combatants with the capability of embarking a helicopter.[104] This new shipboard feature will assist the PLAN on "over-the-horizon targeting (OTH-T), antisubmarine warfare (ASW), and search and rescue."[105] Overall, the PLAN has improved its surface ships' anti-surface warfare (ASUW) capabilities, antiair warfare (AAW) capabilities, and ASW capabilities.[106]

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[97] Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century* (Washington, DC: Office of Naval Intelligence, 2015), 10–5. http://www.oni.navy.mil/Intelligence_Community/china_media/2015_PLA_NAVY_PUB_Print.pdf.

[98] Ibid., 13.

[99] Ibid.

[100] Ibid.

[101] Ibid.

[102] Ibid.

[103] Ibid.

[104] Ibid., 14.

[105] Ibid.

[106] Ibid.

2. The PLAN's Current Fleet

According to the ONI, the PLAN has three fleets. As seen in Figure 2, the fleets are the North Sea Fleet, the East Sea Fleet, and the South Sea Fleet. The North Sea Fleet is headquartered at Qingdao, and is comprised of eight destroyers, 10 frigates, 11 amphibious ships, 18 missile patrol craft, and six corvette surface ships.[107] The East Sea fleet is headquartered at Ningbo, and is comprised of nine destroyers, 22 frigates, 20 amphibious ships, 30 missile patrol craft, and six corvette surface ships.[108] Additionally, the South Sea Fleet is headquartered at Zhanjiang, and is comprised of nine destroyers, 20 frigates, 25 amphibious ships, 38 missile patrol craft, and eight corvette surface ships.[109] Altogether, "the PLA(N) consists of approximately 26 destroyers (21 of which are considered modern), 52 frigates (35 modern), 20 new corvettes, 85 modern missile-armed patrol craft, [and] 56 amphibious ships."[110] The PLAN is producing more modern surface combatants, and is constructing new missiles to complement its surface fleet.

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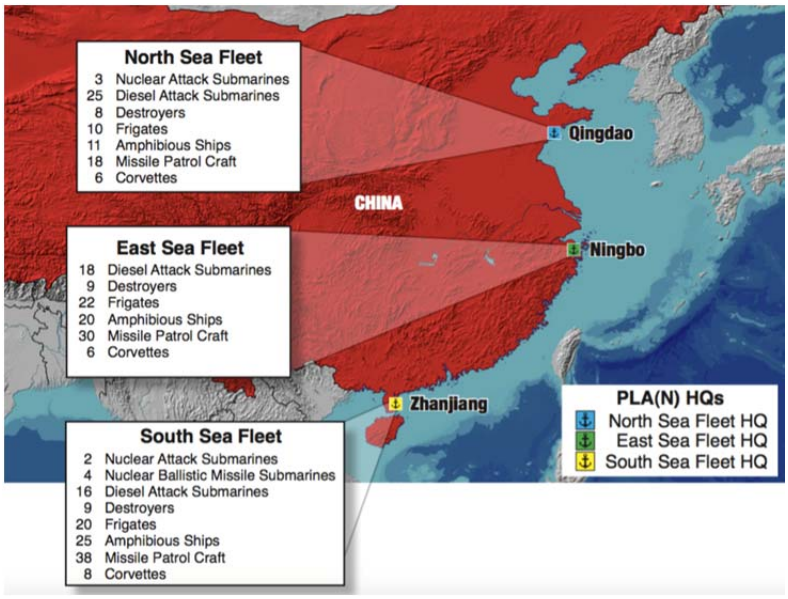
[107] Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, 14.

[108] Ibid.

[109] Ibid.

[110] Ibid., 15.

Figure 2. PLAN Fleet Composition



Source: Office of Naval Research, *The PLA Navy: New Capabilities and Missions for the 21st Century* (Washington, DC: Office of Naval Intelligence, 2015), 14, http://www.oni.navy.mil/Intelligence_Community/china_media/2015_PLA_NAVY_PUB_Print.pdf.

In an effort to strengthen its AAW and ASUW capabilities, the PLAN has improved its shipboard missile capabilities. The PLAN has retired several older ship models with outdated air defense capabilities, and replaced them with LUYANG-class (Type 052C/D) destroyers. The HHQ-9 surface-to-air missile (SAM), with an effective range of approximately 55 nautical miles, is aboard the LUYANG II-class (Type 052C); the HHQ-9 extended range variant, with an effective range of approximately 80 nautical miles, is aboard the new LUYANG III-class (Type 052D) destroyer.[111] The LUYANG II-class (052C) can be seen in Figure 3.

[111] Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, 12–3.

Figure 3. The LUYANG II-class (Type 052C) Destroyer

Source: Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress* (CRS Report No. RL33153) (Congressional Research Service, 2015), 29, https://www.fas.org/sgp/crs/row/RL33153.pdf.

The vertically launched HHQ-16, with an effective range of somewhere between 20 and 40 nautical miles, is aboard the new JIANGKAI II class (Type 054A) frigates.[112] The frigate is shown in Figure 4.

[112] Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, 12.

Figure 4. The JIANGKAI II-class (Type 054A) Frigate

Source: Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress* (CRS Report No. RL33153) (Congressional Research Service, 2015), 31, https://www.fas.org/sgp/crs/row/RL33153.pdf.

While many of the new PLAN ships are outfitted with new antiair missiles, they are also able to employ new anti-surface missiles. The LUYANG II-class (Type 053C) destroyer's anti-surface missile is the YJ-62 family (C602) missile, and has an effective range of over 650 nautical miles.[113] The LUYANG III-class (Type 052D) is outfitted with the vertically launched YJ-18 ASCM.[114] The catamaran hulled HOUBEI (Type 022) class missile patrol craft, which replaced the HOUJIAN and HOUXIN-class missile patrol crafts, is equipped with the YJ-83 family ASCM.[115] Depending if the missile is a C802 or C802A, it will have an effective range of 65 or 100 nautical miles, respectively.[116] While the HOUBEI (Type 022) class is best suited for patrols within 200 nautical miles of China's coast, the new JIANGDAO-class (Type 056) corvette is well equipped to patrol offshore.[117] The new corvette, as seen in Figure 5, is "equipped with

[113] Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, 13.

[114] Ibid.

[115] Ibid., 14.

[116] Ibid.

[117] Ibid.

76mm, 30mm, and 12.7mm guns, four YJ-83 family ASCMs, torpedo tubes, and a helicopter landing area."[118]

Figure 5. The JIANGDAO-class (Type 056) Corvette

Source: Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress* (CRS Report No. RL33153) (Congressional Research Service, 2015), 33, https://www.fas.org/sgp/crs/row/RL33153.pdf.

3. The PLAN's Prospective Future Fleet

In *The Great Wall at Sea: China's Navy in the Twenty-First Century*, Bernard D. Cole writes,

> Admiral Yu Guoquan, director of the Department of Naval Equipment Technology and Warship divisions in 1995, outlined a version of twenty-first century naval systems…New naval weaponry, he wrote, would have six features: (1) improved reconnaissance and observation, precise targeting, and better weapon-sensor integration, creating quicker reaction time; (2) increased lethality; (3) increased mobility and speed, and hence shorter engagements; (4) improved protective and survival systems; (5) increased emphasis on electronic jamming and targeting; (6) and multiple dimensions.[119]

The U.S. Navy's *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for FY2015* details the planned composition of its surface

[118] Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, 14.

[119] Bernard D. Cole, *The Great Wall at Sea: China's Navy in the Twenty-First Century*, 2nd ed. (Annapolis, MD: Naval Institute Press, 2010), 197.

forces for the next 30 years; however, no information was found detailing the PLAN's ship construction plan.[120] Notwithstanding, the growth of the PLAN will hinge on the Navy's ability to maintain or increase its percentage of military funding, and on the growth of the Chinese economy.[121] While the Chinese have not publicly released the PLAN's ship construction plan, several researchers have projected the PLAN's future composition.

Bernard D. Cole suggests that by 2020 the PLAN will have "approximately 70 modern surface combatants, 4–6 new ballistic-missile submarines, and 50 modern attack submarines, perhaps 10 of them nuclear-powered."[122] Additionally, he thinks "it unlikely that the PLAN will include more than approximately two dozen amphibious ships of 2,000 tons displacement or larger, featuring perhaps the 4 LPDs of the Type-071 or follow-on class."[123] A potential follow-on amphibious ship is a Type 081, which would displace 35,000 tons, a marked increase from the Type 071's 18,500 tons.[124]

In 2013, the ONI projected that in 2020 the PLAN will have one to two aircraft carriers, 30 to 34 destroyers, 54 to 58 frigates, 24 to 30 corvettes, 50 to 55 amphibious ships, and 85 missile-armed coastal patrol craft.[125] Table 14 combines ONI's assessment of current PLAN surface forces, ONI's 2013 projection of the PLAN's 2020 surface fleet, and the assumed "worst case" PLAN 2040 surface fleet.

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[120] Integration of Capabilities and Resources (N8) Deputy Chief of Naval Operations, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for FY2015*.

[121] Cole, *The Great Wall at Sea: China's Navy in the Twenty-First Century*, 198.

[122] Ibid.

[123] Ibid.

[124] Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress* ((CRS Report No. RL33153) (Washington, DC: Congressional Research Service, 2015), 35–6, https://www.fas.org/sgp/crs/row/RL33153.pdf.

[125] Ibid., 42.

Table 14. PLAN Surface Forces

Ship Type	ONI's Assessment of Current PLAN Surface Fleet	ONI's 2013 Projection of the PLAN's 2020 Surface Fleet	Our Assumed PLAN 2040 Surface Fleet
Aircraft Carriers	1	1-2	3
Amphibious Ships	56	50-55	55
Destroyers	26	30-34	34
Frigates	52	54-58	58
Corvettes	20	24-30	30
Missile-Armed Coastal Patrol Craft	85	85	85

Based on the current percent of PLAN surface ships of a modern design and current platform capabilities, it is assumed that the entire PLAN 2040 surface fleet will be comprised of the most current (2015) hull design or of a follow-on class with similar capabilities.

4. The PLAN's Prospective 2040 Surface Action Group

While a PLAN SAG may vary in size and may be comprised of different platforms based on mission, available assets, etc., it is assumed a 2040 PLAN SAG will consist of two LUYANG III-class (Type 052) destroyers, three JIANGKAI II-class (Type 054) frigates, and two JIANGDAO-class (Type 056) corvettes.

C. THE UNITED STATES NAVY'S PROSPECTIVE 2040 7TH FLEET AMPHIBIOUS READY GROUP

Based on the assumptions of the forces allocated to 7th Fleet, it is assumed that the Navy's 7th Fleet ARG will consist of one LHA 6 flight I ship, one LPD 17, two LX(R)s, and one flight IIA DDG. As discussed in Chapter IV, it is assumed the Navy's 7th Fleet will be comprised of 11 destroyers, 11 LCSs, one LHA 6 flight I ship, one LPD 17, and two LX(R)s. It is assumed that the Navy's 2040 7th Fleet ARG will be comprised of the four forward-deployed amphibious ships. It is acknowledged that in peacetime an ARG does not typically have an escort, a destroyer; however, for illustrative purposes of distributed lethality, a destroyer is being placed within the ARG assuming a combat tactical situation.

It is assumed *The Advanced Surface Force Fleet's* 7th Fleet ARG will consist of four eLPD 17 class ships. As discussed in Chapter IV, it is assumed *The Advanced Surface Force Fleet's* 7th Fleet will be comprised of 12 destroyers and eight eLPD 17s. When deciding the composition of an ARG without an amphibious assault ship, many risks, benefits, and capabilities need to be considered. The capabilities of the Navy's Prospective 2040 7th Fleet ARG with a Flight IIA DDG escort, *The Advanced Surface Force Fleet's* Prospective 2040 7th Fleet ARG comprised of four eLPD 17s, and *The Advanced Surface Force Fleet's* Prospective 2040 7th Fleet ARG comprised of eight eLPD 17s are seen in Table 15. Each ARG's capabilities are calculated using the individual ship class capabilities discussed in Chapter III.

Table 15. The Measures of Capabilities for the Three Prospective Amphibious Ready Groups

Measures of Capabilities	The Navy's Prospective 2040 7th Fleet ARG with a Flight IIA DDG Escort	The Advanced Surface Force Fleet's Prospective 2040 7th Fleet ARG with Four eLPD 17s	The Advanced Surface Force Fleet's Prospective 2040 7th Fleet ARG with Eight eLPD 17s
VLS Cells	96	64	128
ASCM	TBD	64	128
ASW Capable	1	4	8
60 R Embarked	2	8	16
Sailors	2,707	1,780	3,560
LCAC	8	8	16
USMC Vehicle Storage (Sq Ft)	85,560	96,000	192,000
USMC Cargo Storage (Cubic Ft)	230,000	136,000	272,000
Marines (Surge)	3,683	2,912	5,824
USMC CH 53 Spots	15	8	16
Medical Operating Rooms	6	8	16
Medical Ward Beds	66	96	192
Annual Operating and Support Costs (in Millions of FY15 Dollars)	362	308	616
Number of Ships	5	4	8

Employing the eight eLPD 17s as a single ARG provides the Navy with more lift capability than the Navy's Planned ARG; however, it is assumed *The Advanced Surface Force Fleet's* 2040 7th Fleet ARG will be comprised of only four eLPD 17s.

D. EVALUATING A THEORETICAL CONFLICT

In *Fleet Tactics and Coastal Combat*, Captain Wayne P. Hughes Jr., U.S. Navy (retired) provides an equation to examine how two fleets may fair against one another in a missile engagement:

$$\Delta B = (\sigma_a \alpha A — b_3 B) \div (b_1)$$

Models how A's missile salvo affects B's fleet

$$\Delta A = (\sigma_b \beta B — a_3 A) \div (a_1)$$

Models how B's missile salvo affects A's fleet[126]

In "New Navy Fighting Machine in the South China Sea," Dylan B. Ross and Jimmy A. Harmon provide an explanation of the equations:

> In the above equations, a_1 and b_1 represent the "staying power" of that lettered fleet and is considered the number of missiles required to put a single ship out of action. Characters α and β represent the "striking power" of each attacking fleet denoting the number of missiles that will hit opposition if there is no defense. Symbols a_3 and b_3 represent "defensive power" which is the number of missiles a defender will successfully deflect or defend against when poised to receive attack. Subsequently, "survivability" is derived from combining defensive power and staying power. Additionally, scouting and range factors are represented by σ which scales from zero to one based upon a fleet's ability to not only detect/target the enemy but also find themselves within firing range.[127]

Hughes offers a few examples for the number of survivors against a first strike scenario, as seen in Table 16.

Table 16. First Strike Survivors (A/B)

	Initial Number of Missile Ships (A/B)				
	2/2	**3/2**	**2/1**	**3/1**	**4/1**
A Attacks First	2/0	3/0	2/0	3/0	4/0
B Attacks First	0/2	0/2	0/1	0/1	1/1
A and B Attack Simultaneously	0/0	0/0	0/0	0/0	1/0

After Wayne P. Hughes Jr., *Fleet Tactics and Coastal Combat*, 2nd ed. (Annapolis, MD: Naval Institute Press, 2000), 270.

[126] Hughes Jr., *Fleet Tactics and Coastal Combat*, 268.

[127] Dylan B. Ross and Jimmy A. Harmon, "New Navy Fighting Machine in the South China Sea" (master's thesis, Naval Postgraduate School, 2012), 26–7, http://www.dtic.mil/dtic/tr/fulltext/u2/a563777.pdf.

As revealed in Table 16, the combatant that successfully strikes first against its enemy has a significant advantage in defeating its opponent.

Although several forms of a heterogeneous Hughes' salvo equation exist, the simple form described above is used; in doing so, it is necessary to homogenize different ship capabilities across each respective amphibious ready group and surface action group. Using the missile engagement equations set forth by Hughes, a theoretical naval conflict between the prospective 2040 Navy 7th Fleet ARG and a potential PLAN SAG is assessed, and compared to a theoretical naval conflict between the prospective *Advanced Surface Force Fleet* 7th Fleet ARG and a potential PLAN SAG.

1. The Capabilities of the PLAN's Prospective 2040 Surface Action Group

A 2040 PLAN SAG consisting of two LUYANG III-class (Type 052) destroyers, three JIANGKAI II-class (Type 054) frigates, and two JIANGDAO-class (Type 056) corvettes has an average of approximately 13 ASCMs per ship, nine "good shots" per ship, 10 air defense missiles per ship, and four "defensive power" per ship. For each ship's VLS cells, it is assumed a fourth is allocated for ASCMs, a fourth is allocated for air defense, and half is allocated for other missions. Each LUYANG III-class (Type 052) destroyer has 64 VLS cells.[128] For each set of the 64 VLS cells, it is assumed 16 cells are equipped with ASCMs, 16 cells are equipped with air defense missiles, and the remaining 32 cells are a mixture of missiles for other missions. The JIANGKAI II-class (Type 054) frigate is equipped with 32 VLS cells and 8 ASCMs.[129] It is assumed eight VLS cells are allocated for ASCMs, eight cells for air defense, and the remaining 16 for other missions. The JIANGDAO-class (Type 056) corvette is equipped with four ASCMs and eight

[128] "Luyang III (Type 052D) Class," Jane's Fighting Ships, February 16, 2015, https://janes.ihs.com.libproxy.nps.edu/CustomPages/Janes/DisplayPage.aspx?DocType=Reference&ItemId=+++1524889&Pubabbrev=JFS_.

[129] "Jiangkai II (Type 054A) Class," Jane's Fighting Ships, February 16, 2015, https://janes.ihs.com.libproxy.nps.edu/CustomPages/Janes/DisplayPage.aspx?DocType=Reference&ItemId=+++1357334&Pubabbrev=JFS_.

surface-to-air missiles (SAMs).[130] Altogether, the PLAN's SAG of seven ships will have an average of approximately 13 ASCMs per ship. To find the number of "good shots" per ship, the average number of ASCMs per ship, 13, is multiplied by *"the probability of hit against defendable warships = .684*."[131] An average of approximately nine "good shots" per ship is derived. On average, the PLAN's SAG has about 10 air defense missiles per ship. It is assumed that a ship will fire two missiles to defend itself from an incoming missile. Therefore, the average air defense missiles per ship is divided by two, because each salvo will be two, and then that number is multiplied by *"the probability of hit against defendable warships = .684*."[132] An average "defensive power" of approximately four is derived for each PLAN SAG ship. Table 17 summarizes the PLAN's SAG capabilities.

[130] "Jiangdao (Type 056/056A) Class," Jane's Fighting Ships, March 11, 2015, https://janes.ihs.com.libproxy.nps.edu/CustomPages/Janes/DisplayPage.aspx?DocType=Reference&ItemId=+++1515871&Pubabbrev=JFS_.

[131] Hughes Jr., *Fleet Tactics and Coastal Combat*, 275–76.

[132] Ibid.

Table 17. PLAN's Prospective 2040 SAG Capabilities

PLAN Ships	Number of Ships	ASCMs Per Ship	Air Defense Missiles Per Ship	Average Number of ASCMs Per Ship	Average Number of "Good Shots" Per Ship	Average Number of Air Defense Missiles Per Ship	Average "Defensive Power" Per Ship
LUYANG III-Class (Type 052) Destroyer	2	16	16	13	9	10	4
JIANGKAI II-Class (Type 054) Frigate	3	16	8				
JIANGDAO-class (Type 056) Corvette	2	4	8				

2. The Capabilities of the Navy's Prospective 2040 7th Fleet Amphibious Ready Group

A 2040 Navy ARG consisting of one LHA 6 flight I ship, one LPD 17, two LX(R)s, and one flight IIA DDG has 24 ASCMs aboard the destroyer, 16 "good shots" from the destroyer, an average of 42 air defense missiles per ship, and an average "defensive power" of 14 per ship. The LHA 6 class is equipped with 16 evolved sea sparrow missiles (ESSMs) and two RAM launchers, which hold 21 missiles each.[133] It is assumed the LHA flight I class has the same air defense capabilities. The LPD 17 class ship is equipped with two RAM launchers, each holding 21 missiles.[134] The LX(R) is set to be outfitted with two RAM launchers that hold 21 missiles each.[135] Of the destroyer's 96 VLS cells, it is assumed a fourth is allocated for ASCMs, a fourth is allocated for air defense, and half is allocated for other missions; while the flight IIA DDG does not currently have any ASCM capabilities, it is assumed that 16 of the VLS cells will hold a future ASCM. By multiplying the number of ASCMs aboard the destroyer by "*the probability of hit against defendable warships = .684*," the number of "good shots" fired

[133] Saunders, *IHS Jane's Fighting Ships: 2015–2016*, 960.

[134] Ibid., 957.

[135] "LPD Flight IIA Specifications."

from the destroyer is calculated, which is approximately 16.[136] On average, the Navy's ARG has approximately 42 air defense missiles per ship. It is assumed a ship will fire two missiles at each incoming threat; subsequently, 42 is divided (the average air defense missiles per ship) by two (the number of missiles fired at each incoming missile), and then that number is multiplied by "*the probability of hit against defendable warships = .684*."[137] The number reached is approximately 14, which is the average "defensive power" of each ship. These capabilities are summarized in Table 18.

Table 18. Navy's Prospective 2040 7th Fleet Amphibious Ready Group Capabilities

Ships	Number of Ships	ASCMs Per Ship	Air Defense Missiles Per Ship	Number of "Good Shots" from Flight IIA DDG	Average Number of Air Defense Missiles Per Ship	Average "Defensive Power" Per Ship
LHA 6 Flight I	1	0	58	16	42	14
LPD 17	1	0	42			
LX(R)	2	0	42			
Flight IIA DDG	1	24	24			

3. The Capabilities of The Advanced Surface Force Fleet's Prospective 2040 7th Fleet Amphibious Ready Group

The Advanced Surface Force Fleet ARG, comprised of four eLPD 17s, has 20 ASCMs per ship, 46 air defense missiles per ship, approximately 14 "good shots" per ship, and a "defensive power" of approximately 16 per ship. Of the 16 VLS cells aboard the eLPD 17, it is assumed a fourth is equipped with ASCMs, a fourth is equipped with air defense missiles, and half is outfitted for other missions. In addition to the VLS cells, the eLPD 17 is equipped with 16 ASCMs. Additionally, the eLPD 17 is equipped with two RAM launchers, each of which holds 21 missiles. Thus, 20 ASCMs and 46 air defense missiles are aboard each eLPD 17. To find the number of "good shots" per ship,

[136] Hughes Jr., *Fleet Tactics and Coastal Combat*, 275–76.

[137] Ibid.

the 20 ASCMs are multiplied by "*the probability of hit against defendable warships = .684*."[138] The number of "good shots" for each eLPD 17 is approximately 14. It is assumed an eLPD 17 will fire two missiles at each incoming missile; therefore, the number of air defense missiles on each ship (46) is divided by two (the number of missiles fired at an incoming missile), and then that number is multiplied by "*the probability of hit against defendable warships = .684*."[139] The "defensive power" of each eLPD 17 is approximately 16. Table 19 summarizes these capabilities.

Table 19. The Advanced Surface Force Fleet's Prospective 2040 7th Fleet Amphibious Ready Group Capabilities

Ship	Number of Ships	ASCMs Per Ship	Air Defense Missiles Per Ship	Number of "Good Shots" Per Ship	"Defensive Power" Per Ship
eLPD 17	4	20	46	14	16

4. The PLAN's Prospective 2040 Surface Action Group Versus the Navy's Prospective 2040 7th Fleet Amphibious Ready Group

In a theoretical missile engagement between a PLAN SAG and Navy ARG, potentially neither group would have any ships placed out-of-action. To arrive at this conclusion, the applicable data from Tables 17 and 18 are used within the missile engagement equation from Section D of this chapter.

To find the effect of the Navy's ARG missile salvo on the PLAN's SAG, the steps, as seen in Figure 6, are followed. First, the ARG's number of "good shots" (16) is multiplied by the number of ARG ships firing ASCMs (1). Second, the SAG's average "defensive power" per ship (4) is multiplied by the number of PLAN ships (7). Then, 28 is subtracted from 16 to arrive at -12. Assuming two missile strikes are required to put a ship out-of-action, then -12 is divided by two. In total, the effect of the Navy's ARG on the PLAN's SAG is negative six; consequently, no PLAN SAG ships are placed out-of-action.

[138] Hughes Jr., *Fleet Tactics and Coastal Combat*, 275–76.

[139] Ibid.

Figure 6. The Effect of the Navy's ARG Missile Salvo on the PLAN SAG

$$(16 \times 1 - 4 \times 7) / 2 = (-6)$$

To find the effect of the PLAN's SAG missile salvo on the Navy's ARG, the following steps, as seen in Figure 7, are completed. First, the SAG's average number of "good shots" (9) is multiplied by the number of PLAN ships firing ASCMs (7). Second, the ARG's average "defensive power" per ship (14) is multiplied by the number of Navy ships (5). Then, 70 is subtracted from 63 to arrive at negative seven. Assuming two missile hits are required to put a ship out-of-action, negative seven is then divided by two. In sum, the total effect of the PLAN's SAG on the Navy's ARG is negative three-and-a-half; therefore, none of the Navy's ARG ships are placed out-of-action.

Figure 7. The Effect of the PLAN's SAG Missile Salvo on the Navy ARG

$$(9 \times 7 - 14 \times 5) / 2 = (-3.5)$$

5. The PLAN's Prospective 2040 Surface Action Group Versus the Advanced Surface Force Fleet's Prospective 2040 7th Fleet Amphibious Ready Group

The entire PLAN SAG would potentially be out-of-action in a theoretical missile engagement against *The Advanced Surface Force Fleet's* ARG, and all the ships in the ARG would potentially remain in-action. To arrive at this conclusion, the applicable data from Tables 17 and 19 is used within the missile engagement equation from Section D of this chapter.

To find the effect of *The Advanced Surface Force Fleet's* ARG missile salvo on the PLAN's SAG, the steps, as seen in Figure 8, are followed. First, the ARG's number of "good shots" (14) is multiplied by the number of ARG ships firing ASCMs (4). Second, the SAG's average "defensive power" per ship (4) is multiplied by the number of PLAN ships (7). Then, 28 is subtracted from 56 to arrive at 28. Assuming two missile strikes are required to put a ship out-of-action, 28 is then divided by two. In total, the

effect of *The Advanced Surface Force Fleet's* on the PLAN's SAG is 14; potentially, all the PLAN SAG ships are placed out-of-action.

Figure 8. The Effect of *The Advanced Surface Force Fleet's* ARG Missile Salvo on the PLAN SAG

$$(14 \times 4 - 4 \times 7) / 2 = 14$$

To find the effect of the PLAN's SAG missile salvo on *The Advanced Surface Force Fleet's* ARG, the following steps, as seen in Figure 9, are completed. First, the SAG's average number of "good shots" (9) is multiplied by the number of PLAN ships firing ASCMs (7). Second, the ARG's "defensive power" per ship (16) is multiplied by the number of Navy ships (4). Then, 64 is subtracted from 63 to arrive at negative one. Assuming two missile hits are required to put a ship out-of-action, negative one is then divided by two. In sum, the total effect of the PLAN's SAG on *The Advanced Surface Force Fleet's* ARG is a negative half; therefore, potentially none of *The Advanced Surface Force Fleet's* ships are placed out-of-action.

Figure 9. The Effect of the PLAN's SAG Missile Salvo on *The Advanced Surface Force Fleet ARG*

$$(9 \times 7 - 16 \times 4) / 2 = (-0.5)$$

E. CONCLUSION

The Advanced Surface Force Fleet's Prospective 2040 7th Fleet ARG—comprised of four eLPD 17 ships—demonstrates the offensive effectiveness of the eLPD 17 and the benefits of distributed lethality. Although outnumbered seven to four, *The Advanced Surface Force Fleet's* ARG theoretically defeated the PLAN's SAG. Having an ARG with offensive weaponry provides the Navy with a new, dynamic capability; furthermore, it allows traditional surface combatants, such as destroyers, to be employed in missions other than escorting amphibious ships in contested environments. While training, tactics, procedures, and weapon system capabilities are not considered, this case study still illustrates that the number of platforms with offensive capability matters.

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VI. CONCLUSION

A. KEY FINDINGS

The eLPD 17 provides the Navy with amphibious ships capable of executing AAW, ASUW, ASW, strike warfare, and amphibious operations. By outfitting the LPD 17 class with offensive capabilities, the Navy distributes lethality across more platforms. In "The New Navy Fighting Machine: A Study of the Connections Between Contemporary Policy, Strategy, Sea Power, Naval Operations, and the Composition of the United States Fleet," Hughes highlights the benefits of distributing lethality:

> The special value of a more distributed capability achieved by greater numbers can be shown mathematically and operationally. Mathematically, it has been proven that if an enemy has twice as many ships attacking, then in an exchange of fire, the other fleet to achieve parity in losses must have twice the offensive power, twice the defensive power, and twice the staying power. The operational insight comes from observing that when a ship is put out of action it loses all three of its combat properties—offensive, defensive, and staying power—simultaneously.[140]

This study provides evidence that the eLPD 17 concept is worthy of serious consideration to modify the Navy's surface fleet force structure radically. If adopted, the Navy and USMC will encounter challenges as they transition away from their conventional means of integration and operations; however, the current U.S. inventory of amphibious ships provides time to develop the new tactics and procedures required to facilitate this evolution. Where small surface combatants are required, the U.S. may inspire allies and partners to purchase, maintain, and have available, an adequate number of small surface combatants in their littorals.

B. FUTURE RESEARCH RECOMMENDATIONS

Several areas warrant future research. This study provides evidence for further research in comparing the programmed fleet with an alternative ship building plan that includes eLPD 17s and excludes littoral combat ships, frigates, and other amphibious

[140] Hughes, "New Navy Fighting Machine," 46.

ships.[141] More detailed cost estimation and phased force replacement alternatives should be assessed. To support the eLPD 17's ASW enhancements, research should be conducted to determine the specific ASW mission module components that should be installed aboard the eLPD 17. This study focused on enhancing the LPD 17 class with current weapon systems; however, future studies should determine the compatibility of rail guns, lasers, unmanned aerial vehicles, unmanned surface vehicles, and other future weapons aboard the eLPD 17. In support of a fleet without amphibious assault ships, research should be conducted to determine the composition of an integrated carrier air wing, new tactics and procedures, and the allocation of Marine forces.

[141] This thesis could provide useful research for one of the force structure studies as mandated in U.S. House of Representatives, *National Defense Authorization Act for Fiscal Year 2016: Conference Report to Accompany H.R. 1735* (Washington, DC: U.S. House of Representatives, 2015), 266–68, http://www.gpo.gov/fdsys/pkg/CRPT-114hrpt270/pdf/CRPT-114hrpt270.pdf.

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