



CENTER FOR STRATEGIC AND BUDGETARY ASSESSMENTS

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Littoral Combat Ship

**An Examination of its
Possible Concepts
of Operation**

BY MARTIN N. MURPHY

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About the Author

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INTRODUCTION

In 2008, the US Navy commissioned USS *Freedom* (LCS-1), the first of a new type of ship, the Littoral Combat Ship (LCS), produced by Lockheed Martin. It anticipated commissioning a second, distinctly different LCS variant, to be named *Independence* (LCS-2), produced by General Dynamics, late in 2009. Despite initial issues with design, operational requirements, and especially cost growth, the Navy plans to order substantial numbers of one variant to help address the problem of declining surface ship force levels.

At the urging of then-Chief of Naval Operations (CNO) Admiral Vern Clark, both types were designed without passing through the normal requirements process. Thus, by not keeping with previous practice, there was no formal *a priori* understanding of how these ships were intended to be used operationally, or what defined operational requirements they were intended to help meet.

Consequently, despite some conceptual work by various Navy organizations such as Third Fleet and Navy Warfare Development Command (NWDC), there is rather little understanding of what these ships may, or should, be able to do once they are out in the Fleet in numbers. While much of this no doubt will come from future operational testing, evaluation, and experimentation, it is useful to consider what potential concepts of operation may be possible and worth evaluating further.

PURPOSE OF THE PAPER

The purpose of this paper is to take the platforms as designed and constructed, and attempt to answer the question: “How can they be used effectively?”

This enquiry will offer some possible inputs concerning these four questions:

- > What are the ships’ projected missions?
- > Where and how could they be employed?

- > What do the ships' characteristics enable them to do that other ships cannot?
- > What additional missions could they accomplish if certain modifications were made or capabilities added?

CHAPTER 1 > BACKGROUND

ORIGIN OF THE LCS

From Cebrowski to Clark

Vice Admiral Arthur Cebrowski, USN, during his time as the head of the Naval War College and Navy Warfare Development Command starting in 1998, vigorously advanced four themes regarding the future of the nation's maritime force:

- > Networks should be the central organizing principle of the fleet, and its sensing and fighting power should be distributed across multiple manned and unmanned platforms;
- > The fleet sensor component should collect, collate and interpret data faster than any enemy who was not networked to the same degree, giving US forces a major competitive advantage through “speed of command”;
- > The fleet should become the nation's “assured access” force; and
- > Numbers of hulls count (quantity had its own quality) and consequently the fleet's combat power should be distributed over as many interconnected platforms and systems as the budget allowed.¹

“Assured access” referred to the ability of the fleet to overcome coastal defenses to enable air and, in some circumstances, ground forces to conduct operations on or over enemy territory. The enemy would oppose US operations through the

¹ Robert O. Work, *Naval Transformation and the Littoral Combat Ship* (Washington, DC: Center for Strategic and Budgetary Assessments, 2004), pp. 45–46.

Access could only be achieved by engaging the enemy in its own littoral regions.

use of anti-access and area-denial strategies (A2/AD).² Clearly, access could only be achieved by engaging the enemy in its own littoral regions. When it came to littoral combat, the destruction of the land-based elements of the enemy's A2/AD capability and support for subsequent exploitation operations (as described in the Navy's Sea Strike concept) would be conducted by the Navy's main battle force. Engagement on the seaward side of the littoral, however, including the protection of the main battle force and the destruction of enemy coastal naval assets such as mines, submarines, Fast Attack Craft (FACs) and Fast Inshore Attack Craft (FIACs), would be undertaken by small networked combatants.

Cebrowski held the view, and reiterated it regularly, that in a fleet battle network it was the distribution of networked combat power across platforms that mattered more than the power of any platform individually, and that for networked platforms that were expected to operate in dangerous littoral waters speed mattered more than maneuverability or stealth.³ This emphasis on speed might be traced back to his background as a jet fighter pilot for whom "speed is life."

Although his thoughts on the need for a small, fast ship stimulated much debate, until 2001 the Navy's planning process appeared unmoved. Yet in November of that year it was announced that a Request for Proposals (RFP) for just such a ship would be issued without passing through the normal concept analysis stage first. Backed by then-CNO Admiral Vern Clark, the development of the Littoral Combat Ship (LCS) proceeded apace despite Congressional doubts and the fact that Navy Surface Warfare Division's concept of operations (CONOPS) for the ship was not approved until February 2003.⁴

The reason the Navy changed its position appeared to stem from three influences: Cebrowski's advocacy, Clark's own experience as a small combatant commander in the Mediterranean, and a research study called the Advanced Naval Vehicle Concept Evaluation which identified some promising technologies. Taken together these led Admiral Clark and his staff to embrace a number of points that opened the way to the LCS's development:

- > The Navy needed to assure access to the world's littoral regions for the Joint Force;
- > The Navy supported the Marine Corps concept of launching operations from a littoral-based "sea base" that would need defending;

² Anti-access (A2) strategies aim to prevent US forcible entry into a theater of operations; area-denial (AD) operations aim to prevent US freedom of action in the more narrow confines under an enemy's direct control. See Andrew Krepinevich, Barry Watts and Robert Work, *Meeting the Anti-Access and Area-Denial Challenge* (Washington, DC: Center for Strategic and Budgetary Assessments, 2003), p. ii.

³ Work, *Naval Transformation and the Littoral Combat Ship*, pp. 46–47.

⁴ The *Littoral Combat Ship Concept of Operations* was recommended by N76, Navy Surface Warfare Division, on February 12, 2003, and approved by the Deputy Chief of Naval Operations for Requirements and Programs, N7, on February 13, 2003.

- > Battle fleet operations would revolve around dense networks of distributed sensors and weapons;
- > Distributed networks paved the way for a revised fleet architecture;
- > The revised architecture required a revised fleet deployment pattern; and
- > To discharge these roles effectively the Navy would no longer be able to draw upon an adequate number of intermediate-size multi-purpose ships because these were too expensive to acquire in the numbers needed. Consequently, new, less expensive vessels had to be acquired.

The Surface Combatant (SC)-21, described more fully below, had from its inception in the mid-1990s been conceived as a “family” of five ships, one of which was a small single-mission combatant relying on a common hull that could be fitted-out for particular single missions such as anti-submarine or surface warfare. Although the LCS arrived late in the Navy’s shipbuilding program it effectively filled this slot. Moreover with its modular rather than re-configurable design it offered a very different solution to the requirement for flexibility and economy. What had not changed, however, was the notion that “assured access” meant gaining entry to all littoral regions, however hostile, and that manned surface combatants had a role in such missions.

SHIFT IN EMPHASIS TO LITTORAL MISSIONS

Post-Cold War: No Major Naval Opponents

The rapid and unanticipated collapse of the Soviet Union in 1991 left the United States without a serious naval rival. The situation it faced on land was different: instead of one opponent the United States was faced by several, each of which had a coastline. Recognizing this, the United States rebalanced its forces to undertake expeditionary operations. i.e., limited-scale invasions of potential opponents’ territory by air and ground forces launched from stand-off range.⁵

Although the United States developed the capability to deliver conventional military strike directly from the continental United States, given the absence of sovereign US bases near Iraq, Iran or North Korea, the only way substantial and potentially decisive force could be delivered continued to be by ship. Given the potential hazards presented by littoral operations, the United States nonetheless worked hard to ensure that once an expeditionary force arrived in theater the

⁵ Work, *Naval Transformation and the Littoral Combat Ship*, pp. 25–26.

Ten or so years into the post-Cold War era, however, it was becoming apparent that the ability of the United States to operate in the littorals was coming under varying but increasing degrees of competitive pressure.

final application of combat power against an enemy's territory did not have to come across a beach.⁶

The Anti-Access Challenge

Ten or so years into the post-Cold War era, however, it was becoming apparent that the ability of the United States to operate in the littorals was coming under varying but increasing degrees of competitive pressure. The US Navy had anticipated this development and proposed a class of ships to overcome the anti-access/area-denial (A2/AD) challenge presented by potential competitors. Obviously there is nothing conceptually new about A2/AD, but the extent and variety of the challenges the United States expected it would need to overcome did present new difficulties in a wide variety of operating theaters at great, though not unprecedented distances, from fixed bases.

While the demise of the Soviet Navy meant the US fleet no longer faced a peer competitor on the high seas, naval planners recognized that any power projection operation conducted close to the coast of an enemy equipped with capable air and land-based defensive systems, sea mines and coastal vessels such as quiet submarines, and missile-firing Fast Attack Craft (FAC), would place US ships in considerable danger. The vessel concept that emerged for a ship able to fight and survive in future littoral combat was the SC-21. The SC-21 consisted initially of a cruiser (CG-21) and a destroyer (DD-21) that epitomized the surface navy's traditional preference for multi-mission ships. As conceived originally, each was to displace around 9,000 tons, about the same as the displacement of the *Spruance*- and *Arleigh Burke*-classes. However, their eventual design displacement of over 14,500 tons meant they were much larger than the intermediate size combatants that had characterized the post-World War II US fleet.

The two shared a common hull form. The plan was that these two ships would replace the twenty-two remaining *Ticonderoga*-class cruisers. Twenty-six replacements would be ordered in all, divided between seven DD-21s (eventually renamed DDG-1000s and then the *Zumwalt*-class) and nineteen CG-21s.⁷ The cruiser variant, the CG-21, was a straightforward albeit highly advanced air defense ship with the additional capability of defending against theater-range ballistic missiles (TBMs).⁸ The destroyer variant, the DD-21, was a multi-mission

⁶ The last major US over-the-beach assault was the landing at Inchon in September 1950 during the Korean War. Landings undertaken since then, such as in Grenada in 1983 and on the Faw Peninsula in Iraq in 2003, were historically-speaking closer to raids.

⁷ Robert O. Work, *The US Navy: Charting a Course for Tomorrow's Fleet* (Washington, DC: Center for Strategic and Budgetary Assessments, 2008), p. 24.

⁸ Ronald O'Rourke, "Navy CG(X) Cruiser Program: Background, Oversight Issues, and Options for Congress" Congressional Research Service RL34179, 18 November 2008, p. 3 at <http://www.fas.org/sgp/crs/weapons/RL34179.pdf>.

ship focused on littoral combat. Its ability to contribute to air and maritime dominance was seen as a prerequisite to accomplishing its land-attack mission, which was emphasized to a degree not seen since the battleship had ceased to be a capital ship of the line and taken on the air defense role for carrier task forces and fire support for amphibious landings. However, rising costs and technology problems led to major changes in the program. Continuing cost growth in the DD-21 led the Navy to reduce its displacement and armament. The Navy then determined that the common hull was too small to accommodate the CG(X) combat system. In late 2008 the decision was taken to reduce the planned purchase of DDG-1000s to two ships (subsequently increased to three at Congressional insistence) because the Navy felt it had sufficient land-attack capability but insufficient ballistic missile defense and open-ocean anti-submarine warfare capability. Instead, the *Arleigh Burke*-class (DDG-51) production line would be reopened because these were missions it performed well. Twelve additional ships of this type would be commissioned to fill the gap before production could be shifted to the CG(X). In the meantime a new DDG(X) design would be commissioned.⁹

In 2008 the Navy also revealed a growing sense of concern about the littoral threat in the testimony naval officials gave before Congress: “Rapidly evolving traditional and asymmetric threats continue to pose increasing challenges to Combatant Commanders. State actors and non-state actors who, in the past, have only posed limited threats in the littoral are expanding their reach beyond their own shores with improved capabilities in blue water submarine operations, advanced anti-ship cruise and ballistic missiles.”¹⁰

New Naval Configurations

Research at the Naval War College in Newport, Rhode Island reflects some of these concerns. Studies undertaken there over the past few years have recommended that the Navy move away from the current focus on sea bases built around Strike Groups (SGs), either carrier (CSG)- or expeditionary (ESG)-based, towards what Robert Rubel, Dean of Naval Warfare Studies at the College, has described as “a more dispersed and flowing style of war fighting,” one that is not “orientated to defensive bastions around sea bases of CSGs or ESGs.” Professor Rubel reports that the work undertaken so far also suggests a Navy that is aligned more closely to specific regions or missions because the “access-denial problem is fundamentally different in the Persian Gulf from what it is in Northeast Asia”

“State actors and non-state actors who, in the past, have only posed limited threats in the littoral are expanding their reach beyond their own shores with improved capabilities in blue water submarine operations, advanced anti-ship cruise and ballistic missiles.”

⁹ Work, *The US Navy: Charting a Course for Tomorrow's Fleet*, pp. 25–26.

¹⁰ Vice Admiral Barry McCullough, USN and Allison Stiller, Statement before the Sub-committee on Seapower and Expeditionary Forces of the House Armed Service Committee on Surface Combat Requirements and Acquisition Strategies, 31 July 2008, p. 3 at http://armedservices.house.gov/pdfs/SPEFO73108/McCullough_Stiller_Testimony073108.pdf. LCS was not designed to confront any of these threats.

due to the wide disparities in competence and capability between the potential opponents in the two theaters.¹¹

The College's analysis suggests that three configurations of naval force might emerge. The purpose of the first would be "access generation." Its aim would be to neutralize opposing A2/AD forces on or under the sea, in the air and in space, and on land. The second configuration would be devoted to "power projection." As it would be formed around SGs it would look very much like today's Navy. It would operate only in "permissive environments" but could conceivably support the "access generation" force on occasion. The final afloat configuration would focus on "maritime security." It would patrol and act against terrorists and criminals and help to "catalyze a global maritime security partnership through extensive engagement."¹² Moreover, as the importance of force concentration declined, so the importance of battle networks would rise as fleet units dispersed, either to avoid presenting easy-to-find targets for enemy maritime reconnaissance-strike networks (MRSNs), or because the maritime security role would force the Navy to achieve more with fewer assets over larger areas of sea.

Separate analyses by Robert Work and Wayne Hughes lead to broadly similar conclusions. Work laid great emphasis on the threat posed by MRSNs, particularly when deployed by a continental-sized opponent as competent as China. He pointed to the centrality of the information contest and the decisive effect blinding or collapsing an adversary's sensor network might have on the outcome of the battle. Looking beyond high-end war, he drew attention to the need to create favorable regional security conditions by helping partner navies support action against Islamist terrorists, amongst other threats.¹³ Hughes advanced the idea of a "bi-modal force."¹⁴ He too pointed to the impact of missile technology on the character of this potential conflict and in addition strongly emphasized the need for the Navy to engage in small wars and peacekeeping. He advanced the case for a low-end fleet to address these challenges, foreseeing a role for the LCS but also the need to experiment with other small, high-speed ships. In his view this low-end fleet would release the Navy's highly capable multi-mission units to focus on the high-end threat. He pointed out that such a change would emphasize the need for distributed operations across the fleet as a whole.¹⁵

¹¹ Robert C. Rubel, "The Navy's Changing Force Paradigm," *Naval War College Review*, Vol. 62, No. 2, Spring 2009, p. 17.

¹² *Ibid.*, pp. 17–18.

¹³ Work, *The US Navy: Charting a Course for Tomorrow's Fleet*, pp. 51–6.

¹⁴ Wayne P. Hughes, "A Bi-Modal Force for the National Maritime Strategy," *Naval War College Review*, Vol. 60, No. 2, Spring 2007, pp. 29–47.

¹⁵ *Ibid.*, p. 42.

Changing Views on the Navy's Littoral Role

All operational concepts centered on power projection have viewed the littorals as a dangerous passage to achieving objectives ashore. ...*From the Sea* in 1992 and *Forward...From the Sea* in 1994 encapsulated this approach in the 1990s.¹⁶ Both naval operational concepts emerged after the fall of the Soviet Union, during the period when the Navy faced no serious transoceanic naval competitor and, largely for that very reason, felt most vulnerable about the relevance of its mission.¹⁷ Admiral Cebrowski's "Streetfighter" concept of a small, fast combatant displacing around four hundred tons, which was intended to be a tool that the power projection navy could use to clear the littoral "clutter" of mines, quiet submarines, and FACs, was a radical approach to how the fleet could fight and survive under such potentially hostile conditions.¹⁸ Although conceptually it was developed quite separately from the thinking that underlay the Navy's vision statements, it nonetheless reflected the same general perception about what the Navy could expect to encounter in the world's littorals. The LCS is a descendant of that intellectual effort.¹⁹

However, the prospective intensity of A2/AD threats raised growing doubts about the survivability of any surface combatant in the most heavily contested environments. Cebrowski always acknowledged that "Streetfighters" might suffer high rates of attrition. This, however, was not a cost the Navy as a whole was prepared to accept and may have contributed to a reconsideration of the Navy's role in power projection. Even as it was announcing its decision to build the LCS, changes in the potential operating environment were raising the sort of questions articulated by the Naval War College and others about a naval force structure centered on Carrier and Expeditionary Strike Groups (CSGs and ESGs). These changes included:

- > Advances in ballistic missile technology coupled to improved satellite and Over-The-Horizon (OTH) sensors which when forged into an MRSN meant that ships might no longer be able to hide in the ocean's vastness and could become targetable at great range;
- > The possibility of employing US Navy ships in the anti-ballistic missile role to defend homeland targets and theater-deployed forces;

All operational concepts centered on power projection have viewed the littorals as a dangerous passage to achieving objectives ashore.

¹⁶ ...*From the Sea*, Washington, DC: Department of the Navy, September 1992. Accessed at <http://www.globalsecurity.org/military/library/policy/navy/fts.htm>; *Forward...From the Sea*, Washington, DC: Department of the Navy, September 1994. Accessed at <http://www.globalsecurity.org/military/library/policy/navy/forward-from-the-sea.pdf>.

¹⁷ Rubel, "The Navy's Changing Force Paradigm," p. 14.

¹⁸ A.K. Cebrowski and Wayne P. Hughes, "Rebalancing the Fleet," US Naval Institute *Proceedings*, Vol. 125, No. 11, November 1999, p. 34.

¹⁹ Rubel, "The Navy's Changing Force Paradigm," p. 15.

- > The emergence of China as a viable regional naval competitor on the back of its rapidly-growing economy;
- > The increasingly threatening posture being adopted by Iran in the Persian Gulf and the destabilizing effect its acquisition of nuclear weapons would have on the Middle East generally;
- > A possible resurgence of the Russian navy; and
- > The potency of international Islamist terrorism as revealed by the 9/11 attacks.²⁰

These concerns about survivability and the developing capabilities of potential opponents in littoral waters prompted Admiral Michael Mullen, Vern Clark's successor as CNO, to take forward, in October 2007, a new maritime strategy that had actually started life under Clark and which was eventually promulgated by the Navy, along with the Marine Corps and Coast Guard, in a document entitled "A Cooperative Strategy for 21st Century Seapower." This laid out a more broadly based future for the Navy than the predominantly expeditionary one that had been plotted over the previous decade. The new strategy stressed that "preventing wars is as important as winning wars." Preventing wars still required the deterrent power of "combat credible" war fighting capability (taken to mean aircraft carriers) deployed to East Asia and the Persian Gulf. Also required, however, was the development of flexible "mission-tailored" forces deployable around the globe. According to the new strategy, these forces would bring together a network of SOF, other US government departments, and like-minded navies to deliver maritime security by securing sea lanes, inhibiting nuclear proliferation, curbing disorder at sea, and providing humanitarian aid and disaster relief.²¹ As Work pointed out, most of the Navy's current plans were developed before the new maritime strategy

²⁰ This reconsideration has been reflected in a number of studies and articles, not all of them published contemporaneously with the original debate. For example, Owen R., Coté, Jr., "Assuring Access and Projecting Power: The Navy in the New Security Environment," *MIT Security Studies Program*, ND. Accessed at http://web.mit.edu/ssp/Publications/navy_report/intro_execsumm.pdf; Bernard D. Cole, "Beijing's Strategy of Sea Denial," *The Jamestown Foundation, China Brief*, Vol. 6, No. 23, 22 November 2006. Accessed at http://www.jamestown.org/single/?no_cache=1&tx_ttnews%5Btt_news%5D=4001; Roger, Cliff, et al., *Entering the Dragon's Lair: Chinese Antiaccess Strategies and their Implications for the United States* (Santa Monica: RAND, 2007); Andrew S. Erickson and David D. Yang, "On the Verge of a Game-Changer," *US Naval Institute Proceedings*, Vol. 135, No. 5, May 2009, pp. 27–32; Rubel, "The Navy's Changing Force Paradigm," pp. 15–16; Work, *The US Navy: Charting a Course for Tomorrow's Fleet*, pp.47–54.

²¹ "A Cooperative Strategy for 21st Century Seapower," Washington, DC: US Department of the Navy, October 2007. Accessed at <http://www.navy.mil/maritime/MaritimeStrategy.pdf>; Work, *The US Navy: Charting a Course for Tomorrow's Fleet*, pp. 45–6; Rubel, "The Navy's Changing Force Paradigm," p. 16. For a discussion of this document see Robert O. Work and Jan van Tol, "A Cooperative Strategy for Twenty-First Century Seapower: An Assessment," Center for Strategic and Budgetary Assessments *Background*, 26 March 2008 at http://www.csbaonline.org/4Publications/PubLibrary/B.20080326.A_Cooperative_Stra/B.20080326.A_Cooperative_Stra.pdf.

was written.²² While this was not unusual the import in this case was greater because the “Comprehensive Strategy” suggested a Navy that would be markedly different in terms of its mission, deployment pattern, force structure and, perhaps most elusively, culture from the one that had won the Cold War.

It is therefore possible that the coming decade or so may well be marked by further intellectual ferment about strategy and future force structure, experimentation with weapons, systems and platforms, and the types, numbers and training of the personnel needed to align the Navy’s posture with the new strategy in ways similar to periods in the past when the geo-political constellation was shifting. In this sense Wayne Hughes’s suggestion that the LCS “isn’t right yet,” which is precisely the reason why it should be built, resonates perfectly with the times.²³

Post 9/11 Emphasis on Irregular Warfare: The Navy’s Role

In the wake of 9/11, all US armed forces were required once again to consider the need to build irregular warfare capability and capacity. For the Navy, the role it might play was initially far from clear.

That uncertainty was diminished by the publication of the tri-service “Cooperative Strategy.” In line with its theme of preventing as well as winning wars, it placed a newfound emphasis on the employment of maritime forces “to build confidence and trust among nations through collective security efforts that focus on common threats and mutual interests in an open, multi-polar world.” It made the vital point that although crisis-response forces can be “surged,” trust and cooperation cannot be. Instead they must be “built over time so that the strategic interests of the participants are continuously considered.”²⁴ Work and van Tol in their assessment of the “Cooperative Strategy” placed these ideas in the context of US strategic thinking over the past fifty years. They pointed out that in the 2004–2005 timeframe an important shift appeared to have taken place away from unilateralism and the need to prepare for possible “conventional” wars against weaker regional opponents using “traditional” military power, towards a more “global” perspective that required that the nation’s armed forces build a network of security partnerships to deal with the more diverse threats that were emerging, and to approach strategic and operational challenges in more indirect ways. These changes, they argued, were crystallized in the 2005 *National Defense Strategy* and the 2006 *Quadrennial Defense Review* (QDR), which taken together effectively announced a new cooperative phase in US national security policy. Viewed in this manner, the “Cooperative Strategy” was an attempt

²² Work, *The US Navy: Charting a Course for Tomorrow’s Fleet*, p. 46.

²³ Wayne P. Hughes, “LCS Isn’t Right Yet. That’s A Good Reason To Build It.” Presentation to the 71st Military Operational Research Society Symposium, Working Group 13, 10 June 2003. The Navy needs a small combatant for littoral operations. Hughes argues that the LCS should be built to determine what are the optimal characteristics and operational tasks such combatants can be used for.

²⁴ “A Cooperative Strategy for 21st Century Seapower,” pp. 4, 5 & 11.

to articulate its maritime dimension. It recognized that the Navy might well be called upon to confront violent extremism in the littorals, and to interdict the movement of arms and operatives on the open oceans as they were transferred between operational areas, by advancing the argument that naval presence had a long and successful history of building the capacity needed to deny extremists the opportunity to exploit local grievances in “at risk” areas.²⁵

Hybrid Warfare

What the “Cooperative Strategy” recognized but did not articulate in so many words was the movement towards the hybridization of warfare in which state and non-state actors, separately or together, blur “conventional capabilities, irregular tactics and formations, terrorist acts... and criminal disorder,” and transfer technologies, including high-technology weaponry, sensors, communications and cryptological equipment, between modes of warfare in a conscious attempt to fuse the tactics of irregular war with the most lethal means available. These hybrid challengers aim to wage this complex form of conflict in the densely populated littorals, because they believe it offers them opportunities to prolong conflicts and sap US political will.²⁶

Although these developments have troubled naval forces less than land forces, which have had to overcome the rapid evolutionary development of IEDs for example, there is no room for complacency. The fact that “Hezbollah was able to surprise and hit an Israeli patrol boat with an Iranian-provided C-802 coastal defense cruise missile should be a warning flare to all nations with navies that such weapons can be obtained by non-state actors and secretly positioned almost anywhere.”²⁷ Sailing ships closer to shore reduces their reaction time to onshore attacks, leaving them more exposed to surprise attack by advanced weapons, or even low-technology weapons such as suicide boats brought within range by deception, as epitomized by the 2000 attack in Yemen on the USS *Cole*.²⁸

²⁵ Robert O. Work and Jan van Tol, “A Cooperative Strategy for Twenty-First Century Seapower: An Assessment,” Center for Strategic and Budgetary Assessments *Backgrounder*, 26 March 2008, pp. 10–11 at http://www.csbaonline.org/4Publications/PubLibrary/B.20080326.A_Cooperative_Stra/B.20080326.A_Cooperative_Stra.pdf.

²⁶ Frank G. Hoffman, *Conflict in the 21st Century: The Rise of Hybrid Wars* (Arlington, VA: Potomac Institute for Policy Studies, December 2007), pp. 14, 15 & 29. Accessed at http://www.potomac institute.org/publications/Potomac_HybridWar_0108.pdf.

²⁷ Rubel, “The Navy’s Changing Force Paradigm,” p. 22. For further detail on the attack see Martin N. Murphy, *Small Boats, Weak States, Dirty Money: Piracy and Maritime Terrorism in the Modern World* (New York and London: Columbia University Press/Hurst, 2009), pp. 255–257.

²⁸ Norman Friedman, “New Roles for Littoral Combat Ships,” US Naval Institute *Proceedings*, Vol. 129, No. 1, January 2003, p. 4; Raphael Perl and Ronald O’Rourke, “Terrorist Attack on the USS *Cole*: Background and Issues for Congress,” Congressional Research Service RS20721, 30 January 2001. Accessed at <http://www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB55/crs20010130.pdf>.

LITTORALS ARE A CHALLENGING ENVIRONMENT

The littorals present the Navy with the challenge of operating in a complex environment which can degrade the effectiveness of ISR sensors and place a premium on local knowledge and traditional seafaring skills. For a navy used to operating in the deep ocean, the restrictions on space, distance and time that littoral operations present can be unsettling. The transition from the open ocean to the littoral is akin to the adaptation a ground force must make when transferring from a desert to a city.²⁹

Physical Geography

Littoral waters offer many more natural and geographic challenges to both attackers and defenders which enable them to exploit surprise, including the use of mines and swarming tactics, than do deep ocean waters. Littoral areas contain more *decisive points*, defined as sea areas where shipping—because it is forced to concentrate by the presence of islands, headlands, river mouths, narrows and straits (some of which can be chokepoints)—is more vulnerable to attack.³⁰

The effects of oceanography and meteorology are also more marked in the littoral and make operating there more difficult than on the open ocean. Water depth clearly places limits on vessel drafts but the consistency of the water itself, its temperature, salinity and clarity, the character of the seabed and the proximity and configuration of the coast all affect the performance of undersea sensors. Similarly, air temperature, humidity, wind speed, wave height, precipitation, cloudiness and the presence of fog can affect radar, heat sensors and radio communications, while haze and other forms of visual distortion can affect the performance of optical devices.³¹ Radio and radar signals can also be distorted by the presence of nearby land masses.

Human Geography and the Opportunity for Irregular Warfare

The presence of people adds to this complexity. The numbers who actually make their living or travel on the inshore waters, and who therefore interest naval planners directly, will never equate to the numbers that crowd the world's mega-cities and cause urban warfare specialists so much concern, but they exceed the numbers found on the open oceans by many orders of magnitude. The assumption that when operational space is transformed into battle space—in other words,

The transition from the open ocean to the littoral is akin to the adaptation a ground force must make when transferring from a desert to a city.

²⁹ Murphy, *Small Boats, Weak States, Dirty Money*, p. 402; Michael S. Lindberg, *Geographical Impact on Coastal Defense Navies: The Entwinning of Force Structure, Technology and Operational Environment* (London: Macmillan, 1998), p. 45.

³⁰ Vego, *Naval Strategy and Operations on Narrow Seas*, p. 82.

³¹ *Ibid.*, pp. 34–40.

**The littorals
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when the shooting starts — most of this civilian presence will leave the area may prove to be wrong. People in many parts of the world have to go to sea or they starve, and will therefore take what seem insane risks to feed their families. In other cases, unless an area becomes a theater for major conflict, trade is likely to continue because the losses incurred by *not* doing so are too great; the continuation of tanker traffic during the 1984–1988 “Tanker War” in the Persian Gulf is a case in point. During insurgencies or conflicts where opponents deliberately exploit the presence of humanity to disguise their operations and shield them from retaliation, the expectation must therefore be that the volume of maritime traffic is likely to remain at normal or near-normal levels despite the dangers. Identifying targets of interest within the mass of normal traffic will, in many cases, be achieved only by approaching, interrogating and occasionally boarding suspicious craft.

The fact that three quarters of the world’s population, four fifths of its capital cities, and almost all its productive capacity is situated within two hundred miles of a coastline means that the US Navy cannot avoid the world’s littorals. The late Admiral Jeremy Boorda, USN, put it succinctly when he wrote that the littorals are where “our national interests and potential foes most often collide.” The concentration of population, the pressure on natural resources and the prospect for upheaval as a consequence of natural disasters all heighten the potential for conflict in these regions.

The presence of people also means that emissions from communications, cellular networks, television stations, and commercial and governmental networks can turn the electromagnetic spectrum into a wall of noise. The complexity of this human and information environment, coupled with the challenges and unpredictability of littoral geography, provide ample cover for the approach of small surface or submersible craft equipped with short range-weapons, and complicate the detection of stealthy, low-elevation anti-ship cruise missiles as they emerge from amidst a background of land clutter.³² Clearly these features can impede both sides’ performance; but the side that is likely to be most affected is the one that is the least familiar with this environment.

³² Richard Scott, “Sensing in Clutter: Improving Littoral Situational Awareness,” *Jane’s Navy International*, 23 April 2009.

CHAPTER 2 > LCS DESIGNS

OBJECTIVES, REQUIREMENTS AND FEATURES OF THE TWO VARIANTS

The LCS is being built in two designs: one by Lockheed Martin (LM) (LCS-1 and LCS-3); and the other by General Dynamics (GD) (LCS-2 and LCS-4). LCS-1 was launched at the Marinette Marine shipyard in Marinette, Wisconsin on September 23, 2006; LCS-2 on April 30, 2008 at the Austal USA shipyard, Mobile Alabama.³³ The path to these two events was tortuous.

In 2001, when the Navy announced its revised plan to build a new, small combatant, the intention was to replace the thirty remaining frigates of the *Oliver Hazard Perry*-class and twenty-six mine warfare vessels split between fourteen *Avenger*-class mine countermeasures ships and twelve smaller coastal mine-hunters of the *Osprey*-class, with fifty-five Littoral Combat Ships.³⁴ The Navy felt the functions of two such contrasting vessel types could be combined in one new hull because the new LCS was intended to be able to carry “plug-and-fight” modules that could be changed according to the mission to which the ship was

³³ On LCS-3 and 4 see Casandra Newell, “Littoral-Minded: DoD Keeps LCS Programme Hopes Alive,” *Jane’s Navy International*, 19 March 2009.

³⁴ In the early stages it was suggested that the Navy would need eighty LCSs. This was subsequently scaled back to fifty-five as a number the Navy could afford and which would cover most of its needs.

**“Modularity”
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by the US Navy.**

assigned.³⁵ “Modularity,” as this is known, is not a new concept in naval design although it had never been attempted before by the US Navy.³⁶

The ship’s dimensions were determined not by any pre-determined displacement target but in response to how the Navy’s own thoughts about what the ship would be required to do changed over time. Nonetheless, the displacements of the two versions – approximately 2,800 tons full load for the LCS-2 and 3,000 tons full load for the LCS-1 – put them in the range of frigates operated by many international navies, although well below the 4,000 tons of the *Oliver Hazard Perry*-class they will replace. The principal demands that drove its eventual size were:

- > Independent operation: the LCS had to be capable of self-deploying between 3,500 and 4,300 miles at economical speed while carrying between fourteen and twenty-one days of provisions without recourse to a replenishment or mother ship, the assumption being that forward-basing might no longer be an option by the time the ship entered service. This requirement drove demands for sea-worthiness, bunker capacity and habitability.
- > Battle-force capability: experience since World War II indicated that a displacement of around 3,000 tons was the lowest practicable for ships working as part of carrier or expeditionary strike forces.
- > Speed: the ability to sprint at speeds in excess of 45kts, which determined the size of the machinery space.
- > Mission module: the space to carry a modular payload of between 180 and 210 metric tons, including whatever fuels the module needed in order to operate.
- > Weapons and equipment: the capacity to hanger and launch up to two MH-60 helicopters or UAVs, or a mix of both, in sea states four or five and similarly the ability to store, launch and recover up to 11-meter Rigid-Hulled Inflatable Boats (RHIBs) in sea states three or four, which drove the need for stability.³⁷

³⁵ Work, *The US Navy: Charting a Course for Tomorrow’s Fleet*, p. 27.

³⁶ Work, *Naval Transformation and the Littoral Combat Ship*, p. 119. The ship’s size, however, is not revolutionary. In line with their pioneering work in this area the Royal Danish Navy incorporated modularity into the *Thetis*-class patrol vessels, also known as Stanflex 3000, (2,600 tons standard) and planned to build a future frigate based on the *Absalon*-class hull (5,850 tons standard). Richard Scott, “Denmark Works to Define Future Patrol Ship,” *Jane’s Defence Weekly*, 4 June 2003. This project has been taken forward as the 5,850-ton *Ivar Huitfeldt*-class anti-air warfare (AAW) frigate three of which are due to enter service starting in 2011. The ships will use *Standard Flex* containers for their armament arrangements. Richard Scott and Jon Rosamond, “Nordic Shake-Up: Scandinavian Navies,” *Jane’s Defence Weekly*, 5 October 2009; CASR, “Current Danish Naval Projects,” July 2008. Accessed at <http://www.casr.ca/id-danish-naval-projects-frigate.htm>.

³⁷ *Ibid.*, pp. 117–9.

Sea Frames

The two different base ship designs that the Navy has put into interim production are referred to as sea frames.³⁸ Lockheed Martin is building a ship with a 380-foot long, steel semi-planing monohull, based on an Italian design, with an aluminum superstructure. The General Dynamics ship is a 420-foot long trimaran built entirely of aluminum based on an Australian design for a high-speed ferry. Both draw less than 15 feet. Because personnel costs are now such a substantial proportion of the Navy budget, each version will be crewed by a maximum of seventy-five, although the designs allow for roughly twenty-five more berths to be installed if necessary or if experience demonstrates that holding crew numbers at this ceiling proves impracticable. The “core” crew responsible for the sea frame will number around forty, with the balance allocated to the installed module.

The ships’ navigation, C4ISR and other electronic systems will be based on “open-architecture” protocols that focus on standardizing interfaces rather than standardizing systems. This will allow them to incorporate Commercial Off-The-Shelf (COTS) or Government-Off-The-Shelf (GOTS) technology and for this to be changed and upgraded with the same ease as the ship’s other components. Data links will enable the ship to plug into the Navy’s overall battle network.

Other standard features on the LM version include a flight deck one-and-a-half times larger than that installed on other current surface combatants, a universal, triple-axis overhead crane system to launch and deploy manned and unmanned surface and sub-surface craft, a stern ramp which will permit the launch and recovery of various manned and unmanned watercraft while the ship is underway plus a side door that is designed to facilitate underway replenishment and provide an alternative boat launch and recovery point.

The GD version is comparable except that the flight deck is approximately twice the size of the flight decks of current Navy surface combatants (11,087ft²). Watercraft are launched and recovered from the rear using an extending crane instead of a ramp, which although almost certainly slower than the ramp option might permit launch and recovery operations in higher sea states, while the starboard side access has a roll-on/roll-off ramp for pier side loading but offers no alternative boat launch option. For basic self-defense both ships are equipped with a 57mm naval gun firing at a rate of 220 rounds per minute out to a range of

³⁸ “LCS, unlike previous surface combatants, is envisaged as a ‘seaframe,’ serving much the same purpose as an airframe for a reconfigurable aircraft or helicopter (or as an aircraft carrier with its reconfigurable air wing ‘module’). It will serve as a platform for ‘plug and play’ mission packages that can be changed, modified, or removed in a short period of time.” Navy Warfare Development Command, “Littoral Combat Ship: Concept of Operations,” February 2003 at <http://www.globalsecurity.org/military/library/report/2003/LCSCONOPS.htm>.

nine miles, a close-in missile defense system utilizing a mix of rolling-airframe missiles and decoys, and .50 caliber machine guns.³⁹

In September 2009 the Navy announced that it would be selecting a single design by competition in 2010. The winning team will receive a contract for up to ten ships to be completed by 2014. A second competition to choose a second shipyard to build a ship to the same design will be held in 2012 for a contract for up to five additional ships also for delivery in 2014. The decision eliminates the operational problems that would have arisen from having two ships with entirely different combat systems in the fleet.⁴⁰

Mission modularity
offers users the
ability to adjust ship
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Modularity

Background and Definitions

Modularity has many advantages.⁴¹ *Configuration modularity* refers to ships constructed in a series of modules which can each be connected to the ship's central power, climate control and data services using standardized interfaces. The prime example is the Blohm and Voss MEKO-class ships which offer buyers the opportunity to tailor designs to match their particular requirements, selecting from a baseline series of hulls, and the opportunity to modernize or upgrade the ship's equipment relatively quickly and economically over the course of the hull's life.⁴² The original design for the SC-21 small ship combatant was based on this idea. *Mission modularity* takes this approach a step further. It offers users the ability to adjust ship configurations to suit changed mission requirements with relative ease. Prior to the LCS, the best example of this form of modularity was the Royal Danish Navy's *Flyvefisken*-class Standard Flex, or StanFlex, multi-role vessels.⁴³ The US Navy, however, wanted to stretch the concept of "mission modularity" further. Instead of emphasizing stations for deck-mounted on-board systems, it put its focus on manned and unmanned off-board systems, sensors

³⁹ Work, *The US Navy: Charting a Course for Tomorrow's Fleet*, p. 28; "Modularity, the Littoral Combat Ship and the Future of the United States Navy," The Lexington Institute, ND, pp. 8 & 10 at http://lexingtoninstitute.org/docs/lcs_final.pdf; "Littoral Combat Ship (LCS) High-Speed Surface Ship, USA." *Naval Technology*, ND at <http://www.naval-technology.com/projects/littoral/>.

⁴⁰ Christopher P. Cavas, "Will LCS change fix problems?" *Defense News*, 21 September 2009. Accessed at <http://www.defensenews.com/story.php?i=4286113>.

⁴¹ The Naval Research Advisory Committee defines four types of modularity: capability swapping (mission-package modularity), component sharing, bus, and constriction/design. "Modularity, the Littoral Combat Ship and the Future of the United States Navy," p. 4.

⁴² Work, *Naval Transformation and the Littoral Combat Ship*, pp. 120–121.

⁴³ Work, *Naval Transformation and the Littoral Combat Ship*, pp. 122–123. Also "Flyvefisken Class (SF300) Multi-Role Vessels, Denmark," *Naval Technology*, ND at <http://www.naval-technology.com/projects/fly/>. See also Richard Scott, "Flexing a Snap-to-Fit Fleet," *Jane's Defence Weekly*, 7 November 2001; Nik Moss, "Small but Able Frigate Fleets," *RUSI Defence Systems*, Vol. 10, No. 2, October 2007, pp. 101–102.

and weapons collected into what it termed “mission packages.” Furthermore, by adopting an exceptionally flexible approach towards on-board space, the hull form could be separated from capability to the point where, it was hoped, ships could be configured from one mission to another in around forty-eight hours even at minimally-equipped facilities.⁴⁴

Based on empirical evidence supplied by the Royal Danish Navy, the force of fifty-six LCSs that were planned at the time would have required between 112 and 134 mission packages based on the Danish Navy’s 2.0-2.4:1 packages to hull ratio and would have effectively replaced a mixed-force of between seventy-seven and eighty-eight single-mission small combatants.⁴⁵ By 2008, however, the planned purchase of hulls had been reduced to fifty-five, the number of mission packages to sixty-four, and the number of missions to three: mine warfare, anti-submarine warfare and surface warfare.⁴⁶ RAND, in its 2007 study, suggested that on the basis of four research scenarios built around this truncated set of missions, the Navy might have seriously underestimated the number of mission packages it needed. In its view the Navy would require 89 mission packages in the short term and 126 in the long term.⁴⁷

Mission Packages

Current proposals envision matching the sea frames with the three mission packages settled on in 2008 each with a crew of no more than thirty-five, including the members of any aviation detachment.

- > The Surface Warfare (SUW) package will be equipped with manned and armed helicopters, unmanned aerial systems, vertically-launched guided missiles, 30mm rapid fire cannons and armed unmanned surface vehicles to combat small boat attacks and to threaten larger enemy combatants in narrow seas.
- > The Anti-Submarine Warfare (ASW) package is intended to include embarked helicopters, unmanned underwater vehicles (UUVs) and unmanned surface

⁴⁴ Work, *Naval Transformation and the Littoral Combat Ship*, pp. 123 & 129.

⁴⁵ Work, *Naval Transformation and the Littoral Combat Ship*, p. 136. Work suggests that the US Navy, by improving on the Danish model, should expect to achieve a higher “battle modularity figure.” In practice, however, the Danish Navy rarely swaps out its mission modules, which raises an obvious question over the utility of modularity at all. One reason to retain it would be to “future-proof” the ship and reduce the costs of refits in response to changes in the strategic and operational environment.

⁴⁶ Work, *The US Navy: Charting a Course for Tomorrow’s Fleet*, p. 29; O’Rourke. “Navy Littoral Combat Ship (LCS) Program: Background, Oversight Issues, and Options for Congress,” p. 6; Brian Alkire, et al, *Littoral Combat Ships: Relating Performance to Mission Package Inventories, Homeports, and Installation Sites*, (Santa Monica: RAND, 2007) pp. 3–5 & 11. In point of fact the decision to reduce the number of packages to three was probably taken as early as 2003 and package numbers were reduced slowly as costs escalated.

⁴⁷ Alkire et al, *Littoral Combat Ships*, pp. xxiii–xxiv.

vehicles (USVs) all equipped with anti-submarine torpedoes. Its principal targets will be diesel submarines that present a formidable threat in littoral waters. Detection assets will include Sea TALON (Tactical Littoral Ocean Network), an undersea surveillance system that integrates acoustic sensors with semi-submersible vehicles; the rapidly-deployable Advanced Deployable System (ADS); a bottom-array acoustic surveillance system; and a Remote Towed Active Source (RTAS), a multiband transducer with multi-function towed array sonar drawn through the water by the AN/WLD-1 semi-submersible.⁴⁸

- > The Mine Countermeasures (MCM) package will have a mix of systems similar to the ASW module including the AN/WLD-1 for remote mine-hunting, the AN/AQS-20A mine-hunting sonar and organic airborne surface influence sweep, laser detection and mine neutralization systems.

DIFFERENTIAL ADVANTAGES

**Adaptability is
the key to the
ship's future.**

Adaptability

The potential of the LCS lies in its copious internal space, its ability to incorporate new and updated system modules and its large flight deck, all of which make it readily adaptable to new missions. This adaptability is the key to the ship's future.

Area of Influence

LCS can greatly extend the amount of the world's maritime space that the Navy can influence. Multi-mission combatants in the Navy's inventory currently draw no less than 35 feet. The LCS's draft of 15 feet opens up all waters between 20 and 35 feet, which increases Navy access in a number of critical sea areas including the northern Persian Gulf, parts of East and Southeast Asia, the Caribbean Sea, the Indian Ocean and the Baltic Sea. It expands the number of ports that the Navy can access worldwide from 362 to 1,111.

Battle Network

The LCS's ability to network with other naval and air assets is vital to its operations. Its ability to exchange tactical and operational data with other joint platforms enables it to act as a forward information and Command and Control (C²) node controlling not only its own off-board air, surface and sub-surface assets but similar assets deployed by other platforms located Over-the-Horizon (OTH). Its networked capability enables it to perform its scouting function, relaying ISR

⁴⁸ The ADS was unfunded at the time of writing.

data to other deployed forces. In order to fulfill this function effectively, however, the size of the ship's crew will likely need to be increased. Moreover, it is fair to say that without its enabling networks, the value of the LCS would be little more than previous small US Navy ships beyond its usefulness as a mobile helicopter "lily pad."

Flight Deck

The large flight deck, one-and-a-half times the size of the flight decks installed on current US Navy combatants in the case of the LM version, and twice the size in the case of the GD version, gives the Joint commander tremendous flexibility when deploying aviation assets. The deck can accommodate any wheeled helicopter up to the size of an SH-60 or an equivalent load of VTUAVs. In addition to their designated roles in ASW, SUW and MCM, these air assets can facilitate maritime security operations including VBSS, provide Maritime Domain Awareness (MDA) in support of blockade or interdiction operations; conduct over-the-beach maneuver in support of Special Operations Forces (SOF), Non-combatant Evacuation Operations (NEO) or Humanitarian Assistance/Disaster Relief (HA/DR) operations; and assist final delivery of goods and personnel transported in the course of in-theater mobility operations.

The large flight deck gives the Joint commander tremendous flexibility when deploying aviation assets.

Payload

The large internal volume and payload capacity give the ship great flexibility and utility as a mobility vehicle. In this respect it is very different from other combatants and gives the Joint commander the option to move small parties of regular troops, SOF, supplies and equipment at speed within theater. Illustrative cases might include:

- > Delivery of goods, vehicles, equipment, medical supplies and specialists to disaster areas;
- > Delivery of goods, vehicles, equipment, weapons, ammunition and war fighters to combat zones;
- > Extraction of war fighters and casualties from combat zones;
- > Evacuation of casualties and non-combatants from disaster or crisis areas; and
- > Insertion and extraction of SOF forces.

The internal crane system facilitates the ready movement of loads internally and through the rear access door. Further flexibility might be achieved by installing —

or providing the ability to install—an external on-board crane to facilitate pier-side transfers in ports with limited facilities.

Speed

Operational

The operational advantage conferred by high speed is that the LCS will be able to transfer rapidly between and within theaters of operation provided Underway Replenishment (UNREP) or in-port refueling is available along its route. Prominence has been given to the fact that the ship could, if the need arose, transfer quickly back to a regional base to swap over one mission package for another. Of perhaps greater utility, however, is the option that high speed gives the Joint commander to direct an asset to where it is needed quickly within a relative limited area.

The LCS could exploit its speed to increase the reach of task groups by serving as a fast-moving lilypad for helicopters other than its own.

Tactical

Speed gives the ship's commander an enhanced ability to avoid submarines and gain extra maneuver room when confronting small boat swarms, while also improving, to a degree, the ship's chances of evading torpedo attack, assuming receipt of an incoming torpedo alert and Anti-Ship Cruise Missile (ASCM) strikes by virtue of the increased area of uncertainty for ASCM targeting. The LCS could exploit its speed to increase the reach of task groups by serving as a fast-moving lilypad for helicopters other than its own. In such cases one or more LCSs could be positioned on the periphery of a task group to which manned or unmanned air assets could be deployed from a CVN or LHA, or to take advantage of the LCS's large flight decks to refuel and re-arm in patterns synchronized with the LCS's own air detachment. It could also extend the range of its embarked air assets by using its speed to sprint towards recovery points. Speed would also be of use when interdicting air-detected targets or contacts of interest (COI).

The disadvantage is that speed requires great power. By choosing speed the Navy has consciously chosen to accept lower carrying capacity and endurance.⁴⁹ The impact on endurance is illustrated by the fact LCS's cruising range of around 4,000 nautical miles (nm) at 20kts reduces to 1,500 nm at 45kts. This compares to an endurance of around 12,000 nm at 9kts for the US Coast Guard's *Legend*-class National Security Cutter. Consequently, any mission that requires extensive use of speed will significantly limit the ship's unrefueled time on station. Restrictions on payload and fuel capacity (including aviation fuel) mean that the LCS will require considerable logistical support for the provisioning of fuel,

⁴⁹ Milan Vego, "No Need for High Speed," US Naval Institute *Proceedings*, Vol. 135, No. 9, September 2009, pp. 46–50.

ammunition, perishable foods and other consumables. The Navy will almost certainly need to give greater thought to how the LCS can be supported when operating at distance from base areas, including the provision of “mother ships” to support squadron operations. In addition, UNREP is an expensive capability. The Navy may also need to consider if greater use of alternative refueling and replenishment techniques makes better use of scarce resources. The LCS might also serve as a “mother ship” itself, carrying fuel as a payload to supply smaller craft, and even ground forces if it has access to a suitable pier.⁵⁰

POTENTIAL VULNERABILITIES AND TRADE-OFFS

Armament Limitations

The LCS sea frame is equipped with a:

- > 57mm naval gun firing at a rate of 220 rounds per minute out to a range of nine miles, and .50 cal machine guns;⁵¹
- > On the GD design, a RIM-116 SeaRAM short-range anti-missile defensive system, cued by an integral radar, that evolved out of the Phalanx Close-in Weapon System (CIWS) in which the original 20mm gun has been replaced by a Rolling Airframe Missile (RAM) launcher assembly containing eleven projectiles; on the LM design a Rolling Airframe Missile (RAM) launcher assembly containing twenty-one projectiles cued by the sea frame radar;⁵²

The Navy will almost certainly need to give greater thought to how the LCS can be supported when operating at distance, including the provision of “mother ships” to support squadron operations.

⁵⁰ UNREP is not a straightforward operation for any warship, and it is more difficult with LCS because the usual method of matching the receiving ship’s speed with that of the oiler — synchronizing the revolutions per minute of their respective propellers — is not possible as both versions of the LCS use water-jets. Moreover the LM design is not designed to accept supply pallets using a line from a supply ship in the traditional manner and will depend on vertical replenishment by helicopter. Philip Ewing, “Refueling Tops List of LCS Crew Challenges,” *Navy Times*, 19 May 2009. Accessed at http://www.navytimes.com/news/2009/05/navy_lcs_051809w/.

⁵¹ On the gun system see Joris Janssen Lok, “Navies Look For Ways To Tackle The Ever-Changing Close-In Threat,” *Jane’s International Defence Review*, December 2004, pp. 50–51.

⁵² “SeaRAM to be placed on board LCS,” *Sea Technology*, June 2006. Accessed at http://findarticles.com/p/articles/mi_qa5367/is_200606/ai_n21393694/; Raytheon, “SeaRAM Evolved Ship Defense,” Accessed at http://www.raytheon.com/capabilities/rtnwcm/groups/rms/documents/content/rtn_rms_ps_searam_datasheet.pdf; “Why SeaRAM is superior to Phalanx,” *Strategy Page*, 12 April 2006 at <http://www.strategypage.com/htmw/htada/articles/20060412.aspx>; “RIM-116 RAM Rolling Airframe Missile,” *GlobalSecurity.com*, ND at <http://www.globalsecurity.org/military/systems/munitions/ram.htm>; Richard Scott, ‘Stopping Power: RAM goes head on with new threats.’ *Jane’s Navy International*, 1 March 2008; Lok, “Navies Look For Ways To Tackle The Ever-Changing Close-In Threat,” pp. 52–53.

The ability of the LCS to defend itself when compared to similar ships designed to undertake similar tasks appears to be limited.

- > A missile decoy system;⁵³
- > 4x15 launchers for short range Non Line of Sight (NLOS) missiles intended to deliver a warhead similar in size to a 155mm shell against stationary or moving targets using infrared seeker, laser or GPS coordinated guidance;⁵⁴ and
- > Missiles and rockets carried by the ships' helicopters or unmanned aerial systems.

Although the LCS is intended to be operated with other vessels with air defense and land attack capabilities, critics nonetheless point out that both LCS designs lack a vertical-launch system (VLS) cell that would make it possible to deploy longer range air defense, anti-ship or land-attack missiles. In this sense it compares unfavorably with the Danish *Flyvefisken*-class modular ship that carries a Mk. 48 VLS equipped with either Harpoon anti-ship missiles or longer range air defense missiles depending upon its mission, the Israeli Navy Sa'ar 5 *Eilat*-class corvettes and the Swedish *Visby*-class (and the larger *Visby-plus*) all of which are designed for similar littoral warfare conflicts as the LCS.⁵⁵ While taking due account of the fact that none of these nations operate carriers or long-range strike forces, the ability of the LCS to defend itself when compared to similar ships designed to undertake similar tasks appears to be limited, especially against air attack, regardless of which mission package is carried.⁵⁶

⁵³ The LM version is equipped with a Soft Kill Weapons System (SKWS) launcher; the GD version with three Super Rapid Bloom Offboard Countermeasures (SRBOC) and two Nulka decoy launchers. "Littoral Combat Ship (LCS) High-Speed Surface Ship, USA." For background on soft-kill generally and these systems in particular see Richard Scott, "Smarter Soft Kill." *Jane's International Defence Review*, 1 February 2001; *op.cit.*, "Killing It Softly." *Jane's Defence Weekly*, 7 February 2001; and *op.cit.* "Tailoring Effective Soft-Kill for the Small Ship Cause," *Jane's Navy International*, 1 November 2006.

⁵⁴ "Cheap, Fast, Deadly: The NETFIRES 'Missile in a Box' Program (updated)," *Defense Industry Daily*, 8 July 2008 at <http://www.defenseindustrydaily.com/cheap-fast-deadly-the-netfires-missiles-in-a-box-program-updated-02653/>; The missile comes in two versions, a Precision Attack Missile (PAM) designed to achieve minimum time-to-target and a Loitering Attack Missile (LAM), which is able to loiter over targets of interest, perform automatic target recognition and attack them on its own. The missile's current range is 70 km (43 miles) and its loiter time is 30 minutes. It is envisaged that when the LAM is developed fully it will be capable of achieving a 200 km (124 mile) range and 45 minute flight time. "Non-Line-of-Sight Launch System (NLOS-LS)." *GlobalSecurity.com*, ND at <http://www.globalsecurity.org/military/systems/munitions/net-fires.htm>. The Fire Scout UAV will provide over-the-horizon targeting. Casandra Newell. "Fire Scout and NLOS-LS join forces for LCS surface Missions." *Jane's Navy international*, 18 July 2008 and Newell. "Littoral-Minded: DoD Keeps LCS Programme Hopes Alive."

⁵⁵ "Cost growth puts the brakes on USA's Littoral Combat Ship Program," *Defense Industry Daily*, 19 March 2007 at <http://www.defenseindustrydaily.com/cost-growth-puts-the-brakes-on-the-usa-littoral-combat-ship-program-03142/>; Visby, "The Definition of Maritime Stealth." *Kockums*, ND at <http://www.kockums.se/pdf/visbyprospekt.pdf>.

⁵⁶ Vego, "No Need for High Speed," p. 47.

Crew Integration and Optimization

Economizing on crew numbers should not be confused with optimizing crew numbers. The figure of seventy-five crew members divided among the core crew, the air detachment and the mission crew was apparently a number arbitrarily selected to focus attention on minimizing through-life costs. Moreover, while modularity potentially delivers extraordinary flexibility, it also raises concerns about how a mission package crew can be integrated to work with a core crew on damage control, how many can be released on a regular basis to assist an air detachment during aircraft recovery operations or to undertake underway replenishment tasks. These have, in turn, given rise to a generalized concern about crew fatigue especially under conditions of extreme stress. The expectation is that, in practice, the crew's complement will probably rise to around one hundred, although this is still half the complement of the *Oliver Hazard Perry*-class the LCS is intended to replace.

A related issue is that Navy plans to maximize hull and package utilization through crew rotation may not deliver the anticipated benefits. The intention currently is to assign two core crews to each of the four first hulls: i.e. LCS 1-4, based on the Blue-Gold rotation policy employed for many years by the SSBN community. Consideration has also been given to a number of other alternatives, the most elaborate of which involves assigning four core crews to every three LCS sea frames in line with the ideas put forward in the "Horizon" concept.⁵⁷ Estimates suggest that this will mean only three ships will be required to maintain one forward deployed compared to five ships to maintain one forward based on the single crew system used throughout the rest of the surface fleet.⁵⁸ The Congressional Budget Office has suggested that without the implementation of what has also been referred to as the 4-3-1 system, the Navy will need to build eighty-five LCSs to maintain its target of twenty-three forward-deployed ships.⁵⁹ In addition, the crew of each mission package will require some level of specific training.

Lack of Torpedo Detection Capability

The ship currently lacks a torpedo detection capability. The Navy is now taking urgent steps to rectify this worrisome omission as there is every reason to believe that coastal adversaries will make frequent use of torpedo attacks, launching

⁵⁷ Ronald O'Rourke, "Navy Ship Deployments: New Approaches—Background and Issues for Congress," Congressional Research Service RS21338, 15 November 2004, p. 6 at <http://www.fas.org/sgp/crs/weapons/RS21338.pdf>; Daniel J. Franken and Janice M. Graham, "Changing the Way the Navy Deploys," US Naval Institute *Proceedings*, Vol. 127, No. 1, January 2001, pp. 71–3.

⁵⁸ Work, *The US Navy: Charting a Course for Tomorrow's Fleet*, pp. 28–9.

⁵⁹ Congressional Budget Office, "Crew Rotation in the Navy: The Long term Effect on Forward Presence," October 2007, p. 12 at <http://www.cbo.gov/ftpdocs/87xx/doc8771/10-31-Navy.pdf>.

weapons from land-based launch sites, Fast Attack Craft, and conventionally-powered submarines that can be hard to detect in littoral waters.

Logistics and Support

Small ships generally require extensive logistic support. This will almost certainly be true of the LCS and it is not immediately clear where that support will come from when the ship is operating in littoral waters. The critical requirement will be for fuel (including aviation spirit), oil and lubricants (POL). While the LCS is capable of trans-oceanic deployment at moderate speed without assistance, and while it could sprint for several hours and still have good range, it will require extensive support whenever it exploits its sprint capability for extended periods.

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General Supply Issues

When operating as an SG component, or in the vicinity of friendly ports, maintenance and re-supply should not present a problem. When, however, an LCS is deployed singly, as part of an LCS-only squadron or as part of a Global Fleet Station, consideration needs to be given to providing a “mother ship” or tender in support able to resupply not only fuel but also other consumables, such as ammunition, perishables and spare parts, and provide medical treatment and workshop facilities. The LCS is designed to be self-sustaining for between fourteen and twenty-one days but in circumstances when it is operating at high speed this could conceivably drop to as little as four days. Workshop access may be particularly important because, as part of the drive to restrict crew size, much of the maintenance generally conducted by a ship’s crew has, in the case of the LCS, been transferred ashore. Although it is beyond the scope of this paper to suggest how this issue could be addressed, it is worth pointing out that although any “mother ship” should have the ability to undertake UNREP, many logistics tasks could be undertaken at anchor given that the preponderance of LCS missions will be conducted in benign, or relatively benign, environments close to shore.

Package-specific Issues

Under current plans, LCS packages are to be “swapped out” in any port with access to a crane. Insofar as mission packages are likely to be exchanged in theater during the course of a campaign, such a maneuver would require the LCS to make the transit back to a suitable port and then return to its operating area.⁶⁰ While

⁶⁰ The fourteen Stanflex (SF300) ships of the RDN are grouped into two squadrons (Eskadre). One squadron, 3 Eskadre, is dedicated to MCM operations. The other, 2 Eskadre, has a mobile logistics unit and a mobile base facility, which includes trucks and a shore-based command post to coordinate littoral operations. Scott, “Flexing a snap-to-fit fleet.”

the benefit of this level of flexibility is considerable when compared to a multi-mission ship or specialist MIW vessel, the need to wait for the arrival of specialist equipment from CONUS nonetheless entails a delay. In such cases it might prove advantageous to ship the expected alternative mission package on board a “mother ship” equipped with a crane and undertake the transfer at anchor with crew replacement effected via helicopter. Whichever course is chosen, the resulting solution is likely to demand additional manpower and potentially expensive logistical support, particularly in cases in which elements of the mission package such as the aviation detachment, aircraft, ammunition, mission crew and equipment are geographically dispersed and in varying degrees of readiness.

CHAPTER 3 > LCS MISSIONS

OPERATIONAL ENVIRONMENTS

There are arguably five access-threat scenarios that naval planners need to prepare for:

- > UNIMPEDED: cases where there is no threat to US naval forces;
- > GUARDED: cases where the opponent either has a lightly-armed coast guard capable of mounting modest resistance or a loosely-organized “coast watcher” force, perhaps exploiting the presence of fishermen, to provide warning of an approach; or where pirates, terrorists and local insurgents threaten shipping;
- > DEFENDED: cases where the opponent has a small, modern navy capable of limited air, surface and sub-surface defensive operations or is an irregular non-state actor with the capacity to lay mines, launch swimmer missions, mount small boat swarming attacks including suicide strikes and, if supported by a state (e.g. as Hezbollah was by Iran during its 2006 conflict with Israel) armed with limited quantities of relatively high-technology weaponry such as sensors, ASCMs, coastal launched torpedoes, autonomous underwater vehicles (AUVs) and unmanned aerial vehicles (UAVs);
- > CONTESTED: cases involving a state with highly developed naval A2/AD capabilities able to deliver intense, sustained multi-dimensional attacks out to the limits of its sensor range;
- > DENIED: cases that pose the severest threat where the enemy’s A2/AD capabilities are so strong out to the limits of its sensor range that it can prevent US forces from deploying surface power projection assets.⁶¹

⁶¹ Adapted from Work, *Naval Transformation and the Littoral Combat Ship*, pp. 90–91.

The world's littoral waters are being populated gradually by increasingly more competent and more confident coastal navies.

During the Cold War all the fleet's assets were devoted to prevailing against the Soviet Union on the open ocean under the most adverse combat conditions. Littoral operations including SLOC protection and MCM were delegated to allies. With the transition from a single, peer-level competitor to multiple competitors with qualitatively different military problems and A2/AD capabilities, and the slow erosion of alliance cohesion, which has meant that the United States can no longer rely on its alliance partners to provide coastal minesweepers and patrol craft, the Navy's exclusive focus on high-end threats at the expense of lower-end littoral capabilities has lost much of its justification. Consequently, given that it may need to once again undertake a broader range of naval tasks, often in areas where the threat is low, there is no compelling reason why the entire surface fleet has to be capable of fighting and surviving in the most hostile combat environments.

POSSIBLE MISSIONS

Navy missions in the broadest sense do not change. There are essentially only three: naval war fighting, naval constabulary and naval diplomacy.⁶² Since the end of the Cold War, the Navy has had to face up to the need to increase its presence across those portions of the world's littoral waters that are of growing strategic interest to the United States, yet with which it is relatively unfamiliar. These waters comprise a set of complex physical and human environments that are being populated gradually, in several of the most politically unstable parts of the world, by increasingly more competent and more confident coastal navies. Except where these waters are patrolled by the navies of nations allied or friendly to the United States, access to the rest, in times of conflict, can be graded along the scale described that runs from unimpeded to denied. The only complication to a picture whose outlines would otherwise be familiar to generations of naval leaders is the possible presence of insurgent groups, equipped in some cases with higher-technology weaponry such as guided missiles, and in other cases with older technology weapons such as mines, either of which could unexpectedly transform a location or stretch of coast from the unimpeded classification to one altogether more dangerous.

⁶² Ken Booth, *Navies and Foreign Policy*, (London: Crom Helm, 1977) p. 16. Naval diplomacy is, as Geoffrey Till points out, "as old as civilization." It has also never been blessed by a clear definition although Admiral Stansfield Turner might have caught much of its meaning (and its overlap with the idea of naval presence) when he wrote that it was "the use of naval forces, short of war, to achieve political objectives." Geoffrey Till, *Seapower: A Guide for the Twenty-first Century, Second Edition*, (London & New York: Routledge, 2009), pp. 253–254.

In its Concept of Operation for the LCS, NWDC posited a range of littoral missions drawn from across the operational spectrum which could be fulfilled by the Navy's extant force structure with attendant "significant risks and costs associated with using expensive, high-end, power projection platforms against the enemy's fairly inexpensive" assets. The LCS offered an alternative; a new type of platform that would be "survivable, versatile, and less expensive," which could come "early to the fight" and help "set the stage for sustained situational awareness... develop access when needed (and) perform frequent non-combat related missions," all the while remaining "interwoven, tactically and operationally, with traditional power projection forces."⁶³

At the same time NWDC laid equal stress on "frequently conducted" or "continuous" missions including SOF support, maritime interception operations/SLOC patrol, and logistics. It pointed out that in the 29-year period prior to 1999, 60 percent of all naval missions were of this type. It also suggested that the LCS would "free up multi mission platforms to continue robust preparations for potential power projection missions."⁶⁴ Since the document was published, the Navy's leadership has placed greater stress on the LCS's utility in the performance of these tasks, even though development activity remains focused on delivering mission packages for ASW, SUW and MCM operations. In his 2009 Navy Posture Statement, the CNO, Admiral Roughhead, informed the House Armed Services Committee that the LCS would fill "gaps in support of maintaining dominance in the littorals and strategic chokepoints around the world." Furthermore its inherent characteristics — payload capacity, reconfigurable mission spaces, sensors and weapon systems — "make it an ideal platform for engaging in irregular warfare and maritime security operations, to include counter-piracy missions."⁶⁵

The implication of these statements is that the primary use of the LCS is increasingly considered to be as a naval constabulary vessel (which all naval vessels are to a degree) that is also able to undertake most naval diplomacy tasks and selected missions at the middle and lower ends of naval war fighting. Breaking down these mission areas into their component elements and grouping those tasks for which the LCS is suited in the shaded areas suggest the ship has potential roles in the following:

Its inherent characteristics — payload capacity, reconfigurable mission spaces, sensors and weapon systems — "make it an ideal platform for engaging in irregular warfare and maritime security operations, to include counter-piracy missions."

⁶³ Navy Warfare Development Command, "Littoral Combat Ship: Concept of Operations."

⁶⁴ Ibid.

⁶⁵ Statement of Admiral Gary Roughhead, Chief of Naval Operations, before the House Armed Services Committee on "FY10 Department of Navy Posture," 14 May 2009, p. 6 at http://www.navy.mil/navydata/people/cno/Roughhead/Testimony/Roughhead_Testimony051409.pdf.

TABLE 1. LCS TASKS BY NAVAL MISSION CATEGORY

Naval Warfighting	Naval Constabulary	Naval Diplomacy
Securing & exploiting sea control	Good order at sea*	Deterrence (nuclear & conventional)
Sea denial	Resource protection	Coercion/economic blockade
Fleet blockade	Counter-piracy	Maritime interdiction
BMD/TBMD	Counterterrorism	Freedom of navigation
Expeditionary operations	Counter-crime	Coalition building—naval cooperation
SOF insertion & extraction	Maritime governance	Non-combatant evacuation operations (NEO)
Defense of maritime communications	Trade protection during peace	Influence/HADR operations
Trade protection during war	Maritime domain awareness	MDA/ocean research
Scouting/MDA		

* The sea is, and has been always, a source of economic advantage partly as a consequence of the protein that can be harvested from the water column and the minerals and energy from the seabed below it. It is also a medium for trade and cultural exchange. These benefits can only be realized if seafarers are able to work on the fair assumption that they can go about their business without arbitrary interference by states or criminals; in other words that despite its essential anarchy “good order at sea” generally prevails and “disorder” is usually confronted. For a detailed discussion of this concept see Till, *Seapower: A Guide for the Twenty-first Century*, pp. 286–321.

These mission sets are not stovepipes. A constabulary approach to counterterrorism, for example, could morph into hybrid warfare if the weapons or tactics change. Missions to lay hydrographic sensor nets during peacetime could be transformed into contested ISR missions during periods of rising tension.

When the tasks identified in Table 1 are filtered against the operational environment categories the following emerges:

TABLE 2. LCS TASKS BY OPERATIONAL ENVIRONMENT

(where LCS+ indicates participation in mission-tailored task group)

Tasks	Anti-access				
	Unimpeded	Guarded	Defended	Contested	Denied
<i>Naval Warfighting</i>					
Expeditionary operations	LCS	LCS+	LCS+		
SOF insertion & extraction	LCS	LCS	LCS		
Defense of maritime communications	LCS	LCS+	LCS+		
Trade protection/war	LCS	LCS+	LCS+		
Scouting/MDA	LCS	LCS+	LCS+		
<i>Naval Constabulary</i>					
Resource protection	LCS				
Counter-piracy	LCS				
Counterterrorism	LCS				
Counter-crime	LCS				
Maritime governance	LCS				
Trade protection/peace	LCS				
MDA	LCS				
<i>Naval Diplomacy</i>					
Coercion/economic blockade	LCS	LCS+			
Maritime interdiction	LCS	LCS+			
Freedom of navigation (FON)	LCS	LCS+			
Coalition building/cooperation	LCS				
Non-Combatant Evacuation Operations (NEO)	LCS	LCS+			
Influence/HADR operations	LCS				
MDA	LCS	LCS+			

Key: LCS (independent/flotilla ops). LCS+ (Task Group component).

POSSIBLE FORMATIONS

Independent Operations

The LCS can conduct independent operations as single ships where access is unimpeded or where only low-level risks from criminals are envisaged.⁶⁶ Such operations would include all the “constabulary” tasks that have been given prominence in the “Cooperative Strategy for the 21st-Century,” such as fishery protection, counter-narcotics and counter-piracy operations, the interdiction of vessels engaged in any form of smuggling including the transport of WMD, the evacuation of non-combatants from states lacking a recognizable naval threat, and humanitarian assistance/disaster relief (HA/DR) operations. When it comes to counter-narcotics and counter-piracy operations, the LCS’s speed will almost certainly prove to be an advantageous supplement to its ability to deploy a helicopter, as both drug-runners and pirates use high-speed boats that are often able to out-run existing naval and coast guard vessels.

When it comes to counter-narcotics and counter-piracy operations, the LCS’s speed will almost certainly prove to be an advantageous supplement to its ability to deploy a helicopter.

Squadron Operations

LCS-only

In “unimpeded” or “guarded” environments, LCSs are more likely to operate in squadrons for mutual protection or when undertaking complementary tasks. For example:

- > ASW: LCSs configured for ASW are expected to operate in pairs or groups. The aim would be to optimize collective resources to achieve tactical advantage and sustainment. Sensors, for example, could be deployed, managed and retrieved without slowing an SG’s operational pace. Moreover, dual ASW helicopter operations have a much higher probability of achieving a kill than single helicopter prosecutions, particularly against quiet submarines and in acoustically “noisy” sub-surface environments.
- > SUW: Although the Navy is confident that a single LCS could repel all currently envisaged small-boat attacks, the mutual protection provided by two ships operating together would appear to reduce risk significantly even in situations where they could call upon land- or sea-based air support.
- > MIW: Equally, LCSs engaged in mine-hunting operations may well be exposed to attacks by armed raiders, FACs or FIACs and it might therefore be imprudent to deploy them in the MIW role unless accompanied by a sister LCS configured for SUW. In one of the earliest suggested squadron configurations it

⁶⁶ Navy Warfare Development Command, “Littoral Combat Ship: Concept of Operations.”

was envisaged three LCSs would deploy together to deal comprehensively with the surface, submarine and mine warfare threats. Although this configuration has dropped out of favor it might turn out to be an effective combination given the likelihood that most littoral anti-access threats at the “defended” level and above are likely to be layered.

- > MSO/MIO: The Coast Guard’s counter-narcotics experience suggests that VBSS operations are best conducted by two ships working together in order to be able to place two helicopters and two RHIBs in contact with the target. Given that the LCS is designed to be able to deploy two helicopters, it may be possible to conduct such operations using a single ship. However, the current Navy preference is to deploy a single helicopter and three vertical take-off unmanned aerial vehicles (VTUAVs) suggesting that two ships will be required.

LCS with Other Ships

When LCSs are deployed with SGs they could extend the influence these groups can exert into shallow water by clearing routes through minefields (“Q” routes), intercepting submarines or screening for small boat attacks. They could also perform the scouting (ISR) role using their off-board sensors to detect, identify and track enemy activity. Even when engaged in constabulary tasks where access is unimpeded but the threat or illegal activity might occur over a wide area, the deployment of LCSs in combination with other types of ships would prove advantageous. A future anti-piracy SAG, for example, might be built around:

- > An amphibious ship to provide the necessary C2 facilities, space to hold suspects and secure evidence, and useful numbers of manned and unmanned air assets; *operating in combination with*
- > Several LCSs able to use their speed to close rapidly with boarding targets using their own air and small boats assets.

There is no reason why this concept could not be extended to address other maritime security, interdiction or ASW tasks in which the LCS could increase the reach of task groups by serving as a lilypad for non-organic helicopters. In such cases one or more LCSs could be positioned on the periphery of a task group to which manned or unmanned air assets could be deployed from a CVN or LHA to take advantage of the LCS’s large flight deck to refuel and re-arm. They could operate in patterns synchronized with the LCS’s own air detachment to increase the SG’s search or combat radius; formations could be arranged in a circle around a helicopter carrier for maritime security or ASW operations, or in a line for coastal patrol, blockade or barrier operations. Either of these combinations would extend the sea area an SG could influence substantially. The small crew size on

The LCS will perform its three key tasks of MCM, ASW and SUW, primarily in support of expeditionary or surface power-projection operations. The LCS could operate in advance of the battle fleet but only under its air and missile umbrella.

the LCS could, however, become an issue; extended flight operations would impose a considerable strain on the crew numbers and these may well need to be supplemented if such operations were to be undertaken. In fact, if the concept proved its utility, the development of a Forward Air Base package with berthing for additional flight deck crew and storage for aircraft fuel and weapons could prove worthwhile. Where VBSS is required, the LCS's speed could be exploited to limit the target's opportunity to escape by reducing the time between initial detection using an air asset and placing a ship alongside the target with a boarding party. SOF could be transported in similar fashion for insertions against littoral targets, vessel inspections or medical evacuation (MedEvac) operations in combat or disaster areas.

CURRENT MISSIONS

As currently envisaged by the Navy, the LCS will perform its three key tasks of MCM, ASW and SUW, primarily in support of expeditionary or surface power-projection operations, interchanging its mission packages as required. In threat environments up to and including the defended category, the LCS could operate in advance of the battle fleet but only under its air and missile umbrella. In contested threat environments these tasks, undertaken to protect the follow-on forces by clearing out what "clutter" remained, survived or had been overlooked by the main force, are only likely to be possible by following an advance to a hostile littoral behind what would effectively be a rolling barrage of missile attacks mounted from range or from UAVs. The concepts of operation for these three tasks are:

Anti-Submarine Warfare

All US Navy surface combatants have an anti-submarine warfare (ASW) capability. Successful ASW depends on the ability to coordinate the activities of several assets, networked together to exchange target information, any one of which could provide the initial cue, including surface combatants, maritime patrol aircraft (MPA), ASW-equipped helicopters (such as the SH-60R deployed on-board ASW configured LCS), and SSNs. The LCS is capable of deep-water ASW but because of its shallow draft its ASW strengths lie in littoral and shallow-water operations where it can deploy its off-board sensors at over-the-horizon ranges. The intention is that the LCS will offer improved ASW performance in these areas by:

- > Entering the littoral regions ahead of any surface power projection force (“first responder”) to lay down distributed ASW netted sensor grids;⁶⁷
- > Clearing and subsequently defending operating areas for SGs under their protection;
- > Protecting sea bases in littoral areas; and
- > Supporting feints and deceptions.

The LCS will combine data from off-board sensor suites carried by unmanned systems or bottom sensor grids left behind for persistent coverage, helicopter-borne sensors and from information received from other surface and aerial platforms to either identify and destroy enemy submarines or cue other platforms onto targets. The ship is intended to be equally adept at mounting barrier ASW operations. It can render enemy sub-surface transit through SLOCs and choke-points extremely hazardous and may be particularly well suited to deploying systems designed to gather information on movements in such sea areas. Its suitability for ocean-escort ASW, however, is questionable because it lacks on-board sonar but this is not a task for which it was designed originally.

Surface Warfare

The LCS’s prime surface warfare task (SUW) is to defend Joint maritime forces from the small surface combatant threat. The intention is that the LCS will, by drawing data from its own search radar and from other networked assets, be able to detect and engage hostile surface craft before they can reach weapons-release range.⁶⁸ The presence of small boats will be detected using acoustic and RF sensors, the ship’s aviation assets and by laying deployable surface and bottom acoustic and RF arrays across, for example, expected small boat attack routes or harbor mouths, to act as “tripwires” to warn of their approach. Once detected hostile craft would be engaged in sequence as the range decreases:

- > The ship’s organic SH-60S would engage targets with rocket and cannon fire; other air assets would be vectored using the ship’s organic sensors, and theater and national sensors as available;

⁶⁷ It is important to emphasize that the LCS will be a *surface* “first responder” as in most areas of conflict or potential conflict SSNs will already be in theater, a role they have been fulfilling for decades. Furthermore, the idea that LCS could use its speed to race ahead of an SG to arrive off a hostile coast 96 hours ahead of the main force is inherently implausible. Leaving aside its vulnerability to air attack, LCS cannot run at full speed for 96 hours without refueling which implies it would need to be refueled from pre-positioned tankers during the course of its run and again when it arrived at its operating area before it could conduct its mission.

⁶⁸ LM version is equipped with an EADS TRS-3D G-band radar; the GD version with a Sea Giraffe radar. “Littoral Combat Ship (LCS) High-Speed Surface Ship, USA.” Richard Scott, “Small Ship Radars Scan Broader Horizons,” *Jane’s Navy International*, 1 December 2004.

- > The Non Line-of-Sight Precision Attack Munition (NLOS-PAM) missile system;
- > 57mm main armament;
- > 30mm rapid-fire cannon;
- > .50cal machine guns (2 mounts).

The ship's speed will give its commander greater decision time, the ability to distract or break up small boat formations, and the option to reposition the ship in the face of unfavorable odds.

The ship's gun will be used to achieve area effects and the high-rate-of-fire weapons adjusted to deliver wide dispersal patterns. The Navy has great confidence in the NLOS-PAM system, although its development is currently behind schedule. The ship's speed will give its commander greater decision time, the ability to distract or break up small boat formations, and the option to reposition the ship in the face of unfavorable odds.

The key to success in littoral SUW will lie in achieving persistent detection and cueing, sharing common operational and tactical pictures with other assets to achieve defense in depth, conducting effective information operations including operational deception and security, and employing both hard- and soft-kill weapons.⁶⁹ The difficulty lies in determining intention at range; in other words in being able to discriminate between friendly and neutral surface vessels on the one hand and surface threats on the other in what will almost certainly be crowded shipping environments.

Mine Countermeasures (MCM)

The motto of the MCM community is to "hunt when you can, sweep if you must." Mine hunting involves the use of sonar to detect mines and neutralization equipment to destroy them. It takes place in advance of the hunting vessel. Mine sweeping involves towing equipment behind a surface or airborne sweep craft to either cut the mooring cables of contact mines or detonate influence mines.⁷⁰ Sweeping exposes the vessels involved to greater danger but is still used because some types of bottom surfaces hide mines better than others from mine hunting sensors.⁷¹

⁶⁹ Vego, "No Need for High Speed," pp. 47–48.

⁷⁰ Influence mines are detonated in response to a vessel's magnetic, acoustic, electrical, seismic or pressure signatures. Mines can be designed to respond to specific signatures such that they can be detonated only by specific classes of ships, e.g. they could be triggered by a CVN but ignore its screening ships. Some mines can combine one or more influence mechanisms. Mines can also be set to count vessels before detonating, e.g. they can let the first four ships of a convoy pass overhead but destroy the fifth.

⁷¹ US Navy, *21st Century U.S. Navy Mine Warfare: Ensuring Global Access and Commerce* (Washington, DC: PEO Littoral and Mine Warfare Office and Director Expeditionary Warfare, 2009).

The key to the LCS MCM concept is that the ship itself will never need to enter a minefield even though the steel-hulled Lockheed Martin version has a de-gaussing capability and the aluminum-hulled General Dynamics version has a remarkably low influence signature.⁷² Each LCS equipped with the MCM mission package will deploy different systems for the three mine-hunting areas:

- > On or near the sea floor;
- > On or near the surface; and
- > In the surf/beach zone.

MCM sensors and weapons include mine-hunting sonar, electro-optical sensors, lasers, mine neutralization devices and influence sweep systems from its manned MH-60S helicopter and its unmanned organic off-board vehicles (OOVs).⁷³ As conceived currently, additional MCM-configured LCSs would be deployed if faster area-clearance rates were required.⁷⁴

The Navy's intention is to concentrate all its MCM assets in the LCS fleet by 2024 when the last *Avenger*-class minehunter is withdrawn from service. This gradual retirement of specialized minehunting vessels is part of the US Navy's plan to transition from a dedicated to an organic minehunting capability that can be integrated into the Navy's carrier and expeditionary strike groups to undertake "in-stride" operations.⁷⁵ One example of an "in-stride" operation would find MCM-equipped LCSs moving far enough ahead of an SG to clear a chokepoint immediately prior to its transit yet not so far ahead that they cannot be protected by the SG's air umbrella.

The LCS's prime purpose in the MCM role, therefore, is to support power-projection operations at two levels: tactical and theater. At the tactical level, the intention is that LCS will support the Joint Force Commander by undertaking Intelligence Preparation of the Operational Environment (IPOE) and first response MCM operations ahead of power projection forces.⁷⁶ These could include clandestine insertion and support of EOD teams, clandestine mapping and surveying using USVs and UUVs, and the laying of tripwires to reveal subsequent mine-laying. Some of this IPOE activity could occur well in advance of any opera-

⁷² Vego, "No Need for High Speed," p. 48.

⁷³ For details of the various systems scheduled for inclusion in the LCS MCM mission package see US Navy, *21st Century US Navy Mine Warfare: Ensuring Global Access and Commerce*, pp. 19–22.

⁷⁴ The term "faster" is, however, relative. The operation to clear mines from Um Qasr following the Gulf War took weeks even though the mine field had been mapped fairly accurately by Iraqi forces.

⁷⁵ Richard Scott, "Clearing a Path for MCM," *Jane's Navy International*, 1 April 2002; Newell, "Littoral-Minded: DoD Keeps LCS Programme Hopes Alive."

⁷⁶ On IPOE see "Joint Intelligence Preparation of the Operational Environment," Joint Publication 2-01.3 at http://www.dtic.mil/doctrine/jel/new_pubs/jp2_01_3.pdf.

In addition to the three missions the Navy plans for the LCS currently, there are five others that exploit the ship's strengths of adaptability, payload capacity, seaworthiness and speed.

tion through the mapping of critical waterways and the identification of minable areas off coasts of potential interest. Upon arrival at the forcible entry location, the LCS would undertake mine-hunting operations to explore for the presence of mines and, if any were found, extend the hunt to determine the extent of the mined area. Once the boundary of the minefield and the location of individual mines have been ascertained, the LCS will undertake clearance operations to clear safe transit routes ("Q"-routes) and operating areas and thereafter facilitate more comprehensive mine clearance operations. The LCS could possibly be operated singly, although because a SH-60 cannot carry detection and neutralization equipment at the same time and needs to return to the ship to be reconfigured from one phase to the next, clearance operations would be conducted more expeditiously if two ships were available operating in tandem under joint command. At the theater level, the LCS would need to operate in large groups in order to complete tasks quickly.

The intensity of mine clearance operations and the stress that coordinating air and sub-surface systems simultaneously imposes on crews naturally raise questions about the size of the MCM mission package complement. Although MCM crew package numbers envisaged currently will be able to handle short term clearance operations, it would appear to be unrealistically small if a large field needed to be cleared, something that could take many weeks even with the new more capable systems the LCS is designed to carry and the greater navigational accuracy that can be achieved using GPS. It is likely, therefore, that either package crew numbers will need to be increased or investment in computer-aided detection (CAD) and computer-aided classification (CAC) will need to be accelerated in order to automate the analysis of the returns received from the ship's remote systems.

POSSIBLE ADDITIONAL MISSIONS

In addition to the three missions the Navy plans for the LCS currently, there are five others that exploit the ship's strengths of adaptability, payload capacity, seaworthiness and speed.

"Global Fleet Station" and Humanitarian Assistance/Disaster Relief Operations

Global Fleet Stations (GFS) are being implemented currently off the coast of West Africa, in the Caribbean and the South Pacific but will eventually be stood-up elsewhere. Starting from a conflict prevention premise, the GFS concept seeks to build friendships and engender cooperation with and between local navies. It epitomizes the peaceful use of naval diplomacy.

The GFSs comprise either one large ship of the size and configurability of an LHD, or are built around such a ship which serves as a “mother ship” for the rest of the ships in the GFS and as a focus for such relationship-building activities as conferences and training. The LCS’s large flight deck and internal capacity which, although smaller than an LHD is similarly adaptable, plus the LCS’s shallow draft would enable it to serve a similar role as a “mother ship” to smaller coastal and inshore craft, allowing the Navy to take its diplomatic message, capacity-building activity, medical teams and Seabees into a much larger number of ports if a re-supply, repair and hotel service package were to be developed.

Although the LCS’s ability to transport relief supplies is limited to around 200 tons, the fact that it can navigate in shallow water and transfer supplies and skilled medical, engineering, technical and security personnel to shore using the ship’s organic small boat and helicopter assets makes it well-suited for HA/DR operations. More particularly, its high cruise speed makes it a useful first responder (providing fuel replenishment is available en route and when it arrives at the disaster site). There would appear to be only a minimum requirement for a specialized mission package — accommodation for additional specialists and a medical suite — in order to preserve the maximum amount of on-board space for the relief cargo. Apart from perishable items, much of this cargo could be pre-assembled and packed into containers ready to be air-lifted to a port where the LCS could discharge its embarked package and take on HA/DR cargo, or go directly to the disaster site where it could be unloaded and distributed by an LCS HA/DR team. Among the equipment preloaded into the containers could be medical facilities, power generation and water purification machinery, water pumps, hand and power tools, small excavators and “Gator”-type small trucks.⁷⁷

Maritime Security and Blockade Operations

Maritime Security Operations (MSO) have three aspects: deterrence, domain awareness and interdiction (generally leading to boarding of suspect vessels). The LCS’s role in MSO would be to contribute to all three aspects of the task in coordination with other maritime security assets including long-endurance space and air-based surveillance, MPA surveillance, long-endurance cutters or other patrol craft, and land-based surveillance and intelligence analysis. LCS would enable the Joint commander to respond rapidly to incidents within the AOR and to interdict and conduct VBSS operations against

⁷⁷ Navy Warfare Development Command, “Littoral Combat Ship: Concept of Operations” offers a longer list of heavier items such as “mobile oxygen producing plant...four semi-trailer hospital facility...eight to twelve passenger buses” but it is hard to see how such equipment fits into a “first responder” concept. “Gator”-type trucks are small, open-topped 4x4 and 6x4 low-loader cargo vehicles capable of moving loads of around 800lbs.

**The LCS is “a
frigate for the
21st century.”**

fast-moving small craft. It could be vectored to incidents using either its own sensors or, alternatively, air breathing or space-based assets.

An LCS sea frame alone will have some limited maritime security capability. To perform the task effectively, however, it will need to embark either a SUW mission package with a crew trained specifically for security and VBSS or, at a minimum, additional crew and a RHIB larger than the 5.5m version standard to all sea frames. It could also benefit from the addition of a 30mm cannon. LCSs fitted with ASW or MCM mission packages will not be able to undertake effective MSO due to space and weight restrictions which preclude embarkation of a larger RHIB.

Blockade Operations in operational terms could be viewed as a variation of MSO. In legal terms, however, they are quite different as a blockade is regarded as an act of war. Therefore, although the tactics, techniques and procedures (TTP) employed would be similar to those for MSO, they would be conducted in more hostile circumstances and, even if the blockade were to be conducted at a distance, the ships involved must be prepared to come under attack. In most cases they also require large numbers of ships to be effective.

Ocean Escort Operations

The LCS has many of the attributes of a frigate; according to Natter and Harris, it is “a frigate for the 21st century.”⁷⁸ This places it in the Navy’s long line of self-sustaining ships capable of keeping pace with fast carrier strike groups with the range and sea-keeping qualities to cross the Atlantic without refueling and the Pacific either by island-hopping or UNREP. It shows its frigate lineage most clearly in the emphasis placed on its air assets for the delivery of offensive and defensive ISR and weaponry, a feature that has distinguished frigate designs since the first appearance of fast, long-range submarines in the 1950s. In fact, by having space for two aircraft it reflects the lessons of the past fifty years that two aircraft offer the advantages of flexibility and redundancy. What it lacks compared to its predecessors is sonar employed from the ship, enabling it to search at speed, and ship-launched anti-submarine weapons, which taken together limit its utility as an ocean escort.⁷⁹ This shortcoming does not affect SGs, which have an organic ASW capability. Where it becomes noticeable is in the open-ocean convoy protection role where the Navy currently lacks a relatively low-cost, high endurance vessel appropriate to the task, should it again become necessary. This could be

⁷⁸ Robert J. Natter and R. Robinson Harris, “The Navy’s Tipping Point,” *US Naval Institute Proceedings*, Vol. 135, No. 1, January 2009, pp. 44–49.

⁷⁹ Ship-launched anti-submarine weapons now need to be a rocket-propelled systems such as the VLA if they are to have a chance of interdicting submarines beyond torpedo range. On the VLA see Lockheed Martin, “Vertical Launch Antisubmarine Rocket,” ND at <http://www.lockheedmartin.com/products/VerticalLaunchAntiSubmarineRocket/index.html>; also Richard Scott, “VLA-ER Sprouts Wings to Extend Range,” *Jane’s Missiles and Rockets*, 3 July 2008.

addressed in the absence of a specialist vessel by re-configuring LCS with an Aegis IF system, a sixteen-cell VLS equipped with Harpoon missiles, towed-array and bow-mounted sonar, while retaining one helicopter.⁸⁰

Scouting—ISR and Deception Operations

LCSs could maintain a continuous presence in littoral areas from periods of peace to times of tension, providing the Joint Force commander with situational awareness to support a whole range of potential operations from targeting through to Battle Damage Assessment (BDA).

The LCS also has a role in sensor deployment, including the installation of sensors before the onset of high-intensity conflict and prior to an environment becoming too contested and dangerous for surface craft to operate. The full range of these potential activities, known as DMER5, range from initial deployment of the sensor array or unmanned element, through exploitation in which the role of the LCS would be to serve as a data node, through to sensor recovery, replacement and re-deployment.⁸¹ In order to be able to fulfill the scouting/ISR mission comprehensively, the LCS would almost certainly need to embark additional VTUAVs and USVs. The ship's speed could prove an advantage when reconnoitering long coastlines.

The LCS's speed and large flight deck would enable it to embark and rapidly position substantial non-organic electronic warfare systems applicable to a variety of deception and decoy operations. This may be among LCS's most important roles in any high-threat scenario. The ship's high sprint speeds would be particularly valuable in this context in terms of senior commanders' ability to reposition such systems rapidly in response to high-level intelligence and warning indicators.

SOF Support

The essential features of the LCS sea frame that make it adaptable to overt SOF requirements are its ability to:

- > Launch and recover most of the small craft in the SOF inventory;

⁸⁰ Work, *The US Navy: Charting a Course for Tomorrow's Fleet*, pp. 73–74. LM and GD have both designed multi-mission variants of the LCS that dispense with modularity and incorporate many of these features on a permanent basis instead. Both designs are being considered for purchase by the Saudi Arabian Navy. For more information on the LM Surface Combat Ship go to <http://www.lockheedmartin.com/data/assets/corporate/press-kit/Surface-Combat-Ship-Brochure.pdf>. For the GD Multi-mission Combatant go to <http://www.gdlcs.com/gd-lcs-solution/international-variant>. Also Richard Scott, "General Dynamics Unveils Aegis LCS Variant," *Jane's Navy International*, 1 April 2007.

⁸¹ Navy Warfare Development Command, "Littoral Combat Ship: Concept of Operations." With reference to the LCS sensor capability, DMER5 stands for "Deployment, Management, Exploitation, Refueling, Repositioning, Recovering, Replacement, Redeployment."

The LCS's speed and large flight deck would enable it to embark and rapidly position substantial non-organic electronic warfare systems applicable to a variety of deception and decoy operations.

- > Provide aviation support;
- > Handle ordnance and transport specialized SOF equipment;
- > Provide extra berthing; and
- > Support a medical treatment facility (MTF) and/or a SOF C² module.

Possible SOF craft that could be deployed from the LCS include the Combat Craft Medium (CCM), which is 40–45 feet long and capable of transporting four crew and eight SOF operators on SOF infiltration and VBSS missions, and various sizes of Foreign Internal Defense (FID) craft. Deployable aviation assets include the MH-60, and possibly, the CV-22 Osprey from the GD version; however both aircraft would need to be protected from the corrosive maritime environment. The ship should be able to carry class I and II ordnance. Berthing on-board should have the capacity to accommodate between thirty-five and seventy SOF personnel depending upon the mission, including boat, civil affairs, psychological operations and UAV support operatives. LCS's speed could prove an advantage in situations that demand a fast SOF response (again providing replenishment fuel is available as required). The ship's current lack of land-attack weapons could limit its ability to provide fire support, although this should be rectified once the NLOS missile system becomes available. The rotary wing capacity will be important in order to lift casualties to higher-level medical facilities. The most significant constraint might be the space needed to accommodate adequate SOF C² and communications.

CHAPTER 4 > **CONOP VIGNETTES**

This chapter uses several “vignettes” to illustrate how LCSs might be employed to conduct a range of missions in different operational contexts. The vignettes depict a number of military tasks in which one or more LCSs, operating alone or in conjunction with other maritime forces, could provide particularly useful operational capabilities. As will be seen, these vignettes assume LCS availability in fairly large numbers, and are therefore based on building rates which as projected currently could not become a reality before the latter half of next decade. However, they do suggest new mission options that could open up if the LCS program is implemented as planned or even accelerated.

VIGNETTE 1: SECURING LOOSE NUKES

Scenario

Islamist terrorists have captured several nuclear warheads and an unknown quantity of highly-enriched uranium (HEU) from Pakistani nuclear facilities. The nuclear material is believed to have been moved to the Pakistani coast for onward transportation by sea to an unknown destination overseas.

The principal Pakistani ports of Gwadar, Qasim and Karachi (part of the Karachi complex) are all put under immediate surveillance but there is no guarantee such measures can be watertight, especially in the case of Karachi which is large and surrounded by a teeming city. Moreover, the warheads and the HEU material are readily transportable on any small ship, meaning they can be loaded almost anywhere with a pier and transferred to another vessel at sea.

Pakistani forces (with unspecified US assistance) are responsible for onshore interdiction and recovery efforts. US naval forces are tasked with establishing

a quarantine of the Pakistani coast in cooperation with the Pakistan Navy to prevent the material from being removed from Pakistan by sea.

Naval Tasks

- > Establish wide area surveillance in order to detect and classify all critical contacts of interest (CCOI).
- > Enforce exclusion areas and mandatory shipping routes within designated areas.
- > Intercept and conduct VBSS operations against CCOIs as directed.

Operational Considerations

The Pakistani coast is approximately 500 nm in length. Significant portions of the coast are not suitable for vessels to close for transfer of suspect material due to insufficient water depth or the absence of trafficable roads near the coast. There are only a limited number of coastal cities or towns where seaworthy vessels could dock (see map) or where small craft capable of transporting suspect material could take it onboard and transfer it offshore to a larger vessel.

The Pakistani Navy has about a dozen frigates capable of conducting vessel boarding, search and seizure (VBSS) operations, and a dozen older maritime surveillance aircraft of various makes and quality. The Pakistani Coast Guard consists of about two dozen miscellaneous small craft. Thus it can provide only limited coverage of major ports.

US naval forces are primarily dependent on intelligence from non-organic assets for cueing of CCOIs. Sources include the Pakistani ISI, Pakistani military intelligence, and covert US means. Pakistani Navy and Coast Guard assets may also provide tips concerning suspicious vessels.

Pakistani assets have a far greater likelihood of detecting suspicious vessel and personnel behavior in congested maritime areas than do US forces due to linguistic and cultural familiarity. Thus Pakistani maritime assets should be concentrated near the higher traffic density ports of Karachi/Qasim (approximately ten major vessel movements to and from daily) and Gwadar.

The main operational imperative in other areas along the coast is to detect unusual movements of ships or smaller craft capable of taking on suspected material to and from the handful of minor towns or other points along the coast that can be approached by road. Vessels located in areas where there is no plausible reason for their presence, or rendezvous between vessels for no apparent cause could be grounds for declaring them CCOIs that require rapid investigation.

Wide-area offshore surveillance will come primarily from maritime patrol aircraft (MPA). As MPA (or other surveillance assets) detect contacts that may be designated as CCOIs, it becomes imperative for an asset (e.g., helicopter with SOF; warship with embarked VBSS team) capable of stopping and boarding the contact to close rapidly before detection is lost or before the detecting platform loses too much search time while maintaining contact.

The enemy could use decoy vessels to pin down boarding assets by having them act in a suspicious manner or be in a suspicious location in order to attract VBSS assets that subsequently find nothing suspicious. While such contacts could be stopped and held for later search (sent to the bullpen), this will still require assets and personnel. This problem is somewhat mitigated in the more congested port areas by the employment of mostly Pakistani maritime forces in those areas.

Elsewhere, there is a premium on being able to move ships and/or helicopters rapidly to exploit designated CCOIs. Assuming that a helicopter has a 120 kt cruise speed and four hours' endurance with standard loadout, it would be able to reach any point within a circle of 240 nm radius from the launching platform, thus covering an area of over 2,300 sq nm. If, however, the launching platform were able to sprint at 45 knots for two hours towards the recovery point, the effective mission radius would increase to 285 nm and the area covered to over 2,800 sq nm.

The numbers of helicopters and boarding personnel (SOF or MEU/SOC marines if required for non-compliant boardings or sailors/marines if merely to hold the suspect vessel) are a limiting factor in the numbers of CCOIs that can be boarded and held at any given time. An Expeditionary Strike Group (ESG) or Amphibious Ready Group (ARG) would provide a ready supply of both. Both Navy and Marine armed helicopters would be capable of providing fire support in the case of a non-compliant boarding.

The ability of LCSs to function as rapidly moveable "lily pads" allows for rapid reaction to CCOI queuing or airborne detection. Their speed further allows for rapid "filling in" of a patrol area temporarily emptied by the diversion of one LCS by another from an adjoining area. In effect, it enables the wider quarantine net established along the Pakistani coast to quickly flex and respond to movements, including surges of suspect vessels or CCOIs.

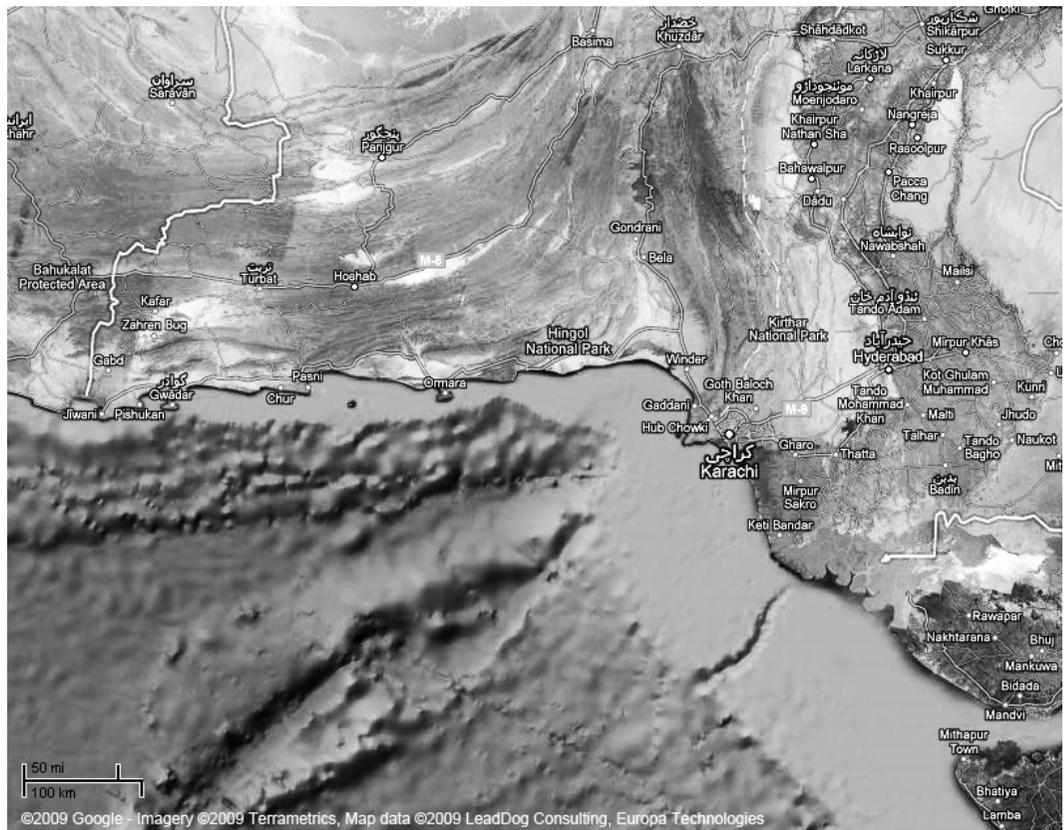
The ability of LCSs to function as rapidly moveable "lily pads" allows for rapid reaction to CCOI queuing or airborne detection.

Operational Employment

- > Pakistani maritime assets are responsible for surface surveillance and boarding operations in 1) the sea and estuary area bounded by a 25 nm radius arc centered on Karachi port, and 2) all sea areas within 20 nm of the coast between Jiwani and Gahdar (western Pakistan).

- > US MPA will conduct surveillance patrols of Pakistani littoral waters out to 50 nm from the coast, with a revisit time not to exceed two hours.
- > One LCS squadron (four ships) will be deployed at 50 nm intervals in the “knee” of the Pakistani coast between Hingol National Park and Keti Bandar. A second squadron (four ships) will be deployed at 50 nm intervals between Jiwani and Omara.
- > Amphibious ships will operate in the northern Arabian Sea 100-150 nm off the Pakistani coast at 100 nm intervals. Spacing of both LCSs and amphibious ships is designed to minimize the time required to get helicopters with appropriate boarding parties (either compliant or non-compliant boarding) on station to stop and board CCOIs or suspicious vessels. Other directed heli-borne SOF missions can be supported as well. Either Navy or Marine armed helicopters can provide fire support if required. (This construct assumes the absence of MANPADs.)

FIGURE 1. PAKISTANI LITTORAL



- > Additional LCSs, if available, will be assigned to supplement the two LCS squadrons, and enable individual LCSs to periodically depart their patrol stations for underway replenishment (UNREP), and to “backstop” other LCSs drawn out of station while conducting intercept operations. UNREP will normally be conducted by Military Sealift Command (MSC) replenishment ships, but amphibious big decks can also refuel LCSs if required.

VIGNETTE 2: CONVOY PROTECTION

Scenario

The situation in the Persian Gulf region remains very tense. The Iranian regime has not tested a nuclear device but the general assessment is that it has accumulated sufficient highly-enriched uranium (HEU) to be able to assemble several bombs within a relatively short period. The UN Security Council has agreed to the imposition of tougher sanctions.

In response Iran has threatened to take action against any state that supports the sanctions, including neighboring states around the Arabian Gulf, and to close the Straits of Hormuz (SOH) to all shipping.

US naval forces are tasked to assert freedom of navigation in the Arabian Gulf and its approaches and ensure the unimpeded movement of shipping between non-Iranian oil and gas terminals, and other major ports around the Gulf, and the southern terminus of the SOH in cooperation with Gulf Cooperation Council (GCC) forces.

Naval Tasks

- > Establish wide area surveillance in order to detect and classify all critical contacts of interest (CCOI).
- > Interdict and board CCOIs as directed.
- > Establish security zones around key oil installations. Enforce mandatory traffic channels within agreed security zones.
- > Provide convoy escort within the Gulf and through the Strait of Hormuz.
- > Rapidly restore safe shipping route(s) near major terminals and ports if the presence of mines is detected or suspected.

Operational Considerations

The main operational imperative is to ensure the security of major shipping operating in the Gulf and through the SOH.

The most likely threat of actual violence against Gulf shipping or energy infrastructure is assumed to come from IRGC (including IRGCN) “rogue” assets, whether these are in fact rogues or are deliberately deployed.

The Persian Gulf is 615 nm in length and covers an area of 97,000 sq. miles. All maritime traffic to and from the Gulf, amounting to about 110 ship movements daily, needs to pass through the SOH which is about 30 nm (23 nm for purposes of deep-draft shipping) wide at its narrowest point. Much of the Gulf is relatively shallow, which makes those areas a highly suitable environment for mine warfare.

Much of this traffic is oil- and gas-related and moves to and from the major oil export terminals located at the head of the Gulf and along its southern shore. There are major terminals off Iraq, Kuwait, Saudi Arabia, Bahrain, and the UAE.

Iran is the dominant indigenous Gulf naval power with both regular navy and Iranian Revolutionary Guard Corps Navy (IRGCN) maritime forces. The Iranian Navy has a competent submarine capability built around several Kilo-class submarines able to operate as far away as the Gulf of Oman and Arabian Sea, and some coastal submarines capable of operating anywhere inside the Gulf. Surface warship capability is limited to a small number of old frigates and corvettes but the Iranians also have large numbers of missile-firing fast attack craft (FACs) which if allowed to concentrate in “swarms” could potentially overwhelm the defenses of almost any surface combatant. The principal naval base is at Bandar Abbas located on the SOH. Other bases are located at Khorramshahr, Kharg Island, Bushehr, and Bandar Khomeini although FACs could almost certainly be dispersed to a wider range of smaller ports and anchorages along the Persian Gulf coast. The Iranian naval forces could employ substantial shore-based missile fire but they lack airborne surveillance that could not be subjected to electronic countermeasures.

While Iranian air, submarine, and coastal cruise missile attacks are possible, Iran is unlikely to engage in deliberate attacks against US and US-protected assets using its professional armed forces, for fear of large-scale reprisals by the United States. The most likely threat of actual violence against Gulf shipping or energy infrastructure is assumed to come from IRGC (including IRGCN) “rogue” assets, whether these are in fact rogues or are deliberately deployed as such in order to maintain Iranian regime plausible deniability in the eyes of certain regional and global actors. IRGCN units could employ missile-equipped small boat “swarms,” mines deployed from a variety of platforms (including ostensibly “innocent” vessels), and combat swimmer attacks against fixed offshore infrastructure.

The United States maintains a Carrier Strike Group (CSG) presence in the western Indian Ocean and Arabian Gulf. But the CSG’s principal role is to provide continuous support to US and partner forces in Afghanistan. US naval forces in the Gulf generally consist of two to three destroyers, sixteen LCSs (including two to four ASW- and MCM-configured variants), several old MCM ships and Patrol Craft (PCs), supported by routine MPA patrols. At least one nuclear-powered attack submarine (SSN) is generally in or near the Gulf.

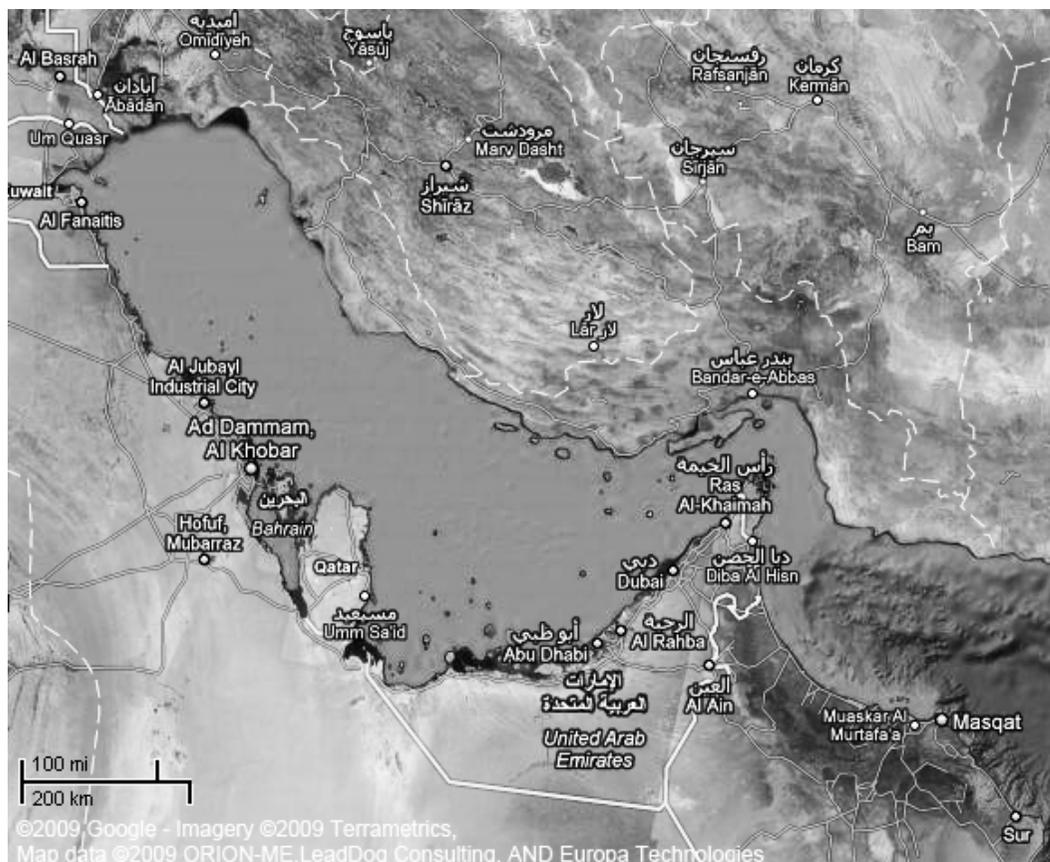
The various GCC navies have enough frigates and corvettes to mount VBSS operations off their own coastlines and provide close-in protection of their oil infrastructure by enforcing exclusion areas near their critical assets. None of them,

however, are capable of confronting Iranian naval forces unaided. The nascent Iraqi navy and coast guard remain incapable of defending shipping at or near the ABOT and KAAOT terminals in the northern Gulf.

As in 1987, a number of shipping companies have taken up the US offer to provide convoy escorts for their shipping (though in this instance “reflagging” has not been deemed necessary). While the smaller Iranian craft comprising potential swarms are unlikely to be able to carry weapons capable of inflicting severe damage on large merchant ships (viz. the damage results during Operation Earnest Will⁸²), the perception of vulnerability and lost control of sea lanes may result in major increases in the cost of maritime insurance and the price of oil and natural gas on world markets. Moreover, some IRCGN fast attack craft (FAC) are

⁸² Operation Earnest Will was a US Navy convoy operation undertaken between 24 July 1987 and 26 September 1988 to protect Kuwaiti-owned oil tankers transiting the Arabian Gulf during the Iran-Iraq “Tanker” War.

FIGURE 2. THE PERSIAN GULF



The LCS's tactical speed allows for rapid interception of potentially threatening Iranian boat swarms before they can close within weapons range of shipping in wider areas of the Gulf and the southern approaches to the SOH.

capable of carrying anti-ship missiles. Thus it will be important to hold IRGCN firing opportunities to a minimum.

The LCS's tactical speed allows for rapid interception of potentially threatening Iranian boat swarms before they can close within weapons range of shipping in wider areas of the Gulf and the southern approaches to the SOH. That speed similarly enables rapid convoy escort screen readjustment or reorientation as units are drawn out of position while reacting to particular threats. Armed helicopters embarked on SUW-configured LCSs would be primary "swarm" killers if strike aircraft with anti-surface attack capability were unavailable.

Minesweeping assets are in short supply relative to the number of locations that Iranian assets could covertly deploy mines, particularly in the shallower waters near oil and gas terminals or in the approaches to major ports. (The SOH is comparatively less vulnerable to serious mining efforts due to the large size of the area to be mined relative to the number of mines that the IRGCN could plausibly lay while remaining covert; plus the strong SOH currents make effective mining difficult.) Since detection of mines, particularly if due to a damaged ship, likely will immediately crimp shipping in that area, there is a strong imperative to clear mines and/or quickly clear a safe channel. The ability of MCM-configured LCSs to proceed rapidly to mine danger areas would be key in minimizing the downtime for an affected harbor or loading terminal where host nation MCM assets were either not available or ineffective and unreliable.

ASW-configured LCSs can supplement limited GCC ASW assets to search approaches to major harbors and oil and gas terminals to impede possible Iranian use of small coastal submarines as minelayers. As with the LCS (MCM variant), its speed would enable the LCS (ASW variant) to rapidly reposition in response to intelligence indicating submarine presence in a given location.

US naval forces will not be able to provide airtight defense to all shipping of interest. The objective is to provide sufficient protection that the Iranians can only have limited success against protected shipping, by forcing the Iranians to employ a level of force that would in turn threaten to provoke much higher levels of US and allied response. Ultimately, then, the objective is to deter Iran from undertaking such operations in the first instance.

Operational Employment

- > GCC navies are responsible for establishing and enforcing exclusion areas around their critical offshore infrastructure and in/near the approaches to their major ports. GCC maritime units will board and search critical contacts of interest (CCOIs) and suspicious vessels in or approaching such areas. Such CCOIs will include vessels capable of minelaying and operating in sensitive areas.
- > US MPA conduct surface surveillance of Iranian littoral between the Iraqi border and Bandar Jask (southern end of SOH approaches) with a revisit time not

to exceed two hours. All Iranian Navy/IRGCN units will be considered CCOIs, and designated as assumed hostile. SSNs are the primary ASW assets to prosecute Iranian submarines. DDGs are assigned primarily to provide BMD to partner GCC states.

- > Assuming four LCS(SUW) squadrons (four ships per squadron, each with one to two armed helos and/or armed VTUAVs embarked) remain available continuously, one squadron will protect the ABOT and KAAOT oil terminals and approaching/departing tankers from swarm attacks out of Khorramsharr and Bushehr. The other three squadrons will escort outbound and inbound high-value merchant shipping in convoys from rendezvous areas near Dubai/Jebel Ali through the SOH to the entrance to the GOO (approximately the latitude of Bandar Jask) and back (i.e. through the highest threat area). Each one-way transit will take approximately one day at 15 knots.
- > Additional LCS(SUW) if available will be stationed in the central Gulf on a NW-SE line at 100 nm intervals to act as pouncers if MPA or other sources detect CCOIs moving towards sensitive areas, as rapid reinforcements towards either end of the Gulf if intelligence and warning (I&W) is received concerning significant specific imminent Iranian threats, and/or to provide relief for other LCSs(SUW).
- > One MCM-configured LCS each will remain in the northern (i.e. in the vicinity of the Kuwait/Iraqi oil terminals) and southern (i.e. in the vicinity of Dubai/Jebel Ali) Gulf in order to be able to respond rapidly on order to augment GCC MCM capabilities or provide initial MCM if no effective local MCM assets are available. Other USN MCM/Airborne MCM assets will augment LCSs and local nation MCM efforts as they become available.
- > ASW-configured LCSs will conduct ASW patrols near the approaches to Dubai, Jebel Ali, the Saudi Ras Tanura complex and Bahrain in that priority order as a function of the number of platforms available. If intelligence indicates submarine movements towards the northern Gulf (i.e., towards the Iraqi ABOT and KAAOT terminals), LCSs(ASW) will reposition rapidly to provide deterrence/protection against submarine mining or anti-shipping attacks.
- > UNREPs will normally be conducted by Military Sealift Command (MSC) replenishment ships operating in the Gulf in delivery boy mode. LCSs(ASW) and LCSs(MCM) will normally refuel in-port.⁸³

⁸³ Delivery-boy mode of UNREP entails the replenishment ship moving sequentially between the receiving ships thus relieving them of the necessity of moving away from their patrol areas to rendezvous with the replenishment vessel at a designated location.

VIGNETTE 3: OFFSHORE OIL INFRASTRUCTURE PROTECTION AND MARITIME STABILITY OPERATIONS

Scenario

Several of the states bordering the Gulf of Guinea face severe challenges policing both their land territory and littorals effectively in the face of insurgents, criminal gangs and other nefarious non-state actors. This has culminated in significant threats to oil and gas supplies, and the risk that the internal disintegration of one or more states will undermine regional security.

US naval forces are tasked to protect key offshore oil and gas infrastructure; support indigenous government efforts to prevent violent and well-resourced insurgents from using maritime areas in conjunction with efforts to spread conflicts to neighboring states; and provide maritime constabulary training.

Naval Tasks

- > Establish wide area surveillance in order to detect and classify all critical contacts of interest (CCOI). Interdict and board CCOIs as directed.
- > In cooperation with local nation maritime forces, establish security zones around critical offshore oil infrastructure, ports and oil terminals. Enforce mandatory traffic routes within agreed security zones.
- > Be prepared to conduct small-scale non-combatant evacuation operations (NEO) and support hostage rescue/platform recapture operations against offshore platforms seized by insurgents/terrorists.
- > Provide host government forces with maritime mobility for selected coastal and riverine stability operations.

Operational Considerations

The main operational imperative is to secure key offshore oil infrastructure. Secondary objectives involve the protection of oil traffic in and out of major coastal terminals and ports, and support of local nation efforts to disrupt militant activity in the Niger Delta and other coastal zones.

The area of interest extends approximately 700 nm along Gulf of Guinea coast and approximately 100 nm to seaward. Much of the coastline is low lying with a belt of mangrove swamp and lagoons separating the sea from the dry land of the interior. The width of this belt varies and in the Niger Delta area turns into a complex maze of creeks and channels covering about 7% of Nigeria's territory.

The bulk of regional oil production came from onshore fields during the previous century. Starting in the 2000s, however, oil production in the Gulf of Guinea

area shifted increasingly offshore, to the point where approximately 90 percent now comes from deepwater wells. Part of the motivation to move production offshore was to avoid disruption from militant groups that posed increasing threats to energy infrastructure ashore. The 2008 attack on the Bonga platform however, which lay 65 nm off the coast in 1,000 feet of water, demonstrated that offshore energy infrastructure was not immune to attacks and they have grown more frequent since then.

There are six primary “clusters” of major offshore energy infrastructure, as well as five significant coastal oil terminals, in the Gulf of Guinea region.

Regional navies possess very limited offshore capabilities: Nigeria has one frigate, one corvette and some patrol craft; Cameroon has three offshore patrol craft. Inshore capabilities are more substantial but still limited, e.g. Nigeria has fifteen “Defender-class” response boats while Cameroon has eight coastal and river craft. US forces will therefore not be able to rely on local partners for any significant naval support though they will depend on local security forces to provide intelligence on militant movements, resources and intentions.

The principal threat to offshore infrastructure is from speedboats bearing insurgents with small missiles and automatic weapons. These weapons constitute a serious threat to oil platforms due to fire and explosion hazards and lack of “damage control” capabilities. Platforms are not designed to be able to defend themselves against deliberate attack. A threat also may be posed by insurgent-hijacked vessels capable of inflicting major damage by ramming. Thus protective efforts must rely on detection and interception of hostile vessels/craft before they can come within range of major infrastructure.

LCSs(SUW) (with armed helicopters and/or armed Vertical Take-off and Landing Tactical UAVs (VTUAVs)) will be the principal means to stop or destroy hostile contacts preparing to attack offshore infrastructure or large tankers. Their ability to function as rapidly moveable “lily pads” also allows for rapid response by available SOF or a MEU(SOC) (Marine Expeditionary Unit (Special Operations Capable)) to recapture insurgent-hijacked vessels that could pose ramming threats to offshore infrastructure. Similarly, such forces could be used to conduct small-scale NEO, rescue hostages and/or recapture oil platforms seized by insurgents.

By virtue of their shallow draft and high speed, LCSs (any variant) and High-Speed Vessels (HSV), if available, are able to move US and/or local SOF rapidly by sea for insertion and extraction in conjunction with riverine operations. High LCS speed can enable such operations to be done covertly over substantial distances under cover of darkness as most parts of the Niger Delta have little or no shore-based radar coverage.

The need for periodic maintenance and repair of both ships and helicopters will limit on-station time for LCSs and embarked aircraft. Reinforcement by amphibious ships, particularly a big deck with an Air Intermediate Maintenance

By virtue of their shallow draft and high speed, LCSs are able to move US and/or local SOF rapidly by sea for insertion and extraction.

Department (AIMD) that could support SH-60 and VTUAV maintenance, would substantially increase the length of time units could remain on station. These ships would also provide additional helicopters and embarked SOF elements to the overall force.

Operational Employment

- > Local nations will use their own maritime forces primarily for patrolling the approaches to their major ports and provide local defense of coastal oil terminals. English-speaking local nation liaison officers will be assigned to US ships conducting offshore infrastructure protection and supporting selected stability operations to facilitate interactions with locals.
- > MPA will conduct surveillance patrols of the Gulf of Guinea, with a revisit rate not to exceed two hours. LCS-embarked helos will conduct supplementary surveillance in their respective ship patrol areas.
- > US maritime forces will be split into three task groups: TG East, TG West, and TG Coastal (as required).
- > Task Group East will enforce exclusion zones established in cooperation with the local nation(s) around the six principal offshore infrastructure clusters. One LCS(SUW) will patrol between each oil cluster and shore along the most likely threat axis, remaining within 25 nm of its assigned cluster. Additional LCSs(SUW), if available, will rotationally relieve individual LCSs for purposes of underway replenishment (UNREP) and “backstop” other LCSs drawn out of station while conducting intercept operations.
- > Task Group West will help enforce mandatory shipping lanes established by the local nation to Lagos (around thirteen to fifteen major vessel movements daily). Two LCSs(SUW) will be positioned within 50 nm of Lagos in order to be able to respond quickly to threats of seaborne insurgent attacks in the approaches to the port.
- > Task Group Coastal will use temporarily assigned LCSs and HSVs to conduct covert infiltration/exfiltration in conjunction with riverine operations by US SOF (and/or (MEU(SOC)) if an ARG is present) and/or indigenous force elements as directed. The LCS will be able to loiter offshore in support as required (e.g., serving as an emergency “lilypad” for Medevac, or for MEU helicopter fire support or MEU reinforcements). LCSs can also locate in river mouths to serve as temporary floating forward operating bases and resupply points for riverine forces.
- > There are no major bases or support facilities in the region. Therefore a sea base will be established offshore. Resupply will be effected primarily from

Military Sealift Command (MSC) replenishment ships but large amphibious ships will be able to refuel LCSs and High Speed Vessels (HSVs) if necessary. LCSs and HSVs will utilize their shallow draft to refuel and replenish floating support bases for riverine craft.

Summary of Key LCS Attributes

These vignettes suggest that LCS has several key attributes which may make it a particularly valuable and flexible asset for operational commanders to employ in carrying out various missions and tasks across a range of contingencies. These include its multi-mission adaptability, high sprint speed, “lily pad” functionality, and shallow draft. It should be emphasized that as much as the individual platforms provide useful capability, it is LCS employment *in quantity* that would appear to enable operational commanders to employ these ships with the greatest flexibility and overall effectiveness.

It is LCS employment *in quantity* that would appear to enable operational commanders to employ these ships with the greatest flexibility and overall effectiveness.

FIGURE 3. NIGERIAN LITTORAL



Multi-Mission Adaptability

The modularity of the LCS platform, i.e., the ability to change between SUW, ASW, and MCM modules, is conceptually well established. Its practical effect is that in theory higher-level commanders can change out their mix of LCS variants to suit new intelligence or circumstances. But in a different—and perhaps even more useful—sense of multi-mission adaptability, what makes the LCS potentially so valuable is its ability to support a wide range of air platforms and SEAL surface craft with their associated sensors and weapons. This reinforces the idea that the LCS should not be thought of primarily as a hull or “sea frame,” i.e., like a traditional surface ship, but rather that the totality of the payloads that can be embarked in, employed from, or supported by the sea frame is really what the term “LCS” should connote in the mind of the commander.

In terms of rapid shifting between LCS missions, it remains to be seen how rapidly, under what circumstances, and with what requirements each of the three main module types can be exchanged. If this generally can be done within one or two days with relative ease and minimum special requirements under a range of sub-optimal conditions, then this might be considered tactically responsive to evolving situations. But the real tactical responsiveness, i.e., adaptability, arguably derives from the ability to support or employ rapidly changing payloads, for instance different helicopter or craft types with their own different possible payloads (e.g., SOF, EOD or Marine troops, missiles/guns, sensors, support gear for minesweeping) that define their contributions to selected missions. So long as a given LCS is stocked with the aviation fuel, ordnance, and some spare parts for minor air platform repairs for given helicopter types, it could readily shift between missions depending on what air platforms or SEAL boats might be required to undertake such missions.

High Sprint Speed

The requirement for high speed has been criticized as a significant cost driver for the LCS. Opponents have been skeptical that speed has significant tactical relevance. Yet, in the preceding vignettes, the value of high speed comes up repeatedly. For example, in situations where there is a premium on rapid reaction after initial detection of CCOIs in order to prevent them from escaping, merging in dense coastal traffic, reaching a non-friendly state’s territorial waters, or arriving within their weapons’ range of a friendly target being protected, LCS speed is an advantage. The ability to rapidly adjust a surface escort screen, surface barrier, or fill in patrol areas when one or more ships is drawn out of position would be tactically valuable, particularly when mission success is critical, e.g., when trying to prevent the smuggling of WMD by sea from certain areas. The LCS’s high speed is tactically advantageous in negating or diminishing the speed advantage FACs and other armed small boats have over conventional escort ships. It can enable

What makes the LCS potentially so valuable is its ability to support a wide range of air platforms and SEAL surface craft with their associated sensors and weapons.

high-speed run-ins to coastal areas or at-sea targets for infiltration/extraction, raiding, and take-down operations of various kinds.

The LCS's speed is also tactically relevant with regard to air operations enabling it to increase the effective range of embarked or supported helicopters by being able to close the expected recovery point. Similarly, it allows for the dynamic, high-speed repositioning of the lilypad its flight deck provides. That repositioning in turn increases airborne mission planning flexibility, especially if multiple lilypads are employed for larger-scale or long-range missions.

Lilypad Functionality

Perhaps the LCS sea frame feature that offers the greatest flexibility to the operational commander is the large flight deck that allows the ship to support a variety of helicopter types as well as VTUAVs. The ability to move the lilypads around rapidly in response to changing tactical circumstances facilitates a greater range of missions and mission profiles.

The power of fast, mobile lilypads is even further enhanced if LCSs operate in conjunction with ESGs or ARGs with their considerably larger number of helicopters of various types that could be supported by LCS flight decks for multiple contemporaneous operations. As noted above, though, this does entail some implicit assumptions concerning parts, personnel, minor repair capability, etc. that must be met to meet sustained air operations requirements, especially involving diverse aircraft types.

Shallow Draft

The LCS's shallow draft relative to that of a destroyer or even a *Perry*-class frigate makes it employable in many littoral areas where the latter ships either cannot go or where their draft adds a significant element of risk to their operations. Without enumerating them, many areas where the kinds of operations illustrated in these vignettes are most likely to actually take place for the foreseeable future, e.g., littorals in the Arabian Gulf, in the Southeast Asian straits and archipelagoes, or in energy-rich areas off West Africa have large areas of shallow water and/or numerous shallow underwater ridges running through them. One can ask whether it makes sense to risk multi-billion destroyers or cruisers with their 32-foot drafts to hunt oil smugglers in the shallows as was so often done in the Arabian Gulf in the 1990s. Certainly it would be more cost-effective and less risky in terms of potential loss or damage to employ LCS-type ships for such operations that may well typify the kinds of routine operations the Navy will conduct in coming years.

The Navy's 2007 "Cooperative Strategy" put considerable emphasis on capacity-building as part of Theater Security Cooperation (TSC) efforts with diverse international partners. Many of these actual or potential partners are nations in the geographic areas cited above that have at best navies, or more

The LCS's shallow draft relative to that of a destroyer or even a *Perry*-class frigate makes it employable in many littoral areas where the latter ships either cannot go or where their draft adds a significant element of risk to their operations.

realistically, coast guards composed of small ships not well-suited to work or train with the large combatants that constitute the preponderant part of the Navy surface force. The LCS, in contrast, would be far better suited for cooperative missions, not least because it could operate in many of the sea areas in which such foreign forces routinely operate.

The LCS, when seen as the totality of the payloads it can embark, employ, or support, and provided they are available in sufficient quantities appear to be a highly attractive asset to operational commanders.

Employment In Numbers

The most important consideration that appears across the vignettes is the importance of employing LCSs operationally in significant numbers to take advantage of the tactical flexibility and operational coverage thereby enabled. Whereas individual ships are relatively lightly armed and equipped, and relatively limited in reach, on the air side, the ability to establish a web of rapidly moveable lilypads through which various airborne payloads can be rapidly moved and employed for effect over reasonably large areas would seem a powerful idea. Given the LCS's high speed, such a web could be rapidly shifted and altered in response to changing tactical circumstances.

Similarly, on the surface side, the ability to rapidly adapt multi-ship screens, barriers, or patrol areas would be particularly useful in the various missions depicted in the vignettes in order to respond to rapidly changing tactical situations, such as those driven by high-speed adversary surface vessels or by deliberate attempts to draw units out of position. The effectiveness of such adaptation would appear a direct function of the numbers of LCSs available for a given mission or task.

In summary, the LCS, when seen as the totality of the payloads it can embark, employ, or support, and provided they are available in sufficient quantities such that they can be deployed in supple, responsive webs to cover large areas and respond rapidly to various changes in the tactical environment, would appear to be a highly attractive asset to operational commanders for a wide range of missions and tasks that are likely to be encountered in the future, particularly in peacetime and/or irregular warfare environments.

INSIGHTS AND FURTHER ANALYSIS

The Navy talks about “wholeness” in connection with the LCS. By this it means the need to conceive of it as a single ship, whatever mission package it may be carrying at any one time. In fact, this needs to be taken a stage further in order to encapsulate the ship’s particular qualities in a way that can be communicated easily across the fleet and which will enable higher commanders to grasp the ship’s potential overall rather than as a bundle of discreet attributes, which the emphasis on payload modularity tends to amplify. Fundamental naval missions do not change, but the manner in which they are conducted can and does change, often in response to developing technology. The US Navy needs to do more with less and in response has developed a class of ships that can reasonably be described as “naval cavalry.”

NAVAL CAVALRY

Two of the LCS’s strengths are speed and flexibility, features that are reminiscent of light cavalry. Although mounted cavalry had a role in battle, their greatest utility often lay in the scouting phase before the main bodies engaged or in the exploitation phase once the enemy’s main force had been broken. They also screened the main body of their own army against similar harassing attacks by the enemy’s skirmishers. In addition, their mobility gave them an enormous utility in warfare against irregular forces and it is perhaps in these roles — scouting, screening, exploitation and confronting irregular adversaries — that the LCS will display its most enduring value.⁸⁴

The Navy’s most pressing challenge to date has been to prepare and equip the LCS for its screening role, as evidenced by the tasks it has chosen for the first

The US Navy has developed a class of ships that can reasonably be described as “naval cavalry.”

⁸⁴ The utility of cavalry continued up to and including World War II when several armies used mounted troops in areas which were inaccessible to mechanized forces. SOF also famously took to horseback during the opening phase of Operation Enduring Freedom.

The LCS is less like “a traditional ship” and more like a highly flexible naval “Swiss Army knife.”

three mission packages. It has demonstrated its interest in the ship’s scouting and exploitation roles by the emphasis it has placed on its qualities as the surface “first responder” that arrives “ahead of any power projection force.” Beyond this, however, it has talked only in general terms about the ship’s other potential roles. Mention has been made of anti-piracy and humanitarian aid missions, both of which have been rolled up historically in the ideas of “presence.”

The concept of naval presence is about “being there.” Unlike other naval missions it is not first and foremost about weapons on target. “There” is wherever the nation needs the Navy to go to perform long-term ISR, naval diplomacy and constabulary missions, which in diplomatic terms are about influence and in constabulary terms are ultimately about being able to interdict vessels and board them. Presence need not be permanent (and in most cases that is infeasible), but when and where it is intermittent, navies need to have sufficient knowledge of the areas where they might be required to go in order to be able to operate effectively when they get there. The geographic complexity of the littorals and the speed of change brought about by the increasing numbers of their human inhabitants, mean that the Navy needs to update its knowledge of potential littoral operating areas more regularly than it does the deep-water battle space.

The Navy can only achieve presence effectively if it has an adequate number of ships. Numbers of hulls also matter in battle. If a fleet commander has access to LCSs then, in some circumstances, a shortage of numbers can be tempered by combining the information superiority delivered by the battle network with the ship’s inherent speed, mission flexibility and its manned and unmanned helicopter capacity. If these elements can be exploited synergistically they could help the Navy restore, to a degree, the sea area each SG is able to influence but which has been lost due to the decline in the fleet’s quantitative superiority.

HOW WILL THE SHIP BE USED?

Like any ship design, the LCS is a compromise between competing demands, but its size, and particularly the size and flexibility of its reconfigurable internal spaces, suggest that if historical experience is a useful indicator, it will be sufficiently adaptable to remain in Navy service for several decades. This adaptability has perhaps been best summed up by the Undersecretary of the Navy, Robert Work, who described it aptly as less like “a traditional ship” and more like a highly flexible naval “Swiss Army knife.”⁸⁵

The ship has considerable strengths. It is adaptable. It is reconfigurable internally, capable of satisfying a number of specialized tasks when equipped with the appropriate mission package (currently ASW, SUW and MCM although other packages are likely to be developed in the future) and has the space to

⁸⁵ Work, *The US Navy: Charting a Course for Tomorrow’s Fleet*, p. 28.

accommodate missions not yet envisioned. It is fast, highly maneuverable and while it is deployable transoceanically its shallow draft enables it to operate in any ice-free sea area at least 20 feet deep, a quality which opens up a much larger percentage of the world's ocean surface to Navy operations. It is UNREP capable, which will enable it to keep up with fast-moving SGs and extend its range without recourse to port facilities. It is lightly-manned and highly automated, two attributes which should deliver life-cycle cost savings, yet because of its high habitability standards it should be able to remain on station without incurring undue levels of fatigue amongst the crew during the event of naval operations. It is able to survive to Level I standard which means that many of the crew would likely survive an attack but the ship would not be able to continue fighting.⁸⁶ It is a stable platform, exceptionally so in the GD trimaran version. This is a huge advantage when deploying off-board systems that include up to two SH-60 helicopters or equivalents (the GD version has a particularly large flight deck theoretically capable of handling the CH-53 and possibly the CV-22 Osprey), and a range of manned and unmanned surface craft in a variety of sea states.

EXPERIMENTATION

Much about the ship remains experimental. The LCS was envisioned as a radically new type of ship; a "sea frame" supporting interchangeable "mission packages" with their attendant off-board systems. Currently the Navy is considering the LCS for three primary roles as described. More were envisaged at the outset and the ship was designed to be able to undertake further roles that will emerge during the time the type will be in service as a consequence of experience and changing threats. All ships require modification in the light of experience. Because the LCS is such a new design it may require more than most. However, given programmatic pressures and the project management and cost problems that arose during the construction of the 1st Flight ships, doubts exist as to whether or not the Navy is willing to acknowledge the need for further significant changes to the ship and its support infrastructure, or that it retains sufficient political capital to admit this to Congress.

⁸⁶ "The Navy divides its surface ships into three broad survivability categories that reflect the environments in which they are expected to function: Level I, Level II, and Level III. Ships built to Level I are expected to operate in the least severe environment, away from the area where a battle group is operating or the general war-at-sea region. Those vessels should be able to maintain good handling in bad weather and should have systems for fighting fires on board the ships, hardening against electromagnetic pulses, and protection against chemical, biological, or radiological contamination. However, they are not expected to 'fight hurt,' as the Navy puts it. Such ships include material support ships, mine-warfare vessels, and patrol combatants." Congressional Budget Office, *The Future of the Navy's Amphibious and Maritime Prepositioning Ship*, November 2004, p. 25. Clearly, if there is a renewed intention to operate LCS as part of SGs in hostile waters then the ship's survivability level will need to be reconsidered.

As it stands now, and bearing in mind the Navy's current needs, the ship can fulfill seven missions:

- > Scouting surveillance and intelligence collection in all circumstances and operational areas up to but not exceeding periods of tension preceding combat with a near-peer competitor;
- > Littoral combat operations, primarily against submarines, surface craft and mines but also SOF insertion and evacuation, and blockade, in all circumstances and operational areas under the Joint air and surface defense umbrella except against a near-peer competitor;
- > Exploitation operations following major combat, again primarily against submarines, surface craft and mines, in all circumstances and operational areas under the Joint air and surface defense umbrella;
- > Constabulary operations including open-ocean interdiction and CT activity;
- > Naval diplomacy up to and including show-of-force actions;
- > HA/DR operations; and
- > Inter- and intra-theater mobility operations in any area with a low probability of air attack.

Effective fulfillment of these missions will require that the experimentation program address seven issues:

- > The ship's high fuel consumption, particularly when exploiting its high speed operationally;
- > The ship's dependence on base or larger mother-ship support for logistic and maintenance requirements;
- > The degree to which its relative light armament against air and missile threats (in all configurations) and against surface threats (mitigated to a degree in its SUW configuration), when compared to its international equivalents, needs to be reviewed; given the need for substantial firepower to overcome the potential attack densities achievable from land- and sea-based platforms in the littoral, this lack of armament appears to be a serious shortcoming that might be improved, at least against surface threats, by the installation of a small number of Harpoon missiles, which, because their range is greater than NLOS-LS range, could be retained even after that system becomes available;⁸⁷

⁸⁷ The Harpoon throws a 488lb warhead up to 124 miles. "Harpoon Missile," US Navy *Fact File*, ND at http://www.navy.mil/navydata/fact_display.asp?cid=2200&tid=200&ct=2.

- > The ship's dependence on networks to optimize its combat potential, including the operation of off-board systems OTH; without network connectivity it would be no more capable than previous small naval combatants and potentially just as exposed to enemy action;
- > Its dependence on manned and unmanned helicopters for the fulfillment of all its missions; the general problem of helicopter availability due to adverse weather or reliability shortcomings could therefore be a factor that affects LCSs more than other combatants and in some circumstances make it vulnerable to attack;
- > The fact that while the ship is as vulnerable as most modern warships to disabling attack when surprised in crowded littoral waters, it is likely to be deployed there for long periods, and may therefore be more likely to suffer damage; moreover this vulnerability extends to the ship's helicopters which are highly susceptible to even shoulder-launched weapons;⁸⁸
- > The ship's dependence on highly-qualified and experienced crew members; because its crew numbers are low this means it is potentially vulnerable to drop-offs in crew efficiency as a result either of fatigue or because crew members have been lost as a consequence of illness or injury.
- > The ship's attributes also suggest that while it is fully capable of operating independently in situations where frigates always have, because much of its scouting activity must of necessity be undertaken in LCS squadrons in support of, and under the protection of, SGs or land-based air power this will inevitably affect the goal of increasing ship numbers to cover more sea area.

OPEN ARCHITECTURE ALLOWS SPACE FOR OPEN MINDS

How the LCS will be deployed will vary in accordance with the mission and threat level. However, in terms of the ship's core utility in constabulary, naval diplomacy, HA/DR and mobility missions (Phase 0 operations), the common factors will be adaptability and "scaleability." When carrying out MSO missions in open ocean areas such as in the waters off the Indian Ocean coast of Somalia, the

⁸⁸ Part of this vulnerability stems from the fact that signature reduction was not a design requirement for the LCS. Although the flat sides of the designs indicate that both sets of designers were conscious of the advantages of signature reduction, the need to contain costs limited what they were able to achieve. This approach contrasts with the approach taken with other littoral combatants such as the Swedish *Visby*. Mark Hewish. "Navies Ask: Is the Coast Clear?" *Jane's International Defence Review*, 1 October 2003; also "Total Ship Survivability and Surface Stealth," *GlobalSecurity.org*, October/November 2002 at <http://www.globalsecurity.org/military/library/report/2002/mil-02-1011-wavelengths02.htm>. Another part stems from its utility in CT or counter-insurgency operations when it could be the object of surprise attack.

The LCS can undertake many of the missions and tasks that have often been assigned to frigates in the past but it can do more than traditional frigates can. It has the potential to be the “cavalry of the fleet,” freeing the Navy’s larger multi-mission combatants to accomplish the missions for which they were designed.

LCS’s ability to deploy helicopters to swamp small boats with their rotor down-draft and attack them with their weapons, to use their UAVs to shadow targets of interest, and to employ their RHIBs to undertake boarding, furnishes the Joint commander with an effective and multi-faceted package. Although the LCS armament “fit” might need to be revised if the LCS is to undertake MSO under more threatening conditions, it is appropriate for the current anti-piracy effort. When deployed with an embarked Marine or SOF force it could also serve as a platform for the delivery and extraction of raiding parties.

The ship’s carrying capacity and off-board air and surface systems will enable it to make a valuable contribution to building partner capacity (BPC) missions, although when and where it will be used needs to be chosen with care as its size, sophistication and high-technology appearance can intimidate as well as impress smaller nations. Its “mother ship” potential could also come into play in such circumstances as well as in the conduct of MSO in narrower waters close-in to shore where the LCS could deploy as the command and support ship for smaller inshore patrol craft. The endurance of such a force could be increased by deploying it with a Joint High Speed Vessel (JHSV), which with its larger load carrying capacity could provide additional fuel, supplies and deployable small craft, and offer additional (if severely limited) support for the air detachment.

More complex and more exacting littoral combat missions will require that the LCS be organized into littoral operations squadrons to facilitate greater logistical support and area air defense.⁸⁹ The air defense requirement could be fulfilled in most cases by an *Arleigh Burke*-class destroyer (DDG-51). Support could be provided currently by an LSD but as this class of ships is retired the Navy will need to give thought to a replacement that could be smaller and therefore capable of operating in shallower water, while at the same time carrying greater offensive and defensive armament perhaps along the lines of the Danish *Absalon*-class, which has features which undoubtedly influenced the LCS concept.⁹⁰ A squadron built around one or, ideally, two such ships, one (or two) DDGs and a small constellation of appropriately configured LCSs would constitute a formidable and flexible littoral task force. Endurance could be increased by deploying a fast combat support ship beyond the range of coastal defenses to which force elements could repair for fuel, ammunition and other supplies.

Historically the cavalry was fast but it was also flexible. Horse soldiers did not have to fight mounted; they could dismount and fight as ordinary infantry. The LCS can undertake many of the missions and tasks that have often been

⁸⁹ See, for example, Henry J. Hendrix, “Buy Fords not Ferraris,” US Naval Institute *Proceedings*, Vol. 135, No. 4, April 2009, pp. 52–57.

⁹⁰ Richard Scott, “Denmark’s new standard ships offer greater flex,” *Jane’s Navy International*, 1 July 2004; Richard Scott and Guy Toremans, “Flexible friends: Flexible support ships,” *Jane’s Defence Weekly*, 26 February 2009; Norman Polmar, “An Operational LCS,” US Naval Institute *Proceedings*, Vol. 135, No. 9, September 2009, pp. 86–87.

assigned to frigates in the past but it can do more than traditional frigates can. It has the potential to be the “cavalry of the fleet,” serving as a bridge or hinge between Phase 0 operations and larger-scale contingencies, freeing the Navy’s larger multi-mission combatants from the need to undertake Phase 0 operations, thereby releasing them to accomplish the missions for which they were designed.



GLOSSARY

A2/AD	Anti-access/area-denial
ADS	Advanced Deployable System
ARG	Amphibious Ready Group
ASCM	Anti-Ship Cruise Missile
ASW	Anti-submarine warfare
BDA	Battle damage assessment
BMD	Ballistic missile defense
C4ISR	Command, control, communications, computer, intelligence, surveillance, and reconnaissance
CCM	Combat Craft Medium
CCOI	Critical Contacts of Interest
CIWS	Close-in Weapon System
CNO	Chief of Naval Operations
CONOPS	Concept of operations
CSG	Carrier Strike Group
DDG	Guided Missile destroyer
ESG	Expeditionary Strike Group
FAC	Fast-Attack Craft
FIAC	Fast Inshore Attack Craft
GFS	Global Fleet Station
HA/DR	Humanitarian assistance/disaster relief
HEU	Highly enriched Uranium
HSV	High speed vessel
IPOE	Intelligence preparation of the operational environment
IRGC	Iranian Revolutionary Guard Corps
IRGCN	Iranian Revolutionary Guard Corps Navy
ISR	Intelligence, surveillance, and reconnaissance

JHSV	Joint High Speed Vessel
LCS	Littoral Combat Ship
LHA	Amphibious Assault Ship
MCM	Mine Countermeasure
MDA	Maritime domain awareness
MEU (SOC)	Marine Expeditionary Unit (Special Operations Capable)
MIO	Maritime Interception Operation
MIW	Mine warfare
MPA	Maritime Patrol Aircraft
MRSN	Maritime Reconnaissance-Strike Network
MSC	Military Sealift Command
MSO	Maritime Security Operation
NEO	Non-Combatant Evacuation Operation
NLOS	Non line of sight
NWDC	Naval Warfare Development Command
OTH	Over-the-Horizon
PC	Patrol craft
RAM	Rolling Airframe Missile
RFP	Request for proposals
RHIB	Rigid-Hulled Inflatable Boat
RTAS	Remote Towed Active Source
SC	Surface Combatant
SG	Strike Group
SLOC	Sea lines of communication
SOF	Special Operations Forces
SSN	Nuclear-Powered Attack Submarine
SUW	Surface warfare
TALON	Tactical Littoral Ocean Network
TTP	Tactics, Techniques, and Procedures

UNREP	Underway replenishment
UAV	Unmanned aerial vehicle
USV	Unmanned surface vehicle
UUV	Unmanned underwater vehicle
VBSS	Vessel Boarding, Search, and Seizure
VLS	Vertical-launch system
VTUAV	Vertical Take-Off Tactical Unmanned Vehicle
WMD	Weapons of mass destruction

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