Getting the Most Out of Littoral Combat Ships

Abstract

The Littoral Combat Ship (LCS) is the Navy's first modular warship and is designed to accept interchangeable packages of components so that it can fulfill a range of missions. These mission package modules—containing different weapons, communications systems, sensors, and other capabilities—raise a number of operational, logistics, and cost issues for the Navy. RAND analysts conducted qualitative and quantitative examinations of the LCS fleet to determine the best locations for LCS homeports and mission package installation sites, the quantity of mission packages that should be procured and when, and the best locations to store the mission packages.

In June 2005, workers at the Marinette Marine shipyard in Wisconsin laid the keel for the USS *Freedom*, the Navy's first Littoral Combat Ship (LCS). Able to achieve speeds of 45 knots and maneuver in waters less than 20 feet deep, the LCS constitutes a new class of fast, agile, and networked warships designed to overcome threats in shallow waters posed by mines, diesel-electric submarines, and "swarm boats" and other fast surface craft.

With a modular design, LCSs are a conceptual departure from traditional naval warships. All LCSs will share a hull and superstructure seaframe equipped with common equipment such as self-defense weapons, radar, communications, and unmanned vehicles. But at the same time, each vessel will be able to accommodate interchangeable, 20-foot cargo container–sized mission packages that allow the ship to be reconfigured for antisubmarine warfare (ASW), mine warfare (MIW), or surface warfare (SUW) missions. In the early years of this decade, the U.S. Navy was considering acquiring upward of 80 LCS seaframes by the year 2025.

Evaluating Operational, Logistical, and Cost Trade-Offs

Because seaframes and mission packages are new concepts, the Navy in early 2005 asked the RAND Corporation to help it evaluate operational, logistics, and cost trade-offs between the number of LCS seaframes planned for the fleet, the number of mission packages those seaframes would require to perform a range of missions, and the preferred number and locations of LCS homeports and mission package installation sites.

RAND's analysis involved qualitative and quantitative examinations of the LCS fleet at three discrete points in the future: the short term (2014), the middle term (2019), and the long term (2024). Our qualitative efforts assessed how the Navy might employ LCSs at those points in time, the locations where the ships might operate, and the missions with which they might be tasked. We used these first-order qualitative assessments to inform our second-order qualitative evaluations of how various combinations of mission package inventories, homeport locations, and installation sites might affect LCS performance and costs at those future junctures. Because surface speed is a major attribute of the LCS, we used the time that *all* LCSs would need to move to the theaters of operation—which we termed total "closure time"—as our principal qualitative measure of effectiveness.

We began our quantitative evaluations by running multiple computer simulations that allowed us to evaluate the effects of varying the operational and logistical elements on operational performance. We used this information to identify the optimal locations of homeports and installation sites and the optimal sizes of mission package inventories. In a third step, we used our cost models to estimate annual and total costs to procure those mission package inventories and construct homeports and installation sites.

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Table 1
Mission Package and LCS Inventories Required in the Short, Middle, and Long Term

Time Period	Mission Package Inventories				LCS Seaframe Inventories (Projected)
	ASW	MIW	SUW	Total	
Short term (by 2014)	20	27	42	89	36
Middle term (by 2019)	23	31	50	104	60
Long term (by 2024)	28	38	60	126	84

The Conditions Under Which LCSs May Be Used

We assumed that the LCS fleet would be involved in four operations at the same time: a major combat operation (either in Southwest Asia, in the Western Pacific, or in Northeast Asia) and three less-encompassing combat operations (such as global war on terrorism operations, stability operations, and homeland security/defense operations).

We also made assumptions based on current operational plans about how the Navy intends to use LCSs. The LCS concept of operations describes plans for the Navy to embed LCSs in carrier strike groups or expeditionary strike groups, to deploy them independently, or to operate them as forward deployed units. Using these deployment concepts and potential threat characteristics, we evaluated ways in which the Navy might employ LCSs in the context of various scenarios.

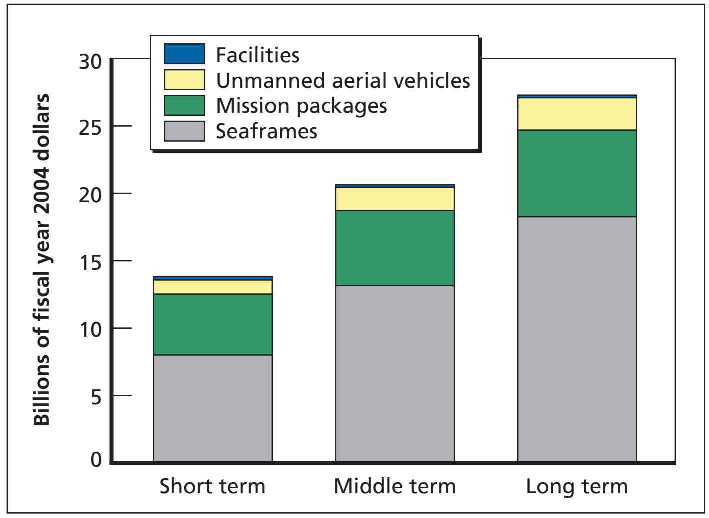
The Best Locations for LCS Homeports and Mission Package Installation Sites

Having identified operations in which LCSs would be involved and ways in which the vessels would be used, we conducted our transportation computer simulations. We chose three homeport locations (Norfolk, San Diego, and Japan) and two mission package installation sites (Singapore and Bahrain) that allowed LCSs equipped with appropriate mission packages to respond to scenarios in the least amount of closure time.

The Number of Mission Packages That the U.S. Navy Should Acquire

Given the above conditions and locations, we conducted a second computer simulation effort to calculate the best LCS mission package inventories for the short, middle, and long term, which are displayed in Table 1.

Figure 1
Estimated Cumulative Procurement and Facility Construction Costs for the Short, Middle, and Long Term

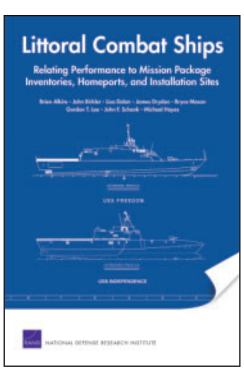


The Cost of the LCS and Mission Package Inventories and Locations

Our third computer simulation effort involved calculating the costs of LCS seaframes, mission packages, facilities, and related equipment. Figure 1 depicts the results of those calculations by graphing our estimates of the total cost of procuring LCS and mission package inventories and associated unmanned aerial vehicles and of constructing homeports and installation sites. The costs (in fiscal year 2004 dollars) would be $13.8 billion in the short term, $20.7 billion in the middle term, and $27.3 billion in the long term.

This study appears to provide the first quantitative evaluation of the best locations for homeports and installation sites, and the inventories of mission packages by type to be stored at those locations or on LCS seaframes. Clearly our results hinge on our assumptions, including the scenarios.

The study was conducted while mission packages were still in development. Decisions about the exact makeup of mission packages appeared to be in flux, and the Navy was considering building some mission modules and mission package components into the seaframe rather than making them part of a mission package. ■



This research brief describes work done for the RAND National Defense Research Institute documented in *Littoral Combat Ships: Relating Performance to Mission Package Inventories, Homeports, and Installation Sites*, by Brien Alkire, John Birkler, Lisa Dolan, James Dryden, Bryce Mason, Gordon T. Lee, John F. Schank, and Michael Hayes, MG-528-NAVY, 2007, 142 pp., $30, ISBN: 978-0-8330-4146-3 (available at http://www.rand.org/pubs/monographs/MG528/). The RAND Corporation is a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. **RAND**® is a registered trademark.

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