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Report to Congressional Committees

March 2005

DEFENSE ACQUISITIONS

Plans Need to Allow Enough Time to Demonstrate Capability of First Littoral Combat Ships

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Highlights

Highlights of GAO-05-255, a report to congressional committees

March 2005

DEFENSE ACQUISITIONS

Plans Need to Allow Enough Time to Demonstrate Capability of First Littoral Combat Ships

Why GAO Did This Study

To conduct operations in littorals—shallow coastal waters—the Navy plans to build a new class of surface warship: the Littoral Combat Ship (LCS). LCS is being designed to accomplish its missions through systems operating at a distance from the ship, such as helicopters and unmanned vehicles, and that will be contained in interchangeable mission packages. The Navy is using an accelerated approach to buy the LCS, building the ships in "flights." Flight 0, consisting of four ships, will provide limited capability and test the LCS concept. The schedule allows 12 months between the delivery of the first Flight 0 ship and the start of detailed design and construction for Flight 1 ships. Estimated procurement cost of the Flight 0 ships is $1.5 billion.

The Congress directed GAO to review the LCS program. This report assesses the analytical basis of LCS requirements; the Navy's progress in defining the concept of operations; the technical maturity of the mission packages; and the basis of recurring costs for LCS.

What GAO Recommends

GAO recommends that the Navy analyze the effect of larger surface threats on LCS operations, incorporate the impact of LCS into helicopter force structure, and sufficiently experiment with Flight 0 ships before selecting a Flight 1 design. The Department of Defense partially concurred with GAO's recommendations.

www.gao.gov/cgi-bin/getrpt?GAO-05-255.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Paul Francis at (202) 512-2811or francisp@gao.gov.

What GAO Found

The formal analysis of requirements for U.S. littoral combat operations—conducted after the Navy established the LCS program—examined a number of options, such as the extent to which existing fleet assets or joint capabilities could be used. While the Navy concluded that the LCS remained the best option, it focused on LCS requirements for combating small boats. The Navy did not conduct an analysis of the impact of larger surface threats LCS may face. Such threats may increase the risk to LCS operations when no other nearby U.S. forces are available to help.

The Navy has developed both a broad concept and more detailed plans on how the LCS will be employed. It has also identified a number of challenges that could put the LCS concept at risk, such as manning, logistics, and communications. For example, reduced manning—a key goal of the LCS program—may not be achievable because maintaining and operating the ship's mission packages, such as the MH-60 helicopter, may require more sailors than the current design allows. Further, the Navy has not yet incorporated the numbers of helicopters that will be needed to fulfill LCS' s concept of operation into its force structure and procurement plans. If the Navy's efforts to meet these challenges are not successful, the Navy may not have sufficient time to experiment with the Flight 0 ships and integrate lessons learned into planning and designing for follow-on ships.

While the Navy designed the first LCS to rely on proven technologies and systems, a number of technologies to be used in LCS's mission packages have yet to be sufficiently matured—that is, they have not been demonstrated in an operational environment—increasing the risk of cost and schedule increases if the technologies do not work as intended. Technologies must also be demonstrated for systems on the LCS seaframe. Other factors may affect the availability of mature technologies and subsystems, such as making the modifications necessary for adaptation to the LCS and transitioning projects from the laboratory to production. Collectively, these technology issues pose an additional challenge to the Navy's ability to sufficiently experiment with Flight 0 ships in time to inform the design efforts for follow-on ships.

Procurement costs for the Flight 0 ships remain uncertain. The basis for the seaframe cost target—$220 million—appears to be more defined than for the mission packages, as the Navy has performed various cost analyses that consider the challenges in detailed design and construction. The Navy seeks to meet the cost target by trading between capability and cost. Cost data for the Flight 0 mission packages are not as firm in part because of the uncertainties associated with immature technologies.

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Abbreviations

DOD	Department of Defense
LCS	Littoral Combat Ship
TRL	Technology Readiness Level

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March 1, 2005

The Honorable John Warner
Chairman
The Honorable Carl Levin
Ranking Minority Member
Committee on Armed Services
United States Senate

The Honorable Duncan L. Hunter
Chairman
The Honorable Ike Skelton
Ranking Minority Member
Committee on Armed Services
House of Representatives

The Navy has begun to build a new class of surface warship—the Littoral Combat Ship (LCS)—to address the challenges of operating U.S. military forces in the shallow waters close to shore, known as the littorals. The three principal threats it is expected to address are from mines, small surface boat attacks, and submarines. The LCS differs from existing types of Navy surface warships in two critical ways. First, it will accomplish its mine, antisubmarine, and surface warfare missions primarily through the use of helicopters, unmanned vehicles and other systems that operate at a distance from the ship itself. Second, the systems used to conduct each main or focused mission will be contained in mission packages; for example, one mission package will consist of the systems needed for detecting, engaging, and neutralizing mines. The mission packages will be interchangeable, so that the LCS can be rapidly reconfigured for different missions. Similar to the concept for an aircraft airframe that can change missions depending on the systems carried, the Navy refers to the LCS hull as a seaframe. The concept of mission packages and the ability to shift among the three focused missions of the ship concentrates each LCS on a single focused mission at a time as opposed to larger multimission surface ships, such as the *Arleigh Burke* guided missile destroyers and *Ticonderoga* guided missile cruisers. However, the Navy envisions that, like other surface ships, the LCS will be capable of conducting certain core missions and functions, such as self defense, regardless of the mission package on board.

The Navy seeks to rapidly build and deploy LCS and has developed an accelerated acquisition schedule that includes delivery of four ships, two each of different designs, between fiscal years 2007 and 2009 with delivery of follow-on ships of a single design beginning in fiscal year 2010. The Congress recently inserted a year into the schedule between the construction of the first and second ship of each design, which may affect the schedule for all subsequent ships. The Navy is developing LCS using an evolutionary acquisition approach. Capabilities are delivered by "flight" with the first four ships referred to as Flight 0 and the next increment of capability as Flight 1. Flight 0 will provide an initial limited capability and platforms to experiment with the critical mission technologies and test the overall concept. Flight 1 will provide greater capability and serve as the basis for learning lessons that will be incorporated into additional follow-on ships. The Navy has not decided how many total ships it will build, though currently it estimates that between 50 and 60 ships may be built. The Navy's cost target for each of the four Flight 0 ships is approximately $370 million. This includes $220 million for the seaframe and approximately $150 million for mission packages (the cost of six packages averaged over four ships).

The Senate report[1] accompanying the National Defense Authorization Act for Fiscal Year 2004[2] and the House of Representatives report[3] accompanying the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005[4] directed that we assess four key areas of the LCS program. Accordingly, this report assesses (1) the analytical basis of LCS requirements; (2) the Navy's progress in defining the concept of operations; (3) the technical maturity of the mission package systems; and (4) the basis of recurring costs for the seaframe and mission packages.

To assess the four key areas of the LCS program, we held discussions and reviewed documents at a number of Navy offices, including the program offices for LCS and its supporting mission package systems, Navy headquarters, the Naval War College, and Navy Warfare Development Command. We identified and analyzed key Navy documents, including those related to capability gaps; requirements; concepts; acquisition

[1] S. Rep. No. 108-46, at 179-180 (2003).

[2] Pub. L. No. 108-136 (2003).

[3] H.R. Rep. No. 108-491, at 184-185 (2004).

[4] Pub. L. No. 108-375 (2004).

planning; consideration of critical doctrinal, logistical, and operational considerations;[5] technology assessment and maturity plans; and cost analyses. Our analyses of technology maturity and costs focused on Flight 0. Details of the costs and technologies for the seaframe are sensitive, due to the ongoing competition. We therefore do not discuss these at length. Further details on our scope and methodology are in appendix I.

Results in Brief

Though the Navy conducted a formal requirements process and an analysis of other potential solutions, it did so after concluding that the LCS concept was the best option to address challenges of operating U.S. forces in the littorals. Normally, a major acquisition program should include an examination of basic requirements and an analysis of potential solutions before a new system is decided upon. Based on Department of Defense (DOD) reviews of the Navy's analysis and the requirements of revised acquisition guidance, the Navy eventually examined a number of alternative solutions to address littoral capability gaps, such as the extent to which existing fleet assets or joint capabilities could be used. The Navy still concluded that the LCS concept was the best option. However, the Navy's analysis of one area of littoral operations—the surface threats facing U.S. forces in littoral waters—did not include consideration of the potential impact of all threats the LCS is likely to face. For example, while the requirements for LCS are focused on combating small boats, the LCS could face threats larger than small boats in littoral waters, including missile-armed warships. Though LCS is to rely on support from other nearby U.S. forces, the Navy also intends for LCS to operate independently of those forces. The Navy has not analyzed the risks such threats could pose to LCS operations and survivability.

The Navy has developed a broad concept of operations that addresses the key operations of the ship and continues to develop more detailed planning on how the LCS and its mission systems will be used. The Navy has also identified challenges in such areas as manning; logistics; command control, communications, computers, and intelligence; and force structure that are critical and may increase risk to the success of the concept. The Flight 0 ships will be the primary means for determining whether these challenges can be met. While the Navy is working to meet these challenges, to the extent they are not met, the Flight 0 ships could

[5] DOD generally refers to these considerations as doctrine, operations, training, materiel, leadership, personnel, and facilities (DOTMLPF).

provide less capability than planned and less experimentation to inform the design of the Flight 1 ships. For example, reduced manning is one of the key goals of the LCS program. If the Navy discovers that it needs more sailors to operate the ship's critical mission package systems than the Flight 0 design can accommodate, significant changes may have to be made in the Flight 1 requirements. The MH-60 helicopter, which will operate from LCS and is critical to all its missions, embodies a number of these challenges. The number of personnel required to operate and maintain the helicopter may be greater than the Flight 0 design can accommodate. Further, the Navy's current force structure and procurement plans do not include the numbers of helicopters that will be needed to fulfill LCS's concept of operation.

A number of the technologies chosen for the LCS mission packages are not yet mature, meaning that they have not been demonstrated in an operational environment, which is a best practice for major acquisition programs. Immature technologies increase the risk that some systems will not perform as expected and may require additional time and funding to develop. The impact of delayed technology is less capability for the Flight 0 ships and less information for the Flight 1 ship design. Other issues beyond technology maturity could prevent some technologies from being available in time for the first ship. For example, some technologies considered mature may require alterations to operate from LCS. Some of the technologies still in development face challenges transitioning into production, while other mature technologies may not be available for LCS. Challenges also remain for technologies included on the LCS seaframe, including those for communications, software, launch and recovery, and command and control of off-board systems.

The cost to procure the first flight of LCS remains uncertain, with seaframe costs more defined than the mission package costs. The basis of the procurement costs for the LCS seaframe appears to be more defined since the Navy has performed a series of cost analyses to anticipate the challenges in detailed design and construction. The Navy seeks to stabilize seaframe costs by establishing a $220 million cost target and is working to meet this target by trading between capability and cost while assuring that seaframe performance meets threshold requirements. As many of the technologies for the mission packages remain immature, cost data for procurement of these technologies are not as firm. Other mission package costs, such as procurement costs for MH-60 helicopters, are not covered by LCS program cost analyses. In addition to issues with procurement costs, development costs for the LCS could expand if more time and effort is needed to mature the technologies in the mission packages and the seaframe.

We are making three recommendations to help the Navy assess and mitigate operational, force structure, and technology risks associated with LCS. We are recommending that (1) the Navy analyze the effect and mitigate any risks associated with a larger surface threat on LCS operations and the impact on other naval forces in support of those operations; (2) the Navy incorporate into its continuing efforts consideration of the impact of LCS operations on helicopter force structure and procurement plans as well as efforts to address the manning, technology, and logistics impacts of helicopter operations from LCS; and (3) the Navy revise its acquisition strategy to ensure that it has sufficiently experimented with Flight 0 ships and mission packages before selecting the design for Flight 1. In comments on a draft of this report, DOD partially concurred with our recommendations and described steps it will take to implement them.

Background

According to Navy guidance, the Navy is required to project power from the sea and maintain assured access in the littoral regions, which for naval vessels refers specifically to the transition between open ocean to more constrictive shallower waters close to shore—the littorals. “Anti-access” threats from mines, submarines, and surface forces threaten the Navy’s ability to assure access to the littorals. The LCS is being developed to address these missions. The LCS design concept consists of two distinct parts, the ship itself and the mission package it carries and deploys. For LCS, the ship is referred to as the “seaframe” and consists of the hull, command and control systems, launch and recovery systems, and certain core systems like the radar and gun. A core crew will be responsible for the seaframe’s basic functions. Operating with these systems alone offers some capability to perform general or inherent missions, such as support of special operations forces or maritime intercept operations. The LCS’s focused missions are mine warfare, antisubmarine warfare, and surface warfare. The majority of the capabilities for these missions will come from mission packages. These packages are intended to be modular in that they will be interchangeable on the seaframe. Each mission package consists of systems made up of manned and unmanned vehicles and the subsystems these vehicles use in their missions. Additional crew will be needed to operate these systems. Each mission package is envisioned as being self contained and interchangeable, allowing tailoring of LCS to meet specific threats. Table 1 shows examples of LCS’s focused and inherent missions.

Table 1: Examples of Littoral Combat Ship Missions

Focused missions	Examples of tasks
Littoral mine warfare	• Detect, avoid, and/or neutralize mines • Clear transit lanes • Establish and maintain mine cleared areas
Littoral antisubmarine warfare	• Detect all threat submarines in a given littoral area • Protect forces in transit • Establish antisubmarine barriers
Littoral surface warfare	• Detect, track, and engage small boat threats in a given littoral area • Escort ships through choke points • Protect joint operating areas
Inherent Missions	
Battle space awareness	• Intelligence, surveillance, and reconnaissance
Joint littoral mobility	• Provide transport for personnel, supplies and equipment within the littoral operating area
Special operations forces support	• Provide rapid movement of small groups of special operations forces personnel • Support hostage rescue operations • Support noncombatant evacuation operations • Support and conduct combat search and rescue
Maritime interdiction/interception	• Provide staging area for boarding teams • Employ and support MH-60 helicopters for maritime interdiction operations • Conduct maritime law enforcement operations, including counternarcotic operations, with law enforcement detachment
Homeland defense	• Perform maritime interdiction/interception operations in support of homeland defense • Provide emergency, humanitarian and disaster assistance • Conduct marine environmental protection • Perform naval diplomatic presence
Antiterrorism/force protection	• Perform maritime interdiction/interception operations in support of force protection operations • Provide port protection for U.S. and friendly forces and protection against attack in areas of restricted maneuverability

Source: GAO from U.S. Navy sources.

Navy Plans an Aggressive Schedule for LCS

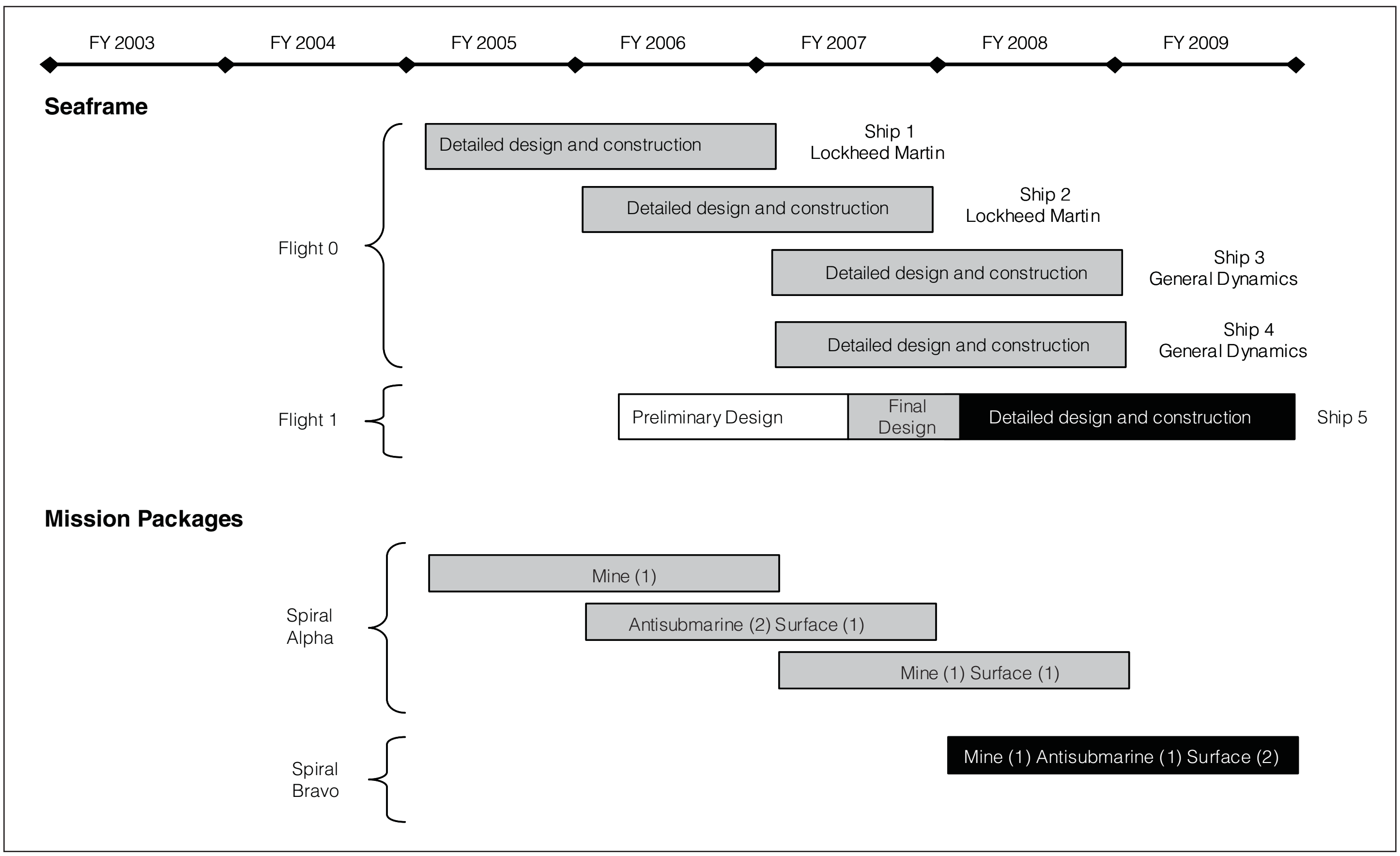
The Navy characterizes the schedule for acquisition and deployment of LCS as aggressive. To meet this schedule, the Navy is pursuing an evolutionary acquisition strategy. Rather than initially delivering a full capability, the program is structured to deliver incremental capabilities to the warfighter. To support this, LCS acquisition is broken into “flights” for the seaframe and “spirals” for mission packages in order to develop improvements while fielding technologies as they become available. The initial flight of ships, referred to as Flight 0, will serve two main purposes: provide a limited operational capability and provide input to the Flight 1 design through experimentation with operations and mission packages. Flight 1 will provide more complete capabilities but is not intended to serve as the sole design for the more than 50 LCS the Navy plans to ultimately buy. Further flights will likely round out these numbers. Flight 0 will consist of four ships of two different designs and will be procured in parallel with the first increment of mission packages—Spiral Alpha. Flight 0 ships are currently being designed, and construction on the first ship will begin in 2005. Due to the accelerated schedule, Spiral Alpha will consist primarily of existing technologies and systems. Spiral Bravo mission packages will be improvements upon these systems and are intended to be introduced with the Flight 1 ships. Figure 1 shows the two designs chosen by the Navy for Flight 0, one by Lockheed Martin and one by General Dynamics.

Figure 1: Flight 0 LCS Designs

Source: Littoral Combat Ship Program Office.

The Navy and Lockheed Martin signed a contract for detailed design and construction of the first Flight 0 ship in December 2004, and the ship builder is expected to deliver the ship to the Navy in fiscal year 2007. The Navy will then begin testing and experimenting with the ship, using the first mission package—mine warfare. A date for any deployment with the fleet has not been determined. Detailed design and construction for the first General Dynamics design ship is scheduled to begin in fiscal year 2006 and delivery is scheduled for fiscal year 2008. The delivery of the first antisubmarine and surface warfare mission packages are aligned with the delivery of the second Flight 0 ship. Figure 2 shows the Navy's current acquisition timeline for Flight 0, Flight 1, and their mission packages.

Figure 2: LCS Acquisition Timeline



Source: GAO, based on Navy data.

Note: Based on congressional action for fiscal year 2005, ship 3 will start construction in fiscal year 2007.

The development of Flight 1 will proceed concurrently with the design and construction of Flight 0. In early fiscal year 2006 the Navy will begin consideration of several preliminary designs for Flight 1. The Navy will choose designs for further development in fiscal year 2007. Selection of a design[6] to start construction of the first Flight 1 ship will be in early fiscal year 2008. Flight 1 and future follow-on designs will be the basis for the LCS class of ships, which the Navy currently estimates could number between 50 and 60. Under the current acquisition strategy, detailed design and construction of the first Flight 1 ship will begin about 12 months after delivery of the first Flight 0 ship. The last two Flight 0 ships will not be available before detailed design and construction of Flight 1 begins. The second Flight 0 ship and the first mission packages for antisubmarine and surface warfare will be delivered just as detailed design and construction of Flight 1 is set to begin. Delivery of the first mission packages in Spiral Bravo will be aligned with delivery of the first Flight 1 ship.

Navy Conducted Detailed Analysis of LCS Requirements, but Surface Threat Risk Is Unclear

Recognizing that it lacks a number of key warfighting capabilities to operate in the littorals, the Navy began to develop the concept of LCS as a potential weapon system before it had completed formal requirements. Normally, a major acquisition program should include an examination of basic requirements and an analysis of potential solutions before a new system is decided upon.[7] The Navy eventually conducted a requirements development process and analyzed a number of alternative solutions to a new ship but concluded that the LCS remained the best option. However, the Navy's analysis of one area of littoral operations—the surface threats facing U.S. forces in littoral waters—did not include consideration of the potential impact of all threats the LCS is likely to face.

Navy Began to Develop LCS before Fully Examining Alternatives

The Navy has known about the capability gaps in the littorals for some time, particularly threats from mines and submarines in shallow waters. As we previously reported, the Navy has acknowledged that it lacks a number of key warfighting capabilities it needs for operations in the littoral environs.[8] For example, it does not have a means for effectively breaching enemy sea mines in the surf zone or detecting and neutralizing enemy submarines in shallow water. The Navy has had programs under way to

[6] The Flight 1 acquisition strategy is under review and Navy officials indicate that no options have been excluded, including the selection of more than one design for Flight 1.

[7] Department of Defense, Instruction No. 5000.2, *Operation of the Defense Acquisition System*, May 12, 2003 and Chairman of the Joint Chiefs of Staff, Instruction 3170.01D, *Joint Capabilities Integration and Development System*, March 12, 2004.

[8] GAO, *Navy Acquisitions: Improved Littoral War-Fighting Capabilities Needed*, GAO-01-493 (Washington, D.C.: May 2001).

improve its capabilities in each of these areas for many years, such as systems designed to provide the fleet with mine detection and limited clearing capabilities, but progress has been slow. Additionally, the Navy has identified the threat of small boats, such as the kind that attacked the U.S.S. *Cole* in 2000, as a potential hindrance to operations in the littorals. The Navy has decided that the LCS is to accomplish these three critical littoral missions.

After recognizing the need to address known capability gaps in the littorals, the Navy conducted a series of wargames to test new concepts for surface combatant ships. One such concept, a very small surface combatant ship called Streetfighter, was incorporated into the Global 1999 war game. The concept was envisaged as a small, fast, stealthy, and reconfigurable ship, which included many characteristics similar to LCS. The Navy's war-fighting assessment processes confirmed gaps in capabilities for mine warfare, shallow water antisubmarine warfare, and surface warfare against small boats. In July 2001, the Global 2001 war game further examined the concepts and potential benefits of modularity—such as using mission packages—and use of unmanned vehicles for littoral missions. As a result of the wargames the Navy continued the process of analyzing a variety of new surface combatant ship concepts to address the threats in the littorals.

In 2002, the Navy established an LCS program office as it began to further identify concepts and characteristics for a new surface combatant ship. In December 2001, the Naval War College was asked to develop and define characteristics that would be desirable in a littoral combat ship. The college used a series of workshops that included operational and technical experts from throughout the Navy to compare three types and sizes of surface combatant ships and describe desirable characteristics that such a ship should have. The experts examined such characteristics as speed, range, manning, and the ability to operate helicopters and unmanned vehicles. The workshop participants also concluded that a potential littoral ship should

- be capable of networking with other platforms and sensors,
- be useful across the spectrum of conflict,
- be able to contribute to sustained forward naval presence,
- be capable of operating manned vertical lift aircraft,
- be capable of operating with optimized manning,
- have an open architecture and modularity,
- be capable of operating manned and unmanned vehicles, and
- have organic self defense capabilities.

The results of the Naval War College study, which was completed in July 2002, were used as a baseline for further developing the concepts for LCS.

At this point the Navy's analysis was focused on a single solution to address littoral capability gaps—a new warship along the lines of LCS. Between April 2002 and January 2004, the Navy conducted an analysis of multiple concepts to further define the concept that would address gaps in the littorals. The analysis began by examining five different ship concepts for LCS (later focusing on three concepts for another stage) and provided the Navy with insight into the trade-offs between features such as size, speed, endurance, and self defense needs. The analysis was performed by the Naval Surface Warfare Center, Dahlgren Division, and drew upon expertise throughout the Navy.

The Office of the Secretary of Defense and the Joint Staff were concerned that the Navy's focus on a single solution did not adequately consider other ways to address littoral capability gaps. Based on these concerns, in early 2004, the Navy was required to more fully consider other potential solutions. The publication of new guidance on joint capabilities development in June 2003,[9] also led the Navy to expand its analysis beyond the single solution of the proposed new ship to include other potential solutions to littoral challenges.

As part of its resulting analysis, the Navy defined littoral capability gaps, developed requirements to address those gaps, and identified and examined 11 nonmateriel and 3 materiel solutions across the joint forces that could be used to mitigate gaps in the littorals. Nonmateriel solutions refer to the use of different operational concepts or methods to meet requirements without buying new assets such as additional ships; materiel solutions are those which involve developing equipment or systems, such as ships and aircraft. The solutions were analyzed to determine the feasibility and risk in mitigating the gaps. The Navy's assessment of feasibility centered on the extent to which each solution addressed the mine, antisubmarine, and surface capability gaps. The Navy's assessment of risk centered on the impacts of each solution on (1) the success of potential operations in the littorals, (2) the sensitivity of diplomatic

[9] This is referred to as the Joint Capabilities Integration and Development System, which is meant to identify joint capabilities that allow joint forces to meet the full range of future military challenges. The current version of this guidance is dated March 12, 2004.

considerations, such as the military support of other nations, and (3) the financial considerations involved in choosing that solution.

Two additional materiel solutions, that centered on maritime patrol aircraft and modified DDG-51 destroyers, were added to the Navy's analysis as a result of input from the Office of the Secretary of Defense's Program Analysis and Evaluation office and the Acquisition, Technology and Logistics office. The Office of the Secretary of Defense and the Joint Staff also provided specific questions to the Navy for further clarification of the Navy's ongoing analysis. With these additions, the Program Analysis and Evaluation office approved the Navy's completed analysis as satisfactory to meet the requirements of a full analysis of alternatives for the LCS program. Table 2 shows the materiel and nonmateriel solutions presented in the Navy's requirements analysis and the results of the Navy's analysis of operational feasibility, as well as operational, diplomatic, and financial risk.

Table 2: Navy's Comparison of Materiel and Nonmateriel Solutions for Mitigating Gaps in the Littorals

Materiel solutions	Gap mitigation	Overall feasibility	Navy's risk assessment
New class of ships tailored to address maritime access tasks mission needs (LCS).	Significant antisubmarine, surface, and mine warfare mitigation	Feasible	Negligible operational risk Negligible diplomatic risk Negligible financial risk
Additional current and programmed forces—includes mine countermeasures assets.	Significant antisubmarine, surface, and mine warfare mitigation	Partially feasible	Negligible operational risk Negligible diplomatic risk Significant financial risk
System upgrades to existing platforms, and additional platforms if necessary. Supplements ships with unmanned vehicles and mission packages.	Significant antisubmarine, surface, and mine warfare mitigation	Partially feasible	Negligible operational risk Negligible diplomatic risk Significant financial risk
Nonsurface combatant solution with emphasis on maritime patrol aircraft.	Significant antisubmarine, surface, and mine warfare mitigation	Partially feasible	Some operational risk Some diplomatic risk Negligible financial risk
DDG-51 destroyer hull with three mission packages for mine, antisubmarine, and surface warfare.	Significant antisubmarine, surface, and mine warfare mitigation	Partially feasible	Some operational risk Negligible diplomatic risk Some financial risk

Nonmateriel solutions	Gap mitigation	Overall feasibility	Navy's risk assessment
Use existing force structure (Combination of assets from carrier and expeditionary strike groups)	Significant antisubmarine, surface, and mine warfare mitigation	Partially feasible	Some operational risk Negligible financial risk Negligible diplomatic risk
Use existing force structure (independent submarines)	Significant antisubmarine mitigation; partial mine warfare mitigation; little to no surface warfare mitigation	Partially feasible	Some operational risk Negligible financial risk Negligible diplomatic risk
Use existing force structure (maritime patrol aircraft and helicopters)	Significant antisubmarine and surface warfare mitigation; partial mine warfare	Partially feasible	Some financial risk Some diplomatic risk Some operational risk
Use existing force structure (Land based tactical aviation for surface warfare)	Little to no antisubmarine and mine warfare mitigation; partial surface warfare	Not feasible	Significant diplomatic risk Some operational risk Some financial risk
Use existing force structure (Long range bombers)	Little to no antisubmarine, mine, and surface warfare mitigation	Not feasible	Significant operational risk Some financial risk Some diplomatic risk
Use existing force structure (Theater-national overhead systems)	Little to no antisubmarine, mine, and surface warfare mitigation	Not feasible	Significant operational risk Negligible diplomatic risk Negligible financial risk
Assign mission to nonmilitary force	Little to no antisubmarine and mine warfare mitigation; partial surface warfare mitigation	Not feasible	Significant operational risk Some financial risk Some diplomatic risk
Not entering contested littorals	Little to no antisubmarine, mine, and surface warfare mitigation	Not feasible	Significant operational risk Significant diplomatic risk Some financial risk
Preemptive actions to eliminate threat	Partial antisubmarine, mine, and surface warfare mitigation	Not feasible	Significant operational risk Significant diplomatic risk Negligible financial risk
Assign tasks to coalition partners	Partial antisubmarine, mine, and surface warfare mitigation	Partially feasible	Significant operational risk Significant diplomatic risk Some financial risk
Tolerate capability gaps (Accept risk)	Little to no antisubmarine, mine, and surface warfare mitigation	Not feasible	Significant operational risk Significant diplomatic risk Negligible financial risk

Source: Navy analysis.

Based on its analysis, the Navy concluded that the materiel and nonmateriel solutions they examined would not provide better operational and cost effective solutions than the proposed LCS to perform the littoral missions. A number of factors were analyzed, including the feasibility of using other surface and non-surface force solutions and the risk associated with those options. Four nonmateriel solutions were considered to be partially feasible for mitigating the gaps in the littorals, while seven other solutions were considered not to be feasible. Partially feasible nonmateriel solutions included the use of maritime patrol aircraft, submarines, and a mix of air and sea assets from carrier and expeditionary strike groups. The most feasible solution considered using a combination of existing forces from carrier and expeditionary strike groups. However, the Navy determined that during a major combat operation, this solution would not be feasible because other mission objectives focused on directing operations onto shore would take a higher priority. Some of the materiel solutions included expanding existing forces, upgrading existing forces, or procuring a new class of platforms tailored for focused missions.

Using a number of studies of threats and analyses of potential military operations in the littoral regions, the Navy developed requirements for the LCS that addressed the identified capability gaps and likely threats in the littorals. This analysis supported revised DOD and Joint Chiefs of Staff requirements for shipbuilding acquisition programs. The Navy identified capability gaps in the littorals by measuring the ability of the current and programmed joint forces to accomplish a number of tasks across a range of operating conditions and standards. The Navy concluded that based on completing the tasks in the littorals under the established measures of effectiveness, it lacked sufficient assets and technology to fully mitigate the gaps. For example, under mine warfare the task for clearing routes for transit lanes covering a specific area within a 7 day period creates a capability gap because the Navy concluded that its force structure lacked the number of assets (mine countermeasures ships, destroyers with remote mine-hunting systems, and the appropriate mine countermeasures helicopters) to fully mitigate the gap in the littorals under the operational timeline of seven days. Table 3 shows examples of tasks for each focused mission, the measures of effectiveness, and the capability gap that exists under the current and programmed force structure.

Table 3: Examples of Mission Warfare Tasks and Related Capability Gaps in the Littorals

Mission task	Criteria to measure success	Capability gaps identified with current and programmed force structure
Mine Warfare: Establish and maintain mine-cleared areas	Clearing transit lanes within 7 days	Inadequate number of mine countermeasures assets in the force to clear transit lanes within seven days.
Antisubmarine warfare: Protect joint operating areas	Detecting submarines at 90 percent success rate	Inadequate number of assets and technology to detect submarines in shallow water at 90 percent success rate.
Surface warfare: Escort through choke points	Neutralizing large sets of small boats in a single raid	Gaps exist in coverage areas in defeating 50 or more small boats, due to shortfall in the numbers of assets. Surface combatant ships and helicopters only provide self defense protection.
Protect port	Neutralizing small sets of small boats in a single raid	Inadequate number of surface combatant assets and technology exists for defeating small boat raid in port operating area. Helicopters provide self defense capability only in port operating area.

Source: GAO from Navy sources.

LCS Requirements Analysis Did Not Cover Some Threats LCS May Face

We analyzed the requirements the Navy developed to address littoral capability gaps and used to support the LCS program, tracking each requirement in the mine, antisubmarine, and surface warfare areas back to the capability gaps and threats identified by the Navy in their requirements development process. We found no inconsistencies in the specific requirements for LCS illustrated in the documents required as part of the joint capabilities integration and development system. However, the requirements the Navy arrived at for LCS's surface warfare capabilities were focused on small boats, and this did not include an analysis of the impact of larger surface threats in the littorals. The Navy focused the surface threat on swarms of small boats, characterized as Boston Whalers, capable of operating at high speeds and employing shoulder mounted or crew served weapons, such as light machine guns. These boats can conduct surprise, simultaneous, short range attacks from or near shorelines. The Navy measured its current and programmed capabilities against defeating swarms of small boats in high numbers. For example, to determine the capability gaps and measures of effectiveness for escorting ships through choke points, the Navy measured its force structure against defeating large numbers of small boats. However, larger threats, such as missile-armed patrol boats and frigates, are also identified in the Navy's LCS concept of operations and threat studies as threats that LCS may face in the littorals. Such vessels may be armed with medium caliber guns, torpedoes, and antiship missiles. These threats could present additional risk to LCS operations.

Some DOD and Navy officials have raised concerns about the extent to which the LCS may face larger threats than it is capable of defending against. Navy officials agreed that the surface threat was focused exclusively on swarms of small boats and told us that LCS is not intended to combat larger threats. The Navy found no capability gap with respect to the larger surface threat, because there is sufficient capability in the existing fleet to counter the threat. Further, Navy officials stated that if a larger surface threat were encountered, LCS would be able to call upon the assistance of other U.S. forces in the area, such as tactical aviation or larger surface warships. In a major combat operation, LCS squadrons would be able to draw upon assistance of those nearby Navy or joint forces in the face of a larger surface threat in the area. However, according to the LCS concept of operations, in addition to operating with other U.S forces on a regular basis, LCS is intended to operate independently of those forces, depending on the type of mission and circumstance. When operating independently, such as during routine deployments to littoral waters, LCS may not be able to call upon assistance from larger U.S. forces. This may impede LCS operations, such as forcing the LCS to withdraw from an operating area, a situation contrary to the Navy's goals. Since the Navy did not analyze the impact of larger surface threats on LCS operations, the extent of the risk and the impact on U.S. operations is not known.

A Detailed Concept of Operations Has Been Developed for LCS but Faces a Number of Challenges in Implementation

Although there are no formal criteria for developing a concept of operations, the Navy has developed both a broad concept and more detailed plans as to how the LCS and its mission systems will be used to meet requirements. The concept of operations also includes several challenges that, if not met, may increase the risk in actual LCS operations. However, the Navy has not yet fully considered the LCS concept of operations in the force structure and procurement plans for the MH-60 helicopter, which is critical to all LCS missions. The Navy has recognized these risks and is attempting to address them. However, if these efforts are not successful within the time constraints of the schedule, the Flight 0 ships may not provide the planned capability or the level of experimentation needed to inform the Flight 1 design.

The Navy has developed a broad concept of operations document for LCS. Though there are no formal guidelines that describe how the concept of operations should be written or the level of detail it should contain, it is a high level requirements document that describes how the user (in this case, the Navy) will use the weapon system to address mission needs. The concept of operations can also be used as guidance in developing testable system and software requirements specifications. In particular, the LCS concept of operations describes how the ship will contribute to U.S. Joint Force operations in countering threats in the littorals. These include mine warfare (detecting and neutralizing mines), antisubmarine warfare (detecting and engaging hostile submarines), and surface warfare (detect, track, and engage surface threats). In addition to these focused missions, the LCS concept of operations discusses how the LCS can perform inherent missions, such as support for special operations forces, maritime interception operations and supporting homeland defense related missions. For example, the LCS concept of operations for maritime interception operations envisages use of the ship's core crew, and any additional personnel in case of operations in higher threat areas, to provide boat crews and boarding teams to board suspect vessels as well as using an embarked helicopter for assistance. The concept of operations is directed at Flight 0 but also provides a vision for follow-on ships. The document has also been used to build consensus among warfighters, the acquisition community, and the various industry teams involved in building LCS as to how the ship is intended to be used.

The development process for the LCS concept of operations began with the Navy Warfare Development Command in late 2002 when it created the first version of the Concept. The document described the projected threat context, capabilities, and operational employment of LCS to help industry with their designs. The Command based this version of the concept of operations on their experience with various pre-LCS studies and war games that employed fast, small ships with modular payloads. The Navy subsequently updated and expanded the concept of operations with new information that related to critical areas that impact, and are impacted by, LCS operations, including doctrine, training, and personnel. The Navy approved the LCS concept of operations in December 2004.

The Navy is also continuing to refine concepts for how LCS and its mission systems will be used to address anti-access threats. These efforts include a Concept of Employment, which describes the way mission package systems are intended to be used to meet warfare requirements, and an analysis of performance data for individual systems in order to inform experiments on the actual operation of LCS mission systems. In addition, the Navy will incorporate lessons learned from Flight 0 operations into future versions of the LCS concept of operations.

We compared the LCS concept of operations to the approved requirements for the ship and the capability gaps identified by the Navy and found that each of the capability gaps and LCS mission requirements were addressed in the concept of operations. For example, the requirements to address the mine warfare capability gap call for mines to be detected, identified, and neutralized. The concept of operations discusses how the LCS will address these requirements by using a combination of helicopters and unmanned vehicles to detect and identify mines, and either a helicopter or an explosive ordinance disposal detachment with unmanned underwater vehicles to neutralize mines.

The LCS concept of operations includes several operational and logistical challenges that may increase the operational risk for LCS. One challenge is to reduce the numbers of sailors required to operate the ship's critical mission systems. This challenge is exacerbated by the limited space on the ship. If this cannot be achieved, the Navy may have to make significant changes to the design or capability of follow-on ships. Another challenge is the logistics support required to meet the Navy's goal of changing LCS mission packages within 4 days of arriving at an appropriate facility. A number of factors frame this challenge, including where packages are to be stored, how they are to be transported, and the proximity of LCS operating areas to ports required to swap mission packages. Any of these factors could increase the time required for a change in LCS mission packages once the decision has been made to do so. Other challenges include training; command, control, communications, computers, and intelligence; survivability; and the impact on the Navy's force structure.

The two versions of the MH-60 helicopter[10] intended for use with LCS embody a number of these challenges. The helicopter is vital to each of the LCS's focused missions as well as some of the ship's inherent missions, such as maritime intercept operations. In order to operate a helicopter from LCS, a detachment of flight and maintenance personnel are required. The Navy's current helicopter detachments on surface warships each number at least 20 people. When combined with the ship's core mission crew, this number could exceed the capacity of LCS to house crews, thereby limiting the ability of LCS to operate other mission package systems and reducing the ship's operational effectiveness.

[10] MH-60R and MH-60S.

Additionally, the Navy's plans for buying and fielding MH-60s do not yet include the quantities needed for the numbers of follow-on LCS ships the Navy intends to buy. Since the helicopter is critical for LCS's concept of operations, the ship's operations will be significantly limited if the helicopters are not bought and made available. To do this, the Navy needs to plan for the numbers of helicopters needed, modify its procurement plans, obtain the funds, build the helicopters, deliver them, conduct operational evaluations, and train the crews.

The Navy recognizes these risk areas and has mitigation efforts underway in each area. For example, in the risk area of manning reduction, the Navy is using the "Sea Warrior" program to cross train sailors so that they are more able to multitask and perform a wider set of duties. The Navy is also conducting additional analysis to validate the maximum number of crewmembers needed and will make changes to crew accommodations if necessary. Further, the Navy is analyzing ways to reduce the size of helicopter detachments and is currently reevaluating its helicopter force structure and procurement plans to provide the MH-60s needed for LCS. In addition, the Navy has established an LCS risk management board to track and manage each of the risk areas as well as monitor the effectiveness of risk mitigation efforts. Table 4 lists the challenges for LCS and examples of Navy mitigation efforts.

Table 4: Challenges for LCS and Examples of Navy Mitigation Efforts

Challenge	Description	Examples of Navy mitigation efforts
Manning	Crew size of core crew and for mission packages could overcome capabilities of the ships as built	• Top-down manning requirements analysis. • Early involvement with human systems integration and manning communities. • Industry integration response. • Navywide effort to analyze and change how sailors are trained in order to allow fewer sailors to monitor and maintain a greater number of the ship's systems.
Training	Need for innovative methods to cross-train personnel in order to achieve reduced manning levels	• 13 Sailors identified and detailed to report to the LCS unit in Norfolk in January. The Naval Personnel Development Command will work with these sailors to mature and develop the "Revolution in Navy Training" approach for developing hybrid sailors. • Combined Navy-Industry team has developed a breakdown of specific skill sets (knowledge, skills, and abilities). • Training will occur at contractors' facilities for the Seaframe and mission packages. This will include hands on training and simulations in the intended environment.
Sustainability/ Logistics	Infrastructure needed to sustain LCS while deployed, including storing and swapping mission packages; maintaining mission technologies while deployed; and viability of long-term unmanned vehicle operation	• Navy is working with both seaframe contractors to classify personnel requirements in performing integrated logistics support tasks in final design. • Realigning current funding to support required integrated logistics support tasking and making this risk an award fee issue.
Command, control, communications, computers, and intelligence	General bandwidth, communication of data from unmanned vehicles to ship, and data links/communications with other fleet assets in support of LCS	• Develop prototype mine, antisubmarine, and surface warfare mission planning applications. • Utilize unmanned vehicle control residual capability from technology demonstration. • LCS command and control iterative process team has been working directly with the two seaframe industry teams to insure that the seaframes include sufficient core communications systems/equipment to operate the Flight 0 mission packages.
Survivability	Ability of LCS to operate in hostile littoral environments, including structural and operational aspects	• LCS seaframe and mission packages teams are working to established Navy survivability requirements.
Force structure	Integration of elements critical to LCS operations (e.g., adequate numbers of appropriate helicopters in the fleet)	• The Navy has conducted numerous force structure studies including the Analysis of Multiple Concepts and Navy headquarters ongoing force structure assessments.

Source: GAO from U.S. Navy sources.

None of these challenges are insurmountable, given enough time and other resources to address them. However, if the Navy is unsuccessful in mitigating the risk areas by the time the first Flight 0 ships are delivered, LCS may be unable to meet even the limited mission capability planned for Flight 0. The Navy plans for a period of about 12 months between the time of delivery of the first Flight 0 ship and the start of construction for the first Flight 1 ship, provided the first Flight 0 ship is available on time. Further, only one mission package (mine warfare) will be available for testing and experimentation during that time. The last two Flight 0 ships will not be available before detailed design and construction of Flight 1 begins. The second Flight 0 ship and the first mission packages for antisubmarine and surface warfare will be delivered just before detailed design and construction of Flight 1 begins. Delays caused by any of the risk areas discussed above might further reduce the already limited time to adequately experiment with one Flight 0 ship in order to integrate lessons learned into planning and designing for Flight 1.

Immaturity in Mission Package Technologies Could Decrease the Experimental and Operational Utility of Flight 0 Ships

A number of the technologies chosen for the LCS mission packages are not mature, increasing the risk that the first ships will be of limited utility and not allow sufficient time for experimentation to influence design for follow-on ships. Our work has shown that when key technologies are immature at the start of development, programs are at higher risk of being unable to deliver on schedule and within estimated costs.[11] The remaining technologies are mature although some may require alterations to operate from LCS. Other issues beyond technology maturity could prevent some systems from being available in time for the first ship. Some technologies still in development face challenges going to production, while other mature technologies may not be available for LCS due to other Navy priorities. Challenges remain for technologies included on the LCS seaframe, including those for communications, software, launch and recovery, and command and control of off-board systems. As a result, the first Flight 0 ships may not be able to provide even the limited amount of mission capability envisaged for them. These factors could also impair the

[11] The standard we used for assessing technology maturity is the demonstration of form, fit, and function in an operational environment. This standard is based on defined technology readiness levels developed by NASA and adopted by DOD. See GAO, *Best Practices: Using A Knowledge-Based Approach to Improve Weapon Acquisition*, GAO-04-386SP (Washington, D.C.: January 2004). A DOD acquisition instruction also states that technology should be demonstrated, preferably in an operational environment, to be considered mature enough for product development in systems integration. See Department of Defense, Instruction No. 5000.2, *Operation of the Defense Acquisition System*, § 3.7.2.2, May 12, 2003. Technology maturity levels are discussed further in GAO, *Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes*, GAO/NSIAD-99-162 (Washington, D.C.: July 30, 1999).

Navy's ability to experiment with the Flight 0 ships and adequately gather and incorporate lessons learned into the designs for the Flight 1 ships.

In order to perform its focused missions of finding and neutralizing mines, submarines, and small boats in the littorals, LCS will deploy mission packages consisting of helicopters and unmanned vehicles with a variety of sensors and weapons. Each of the interchangeable mission packages is tailored to a specific mission and is optimized for operations in the littorals. By using a mix of manned and unmanned vehicles, program officials hope to increase the areas covered and decrease the time required by existing systems. The use of multiple mission packages is to be enabled by the design of the ship itself which will use a number of common connections or interfaces that will work regardless of the individual technologies or systems used in the mission packages.

In order to speed the development of the first LCS, the Navy planned for the mission packages to comprise technologies that are either already demonstrated in an operational environment and used by the Navy, and therefore fully mature, or very close to the end of the development cycle and near full maturity. However, in some cases the program office chose technologies that have not completed testing and are not considered mature. Some of these technologies will be delivered to LCS as prototypes or engineering development models and may not be fully mature. The program office has used an informed process in choosing which technologies to pursue for Flight 0, tracking the maturity of technologies and the plans for further development. Those technologies selected by the program that lack maturity are being monitored and decisions about their inclusion are made based on results of further testing. Once initial choices were made, the Navy used an independent panel of experts, consisting of Navy and industry technology experts, to reassess the maturity of technologies and the efforts needed for risk reduction. The assessment paid particular attention to technologies at low levels of readiness, such as the Non-Line-Of-Sight missile launching system (also referred to as NetFires) and the environment in which the technologies are to be used.

The first mission package to be developed will focus on mine warfare and will align with the delivery of the first ship in January 2007. The systems within this mission package contain both mature and immature technologies, although some mature technologies, like the remote mine-hunting vehicle, may need modifications to operate from LCS. Table 5 shows the maturity and availability of mission package technologies for mine warfare, based on the Navy's current assessment. The first mission package is intended to be delivered with the first Flight 0 ship in fiscal year 2007.

Table 5: Mine Warfare Mission Package Status

Mission	Role	Mature	Available in FY 2007	Issues
Vertical takeoff unmanned aerial vehicle & Coastal battlefield reconnaissance analysis system	Detect	No	Yes	Still in development
Remote mine-hunting vehicle & AQS-20A sonar	Detect	Yes	Yes	May require alterations
Battlefield preparation autonomous underwater vehicle	Detect	Yes	Yes	Has performance problems
Sculpin undersea autonomous vehicle	Detect	Yes	Yes	
MH-60s helicopter		No	Unknown	Schedule risk
• AQS-20A sonar	Detect	Yes	Unknown	Linked to helicopter
• Airborne laser mine detection system	Detect	Yes	Unknown	Linked to helicopter. Only system for detecting floating mines in shallow water
• Rapid airborne mine clearance system	Neutralize	Yes	Unknown	Linked to helicopter
• Organic airborne surface influence sweep system	Neutralize	No	Unknown	Linked to helicopter
• Airborne mine neutralization system	Neutralize	No	Unknown	Linked to helicopter
Unmanned surface vehicle & influence sweep system	Neutralize	No	Unknown	Still in development
Navy mine clearance team	Neutralize	Yes	Yes	Still in development

Source: GAO from U.S. Navy sources.

A number of critical mine warfare systems are not mature or will not be ready due to the unavailability or immaturity of subsystems. This could have a negative effect on LCS as the loss of certain technologies leads to a decrease in capabilities. The MH-60S helicopter is a key system for mine warfare employing technologies for both the detection and the neutralization of mines in shallow water. While the helicopter has proven its ability to detect mines, two of the technologies for neutralization lack maturity. Testing on neutralization technologies continues but is not expected to complete until after delivery of the first ship, limiting the ability of LCS to destroy sea based mines. One system which could fill the gap in this area, the unmanned surface vehicle, also lacks maturity in key systems and ultimately may not be available.

The first systems for antisubmarine and surface warfare packages of Spiral Alpha are scheduled to be available at the time the second Flight 0 ship is delivered in fiscal year 2008. Of these technologies, few are currently mature. Two of the systems used for detecting submarines, the unmanned surface vehicle and remote mine-hunting vehicle, lack maturity in key subsystems and will be delivered to LCS while still experimental. If these systems fail to meet requirements, LCS may have to depend on the MH-60R helicopter to find submarines. The MH-60R is an important system in both these missions, and while fully mature in the antisubmarine warfare configuration, it has not yet completed testing for surface warfare and is not expected to do so until September 2005. The helicopter has potential capability in both detecting and neutralizing surface targets, such as small boats, due to the types of sensors and weapons it carries. Tables 6 and 7 show the maturity and availability of mission package technologies for antisubmarine and surface warfare, respectively. These packages are scheduled to be delivered with the second Flight 0 ship in fiscal year 2008.

Table 6: Antisubmarine Warfare Mission Package Status

Mission package systems	Role	Mature	Available in FY 2008	Issues
Unmanned surface vehicle & sensor systems	Detect	No	Unknown	Still in development
Advanced deployable system	Detect	No	Yes	Still in development
Remote mine-hunting vehicle & sensor systems	Detect	No	Unknown	Still in development
MH-60R helicopter		Yes	Unknown	Schedule risk
• Mk 54 torpedo	Neutralize	Yes	Unknown	Linked to helicopter
• Airborne low frequency sonar	Detect	Yes	Unknown	Linked to helicopter
• Sonobuoys	Detect	Yes	Unknown	Linked to helicopter
Torpedo countermeasures on ship	Defense	No	Yes	
Vertical takeoff unmanned aerial vehicle & communications equipment	Communications	No	Unknown	Still in development

Source: GAO from U.S. Navy sources.

Table 7: Surface Warfare Mission Package Status

Mission package systems	Role	Mature	Available in FY 2008	Issues
Unmanned surface vehicle & electro-optical infrared sensors	Detect	No	Unknown	Still in development
• 30mm gun system	Neutralize	No	Yes	Still in development
• NetFires Missile System	Neutralize	No	Yes	Still in development
• Running gear entanglement system	Neutralize	No	Yes	Still in development
Vertical takeoff unmanned aerial vehicle & electro-optical infrared sensors	Detect	No	Yes	Still in development
MH-60R helicopter & sensor systems	Detect	No	Unknown	Schedule risk
• GAU 16 gun system	Neutralize	No	Unknown	Linked to helicopter
• Hellfire	Neutralize	Yes	Unknown	Linked to helicopter
NetFires missile system on ship	Neutralize	No	Yes	Still in development
30mm gun system on ship	Neutralize	No	Yes	Still in development

Source: GAO from U.S. Navy sources.

In addition to challenges posed by the lack of mature technologies, there may be other challenges in obtaining some mission package systems in time for the first ships. The unmanned surface vehicle, a system used in all three mission packages, is being developed through an advanced concept technology demonstration[12] and does not yet have a planned production schedule. The current development program for the unmanned surface vessel ends in fiscal year 2005 and seeks only to prove the military utility of the vehicle. In order to procure the systems needed for LCS, a new program will have to be established to conclude development, finalize design and start production of vehicles.

Other technologies have planned production schedules but need to complete significant demonstrations and tests before they are able to deploy operationally. The vertical takeoff unmanned aerial vehicle, another system used in all mission packages, underwent a major redesign, and the first deliveries to LCS will not represent a final design. The remote mine-hunting vehicle only recently began development as an antisubmarine warfare platform and remains in development as an

[12] Advanced concept technology demonstrations are DOD efforts to provide mature or maturing technology prototypes to the warfighter in order to test concepts and applicability of the technology and evaluate the extent to which further acquisition is needed.

advanced concept technology demonstration. These factors could jeopardize the dates established for the delivery of the LCS mission packages and may ultimately affect the ability of LCS to execute many of the missions assigned to it.

Other technologies, while mature, may not be available to LCS in time for the ship's deployment due to other Navy priorities. For example, the MH-60 helicopters, in both the MH-60R and MH-60S configurations, are scheduled to complete testing in fiscal year 2007, but may not be fully available until fiscal year 2009, assuming the Navy makes them available for LCS, because of training requirements. This could have an impact on LCS capabilities in all missions. The MH-60S is a key system for mine warfare, and the lack of this helicopter results in the loss of some capability, in terms of detecting some mines, and limitations in the ability to neutralize others. While LCS will still be capable of detecting and destroying mines in littorals without the helicopter, it will do so more slowly, which minimizes operational effectiveness. If the MH-60R is unavailable, the ability to neutralize submarines from LCS is severely compromised as no other mission package system is planned to provide a neutralization capacity. Older, less capable, versions of the MH-60 helicopter can be used in this mission but changes would be needed in the ship's communications systems. The Navy acknowledges that no helicopters will be available for LCS operations until fiscal year 2009 and are working to align crew training schedules to permit operations with LCS.

Challenges also remain for systems on the LCS seaframe, including technologies for communications, software, launch and recovery, and command and control of off-board systems. Further tests of these systems are expected before ship installation.[13]

In addition to limiting the operational capability of the Flight 0 ships, technology maturity and availability issues could limit the time available for the Navy to adequately experiment with operation of the seaframe and mission packages and gather valuable lessons for incorporation into Flight 1 ships. Detailed design and construction of the first Flight 1 ship is currently scheduled to begin in fiscal year 2008. Spiral Alpha mission packages for antisubmarine warfare and surface warfare are not

[13] The exact nature of the seaframe technologies is considered competition sensitive and is not discussed in detail in this report.

scheduled for delivery to the Flight 0 ships until fiscal year 2008, just as detailed design and construction for Flight 1 is set to begin. If technology immaturity causes any of the mission packages systems to slip to later delivery dates, the opportunity to experiment and gather lessons learned from these systems aboard the Flight 0 ships would be lost, unless the time allowed for such experimentation is extended. If the helicopters are not available for operations until fiscal year 2009, input on the full impact of their operations could be lost as well.

Procurement Cost Estimates Are Uncertain

The cost to procure the first flight of LCS ships remains uncertain, particularly regarding the mission packages. The basis of the procurement costs for the LCS seaframe appears to be more defined because the Navy has conducted a series of cost analyses to investigate the challenges in detailed design and construction. The Navy seeks to stabilize seaframe costs by establishing a $220 million cost target and working to meet this target by trading between capability and cost while assuring that seaframe performance meets threshold requirements. Nevertheless, seaframe costs could be affected by changes to ship design and materials that might be necessary as a result of changes to naval ship standards. As many of the systems for the mission packages lack maturity, cost data for these technologies are not as firm. Other mission package costs are not covered by LCS program cost analyses. For programs like LCS, an independent cost estimate by the Office of the Secretary of Defense normally provides additional confidence in program cost estimates, but such an estimate will not be done on LCS until Flight 1. In addition to issues with procurement costs, nonrecurring development costs for the LCS could expand, as systems both in the mission packages and the seaframe remain in development.

The Navy's procurement cost target for Flight 0 is about $1.5 billion (fiscal year 2005 dollars). The cost target for each of the four Flight 0 ships is approximately $370 million. This includes $220 million for the seaframe and approximately $150 million for mission packages (the cost of six packages averaged over four ships).

The Navy currently estimates that the mission packages for Flight 0 will cost approximately $548 million, which is approximately $137 million for the six packages averaged over four ships. This is about $13 million below the mission package target. Table 8 shows the current cost estimates for the mission packages for Flight 0. The estimated cost for seaframe detailed design and construction is considered competition sensitive and is not discussed in detail in this report.

Table 8: Current Estimated Costs for Flight 0 Mission Packages

Fiscal year 2005 dollars in millions			
Item	**Individual cost**	**Quantity**	**Total cost**
Vertical takeoff unmanned aerial vehicle	$37.0	4	$148.0
Advanced deployable system[a]	12.3	1	12.3
Mine warfare package	102.8	2	205.6
Antisubmarine warfare package	67.0	2	134.0
Surface warfare package	23.8	2	47.6
Total for mission packages			**547.5**

Source: GAO from Navy data.

[a]The advanced deployable system is used for detection of submarines.

The Navy has conducted a number of cost reviews for procurement of the LCS seaframe and mission packages to support decision making at key points in the program. One of the most detailed of these reviews took the form of a cost assessment used to support the program's initiation. In this assessment the program office analyzed cost data, provided by the contractor, to establish a preliminary cost and challenged some assumptions behind these costs. The Cost Analysis and Improvement Group of the Office of the Secretary of Defense also performed cost assessments for Flight 0. More recently, a cost estimate for procuring the seaframe and mission packages of Flight 0 was performed by the Navy and became the official program estimate. A cost estimate differs from an assessment in that it goes into greater depth in challenging assumptions behind costs provided by the contractors and may use different methodologies and assumptions to arrive at a final number. As a result, the program estimate may differ from the price provided by contractors and offers a more detailed cost analysis for decision making.

The basis of the procurement costs for the LCS seaframe appears to have become more defined over time as successive cost analyses have been developed to anticipate the challenges in detailed design and construction. Analyses included recommendations to add funds to mitigate changes to seaframe design as well as firm fixed price quotes for some materials. In addition, the Navy seeks to manage seaframe costs by establishing a $150 to $220 million cost range, which the Navy considers aggressive, and has been working to meet this range by trading between capability and cost while assuring that seaframe performance meets requirements. Any capabilities in the seaframe that exceed the requirements established by the Navy are considered trade space areas, in which less expensive systems may be substituted at the cost of lower performance. Each trade is analyzed for impact to cost and operational capability by a team of program officials and is fully vetted through the chain of command.

One factor that increases risk to seaframe cost estimates is applying the current changes in the naval vessel rules for design and construction of surface ships. The unconventional hull designs and materials used in both Flight 0 LCS designs reflect new types of ships the Navy has not hitherto built. Changes to the rules are occurring at the same time as development of the LCS. The process of meeting these rules could lead to changes in the designs and materials used. Such changes may increase uncertainty in seaframe procurement and life-cycle costs.

The costs for the first spiral of mission packages are less defined, as many of the technologies are not mature. For example, the unmanned surface vehicle remains in an advanced concept technology demonstration program into fiscal year 2005. This program seeks only to prove the military utility of the vehicle. Any cost data that emerges as a result of tests and construction of test vehicles does not accurately represent the final cost of the system and is thereby preliminary. The vehicle may also use different subsystems or have different capabilities when used on LCS. This would further change actual procurement costs.

Additional confidence in a program's costs is usually gained through an independent cost estimate done outside the Navy. According to a DOD acquisition instruction, an independent cost estimate should be completed as part of the process that normally authorizes the lead ship, referred to as the Milestone B decision.[14] For programs like LCS, an independent group, like the Cost Analysis and Improvement Group, is required to perform such an estimate. While this group performed assessments of Flight 0 costs, it has not yet performed a cost estimate for LCS. On the LCS program, the Flight 0 ships are considered to be predecessors to the Milestone B decision. The Milestone B decision will authorize the first Flight 1 ship. The Navy considers this to be the point at which an independent estimate is required. An independent cost estimate is thus planned for authorization of Flight 1 in January of 2007. While DOD would

[14] Department of Defense, Instruction No. 5000.2, *Operation of the Defense Acquisition System*, § 3.7.1.2, May 12, 2003. The statutory basis for this requirement is 10 U.S.C. § 2434, which provides that the Secretary of Defense may not approve the system development and demonstration or the production and deployment of a major defense acquisition program unless the Secretary considers an independent estimate of the full lifecycle cost of the program.

not have been prevented from conducting an independent estimate for Flight 0, given the short time in which the Navy solicited and selected designs for Flight 0, it is unclear whether there was enough time to do so.

Other mission package costs are not covered by LCS program cost analyses but could have an effect on the broader Navy budget. For example, mission package costs do not include procurement costs for the MH-60R and MH-60S helicopters utilized in LCS operations. The Navy estimates that the procurement cost for each MH-60R is about $36 million and the cost for each MH-60S is about $23 million. The number of helicopters acquired by the Navy is determined by the helicopter concept of operations, which has not yet been modified to reflect the deployment of LCS. Given the reliance of LCS mission packages on these platforms, costs for these systems, or number needed for operations, could increase.

The developmental nature of the mission package technologies may affect more than the procurement, or recurring, costs of LCS. Development and integration of technologies on many of the mission package systems is not complete. Testing for these systems will continue, in some cases, up to the delivery date of the mission packages. Should these tests not go as planned, or if more time and money is needed for integration and demonstration, development costs could rise. Since the development of mission package systems is only partially funded by LCS, the costs for continued development could spread to other programs. Alternately, the decision maybe made to reduce the quantities of certain technologies aboard LCS, as was the case with the Advanced Deployable system. Some seaframe technologies remain developmental as well, such as the launch and recovery systems. Unlike the mission packages, the LCS program office would assume any increase in development funding that occurs on seaframe systems.

Conclusions

The Navy has embarked on a plan to construct four Flight 0 ships, complete development and procure multiple mission packages, experiment with the new ships, and commit to the construction of follow-on ships in a span of only four years. The Flight 1 and follow-on designs form the basis of a class of ships that may eventually total more than 50. At this point, we see three risks that could affect the success of the program.

First, because the Navy focused the surface warfare threat and requirements analysis exclusively on small boat swarms, the risks posed by larger surface threats when the LCS operates independently from nearby supporting U.S. forces have not yet been assessed.

Second is the availability of the MH-60 helicopter in light of its criticality to all LCS missions. Experimentation with the MH-60 will provide key information on mission performance, operations issues such as manning, and technology maturity. Thus, it is essential that the helicopters, equipped with the systems needed for LCS missions, be available for testing on the Flight 0 ships. In addition, if the quantities of MH-60s are not available for the Flight 1 ships the Navy's ability to deploy these ships operationally as intended, would be reduced. Making the MH-60s available requires meeting a number of challenges, including developing requirements, force structure planning, budgeting, delivering, and training air crews.

Third, the Navy intends to begin considering multiple designs for Flight 1 in fiscal year 2006 and to begin detailed design and construction of a single design in fiscal year 2008. By 2007, only one Flight 0 ship will be delivered, and only one mission package will be available, providing there are no delays for either ship or mission package. While maturing technologies and evaluating potential designs for Flight 1 while Flight 0 ships are being delivered could be beneficial, committing to a single design for follow-on ships before gaining the benefit of tests and experiments with the two Flight 0 designs increases the risk to the Flight 1 design. The current schedule allows about 12 months for the Navy to conduct operational experiments to evaluate the first Flight 0 seaframe design; the mine warfare mission package; and the doctrinal, logistics, technology maturity and other operational challenges the Navy has identified before committing to production of follow-on ships. The Navy's schedule does not allow for operational experimentation with the other three ships or the antisubmarine or surface warfare mission packages before Flight 1 is begun. Setbacks in any of these areas further increases the risk that the Navy will not be able to sufficiently evaluate and experiment with Flight 0 ships and incorporate lessons learned into the design and construction of the Flight 1 ships.

Recommendations for Executive Action

To help the Navy assess and mitigate operational, force structure, and technology risks associated with LCS, we are making the following three recommendations:

- To determine whether surface threats larger than small boats do pose risks to the LCS when operating independently and to mitigate any risks the Navy subsequently identifies, we recommend that the Secretary of Defense direct the Secretary of the Navy to conduct an analysis of the effect of a surface threat larger than small boats on LCS operations and the impact on other naval forces in support of those operations.

- To address challenges associated with integrating the MH-60 helicopter into LCS operations, we recommend that the Secretary of Defense direct that the Navy include in its ongoing evaluation of helicopter integration with LCS (1) evaluation of the numbers and budget impact of helicopters required to support future LCS ships and (2) examination of how to address manning, technology, and logistical challenges of operating the helicopters from LCS.

- To allow the Navy to take full advantage of the technical and operational maturation of the Flight 0 ships before committing to the much larger purchases of follow-on ships, we recommend that the Secretary of Defense direct the Navy to revise its acquisition strategy to ensure that it has sufficiently experimented with both Flight 0 ship designs, captured lessons learned from Flight 0 operations with more than one of the mission packages, and mitigated operational and technology risks before selection of the design for an award of a detailed design and construction contract for Flight 1 is authorized.

Agency Comments and Our Review

In written comments on a draft of this report, DOD generally agreed with the intent of our recommendations. DOD discussed steps it is currently taking as well as actions it plans to take to address these recommendations.

In response to our recommendation that the Navy analyze the effect of a larger surface threat on LCS operations, DOD indicated that, in addition to efforts it already has underway to analyze elements of the threats facing LCS, the Navy will assess the impact of larger surface threats on LCS as part of the capabilities development process for Flight 1. Using the analyses required in this process should help the Navy clarify the extent to which a larger surface threat poses a risk to LCS operations.

In commenting on its plans to address helicopters' needs and challenges, DOD indicated that it is currently assessing the helicopter force structure including both manned and unmanned aerial vehicles. While this may clarify the Navy's helicopter force structure requirements, we continue to believe that due to the importance of helicopters to LCS operations and the numbers of LCS the Navy plans to acquire, the Navy should also analyze the budgetary impact of potential helicopter force structure changes.

In response to our recommendation that the Navy revise its acquisition strategy to ensure time to experiment with Flight 0 designs, DOD stated that, before award of Flight 1 contracts, it will review the acquisition strategy to ensure the strategy adequately provides for experimentation, lessons learned, and risk mitigation. DOD stated that it is balancing the acquisition risks with the risk of delaying closure of warfighting gaps that LCS will fill. It also stated that mission package systems will potentially be spiraled with a different cycle time than the historically more stable hull and systems that comprise the seaframe. We believe the separation of development spirals for the mission packages and seaframe has merit. However, decisions leading to the award of a detailed design contract for the Flight 1 seaframe must go beyond technology risks. Because the Navy plans to begin design of the Flight 1 seaframe with a new development effort and competition, it is important to gain experience with the two Flight 0 seaframe designs that are being acquired so that the benefits of this experimentation can be realized in the design and development of a new seaframe. Experimentation with Flight 0 in terms of basic mission performance, swapping mission packages, actual manning demands, and operations with multiple LCS are all factors that could have a significant effect on the Flight 1 ship design.

DOD also noted that its plan for acquiring LCS provides for multiple flights. Under this strategy, DOD would have more opportunities beyond the fiscal year 2008 Flight 1 decision to upgrade mission packages and seaframes as the 50 or so remaining ships are bought. We have made changes in the report to reflect this strategy. However, we do not believe it lessens the value of incorporating experience from Flight 0 operations into the design for Flight 1.

DOD's written comments are included in their entirety in appendix II.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Defense, and the Secretary of the Navy. We will also make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you or your staff have any questions concerning this report, please contact Paul Francis at (202) 512-2811; or Karen Zuckerstein, Assistant Director, at (202) 512-6785. Key staff members that contributed to this report are listed in appendix III.

Paul L. Francis
Director, Acquisition and Sourcing Management

Janet St. Laurent
Director, Defense Capabilities and Management

Appendix I: Scope and Methodology

To assess the basis of the LCS requirements and the concept of operations, we obtained and analyzed Navy wargames and operational plans, requirements documents, and other sources used by the Navy to identify capability gaps in the littoral waters. We conducted our own analysis of all critical concept, requirements, and acquisition documents required as part of the Joint Capabilities Integration and Development system to determine the extent to which the Navy (1) developed specific requirements to address capability gaps and examined materiel and nonmateriel solutions to meet those requirements; and (2) developed a concept of operations that addressed each of the identified requirements as well as critical doctrinal, logistical, and operational considerations. We compared the sources of the requirements for the LCS, such as analyses of military operations based on specific scenarios and threat assessments to the final validated requirements document (Capabilities Development Document), and highlighted each capability gap. We identified the capability gaps in the Navy's functional analysis for each of the warfare missions—mine warfare, antisubmarine warfare, and surface warfare. This included looking at the Navy's standards that were used to measure how well the current and programmed joint forces could mitigate the warfare threats in the littorals during a major combat operation. We then reviewed the materiel and nonmateriel solutions identified by the Navy that could be used as alternative solutions for mitigating the gaps. We also conducted a comparative analysis of the Initial Capabilities Document with the validated requirements in the Capabilities Development Document to highlight additional gaps. We also compared the requirements, as developed in the CDD and the Preliminary Design Interim Requirements Document to the LCS operating concepts and capabilities, as developed in the Navy's two versions of the concept of operations.

To assess the Navy's progress in defining the concept of operations we used a gap analysis, similar to the one used for the requirements, to trace the extent to which the concept of operations were developed. GAO compared the LCS concept of operations to the ship's requirements (specifically the Capabilities Development Document) and the identified capability gaps to determine if the LCS concept of operations fulfilled the requirements. We also discussed with Navy officials the extent to which they included doctrinal and operational challenges and the Navy's assessment of where the risks are stemming from these challenges and their mitigation efforts.

To assess the progress of technology development in LCS mission packages, we reviewed the basis of the Navy's estimation of technology readiness and plans to bring these technologies to full maturity. As a part of this assessment we analyzed the Technology Readiness Assessment performed by the Navy and reviewed development and testing plans developed by the program offices. As a measure of technology maturity we utilized Technology Readiness Levels, the same metric used by the Navy in the Technology Readiness Assessment. The standard we used for assessing technology maturity is the demonstration of form, fit, and function in an operational environment. This standard is based on defined technology readiness levels developed by the National Aeronautic and Space Administration and adopted by DOD.[15]

[15] See GAO, *Best Practices: Using A Knowledge-Based Approach to Improve Weapon Acquisition*, GAO-04-386SP (Washington, D.C.: January 2004); GAO, *Defense Acquisitions: Assessments of Major Weapons Programs*, GAO-04-248 (Washington, D.C.: March 2004) and *Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes*, GAO/NSIAD-99-162 (Washington, D.C.: July 30, 1999); and Department of Defense, Instruction No. 5000.2, *Operation of the Defense Acquisition System*, § 3.7.2.2, May 12, 2003; and Defense Acquisition Guidebook, § 10.5.2, December 2004.

Table 9: Technology Readiness Levels and Their Definitions

Technology readiness level (TRL)	Description	Hardware software	Demonstration environment
1. Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.	None (paper studies and analysis).	None
2. Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there may be no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.	None (paper studies and analysis).	None
3. Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.	Analytical studies and demonstration of nonscale individual components (pieces of subsystem).	Lab
4. Component and/or breadboard. Validation in laboratory environment.	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.	Low fidelity breadboard. Integration of nonscale components to show pieces will work together. Not fully functional or form or fit but representative of technically feasible approach suitable for flight articles.	Lab
5. Component and/or breadboard validation in relevant environment.	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.	High fidelity breadboard. Functionally equivalent but not necessarily form and/or fit (size weight, materials, etc.). Should be approaching appropriate scale. May include integration of several components with reasonably realistic support elements/subsystems to demonstrate functionality.	Lab demonstrating functionality but not form and fit. May include flight demonstrating breadboard in surrogate aircraft. Technology ready for detailed design studies.

Technology readiness level (TRL)	Description	Hardware software	Demonstration environment
6. System/subsystem model or prototype demonstration in a relevant environment.	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment or in simulated operational environment.	Prototype—Should be very close to form, fit and function. Probably includes the integration of many new components and realistic supporting elements/subsystems if needed to demonstrate full functionality of the subsystem.	High fidelity lab demonstration or limited/restricted flight demonstration for a relevant environment. Integration of technology is well defined.
7. System prototype demonstration in an operational environment.	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in an operational environment, such as in an aircraft, vehicle, or space. Examples include testing the prototype in a test bed aircraft.	Prototype. Should be form, fit, and function integrated with other key supporting elements/subsystems to demonstrate full functionality of subsystem.	Flight demonstration in representative operational environment such as flying test bed or demonstrator aircraft. Technology is well substantiated with test data.
8. Actual system completed and "flight qualified" through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.	Flight qualified hardware.	Developmental test and evaluation in the actual system application.
9. Actual system "flight proven" through successful mission operations.	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last "bug fixing" aspects of true system development. Examples include using the system under operational mission conditions.	Actual system in final form.	Operational test and evaluation in operational mission conditions.

Source: GAO and its analysis of National Aeronautics and Space Administration data.

Our analysis was supplemented by interviews with officials from the LCS program offices and other Navy programs supporting the mission packages. Our audit focused on technologies for Flight 0, as technologies for Flight 1 have not been selected.

To assess the basis of LCS costs we reviewed the cost analyses prepared by the contractors and the LCS program office. We analyzed the basis of costs for design and construction of the seaframe as well as the development and procurement costs of mission packages for Flight 0. Our analysis was supplemented by interviews with the program offices and contractors involved in LCS. Costs for operation of Flight 0 and procurement of Flight 1 have not been estimated. Details of the costs and technologies for the seaframe are sensitive, due to the ongoing competition. We therefore do not discuss these at length.

To address our objectives, we visited and interviewed officials from Navy headquarters' surface warfare requirements office; LCS program offices; mine warfare program office; the MH-60 program office; the Unmanned Aerial Vehicles program office; the Naval Surface Warfare Center, Dahlgren Division; the Naval Undersea Warfare Center; the Naval War College; and the Navy Warfare Development Command. We also interviewed officials from the Office of the Secretary of Defense's Program Analysis and Evaluation division, General Dynamics, and Lockheed Martin.

We conducted our review from July 2004 through December 2004 in accordance with generally accepted government auditing standards.

Appendix II: Comments from the Department of Defense

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

Mr. Paul L. Francis
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Francis:

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) draft report, "DEFENSE ACQUISITIONS: Plans Should Allow Enough Time to Demonstrate Capability of First Littoral Combat Ships," dated January 21, 2005 (GAO Code 120344/GAO-05-255).

The Department has reviewed the draft report and partially concurs with the three recommendations. I am enclosing specific DoD comments that address each of the recommendations.

We appreciate the opportunity to comment on the draft report.

Sincerely,

Glenn F. Lamartin
Director
Defense Systems

Enclosure:
As stated

GAO DRAFT REPORT - DATED JANUARY 21, 2005
GAO CODE 120344/GAO-05-255

"DEFENSE ACQUISITIONS: PLANS SHOULD ALLOW ENOUGH TIME TO DEMONSTRATE CAPABILITY OF FIRST LITTORAL COMBAT SHIPS"

DEPARTMENT OF DEFENSE COMMENTS TO THE RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommended that the Secretary of Defense direct the Secretary of the Navy to conduct an analysis of the effect of a surface threat larger than small boats on Littoral Combat Ships (LCS) operations and the impact on other naval forces in support of those operations. (p. 36/GAO Draft Report)

DOD RESPONSE: Partially Concur.
The GAO draft report identifies the "surface threat larger than small boats" as missile-armed patrol boats and frigates that might have medium-caliber guns, torpedoes, and anti-ship missiles. The GAO draft report states the Navy's analysis of LCS requirements does not consider these.

The Navy either has completed or is in the process of conducting some of the analysis the GAO recommends. Specifically, the Navy has completed an analysis of anti-ship cruise missile threats to LCS. The torpedo defense analysis is complete for Flight 0 and is ongoing for Flight 1. For the remaining areas, the Navy will assess capabilities against larger surface targets in the littoral as part of the LCS Flight 1 Capabilities Development Document generation.

RECOMMENDATION 2: The GAO recommended that the Secretary of Defense direct that the Navy include in its ongoing evaluation of helicopter integration with LCS: (1) an evaluation of the numbers and budget impact of helicopters required to support future LCS ships, and (2) an examination of how to address manning, technology, and logistical challenges of operating the helicopters from LCS. (p. 36/GAO Draft Report)

DOD RESPONSE:
Part 1. Partially Concur. A review of helicopter force structure is underway, taking into account several recent changes, including the introduction of LCS and unmanned aerial vehicles.

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Part 2. Concur. Ongoing Navy studies are addressing manning, technology, and logistical challenges of operating helicopters and unmanned aerial vehicles from LCS. These comprehensive, integrated supportability and engineering studies span LCS, mission module, MH-60, and Vertical Takeoff Unmanned Aerial Vehicle program activities in an effort to define solutions that meet an optimal, total capability need versus system-specific needs. These studies also maximize opportunities to leverage technology development and innovative supportability concepts introduced by other aviation-capable ship programs. The completed study will offer manning alternatives and identify training tracks for the aviation detachment.

RECOMMENDATION 3: The GAO recommended that the Secretary of Defense direct the Navy to revise its acquisition strategy to ensure that it has sufficiently experimented with both Flight 0 ship designs, captured lessons learned from Flight 0 operations with more than one of the mission packages, and mitigated operational and technology risks before selection of the design for an award of the detailed design and construction contract for Flight 1 is authorized. (p. 36/GAO Draft Report)

DOD RESPONSE: Partially Concur.

The Department concurs with the intent of this recommendation and will review the acquisition strategy before award of Flight 1 contracts to ensure that the transition from Flight 0 to Flight 1 adequately provides for experimentation, lessons learned, and risk mitigation. However, the LCS program entails risk by design. The Department balances the program acquisition risks with the risk of delaying closure of the warfighting gaps that LCS will fill. The Navy intends for LCS Flight 0 to deliver an immediate capability to the fleet to address critical littoral anti-access capability gaps and to provide risk reduction for follow-on flights.

The Department previously has identified the risks discussed in this report and actively is managing the risks and developing appropriate mitigation plans. The inherent modularity of the LCS concept mitigates the current schedule risks, especially for the mission packages. Mission package systems will potentially be spiraled with a different cycle time than the historically more stable hull, mechanical, and electrical systems of the seaframe. The primary risks identified by GAO reside in the mission systems. The acquisition of the seaframe has a more manageable risk. Acquisition of new spirals for each of the mission packages will proceed at the pace optimal to their technical maturity to provide warfighting improvements over time.

The evolutionary development plan for LCS provides for multiple flights. The Department does not anticipate the Flight 1 execution decision in FY08 will be for an extended 50+ ship run as suggested in the report, but will be limited to an optimal flight

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size before the Department initiates a flight upgrade with its associated requirements definition process and acquisition milestones. The Navy plans to acquire 50+ LCS, but the acquisition strategy is designed to allow the Department to buy the optimum seaframe and mission packages at every point along the acquisition timeline. We will clarify this in the acquisition strategy update.

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Appendix III: GAO Contacts and Staff Acknowledgments

GAO Contacts

Paul L. Francis (202) 512-2811
Janet A. St. Laurent (202) 512-4402
Karen S. Zuckerstein (202) 512-6785

Staff Acknowledgments

In addition to those named above, Richard G. Payne, Jerome A. Brown, J. Kristopher Keener, Joseph W. Kirschbaum, James C. Lawson, Jodie M. Sandel, Angela D. Thomas, Roderick W. Rodgers, and Bethann E. Ritter made key contributions to this report.

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