Congressional Budget Office

Testimony

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The Navy's Surface Combatant Programs

before the
Subcommittee on Seapower and Expeditionary Forces
Committee on Armed Services
U.S. House of Representatives

July 31, 2008

CONGRESSIONAL BUDGET OFFICE
SECOND AND D STREETS, S.W.
WASHINGTON, D.C. 20515

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
31 JUL 2008		**00-00-2008 to 00-00-2008**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The Navy's Surface Combatant Programs	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Congressional Budget Office,Ford House Office Building, 4th Floor ,Second and D Streets, SW ,Washington,DC,20515-6925**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**16**	

Mr. Chairman, Congressman Bartlett, and Members of the Subcommittee, I appreciate the opportunity to appear before you today to discuss expanding and modernizing the Navy's surface combatant force. The Congressional Budget Office's (CBO's) analysis of surface combatant programs in particular, of the Navy's fiscal year 2009 shipbuilding plan in general, and of information from the Navy about its individual ship programs indicates the following:

- The total cost of the Navy's shipbuilding program through the period covered by the Department of Defense's 2009–2013 Future Years Defense Program (FYDP) would be about 30 percent higher than the Navy currently estimates.

- Building the newest generation of destroyers and cruisers—the DDG-1000 Zumwalt class guided-missile destroyer and the CG(X) future cruiser (the intended replacement for the Ticonderoga class guided-missile cruiser)—would probably cost significantly more than the Navy estimates.

- Building two DDG-51 Arleigh Burke class destroyers—the class of destroyer currently in use—per year would cost less than building one DDG-1000 per year. Procuring three DDG-51s per year would cost about 35 percent more than buying a single DDG-1000. Counting projected operating costs over a period of 35 years, the total ownership cost of five DDG-1000s would almost equal that of eight DDG-51s.

Shipbuilding Costs Under the 2009–2013 FYDP

In February 2008, the Navy released the latest version of its long-term shipbuilding plan, which describes the number, types, and projected costs of ships the Navy has stated it requires to conduct peacetime and wartime missions over the next 30 years. Like the other long-range plans the service has submitted in recent years, the 2009 plan calls for increasing the size of the existing fleet, which consists of 280 battle force ships, to 313 ships by 2020 and beyond.[1] CBO testified before this Subcommittee in March on the overall affordability of that plan and recently released a report updating its analysis.[2] In today's testimony, CBO will focus more narrowly on the five-year period encompassed by the Future Years Defense Program—2009 to 2013—and on surface combatant programs in particular.

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1. The Navy's existing fleet of battle force ships consists of aircraft carriers, submarines, surface combatant ships, amphibious warfare ships, and various support vessels. Surface combatants include destroyers, cruisers, and frigates and are designed to escort and protect other naval ships, such as aircraft carriers, as well as perform missions independently.

2. For a detailed analysis of the Navy's fiscal year 2009 shipbuilding plan through 2038, see Congressional Budget Office, *Resource Implications of the Navy's Fiscal Year 2009 Shipbuilding Plan*, letter to the Honorable Gene Taylor (June 9, 2008). Some of the estimates presented in this testimony differ slightly from those published in earlier analyses because CBO received new information or refined its method of calculating costs.

According to the budgetary information provided in the 2009 shipbuilding plan, as well as in the President's 2009 budget submission and the associated FYDP, the Navy estimates that the costs of constructing new ships of all types, refueling its nuclear-powered vessels, purchasing mission modules (combat systems) for littoral combat ships, and modernizing its large surface combatants—activities that CBO defines as "total shipbuilding"—would average about $16 billion per year (in 2009 dollars) over the period covered by the 2009–2013 FYDP. (Unless otherwise indicated, the cost figures presented in this testimony are expressed in billions of 2009 dollars of budget authority, and years denote fiscal years.) Funding would be about $14 billion in 2009 and then climb to nearly $18 billion by 2013. That amount is 25 percent greater than the $13 billion that the Navy spent, on average, for total shipbuilding each year between 2003 and 2008. According to the Navy's estimates, funding for new construction alone would average $13 billion per year between 2009 and 2013, compared with an annual average of somewhat more than $11 billion between 2003 and 2008.

CBO's estimates of the costs of the Navy's proposed shipbuilding program indicate that the funding needed over the period spanned by the 2009 FYDP would probably be higher, however. Annual costs for total shipbuilding within the FYDP would average about $21 billion, CBO estimates, which is about 30 percent more than the costs projected in the Navy's plan and about 60 percent more than the amounts the Navy has recently spent on shipbuilding. CBO estimates that the annual costs for new construction alone could average $18 billion through 2013, or about 35 percent more than the Navy projects.

The largest differences between the Navy's estimates and CBO's estimates within the FYDP are for the costs of the DDG-1000 Zumwalt class destroyer and the CG(X) future cruiser. Prior to its decision to recommend ending the DDG-1000 program at two ships, the Navy planned to buy five DDG-1000s and two CG(X)s between 2009 and 2013. (Funding for the first two DDG-1000s was authorized in 2007, and construction of those ships is expected to begin this summer.) Whereas the service put the cost of those seven ships at a total of $16.4 billion, CBO estimates the cost would be $28.5 billion. According to CBO's calculations, purchasing a total of seven DDG-1000s would have cost about 60 percent more than the Navy projected, and costs for the five ships purchased over the period covered by the 2009 FYDP would have exceeded the Navy's estimates by almost 45 percent.

In addition, CBO's estimate of the cost of the CG(X) is higher than the Navy's because of the relationship between the DDG-1000 and CG(X) programs. Currently, funding for the CG(X) within the 2009 FYDP is based on constructing the CG(X) using the hull design developed for the DDG-1000, while incorporating within that hull more-sophisticated radars and combat systems than those carried by the DDG-1000. Higher costs for the DDG-1000 would therefore mean higher costs for the two CG(X)s slated for purchase within the FYDP and for the 17 additional CG(X)s the Navy plans to purchase between 2014 and 2023. If CBO's estimate of the cost of the CG(X) is realized, the Navy may find it difficult to purchase two CG(X)s

a year between 2015 and 2021, as proposed in the 2009 shipbuilding plan. Further, if the CG(X) is nuclear powered, as directed by the National Defense Authorization Act for Fiscal Year 2008, the costs of those ships could be higher still. (The prospect for a nuclear-powered CG(X) is discussed in more detail subsequently.) If the service was able to afford only one CG(X) per year, the purchase of seven CG(X)s would have to be either canceled or delayed until the mid- to late 2020s. A delay in CG(X) purchases, rather than a cancellation, could mean that other ship purchases contained in the 2009 plan for the period beyond 2020 might have to be canceled or delayed.

Conversely, postponing the start of the CG(X) program to a point beyond the 2009–2013 FYDP would substantially reduce the pressure on the Navy's shipbuilding budget over the next few years. CBO estimates that the first two CG(X)s would cost a little more than $5 billion each. Thus, canceling the purchase of those ships in the near term would eliminate the $10 billion disparity between the Navy's and CBO's estimates for shipbuilding costs through the FYDP. However, such a shift in procurement would place increased pressure on the Navy's shipbuilding program beyond 2013.

If CBO's cost estimates for the DDG-1000 and the CG(X) are realized, it would be difficult for the Navy to build a 313-ship fleet without substantially increasing its shipbuilding budgets for the years spanning the 2009 FYDP and beyond. (CBO's cost estimates for those ships are discussed in more detail subsequently.) The gap between CBO's and the Navy's estimates of the cost of the DDG-1000 represents more than 12 percent of the Navy's total shipbuilding budget between 2009 and 2013, or about $10 billion. In the absence of additional resources, paying that difference could require canceling the purchase of either 20 littoral combat ships (LCSs) or most of the future maritime prepositioning, or MPF(F), ships within the 2009 FYDP.

DDG-1000 Guided-Missile Destroyer

The Navy had planned to buy one DDG-1000 Zumwalt class destroyer each year between 2009 and 2013, in addition to the two authorized in 2007. The service's 2009 budget suggests that the Navy expected the first two ships to cost $3.2 billion each and the next five to cost an average of $2.3 billion each—reflecting an increase of about $200 million per ship for the last five ships compared with the costs projected in the Navy's 2008 budget. CBO, by contrast, estimates that the first two DDG-1000s would cost about $5.0 billion apiece and that the next five would have cost an average of $3.6 billion each.

The Navy's cost goals and estimates for the DDG-1000 program and its predecessors, the DD(X) and DD-21, have increased several times since 1996 (see Table 1); further growth in the ship's cost is likely. The Navy's current estimate for the two lead-ship DDG-1000s prices the ship at about $250 million per thousand tons of lightship displacement (the weight of the ship minus its crew, materiel, weapons, or fuel). By contrast, the lead ship of the DDG-51 Arleigh Burke class destroyer cost about

Table 1.

Estimated Costs of the Fifth Ship of the DD-21/DD(X)/ DDG-1000 Destroyer Program, Selected Years

	Billions of 2009 Dollars
1996 Navy Cost Goals (DD-21)	
Objective Goal	1.2
Threshold Goal	1.4
2004 Future Years Defense Program	1.6
2009 Navy Estimate	2.1
2009 CBO Estimate	3.6

Sources: Department of the Navy, Fiscal Year 2009 Budget Estimates, Shipbuilding and Conversion (February 2008); Department of Defense, Future Years Defense Program for Fiscal Year 2004; and Department of the Navy, DD-21 Program Office, DD-21 Program Brief (October 19, 1998).

Notes: All years denote federal fiscal years.

For the purpose of historical comparison, the numbers exclude outfitting and postdelivery costs.

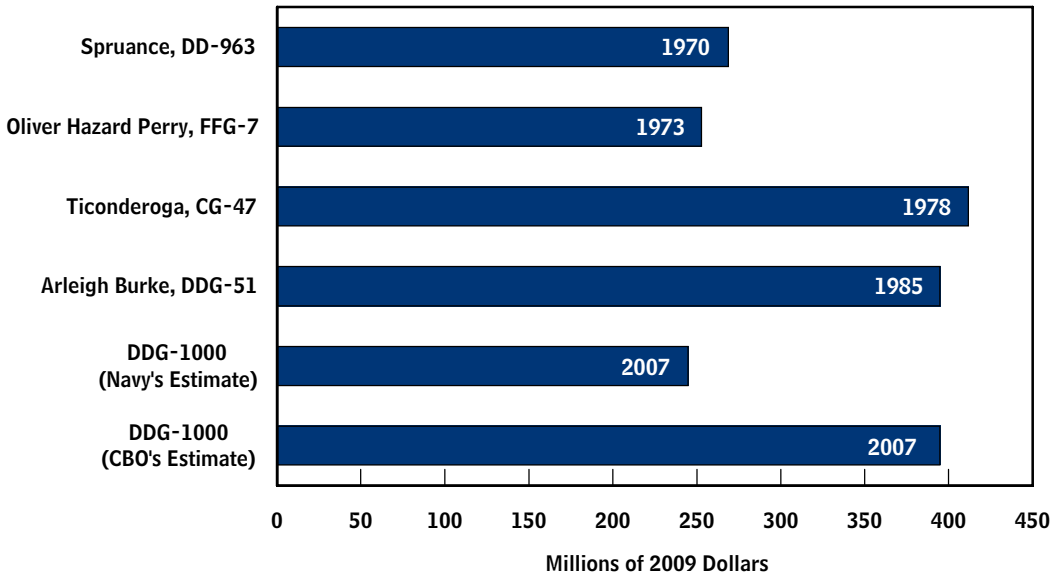
$390 million per thousand tons, and the lead ship of the Ticonderoga class cruiser cost more than $400 million per thousand tons (see Figure 1). CBO used the DDG-51 lead-ship cost as its basis for estimating the cost of the lead ship of the DDG-1000 class, adjusting for the size of the ship.

The Navy has asserted that the basis for CBO's estimate may not be valid because the DDG-51 had a number of problems in the early stages of its construction that should not be expected to occur during the construction of the first DDG-1000s. Specifically, the design of the lead DDG-51 was disrupted and delayed because a new design tool being used at the time was incomplete and not well understood. It had to be abandoned and the design restarted using more traditional methods. The design of the lead DDG-51 was thus about 20 percent complete when construction began. By contrast, according to the Navy, the design of the DDG-1000 progressed far more smoothly; the Navy expects to have the design 85 percent complete when construction begins this summer. In addition, because the DDG-51 is a smaller, more compact ship, the Navy believes that, on a ton-for-ton basis, it has been more difficult to build than the DDG-1000 class is designed to be. (The more open internal spaces of the DDG-1000 mean that it would not be as difficult to install piping, wiring, and other components, and, thus, on a ton-for-ton basis, it should be less time-consuming, and therefore less expensive, to build than a DDG-51.)

Although the Navy may not encounter the same problems constructing the lead DDG-1000s that it did when constructing the lead DDG-51, CBO expects that the service will encounter other problems that will increase the costs of the DDG-1000 and delay its construction. As Navy officials have stated, lead ships are often very difficult to build, and many problems typically occur during construction. Problems

Figure 1.

Cost per Thousand Tons for the Lead Ship of Various Classes of Surface Combatants



Source: Congressional Budget Office based on data from the Department of the Navy.

Notes: The years shown here indicate the year in which each lead ship was authorized.

Costs are per thousand tons of lightship displacement (the weight of the ship minus its crew, materiel, weapons, or fuel).

with the first littoral combat ships (for which costs doubled) and with the lead ship of the LPD-17 class amphibious transport dock (for which costs increased by 80 percent and construction time more than doubled) illustrate the difficulties the Navy has encountered recently in constructing lead ships.[3] Both the LCS and the LPD-17 are much less complex technologically than the DDG-1000 will be. In addition, while the designs of the littoral combat ships and DDG-51 were 20 percent to 30 percent complete at the start of fabrication, the design of the LPD-17 was about 80 percent complete at the start of fabrication—and it was arguably the Navy's most troubled lead-ship program over the past 20 years. Experience with the Virginia class submarine program raises similar concerns. Recently, Navy officials stated in testimony before the Congress that, when construction of those new submarines began, the Virginia class program was at about the same point in its design that the DDG-1000 will be. The cost of the first two ships of the Virginia class exceeded their budget by an average of 17 percent.

3. Problems with the LCS included a change in construction standards, other design changes, and mistakes made by the contractor. The LPD-17 had suffered from an incomplete design before construction began, difficult integration of new technologies on the ship, and higher than expected labor and material costs.

Moreover, the DDG-1000 program is incorporating 10 major new technologies in the lead ship of the class that are intended to improve on technologies used in the previous-generation DDG-51 destroyer. Those technologies include electric drive and a distributed power system, a tumblehome hull (one in which the sides of the ship slope outward to increase stealthiness), an advanced gun system, new radars, and composite materials and stealth-enhancing coatings for the deckhouse. In the past, the Navy typically introduced three or four major new technologies into a new class of surface combatant.

A comparison of the Navy's estimate for two additional DDG-51s and its estimate for the seventh DDG-1000, which was slated to be purchased in 2013, illustrates the risk for cost growth in the latter program. In information recently provided to the Chairman of the Subcommittee on Seapower of the Senate Armed Services Committee, the Navy stated that if the Congress authorized the purchase of two new DDG-51s in 2009—ships that would benefit from lessons learned during the construction of 62 similar ships—the cost would be about $3.3 billion, or slightly less than $1.7 billion each. At the same time, in its fiscal year 2009 budget submission to the Congress, the Navy stated that the cost to build the seventh DDG-1000 in 2013 would be about $2.4 billion in 2013 dollars. Deflating the cost of the seventh DDG-1000 using the inflation index for shipbuilding that the Navy provided to CBO brings the Navy's estimate for that ship to about $1.9 billion (excluding outfitting and postdelivery costs). The lightship displacement of the DDG-1000 is about 5,000 tons (or more than 50 percent) greater than that of the DDG-51s being constructed today. In effect, the Navy's estimates imply that those 5,000 extra tons, as well as the 10 new technologies being incorporated in the DDG-1000 class, will increase the ship's cost by only $200 million, or about 10 percent.[4]

If CBO's cost estimates for the lead DDG-1000s are realized—CBO's estimate is about 55 percent higher than the Navy's for the cost of procuring the first two DDG-1000s—the lead ships of the DDG-1000 program would still experience lower cost growth than the Navy's other lead-ship programs did over the past 20 years. According to an analysis conducted in 2006 by the Department of Defense's Cost Analysis Improvement Group, commonly known as the CAIG, five of eight lead-ship programs experienced cost growth of over 60 percent. The CAIG's analysis at the time did not include the Virginia class submarine program, the first two ships of which experienced cost growth of 11 percent and 25 percent. (Those ships were built under a teaming arrangement and assembled in two different shipyards). The analysis also did not include the first two littoral combat ships, which have experienced cost growth of about 100 percent.

4. The Navy's estimate for the seventh DDG-1000 benefits from the assumption in the FYDP that a CG(X) would also be purchased in 2013, spreading the fixed overhead costs at the shipyards over two ships. If one compares the costs of the sixth DDG-1000, which was slated to be purchased in 2012, with the Navy's estimate of the cost to buy one DDG-51—$2.3 billion versus $2.2 billion—the Navy's estimate assumes those new technologies and the 5,000 additional tons are virtually free.

Table 2.

Projected Costs of Constructing DDG-1000 and DDG-51 Destroyers, 2009 to 2013

(Billions of 2009 dollars)

	2009	2010	2011	2012	2013	Total
DDG-1000 Zumwalt Class (One per year)[a]	3.7	3.8	3.6	3.7	3.6	18.5
DDG-51 Arleigh Burke Class						
One per year starting in 2010	0.4 [b]	2.2	2.3	2.3	2.4	9.6
Two per year starting in 2010	0.4 [b]	3.7	3.8	3.9	3.9	15.7
Three per year starting in 2010	0.4 [b]	5.1	5.2	5.3	5.4	21.4
Memorandum:						
DDG-1000 (Navy's Estimate)	2.5	2.5	2.2	2.3	2.0	11.4

Source: Congressional Budget Office.

Notes: All figures include outfitting and postdelivery costs.

The Navy has announced that it will recommend ending the DDG-1000 program at two ships and resume building DDG-51s in 2010.

a. Figures exclude amounts needed to pay for potential cost overruns on the first two DDG-1000s.

b. Figure represents an assumption about the costs of restarting the production of DDG-51s.

The Cost of Restarting the DDG-51 Program

The Subcommittee specifically asked CBO to examine the costs of canceling the DDG-1000 program and restarting production of DDG-51 destroyers. The Congress authorized funding for what were to be the last DDG-51s in 2005; out of a total program of 62 DDG-51s, nine remain under construction. CBO does not have sufficient information available to determine how much it would cost to restart production of DDG-51s, above extrapolating from the costs of the ships themselves. The authorization bill passed by the House (H.R. 5658) on May 22 allocated $400 million in advance procurement that was to be applied either to the purchase of a third DDG-1000 or to restarting the production of DDG-51s. In the absence of other information, CBO used that figure as an approximation of the amount needed to reestablish production lines for parts and components that were used to build DDG-51s and may no longer be available. Under that assumption and using estimates for DDG-51 production costs that the Navy provided to the Seapower Subcommittee this year, buying eight DDG-51s—two per year between 2010 and 2013—would cost a total of $15.7 billion. Building five DDG-1000s between 2009 and 2013 would cost $18.5 billion, CBO estimates. Twelve DDG-51s, or three per year between 2010 and 2013, would cost about $21.4 billion (see Table 2).

Table 3.

Total Projected Ownership Costs of DDG-1000 and DDG-51 Destroyers Over a Service Life of 35 Years

Program	Billions of 2009 Dollars
DDG-1000 Zumwalt Class	
Single Ship	3.9
5-Ship Purchase	19.4
DDG-51 Arleigh Burke Class	
Single Ship[a]	2.4
8-Ship Purchase	19.2
12-Ship Purchase	26.8
Memorandum:	
Navy's Estimate for DDG-1000	
Single Ship	2.6
5-Ship Purchase	13.2

Source: Congressional Budget Office.

Note: Total ownership costs include construction costs, operating costs, and outfitting and post-delivery costs.

a. The total ownership cost of the single ship assumes that it is part of an annual two-ship purchase. Total ownership costs for ships purchased at rates of one per year and three per year would be $2.8 billion and $2.2 billion, respectively.

Total Ownership Costs of DDG-1000 and DDG-51 Destroyers

In the information provided to the Seapower Subcommittee regarding DDG-51 costs, the Navy indicated that the costs to operate a DDG-51 destroyer and a DDG-1000 destroyer would be fairly comparable. Specifically, the Navy stated that the total operating costs of a DDG-51 would be about $41 million per year, or about 10 percent more than the DDG-1000's $37 million annual operating costs. That difference is much smaller than the Navy had previously estimated. In 2005, the Navy asserted that operating a DDG-51 would cost about 28 percent more than operating a DDG-1000. In comparison, CBO testified in 2005 before this Subcommittee that operating costs for the DDG-51 would probably be about 6 percent more than those for a DDG-1000.

Using data culled from two sources—the Navy's recent estimates of the costs to operate the two types of destroyer, and CBO's estimates of the costs to purchase additional DDG-51s and DDG-1000s—CBO expects that the total ownership cost of a DDG-51 would be about 60 percent of the cost of a DDG-1000. Over the course of a 35-year service life, the costs to buy and operate a DDG-51 would be $2.4 billion on a discounted (net-present-value) basis. In comparison, using the average expected

procurement cost for the five DDG-1000s the Navy expects to buy between 2009 and 2013, the total cost to build and operate a DDG-1000 destroyer would be about $3.9 billion.[5] Thus, the costs to buy and operate five additional DDG-1000s would total $19.4 billion over 35 years. In comparison, the costs to buy and operate more DDG-51 destroyers over a period of 35 years would be about $19.2 billion for eight ships and $26.8 billion for 12 ships (see Table 3).

CG(X) Future Cruiser

In its 2009 budget submission, the Navy proposed to begin buying a new type of missile defense surface combatant, the CG(X) cruiser, in 2011. CBO's estimates of the costs of procuring the first two ships in that class are about double the Navy's estimates. CBO assumed that the CG(X) would use the same hull design and be the same weight as the DDG-1000. The Navy's budget estimates for the cruisers slated for purchase in 2011 and 2013 are based on similar assumptions; the service expects those ships to cost $2.8 billion and $2.5 billion, respectively. Last year, the Navy conducted an Analysis of Alternatives (AoA) to determine what capabilities the CG(X) should have. Results of that analysis have not yet been released, but a version of the CG(X) built using the DDG-1000 hull is only one of the options considered in the AoA. The Navy says that it is studying other options that would be larger and more capable than a CG(X) built using the DDG-1000 hull, including ships that would use nuclear propulsion (see Box 1). It appears now, moreover, that the Navy will not purchase the CG(X) in 2011 but delay the ship to 2015 or beyond.

The Navy does not appear to be considering a ship smaller than the DDG-1000 as the basis for the CG(X). If the DDG-1000 program is canceled after two ships, it appears unlikely the Navy will use that hull form for a future cruiser. Any design that is larger is likely to be substantially more expensive than the DDG-1000. Using the DDG-51 as an analogy, CBO estimates that the lead CG(X) would cost $5.2 billion, about the same as the lead DDG-1000. The average cost of each ship in that class would be about $4.2 billion, assuming that the CG(X) was conventionally powered and used the DDG-1000 hull. CBO also assumed that, consistent with the DDG-1000 program, two shipyards would build the CG(X)s.

CBO's estimate for the cost of the CG(X) may be optimistic. The last time the Navy reused a hull design for a new class of surface combatants was in the 1970s, when the service built the Spruance class destroyers and Ticonderoga class cruisers. Both ship classes shared the same hull design but were intended for different missions. The Spruances were general-purpose destroyers used to escort other Navy ships in the event of war and were designed in particular for antisubmarine warfare. The

5. Using the Navy's cost estimates for the DDG-1000 also shows a higher total ownership cost for the DDG-1000—about $2.6 billion over a 35-year service life.

Box 1.

A Nuclear-Powered Cruiser

The National Defense Authorization Act for Fiscal Year 2008 directed that future Navy aircraft carriers, submarines, and cruisers should be nuclear powered. Building a future nuclear cruiser, a CGN(X), would probably cost more than the Congressional Budget Office (or the Navy) has currently estimated for a conventionally powered CG(X). A Navy report on the cost-effectiveness of nuclear propulsion estimates that the additional cost to install that capability in a conventionally powered surface combatant would be approximately $700 million. If a CGN(X) had to be much larger than the DDG-1000 or a conventionally powered CG(X), there would be additional costs. Press reports have indicated that a CGN(X) could displace as much as 23,000 to 25,000 tons, or 60 percent to 70 percent more than the DDG-1000. A large ship might be necessary, for example, if the Navy were to use for the CGN(X) one of the reactors now used in the CVN-78 class of aircraft carrier; according to the Navy, that reactor's size, weight, and supporting systems could not be accommodated within a hull the size of the DDG-1000's. If that proved to be the case, the larger, nuclear-powered CGN(X) could cost much more than the DDG-1000.

Ticonderoga class cruisers incorporated the Aegis antiair combat system, the SPY-1 radar, and surface-to-air missiles to counter the threat to Navy carrier battle groups posed by Soviet naval aviation. Reflecting its more complex combat systems, the lead Ticonderoga's cost per thousand tons was more than 60 percent higher than that of the lead Spruance, their many common hull features and mechanical systems notwithstanding.

Modernizing DDG-51 Destroyers

The 40-year service life assumed for the DDG-51 Arleigh Burke class destroyers in the Navy's 2009 shipbuilding plan is a significant change from the 35-year service life assumed in the 2007 and 2008 shipbuilding plans. Historical evidence suggests that the Navy's assumption that those destroyers can serve effectively for 40 years may be optimistic. The average retirement age of the last 18 classes of cruisers, destroyers, and frigates was below 35 years, and many were retired at 25 years or less (see Table 4). When the DDG-51 class was first built, it was designed to have a service life of 30 years.

Generally, the Navy has considered surface combatants to be obsolete when their installed combat systems are deemed no longer effective to counter the threats they would face in the event of war. The hull and mechanical systems of the ships have

Table 4.

Average Retirement Age of Surface Combatant Classes

(Billions of 2009 dollars)

Ship Class	Average Retirement Age (Years)	Reason(s) for Retirement
CG-47 (Non-VLS)	20	Budgetary; not as capable as other ships
CG-26	28	Budgetary
CG-16	30	Budgetary
CGN-38	17	Budgetary
CGN-36	24	Budgetary
CGN-35	27	Budgetary
CGN-9	32	Budgetary
DD-963 (VLS)	25	Budgetary; not as capable as other ships
DD-963	25	Budgetary; not as capable as other ships
DD-931	29	End of service life
DDG-993 (Non-VLS)	17	Budgetary; not as capable as other ships
DDG-37	30	End of service life
DDG-2	26	End of service life
FF-1052	17	End of service life; limited capability
FF-1040	22	End of service life; limited capability
FF-1037	25	End of service life; limited capability
FFG-7	18	Budgetary; end of service life
FFG-1	21	End of service life

Source: Congressional Budget Office based on data from the Department of the Navy.

Notes: The reasons cited for retirement are the Navy's descriptions.

CG = guided-missile cruiser; VLS = vertical launch system; CGN = nuclear-powered guided-missile cruiser; DD = destroyer; DDG = guided-missile destroyer; FF = frigate; FFG = guided-missile frigate.

usually had some remaining service life, even if additional resources would have been required to keep them in good working order. Currently, the Navy is planning a modernization program that will focus mostly on the DDG-51's hull and mechanical systems, at an average projected cost of about $100 million per ship. On the basis of historical experience, CBO expects that the combat systems of the DDG-51s may have to be upgraded twice in order for those ships to serve in the fleet for 40 years. In comparison, the Navy plans to spend more than $200 million per ship on modernizing the Navy's remaining CG-47 Ticonderoga class cruisers, including their combat systems, so that those ships can serve effectively for at least 35 years. CBO estimates that the per-ship cost of one round of DDG-51 modernizations, including upgrades to the combat systems, would be at least comparable to the costs projected for modernizing the CG-47s, or more than $200 million apiece.

Littoral Combat Ship

The Navy's 2009 shipbuilding plan envisions building 55 littoral combat ships between 2005 and 2019. Because those ships are assumed to have a service life of 25 years, the Navy would need to begin procuring their replacements in 2032. The LCS differs from the Navy's existing and previous warships in that the program is divided into two components: the sea frame (the ship itself) and mission modules (combat systems). The LCS is designed modularly so that it can be reconfigured fairly quickly to perform one of three distinct missions: finding and sinking quiet diesel submarines operating in crowded, noisy, and shallow coastal waters; finding and neutralizing mines; and countering swarm attacks by small, high-speed boats armed with missiles. The Navy expects to buy 64 mission modules for the 55-ship program.

The Navy intends for the LCS to be a relatively affordable ship that will be fairly simple to design and build. Originally, each sea frame was expected to cost about $260 million (in 2009 dollars, or $220 million in 2005 dollars). The Navy's 2009 budget would allow the purchase of 18 LCSs during the 2009–2013 period, at an average cost of about $450 million per sea frame. That is 11 fewer than the 2008 plan envisioned for the same time period. In the summer of 2007, the Navy requested that the cost cap for the fifth and sixth LCSs be raised to $460 million. Based on the effects of a higher production rate and experience gained between the construction of the first and subsequent ships, that figure suggested that the total construction cost of the first ships would be about $600 million each. In the 2009 budget, the Navy estimates the cost of LCS-1 at $631 million and LCS-2 at $636 million. In recent testimony, the Navy indicated that the costs of LCS-2 will probably grow further but did not indicate by how much.

Historical experience indicates that cost growth in the LCS program was likely. In particular, using the lead ship of the FFG-7 Oliver Hazard Perry class frigate as an analogy, historical cost-to-weight relationships indicate that the Navy's original cost target for the LCS of $260 million in 2009 dollars (or $220 million in 2005 dollars) was optimistic. The first FFG-7 cost about $670 million to build (in 2009 dollars), or about $250 million per thousand tons, including combat systems. Applying that metric to the LCS program suggests that the lead ships would cost about $600 million apiece, including the cost of one mission module. Thus, in this case, the use of a historical cost-to-weight relationship produces an estimate that is less than the actual costs of the first LCSs to date but substantially more than the Navy's original estimate.

On the basis of the actual costs that the Navy has incurred for the LCS program, CBO estimates that the first two LCSs could cost about $700 million each, including outfitting and postdelivery costs and various nonrecurring costs associated with the first ships of a class but excluding mission modules. As of April 27, 2008, LCS-1 was 87 percent complete and LCS-2 was 72 percent complete. So, additional cost growth is possible, and CBO's estimate reflects that cost risk.

Overall, CBO estimates that the LCSs in the Navy's plan would cost about $550 million each, on average, excluding mission modules. That estimate assumes that the Navy would select one of the two existing designs and make no changes. As the program advanced with a settled design and higher annual rates of production, the average cost per ship would probably decline. If the Navy decided to make changes to that design, however, the costs of building future ships could be higher than CBO now estimates.

The relatively simple design of the LCS and the substantial cost increases that have occurred in the program suggest that the Navy may also have trouble meeting its cost targets for the larger, much more complex surface combatants in its shipbuilding plan, such as the DDG-1000 and the CG(X).