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DEFENSE ACQUISITIONS

Zumwalt-Class Destroyer Program Emblematic of Challenges Facing Navy Shipbuilding

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GAO-08-1061T

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Highlights

Highlights of GAO-08-1061T, a testimony before the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives

Why GAO Did This Study

The U.S. Navy is about to begin construction of the first Zumwalt-class destroyer (DDG 1000) amid considerable uncertainties and a high likelihood of cost and schedule growth. Significant cost growth and schedule delays are persistent problems that continue to compromise the Navy's shipbuilding goals. This testimony focuses on (1) the challenges faced by the DDG 1000 program and (2) the strain such challenges portend for long term shipbuilding plans.

What GAO Recommends

While GAO is making no new recommendations in this testimony, GAO has made numerous recommendations through the years to improve business cases for Navy acquisitions as well as other Department of Defense weapon acquisitions. The Department's acquisition policies largely incorporate these recommendations, but program execution has fallen short.

To view the full product, including the scope and methodology, click on GAO-08-1061T. For more information, contact Paul Francis at (202) 512-4841 or francisp@gao.gov.

What GAO Found

From the outset, DDG 1000 has faced a steep challenge framed by technical sophistication, demanding mission requirements, and a cost and schedule budget with little margin for error. The Navy has worked hard to manage the program within these competing goals. Yet recently, the Navy has discussed canceling construction of the remaining five DDG 1000 ships. Although a cancellation may stem from fiscal necessity, it reflects poorly on the acquisition, requirements, and funding processes that produced the DDG 1000 business case. Future success in shipbuilding depends on understanding why the weaknesses in the DDG 1000 business case, which now seem to threaten the program, did not prompt a similar re-examination several years ago.

The current program of record faces significant execution risks. The Navy will be pressed to complete a large amount of design work in time for the start of construction in October 2008. Demonstration of key components—particularly, the deckhouse, the volume search radar, and the integrated power system—have fallen behind. Despite restructuring the construction schedule, margins between several major events are gone. For example, land-based tests of the integrated power system are now scheduled after installation on the lead ships. Software development has also proven challenging; the Navy certified the most recent software release before it met about half of its requirements. Further, the full costs of constructing the two lead ships have not been entirely recognized or funded. The complexity and unique features of DDG 1000, along with the design work, testing, and actual construction experience to come, make cost growth beyond budgeted amounts likely.

The challenges confronted by DDG 1000 are not unique. Across the shipbuilding portfolio, executing programs within cost and schedule estimates remains problematic, largely because of unexecutable business cases that allow programs to start with a mismatch between scope and resources. Collectively, problems in individual programs erode the buying power of the Navy's long-range construction budget. The Navy compensates for near-term construction deferrals by increasing construction in the out-years, but this will require significant funding increases in the future, which are unlikely. Near-term tradeoffs could have long-term consequences for maintaining a rational balance between mission capability, presence, industrial base, and manning.

The Navy's consideration of cutting the DDG 1000 program back comes after over 10 years of development and $13 billion have been invested. Clearly, changes are needed in how programs are conceptualized and approved. Although the elements needed for success are well known, unrealistic compromises are made to make business cases conform to competing demands. An examination of the root causes of unexecutable business cases must be done or shipbuilding programs will continue to produce unsatisfactory outcomes. This examination must begin with an honest appraisal of the competing demands made on new programs early in the acquisition process and how to strike a better balance between them.

Mr. Chairman and Members of the Subcommittee,

I am pleased to be here today to discuss the Department of the Navy's Zumwalt-class (DDG 1000) destroyer program, part of the family of future surface combatants. Much of my statement is drawn from a detailed report we issued today on the status of the program.[1] DDG 1000 is an ambitious program that is now in the first year of a 6-year construction schedule for the two lead ships. Last week, the Navy began discussing cancellation of the remaining five ships in the class. While a cancellation may stem from fiscal necessity, it comes after well over 10 years of development and over $13 billion in investments thus far. Future success in shipbuilding programs depends on recognizing the factors that necessitated the decision and taking steps to avoid having to do so again in the future.

Accordingly, today I will be discussing (1) the challenges faced by the DDG 1000 program and (2) the strain such challenges portend for the shipbuilding budget. I do this not as a critique of the Navy's management of the program (for there is much about the acquisition that exhibits foresight and thoughtful planning), but as the latest in a series of shipbuilding programs in which the scope of the program is a mismatch for the time and money resources that have been allotted for it. These mismatches result in reductions in quantities that, in turn, have a collective effect on the Navy's long-term shipbuilding goals. I look forward to today's hearing as an opportunity to discuss not only the symptoms of the problem, but the root causes as well.

Summary

DDG 1000 development has been framed by challenging multimission requirements, resultant numerous new technologies, and a cost and schedule budget that added to—rather than eased—the challenge. While the Navy has done much work to try to manage the program within these competing goals, it will begin lead ship construction in October 2008 with significant uncertainties, particularly in developing the ship's design, key components, and the ship software system. Recent restructuring of the schedule buys more time for technology development, but shifts key efforts like installation and testing of the combat systems until later in the construction schedule—after the ships have been initially delivered. Such compromises—made before construction has even begun—suggest that

[1]See GAO, *Defense Acquisitions: Cost to Deliver Zumwalt-Class Destroyers Likely to Exceed Budget*, GAO-08-804 (Washington, D.C.: July 31, 2008).

the Navy already has little margin for solving future problems without adding money and time. In fact, it appears that the budget for the lead ships is not adequate to deliver fully operational ships. The complexity and unique features of DDG 1000, along with the design work, testing, and actual construction experience to come, add to the risk of cost growth.

DDG 1000 is not unique in this respect. Across the shipbuilding portfolio, the Navy has had problems executing its programs within cost and schedule estimates, particularly with first-in-class ships. I see this as a mismatch between the scope of programs and the resources (time and money) allotted to execute them. For example, albeit a much simpler vessel, the Littoral Combat Ship (LCS) program proceeded into construction with unstable designs and unrealistic cost and schedule estimates. Similarly, the Navy is proceeding with construction of the Ford-class (CVN 78) aircraft carrier as it faces problems with an enabling technology and a budget that has no margin for unanticipated problems. Cost and schedule problems in individual programs have a collective effect on the Navy's long-range construction plans. Each year, the Navy prepares a 30-year shipbuilding plan that attempts to balance the competing objectives of maximizing the mission capabilities of each ship and reducing crew size, while at the same time providing a sufficient quantity of ships to achieve the necessary level of global presence and to provide a stable workload for shipyards. This year, the Navy has reduced the plan's ship quantities in the near term and compensated for current shipbuilding problems by projecting increased ship construction in the out-years based on the hope that more money will be available in the future. The Navy's proposed decision to discontinue the DDG 1000 program after the two lead ships and build more of the less costly Arleigh Burke-class (DDG 51) destroyers should restore some balance in the plan. However, we would do well to understand the factors that led to the DDG 1000 business case so that future programs do not suffer the same fate.

This statement is based on work we conducted between September 2007 and July 2008, as well as our previous testimonies and reports and is in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Navy Unlikely to Execute DDG 1000 Program within Current Cost and Schedule Estimates

The DDG 1000 program has from the onset faced a steep challenge framed by demanding mission requirements, stealth characteristics, and a desire to reduce manning levels by more than half that of predecessor destroyers. These requirements translated into significant technical and design challenges. Rather than introducing three or four new technologies (as is the case on previous surface combatants), DDG 1000 plans to use a revolutionary hull form and employ 11 cutting-edge technologies, including an array of weapons, highly capable sensors integrated into the sides of a deckhouse made primarily of composite material—not steel, and a power system designed for advanced propulsion as well as high-powered combat systems and ship service loads. This level of sophistication has necessitated a large software development effort—14 million to 16 million lines of code. All of this is to be accomplished while splitting construction between two shipyards. The Navy believes this approach and schedule is important to managing shipyard workloads, as starting later would have caused shipyard workload to drop too low. In a sense, then, the construction approach and schedule became an additional challenge as they became constraints on the pace of technology and design development. To meet these multiple and somewhat conflicting demands, the Navy structured its acquisition strategy to develop key systems and mature the design before starting to build the ship. While the Navy has made good decisions along the way to address risk, it is already likely, shortly before the Navy embarks on ship construction, that additional funding will be necessary or trade-offs will need to be made to develop and deliver DDG 1000 ships.

Despite a Thoughtful Approach, Delays in Technology, Software, and Design Development Pose a Risk to Successful Program Execution

Despite multiple and somewhat competing demands, the Navy conceived a thoughtful approach and achieved developmental successes on DDG 1000. Developing 10 prototypes of the ship's critical systems helped to create confidence that a number of technologies would operate as intended, and the Navy's plan to mature the ship's design before starting construction aims to reduce the risk of costly design changes after steel has been cut and bulkheads built. For example, the Navy successfully demonstrated the advanced gun system through initial guided flight and testing on land. In other cases, such as for the integrated power system, tests brought to light technical problems, which the Navy was able to address by going to an alternate technology. However, notwithstanding these efforts, significant challenges remain in developing the ship's design and a number of key components—in particular, the deckhouse, volume search radar, and the integrated power system. Moreover, the ship's capability is contingent on an unprecedented software development effort. Recently, the Navy restructured the schedule to buy more time for development—a good decision. However, as construction of the first ship has not yet begun, the Navy may have exhausted its options for solving future problems without adding money and time.

Although the initial phases of the design are complete, the shipbuilders will be pressed to complete a large amount of design work by October 2008 when lead ship construction begins. From August 2007 through May 2008, the shipbuilders finished work on 16 of the 100 design zones (individual units that make up the ship's design) leaving 5 months to finish the final design phases in 84 zones leading up to the start of construction. While the shipbuilders believe they can finish the design by the start of ship construction, delays in the development of the ship's key systems could impede completion of the design and eventually interfere with DDG 1000 construction. If the shipbuilders cannot finish planned design work prior to the start of lead-ship construction, the program is at greater risk for costly rework and out-of-sequence work during construction.

To maintain the start of ship construction in 2008 while continuing to develop the ship's technologies, the Navy recently realigned the program's schedule. Rather than delivering a fully mission-capable ship, the Navy will take ownership of just the vessel and its mechanical and electrical systems—including the ship's power system—in April 2013. At that point, the Navy plans to have completed "light-off" of the power, mechanical, and electrical systems. Light-off refers to activating and testing these systems aboard ship. The Navy deferred light-off of the combat systems—which include the radars, guns, and the missile launch systems—by over 2 years until May 2013. According to the Navy, conducting light-off in phases allows the program to test and verify the ship's major systems, in particular the integrated power system, in isolation and creates additional time to mature the combat systems, as well as the software that supports these systems, before ship installation and shipboard testing. However, since the Navy will only test and inspect the hull prior to taking ownership of the vessel, it will not have a full understanding of how the ship operates as a complete and integrated system until after final shipboard testing of the combat systems in 2014.

While the restructure maintains the construction schedule, it does delay verifying the performance of the integrated power system before producing and installing it on the ship. Tests of a complete integrated power system with the control system will not occur until 2011—nearly 3 years later than planned. To meet the shipyard's schedule, the Navy will buy a power system intended for the third ship and use it in land-based tests. As a result, the integrated power system will not be demonstrated until a year after the power systems have been produced and installed on the two lead ships—an approach that increases exposure to cost and schedule risk in production.

Finalizing deckhouse manufacturing and assembly processes are essential to constructing and delivering the deckhouse as planned. Changes to the manufacturing processes for deckhouse production are ongoing. The shipbuilder is validating process changes through production and inspection of a series of test units, culminating with a large-scale prototype manufactured to the same thickness and other specifications of the deckhouse. Final validation of the manufacturing processes for deckhouse construction will not occur until after construction, inspection, and shock testing of the large-scale prototype. However, test and inspection activities are not scheduled for completion until after the deckhouse production readiness review in September 2008. Problems discovered during testing and inspection may require additional changes to manufacturing methods. Moreover, facility and machinery upgrades necessary to construct and assemble the deckhouse are not all scheduled to be complete until March 2010—over a year after the start of construction of the first deckhouse. While the shipbuilder expects to complete efforts to meet the construction schedule, if difficulties occur, the deckhouses may not be delivered to the shipyards on time, disrupting the construction sequence of the ships.

Further, the volume search radar (one of two radars in the dual band radar system) will not be installed during deckhouse construction as initially planned. Instead, installation will occur at the shipyard when the first ship is already afloat, a more costly approach. The change was partly due to delays in developing the volume search radar. Land-based demonstrations of the volume search radar prototype originally planned to be done before starting ship construction will not be completed until 2009—almost 2 years later. Development difficulties center on the radar's radome and transmit-receive units. The contractor has been unable to successfully manufacture the radome (a composite shield of exceptional size and complexity), and the transmit-receive units (the radar's individual radiating elements) have experienced failures operating at the voltage needed to meet range requirements. While the Navy believes that the voltage problem has been resolved, upcoming land-based tests will be conducted at a lower voltage—and without the radome. The Navy will not demonstrate a fully capable radar at its required power output until after testing of the first production unit sometime before combat systems light-off in 2013.

Crucial to realizing DDG 1000's required manning reductions is the ability to achieve a high degree of computer automation. If the ship's software does not work as intended, crew size would need to be increased to make up for any lack of automation. Given the risks associated with the ship's software system, referred to as the total ship computing environment, the Navy initially planned to develop and demonstrate all software functionality (phased over six releases and one spiral) over 1 year before ship light-off. As a result of changes in the software development schedule, the Navy eliminated this margin. Until recently, the Navy was able to keep pace with its development schedule, successfully completing the first three software releases. However, the Navy is now entering the complex phases of software development when ship functionality is introduced. The Navy certified release 4 without the release meeting about half of the software system requirements, mainly because of issues coding the ship's command and control component—the heart of the ship's decision-making suite. Problems discovered in this release, coupled with the deferred work, may signify larger software issues that could disrupt the development of releases 5 and 6 and prevent the timely delivery of software to meet the ship's schedule.

DDG 1000 Costs Likely to Exceed Budget

Costs of the DDG 1000 ships are likely to exceed current budgets. If costs grow during lead ship construction due to technology, design, and construction risks, as experience shows is likely, remaining funds may not be sufficient to buy key components and pay for other work not yet under contract.

Despite a significant investment in the lead ships, the remaining budget is likely insufficient to pay for all the effort necessary to make the ships operational. The Navy estimates a total shipbuilding budget of $6.3 billion for the lead ships. Of this amount, the Navy has approximately $363 million remaining in unobligated funds to cover its outstanding costs and to manage any cost growth for the two lead ships,[2] but known obligations for the lead ships, assuming no cost growth during construction, range from $349 million to $852 million (see table 1).

[2]Based on data as of June 2008.

Table 1: Unfunded Lead Ship Expenses

Expense	Status	Estimated value
Deferred ship construction scope	Work removed from scope of construction contract to stay within construction budget. Since this work is necessary to meet ship specifications, the Navy plans to perform and fund work sometime after the lead ships are delivered. Includes the following: • windows and enclosures for certain sensors, • special hull treatment, • deck coverings that comply with the ship's radar cross section requirements, • secondary hull sheathing, • anchor handling system.	$85 million
Contract price adjustments	Construction contracts structured to allow price adjustments based on future events that were considered largely outside of the shipbuilders' control. Adjustments reduced the shipbuilders' risk premium allowing a lower initial contract price. Includes the following: • shifts in future workload, • escalations in future rates, • changes in the price of raw materials such as steel and copper.	Not available
Deferred procurement of select combat systems	Purchase and installation are not yet under contract for the following systems: • volume search radar aperture and other components • vertical launch system electronics, cell adapters, uptakes, and junction boxes • 34 external communications antennas and apertures per ship. The contractor estimate of these costs is approximately $763 million; the Navy estimates approximately $200 million for both ships.	$264 million to $767 million
Deferred activation of combat systems	Funds also not obligated toward light-off and final shipboard testing of the combat systems. The Navy estimates as much as $64 million for both ships, including about $4 million in costs for activation to be provided to the shipbuilders. Contractor and shipbuilder estimates may be higher.	

Source: GAO analysis of Navy and contractor data.

The main discrepancy is the current estimated cost of the combat systems. In order to create a cash reserve to pay for any cost increases that may occur during construction of the lead ships, the Navy has deferred contracting and funding work associated with conducting shipboard testing of the combat systems—and in some cases has also delayed purchasing and installing essential ship systems until later in the construction sequence. The Navy has estimated the cost of these combat systems to be around $200 million, while the contractor's estimate is over

$760 million. If the agreed-on cost approaches the contractor's estimate, the Navy will not have enough in its remaining funds to cover the cost.[3]

There is little margin in the budget to pay for any unknown cost. To ensure that there was enough funding available in the budget to cover the costs of building the lead ships, the Navy negotiated contracts with the shipbuilders that shifted costs or removed planned work from the scope of lead ship construction and reduced the risk contingency in the shipbuilders' initial proposals. For example, the Navy stated that it shifted in excess of $100 million associated with fabrication of the peripheral vertical launch system from the scope of ship construction and funded this work separately using research and development funding.[4] As a result, this work is no longer included in the $6.3 billion end cost to construct DDG 1000.

To the extent that the lead ships experience cost growth beyond what is already known, more funding will be needed to produce operational ships. However, these problems will not surface until well after the shipyards have begun construction of the lead ships. Cost growth during construction for lead ships has historically been about 27 percent, and an independent estimate by the Department of Defense already projects the cost of the two lead ships to be $878 million higher than the Navy's budget. With ships as expensive as DDG 1000, even a small percentage of cost growth could lead to the need for hundreds of millions of dollars in additional funding.

[3]According to Navy officials, the Navy expects to definitize the contract for combat systems procurement in August 2008.

[4]By shifting these costs the Navy stated that it could use research, development, testing, and evaluation (RDT&E) funding instead of procurement funding (SCN). However, this may lead to increases in the RDT&E budget.

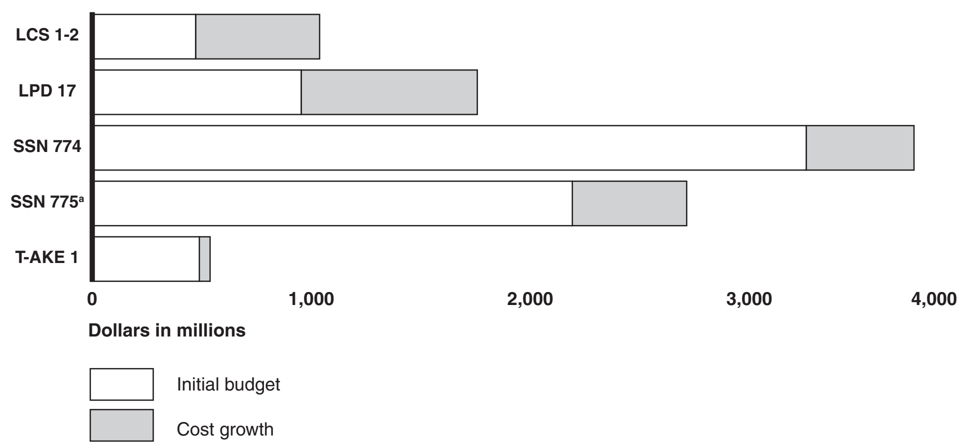
Program Execution Challenges Have Required the Navy to Make Trade-Offs In Its Long-Range Shipbuilding Goals

The challenges facing DDG 1000 are not unique among Navy shipbuilding programs nor to Department of Defense acquisition programs at large. Across the shipbuilding portfolio, the Navy has not been able to execute programs within cost and schedule estimates, which has, in turn, led to disruptions in its long-range construction plans. This outcome has largely resulted from Navy decisions to move ships forward into construction with considerable uncertainties—like immature technologies and unstable designs. However, by doing so the Navy has effectively eroded its buying power by forcing it to make near-term quantity reductions within its shipbuilding plan. Because fleet requirements remain steady at 313 ships, the Navy must compensate for near term construction deferrals by increasing ship construction in the out-years. Achieving this plan, however, will require significant funding increases in the future, which will likely be difficult to obtain. These near term trade-offs could have long-term consequences for balancing mission, presence, industrial base, and manning tensions. For example, if ship quantities are deferred to the future to accommodate near-term cost growth, the Navy could be trading off presence and industrial base if additional funds do not materialize in the future.

The Navy Consistently Underestimates the Effort Required to Successfully Execute Its New Shipbuilding Programs

Cost growth and schedule delays are persistent problems for shipbuilding programs as they are for other weapon systems. These challenges are amplified for lead ships in a class (see figs. 1 and 2).

Figure 1: Cost Growth in Recent Lead Ships (Dollars in Millions)

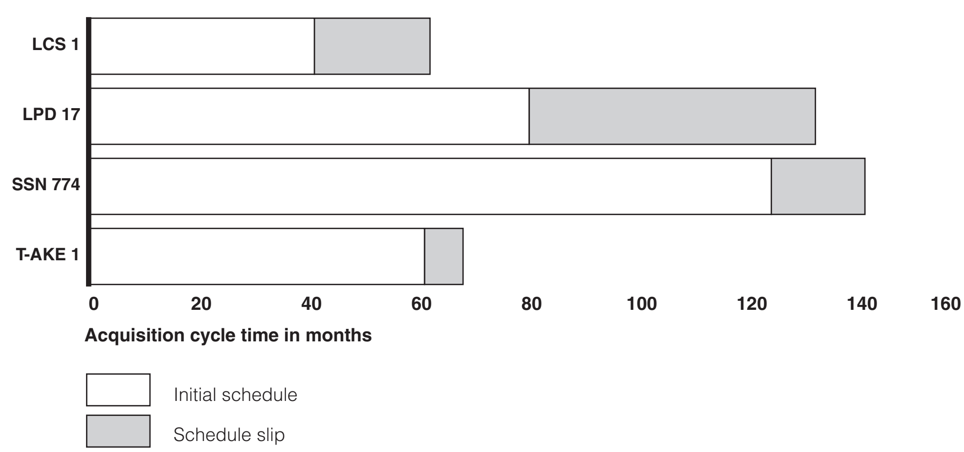


Source: GAO analysis of Navy data.

[a]SSN 775 is the second Virginia-class submarine, but represents the first hull delivered by Northrop Grumman Newport News shipyard.

Note: all ships with the exception of LCS 1-2 have been delivered to the Navy.

Figure 2: Delays in Achieving Initial Operating Capability in Recent Lead Ships



Source: GAO analysis of Navy data.

The Navy's six most recent lead ships[5] have experienced cumulative cost growth over $2.4 billion above their initial budgets. These cost challenges

[5]While SSN 775 does not use a different ship design, it was constructed by a different shipyard than SSN 774.

have been accompanied by delays in delivering capability totaling 97 months across these new classes. The first San Antonio-class ship (LPD 17) was delivered to the warfighter incomplete and with numerous mechanical failures—52 months late and at a cost of over $800 million above its initial budget. For the LCS program, the Navy established a $220 million cost target and 2-year construction cycle for each of the two lead ships. To date, costs for these two ships have exceeded $1 billion, and initial capability has been delayed by 21 months. Cost increases are also significant if the second ship is assembled at a different shipyard than the first ship. This was the case with SSN 775, with cost growth of well over $500 million.

These outcomes result from the Navy consistently framing its shipbuilding programs around unexecutable business cases, whereby ship designs seek to accommodate immature technologies and design stability is not achieved until late in production. New ship programs have moved forward through milestones, whether or not desired knowledge had been attained. In turn, initial ships in Navy programs require costly, time-consuming out-of-sequence work and rework during construction, and undesired capability trade-offs are often required. In essence, execution problems are built into the initial strategy for a new ship, as the scope of the ship—that is, the innovative content and complexity owing to multiple mission requirements—overmatches the time and money set aside to develop and construct the ship. For example, while the scope of the DDG 1000 and CVN 78 ships were driven by mission requirements, the schedules for these ships was set by shipyard workload needs or by the retirement schedule of a predecessor ship. The result is the scope of work is compressed into a schedule that is based on something else.

LCS is a recent example. In this program, the Navy sought to concurrently design and construct two lead ships in an effort to rapidly meet pressing needs in the mine countermeasures, antisubmarine warfare, and surface warfare mission areas. However, changes to Navy requirements required redesign of major elements in both lead ships to provide enhanced survivability, even after construction had begun on the first ship. While these requirements changes improved the robustness of LCS designs, they contributed to out-of-sequence work, rework, and weight increases on the lead ships. These difficulties caused LCS construction costs to grow and delivery schedules to be extended and prompted the Navy to reduce speed requirements for the class due to degraded hydrodynamic performance. In turn, the Navy canceled construction contracts for the third and fourth ships and used funds from other previously appropriated ships to pay for lead ship cost growth. Although these steps increased the resources available to the two lead ships, continuing technology immaturity and unproven watercraft launch and recovery systems included within each design could trigger additional cost growth and schedule delays above and beyond current estimates.

The Ford-class aircraft carrier (CVN 78) also faces uncertainty related to its cost and schedule estimates and eventual capability. The business case for CVN 78 is framed around delivering the carrier to maintain the Navy's force of 11 operational carriers given the impending retirement of USS *Enterprise* (CVN 65), but includes a cost target that leaves little if any margin for error. As construction begins, remaining technology risk in the program—particularly with the electromagnetic aircraft launch system (EMALS)—has positioned the program to face future construction challenges similar to other lead ships. Previously, the Navy planned to demonstrate full functionality of a ship-ready system prior to production and installation on CVN 78—an approach aimed at reducing risk to ship construction. However, the contractor encountered technical difficulties developing the prototype generator and meeting detailed Navy requirements which left no margin in the schedule to accommodate unanticipated problems discovered in testing or production. In order to maintain the ship's construction schedule, the Navy adopted a test and production strategy that will test, produce, and ultimately install EMALS with a high degree of concurrency. At the same time test events are occurring, the Navy will authorize and begin production of EMALS intended for ship installation. While Navy officials recognize that concurrency is undesirable, they believe it is the only way to meet the ship's delivery date in September 2015. However, by moving ahead with production in order to accommodate schedule milestones, CVN 78 is at risk of cost growth and ultimately schedule changes if unexpected problems arise in EMALS testing.

Challenges Facing Current Programs Have Disrupted the Navy's Long-Range Construction Plans

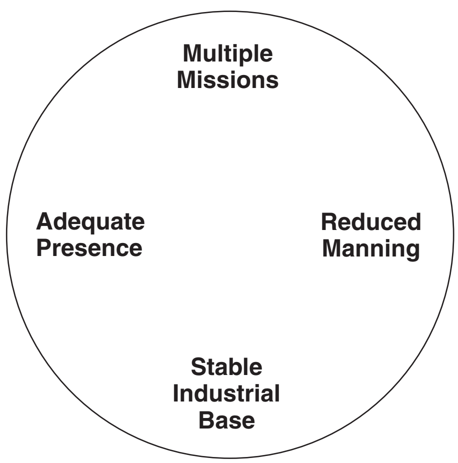
Since 2006, the Navy has annually issued a long-range plan for shipbuilding. These plans outline expected new ship procurements 30 years into the future and the funding the Navy estimates will be needed to support those procurements. The long-range plan is predicated upon the stated fleet need for 313 ships. However, mounting cost and schedule challenges in current programs have required the Navy to increasingly reshape its long-range ship procurement plans, placing the 313 ship goal in jeopardy.

The Navy's long-range ship construction plan embodies multiple objectives including

- building sophisticated ships to support new and existing missions,
- improving presence by increasing the numbers of ships available to execute these missions,
- designing ships and operating concepts that reduce manning requirements, and
- supplying construction workloads that stabilize the industrial base.

There is an inherent tension among the multiple objectives in the plan that is depicted in simple form in figure 3.

Figure 3: Multiple Objectives Embodied in the Navy Shipbuilding Plan



Source: GAO.

This tension can play out in several ways. If, for example, a class of ship is expected to perform multiple challenging missions, it will have sophisticated subsystems and costs will be high. The cost of the ship may prevent its being built in desired numbers, subsequently reducing presence and reducing work for the industrial base. Requirements to reduce manning can actually add sophistication if mission requirements are not reduced. To some extent, this has happened with DDG 1000 as decisions have tended to trade quantities (that affect presence and industrial base) in favor of sophistication. Several years ago, the program was expected to deliver 32 ships at an approximate unit cost of $1 billion. Over time, sophistication and cost of the ship grew as manning levels lower than current destroyers were maintained. Today, the lead ships are expected to cost $8.9 billion in research and development funding and another $6.3 billion to build. Similarly, cost growth in the LCS program has precluded producing ships at the rate originally anticipated, and it is possible the Navy will never regain the recent ships it traded off to save cost. Had the Navy anticipated that LCS lead ship costs would more than double, it may have altered its commitment to the program within its previous long-range shipbuilding plan.

The Navy's fiscal year 2009 long-range ship construction plan reflects many of the recent challenges that have confronted Navy shipbuilding programs. The plan provides for fewer ships at a higher unit cost—in both the near term and the long term—from what the Navy outlined in its fiscal year 2008 plan. Across the next 5 years, the Navy now expects to fund construction of 47 new ships at a cost of almost $74 billion. However, only 1 year ago the Navy expected to purchase 60 ships at a cost of $75 billion during this same time span. Instead, as cost growth has mounted in current shipbuilding programs, the Navy has had to reallocate funds planned for future ships to pay for ones currently under construction. These problems have also required the Navy to adjust its long-term plans. To compensate for its recent near-term quantity reductions, the Navy now plans to increase construction rates starting in fiscal year 2014. This strategy is based upon the premise that increased funding—on the order of $22 billion between fiscal years 2014 and 2018—will become available to support its plans. The Navy assumes this trend of increased funding—above and beyond annual adjustments for inflation—will continue through the end of its plan, which culminates in fiscal year 2038.

Cost and schedule pressures in current programs have also led the Navy to make a number of operational trade-offs to help maintain the viability of its shipbuilding goals. For instance, the Navy's current long-range plan includes a new provision to extend the service lives of current DDG 51 ships by 5 years to maintain an adequate number of surface combatants in its fleet. In addition, the Navy plans to extend the service life of selected attack submarines as well as the length of attack submarine deployments. These actions, however, will require the Navy to increase funding for future upgrades, modernization programs, and maintenance for these vessels—from sources the long-range plan does not identify.

Concluding Remarks

The discussion over whether to conclude the DDG 1000 program at two ships should prompt some introspection given that over $13 billion has been spent. In a sense, some of the key factors influencing the discussion—such as the high cost of the ship, the potential for cost growth, and the questionable affordability of the 30-year shipbuilding plan—are not markedly different from what they were a few years ago. Future success in shipbuilding depends on understanding why the weaknesses in the DDG 1000 business case, which now seem to threaten the program, did not prompt a similar re-examination several years ago.

I believe that Navy managers and shipbuilders have enough knowledge about cost estimating, technology development, engineering, and construction to develop more executable business cases for new ships—that is, a better match between the scope of the ship and the time and money allotted for delivering it. The fact remains that we do not get these matches when they really count—before detail design and construction for a new ship are approved. So, the question is, why are well-understood elements of success not incorporated into new ship programs?

Part of the answer is that while managers may know what it takes to put an executable business case together, compromises in judgment have to be made to bring the business case in conformance with competing demands. For example, in a program like the DDG 1000 that undertook multiple technical leaps to meet challenging requirements, yet also had to deliver in time to match shipyard availability, pressures existed to make optimistic assumptions about the pace of technology maturity. At the same time, budget constraints exert pressure on cost estimates to be lower. These demands do not all fall just within the province of the Navy—industry, Congress, and the Office of the Secretary of Defense all play important roles. Over time, the business case for DDG 1000 eroded. The primary mission of DDG 1000—and the foundation for its business case—was land attack. Yet, subsequent decisions ultimately forced trade-offs in that mission. For example, while including features like a more sophisticated radar and stealth characteristics may be good decisions individually, collectively they made the ship more expensive. Efforts to contain cost involved both reducing the quantity of ships and the actual land attack capability possessed by each individual ship. Ironically, the advanced gun system, which was the primary land attack weapon of the ship and a technical success to date, will now not have a platform to operate from beyond the first two DDG 1000s.

The reconsideration of the DDG 1000 buy reflects poorly on the requirements, acquisition, and funding processes that produced the ship's business case. Unless some attempt is made to examine the root causes of decisions that hope for the best and result in poor outcomes, shipbuilding programs seem destined to the same fate: despite the best efforts to manage, the scope of the program will outstrip the cost and schedule budget. This examination must begin with an honest self-appraisal of what each player in the shipbuilding acquisition process demands of programs in terms of requirements, technologies, design, industrial base, quantities, and cost. Otherwise, while cost and other problems of current ships are lamented, these same problems could continue to curb the outcomes of future programs like the potentially sophisticated next-generation cruiser (CG(X)) or even renewed construction of DDG 51.

Mr. Chairman, that concludes my statement. I would be pleased to answer any questions.

Objectives, Scope, and Methodology

To develop information on the status of the DDG 1000 program, we relied largely on our current work examining the DDG 1000 program, as well as a number of prior GAO products on shipbuilding programs. We supplemented this work with analysis of the Navy's most recent and previous long-range plan for ship construction and Selected Acquisition Reports for current Navy ships. Finally, we updated our estimates of lead ships costs through the use of the Navy's budget justification documentation.

Contact and Staff Acknowledgments

For future questions about this statement, please contact me at (202) 512-4841 or francisp@gao.gov. Individuals making key contributions to this statement include Marie P. Ahearn, Christopher R. Durbin, Brian Egger, James Madar, Diana Moldafsky, Gwyneth B. Woolwine, and Karen Zuckerstein.

Related GAO Products

Defense Acquisitions: Cost to Deliver Zumwalt-Class Destroyers Likely to Exceed Budget. GAO-08-804. Washington, D.C.: July 31, 2008.

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