



Testimony

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FORD CLASS AIRCRAFT CARRIER

Poor Outcomes Are the Predictable Consequences of the Prevalent Acquisition Culture

Statement of Paul L. Francis, Managing Director
Acquisition and Sourcing Management

Accessible Version

GAO Highlights

Highlights of [GAO-16-84T](#), a testimony before the Committee on Armed Services, U.S. Senate

Why GAO Did This Study

The Navy set ambitious goals for the Ford-class program, including an array of new technologies and design features that were intended to improve combat capability and create operational efficiencies, all while reducing acquisition and life-cycle costs. The lead ship, CVN 78, has experienced significant cost growth with a reduced capability expected at delivery. More cost growth is likely. While CVN 78 is close to delivery, examining its acquisition history may provide an opportunity to improve outcomes for the other ships in the class and illustrate the dynamics of defense acquisition.

GAO has reported on the acquisition struggles facing the Ford-class, particularly in [GAO-07-866](#), [GAO-13-396](#), and [GAO-15-22](#). This statement discusses: (1) the Navy's initial vision for CVN 78 and where the ship stands today; (2) plans for follow-on ship cost and construction; and (3) Ford-class experiences as illustrative of acquisition decision making. This statement is largely based on the three reports as well as GAO's larger work on shipbuilding and acquisition best practices, and also incorporates updated audit work where appropriate.

What GAO Recommends

GAO is not making any new recommendations in this statement but has made numerous recommendations to the Department of Defense in the past on Ford-class acquisition, including strengthening the program's business case before proceeding with acquisition decisions. While the Department has, at times, agreed with GAO's recommendations it has taken little to no action to implement them.

View [GAO-16-84T](#). For more information, contact Paul L. Francis at (202) 512-4841 or francispl@gao.gov.

October 2015

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What GAO Found

The Ford-class aircraft carrier's lead ship began construction with an unrealistic business case. A sound business case balances the necessary resources and knowledge needed to transform a chosen concept into a product. Yet in 2007, GAO found that CVN 78 costs were underestimated and critical technologies were immature—key risks that would impair delivering CVN 78 at cost, on-time, and with its planned capabilities. The ship and its business case were nonetheless approved. Over the past 8 years, the business case has predictably decayed in the form of cost growth, testing delays, and reduced capability—in essence, getting less for more. Today, CVN 78 is more than \$2 billion over its initial budget. Land-based tests of key technologies have been deferred by years while the ship's construction schedule has largely held fast. The CVN 78 is unlikely to achieve promised aircraft launch and recovery rates as key systems are unreliable. The ship must complete its final, more complex, construction phase concurrent with key test events. While problems are likely to be encountered, there is no margin for the unexpected. Additional costs are likely.

Similarly, the business case for CVN 79 is not realistic. The Navy recently awarded a construction contract for CVN 79 which it believes will allow the program to achieve the current \$11.5 billion legislative cost cap. Clearly, CVN 79 should cost less than CVN 78, as it will incorporate lessons learned on construction sequencing and other efficiencies. While it may cost less than its predecessor, CVN 79 is likely to cost more than estimated. As GAO found in November 2014, the Navy's strategy to achieve the cost cap relies on optimistic assumptions of construction efficiencies and cost savings—including unprecedented reductions in labor hours, shifting work until after ship delivery, and delivering the ship with the same baseline capability as CVN 78 by postponing planned mission system upgrades and modernizations until future maintenance periods.

Today, with CVN 78 over 92 percent complete as it reaches delivery in May 2016, and the CVN 79 on contract, the ability to exercise oversight and make course corrections is limited. Yet, it is not too late to examine the carrier's acquisition history to illustrate the dynamics of shipbuilding—and weapon system—acquisition and the challenges they pose to acquisition reform. The carrier's problems are by no means unique; rather, they are quite typical of weapon systems. Such outcomes persist despite acquisition reforms the Department of Defense and Congress have put forward—such as realistic estimating and “fly before buy.” Competition with other programs for funding creates pressures to overpromise performance at unrealistic costs and schedules. These incentives are more powerful than policies to follow best acquisition practices and oversight tools. Moreover, the budget process provides incentives for programs to be funded before sufficient knowledge is available to make key decisions. Complementing these incentives is a marketplace characterized by a single buyer, low volume, and limited number of major sources. The decades-old culture of undue optimism when starting programs is not the consequence of a broken process, but rather of a process in equilibrium that rewards unrealistic business cases and, thus, devalues sound practices.

Chairman McCain, Ranking Member Reed, and Members of the Committee:

I am pleased to be here today to discuss the Department of the Navy's Ford-class nuclear-powered aircraft carrier, the successor to the Nimitz-class aircraft carrier designed in the 1960s. The Navy set ambitious goals for the Ford-class program, designing the carrier with an array of cutting edge technologies, including an aircraft launch system that would use electromagnetics—versus steam—to propel aircraft off of the ship (EMALS), an advanced arresting gear (AAG) with an electric motor to recover aircraft, and a dual band radar (DBR) that would use two planar (stationary) radars to provide air traffic control, ship self-defense, and other capabilities. These technologies, along with new design features, like an enlarged flight deck and aft positioned island, would improve combat capability and create operational efficiencies by increasing the ship's sortie generation rate and reducing manpower—with a \$4.4 billion investment needed to research and develop these improvements for the class. The Navy expected to achieve these improvements while simultaneously reducing acquisition and life cycle costs. From the outset there was inherent tension between these goals. Budgets set early in the Ford-class program were not realistically achievable and included optimistic delivery dates to the fleet. The consequences of this tension have been realized today. The costs to construct the lead ship, CVN 78, have increased by over \$2 billion, with promised levels of capability potentially compromised.

Today, with CVN 78 over 92 percent complete, the ability to make course corrections is limited. Yet, it is not too late to examine the lead ship's acquisition history not only in an effort to improve the outcomes for the other ships in the class, but to illustrate the dynamics of shipbuilding—and weapon system—acquisition. Accordingly, I will discuss: (1) the initial vision for CVN 78 and where we are today; (2) plans for follow-on ship cost and construction; and (3) Ford-class experiences as illustrative of acquisition decision making.

This testimony largely leverages our past Ford-class program reports from August 2007, September 2013, and November 2014.¹ Details of the scope and methodology are available in these reports. This statement also includes updates to this information as appropriate based on program documentation and discussions with Navy officials. We also draw on some conclusions from our broader work on Navy shipbuilding and acquisition reform initiatives. We conducted this work in accordance with generally accepted government auditing standards. Those standards required that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions.

Weaknesses in CVN 78's Business Case Manifested by Less Capability at Higher Cost

In July 2007, we reported on weaknesses in the Navy's business case for the Ford-class aircraft carrier and focused mainly on the lead ship, CVN 78.² We noted that costs and labor hours were underestimated and critical technologies were immature. Today, all of this has come to pass in the form of cost growth, testing delays, and reduced capability—in other words, less for more. In August 2007, we also observed that in consequence of its optimistic business case, the Navy would likely face the choice of (1) keeping the ship's construction schedule intact while deferring key knowledge-building events—such as land-based tests of technologies—until later, or (2) slipping the ship's construction schedule to accommodate technology and other delays. Today, those choices have been made—the ship's construction schedule has been delayed slightly by a few months, while other events, like land-based tests for critical technologies, have slid by years. The result is a final acquisition phase in which construction and key test events are occurring concurrently, with no margin for error without giving something else up.

In its simplest form, a business case requires a balance between the concept selected to satisfy warfighter needs and the resources—

¹ GAO, *Defense Acquisitions: Navy Faces Challenges Constructing the Aircraft Carrier Gerald R. Ford within Budget*, [GAO-07-866](#) (Washington, D.C. Aug. 23, 2007); GAO, *Ford-Class Carriers: Lead Ship Testing and Reliability Shortfalls Will Limit Initial Fleet Capabilities*, [GAO-13-396](#) (Washington, D.C.: Sept. 5, 2013); and GAO, *Ford-Class Aircraft Carrier: Congress Should Consider Revising Cost Cap Legislation to Include All Construction Costs*, [GAO-15-22](#) (Washington, D.C.: November 20, 2014).

² GAO, *Defense Acquisitions: Realistic Business Cases Needed to Execute Navy Shipbuilding Programs*, [GAO-07-943T](#) (Washington, D.C. Jul. 24, 2007).

technologies, design knowledge, funding, and time—needed to transform the concept into a product, in this case a ship. In a number of reports and assessments since 2007, we have consistently reported on concerns related to technology development, ship cost, construction issues, and overall ship capabilities. Absent a strong business case, the CVN 78 program deviated from its initial promises of cost and capability, which we discuss below.

In August 2007, before the Navy awarded a contract to construct the lead ship, we reported on key risks in the program that would impair the Navy’s ability to deliver CVN 78 at cost, on time, and with its planned capabilities (as seen in table 1 below).

Table 1: Expectations for CVN 78 Program and Risks Identified by GAO in 2007

	Navy Expectations in 2007	Risks Identified in 2007 GAO Report
Critical technologies	<ul style="list-style-type: none"> The Navy expected to deliver CVN 78 with increased capability over the Nimitz class. EMALS, AAG, and DBR would all complete land-based testing before their equipment was required in the shipyard for installation. 	<ul style="list-style-type: none"> Delays in critical technology development and testing could increase lead ship construction costs. Technology challenges could also lead to reductions in the ship’s required capability at delivery.
Design Knowledge	<ul style="list-style-type: none"> CVN 78’s design would be more complete than the previous carrier. A new 3-dimensional design tool would help complete 75 percent of the product model by the time of construction contract award. 	<ul style="list-style-type: none"> While the design process was relatively sound, the design schedule may be difficult to maintain because immature technologies could require future design changes. Design changes could also interfere with ship construction.
Cost	<ul style="list-style-type: none"> CVN 78 would cost \$10.5 billion total to design and construct The shipbuilder would use 42.7 million total labor hours to construct the ship. 	<ul style="list-style-type: none"> The Navy’s cost estimate used to develop the CVN 78 budget was optimistic. Costs will likely exceed budget if: <ul style="list-style-type: none"> technologies or other materials are delivered late, labor hour efficiencies are not realized, materials are delayed, or cost exceeds estimates.
Time	The Navy would deliver a complete ship by September 2015 to meet operational needs.	Immature critical technologies and an optimistic budget could delay the CVN 78 schedule.

Source: GAO analysis of Navy data and GAO-07-866 | GAO-16-84T

Specifically, we noted that the Navy’s cost estimate of \$10.5 billion and 2 million fewer labor hours made the unprecedented assumption that the CVN 78 would take fewer labor hours than its more mature predecessor—the CVN 77. The shipbuilder’s estimate—22 percent higher in cost was more in line with actual historical experience. Moreover, key technologies, not part of the shipbuilder’s estimates because they would

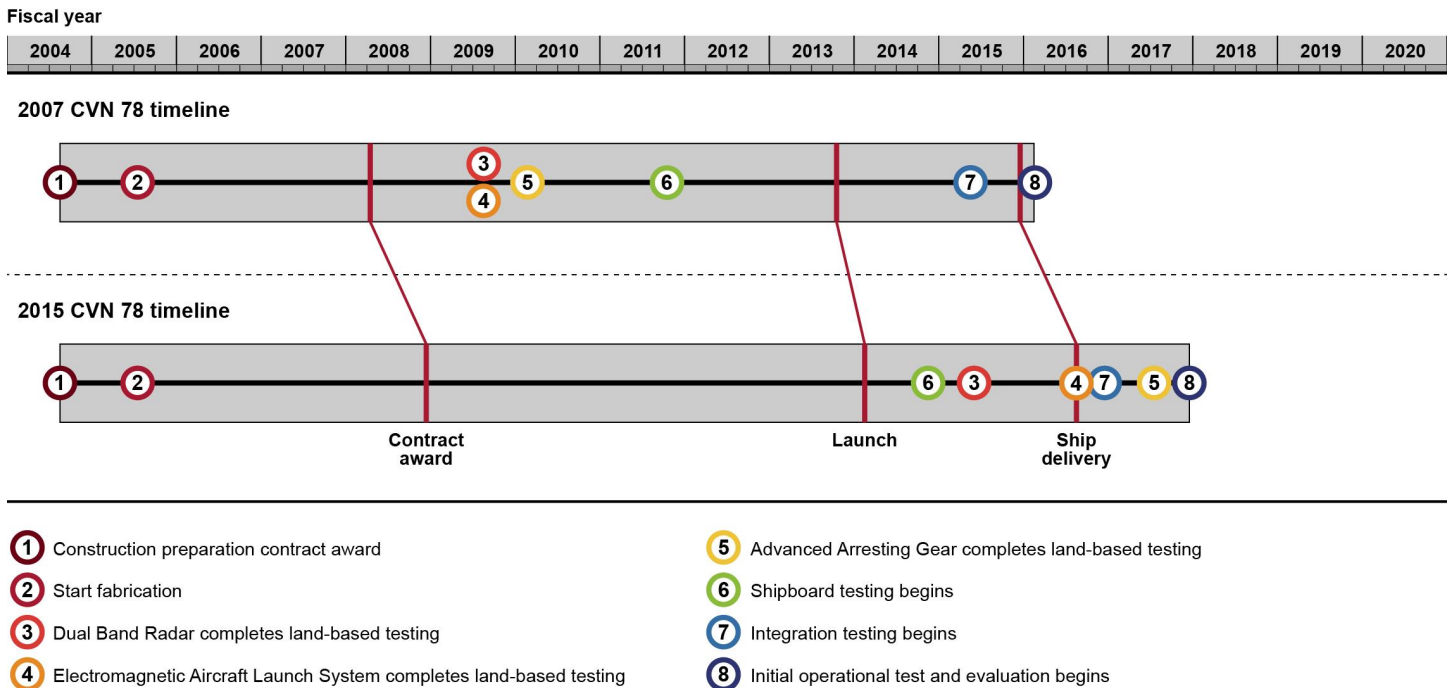
be furnished by the government, were already behind and had absorbed much of their schedule margin.

Congress expressed similar concerns about Ford-class carrier costs. The John Warner National Defense Authorization Act for Fiscal Year 2007 included a provision that established (1) a procurement cost cap for CVN 78 of \$10.5 billion, plus adjustments for inflation and other factors, and (2) a procurement cost cap for subsequent Ford-class carriers of \$8.1 billion each, plus adjustments for inflation and other factors. The legislation in effect required the Navy to seek statutory authority from Congress in the event it determined that adjustments to the cost cap were necessary, and the reason for the adjustments was not one of six factors permitted in the law.³

The risks we assessed in 2007 have been realized, compounded by additional construction and technical challenges. Several critical technologies, in particular, EMALS, AAG, and DBR, encountered problems in development, which resulted in delays to land-based testing. It was important for these technologies to be thoroughly tested on land so that problems could be discovered and fixes made before installing production systems on the ship. In an effort to meet required installation dates aboard CVN 78, the Navy elected to largely preserve the construction schedule and produce some of these systems prior to demonstrating their maturity in land-based testing. This strategy resulted in significant concurrency between developmental testing and construction, as shown in figure 1 below.

³ The 2007 legislation allowed the Navy to make adjustments to the cost cap without seeking additional statutory authority due to: 1) cost changes due to economic inflation; 2) costs attributable to compliance with changes in federal, state, or local laws; 3) outfitting and post-delivery costs; 4) cost changes related to the insertion of new technologies; 5) cost changes due to nonrecurring design and engineering; 6) costs associated with the correction of deficiencies that would affect the safety of the ship and personnel or otherwise preclude safe ship operation and crew certification. The National Defense Authorization Act for Fiscal Year 2014 expanded this list to include changes due to urgent and unforeseen requirements identified during shipboard testing. Pub. L. No. 113-66, § 121 (2013).

Figure 1: Delays in CVN 78 Program Events, from 2007 to July 2015



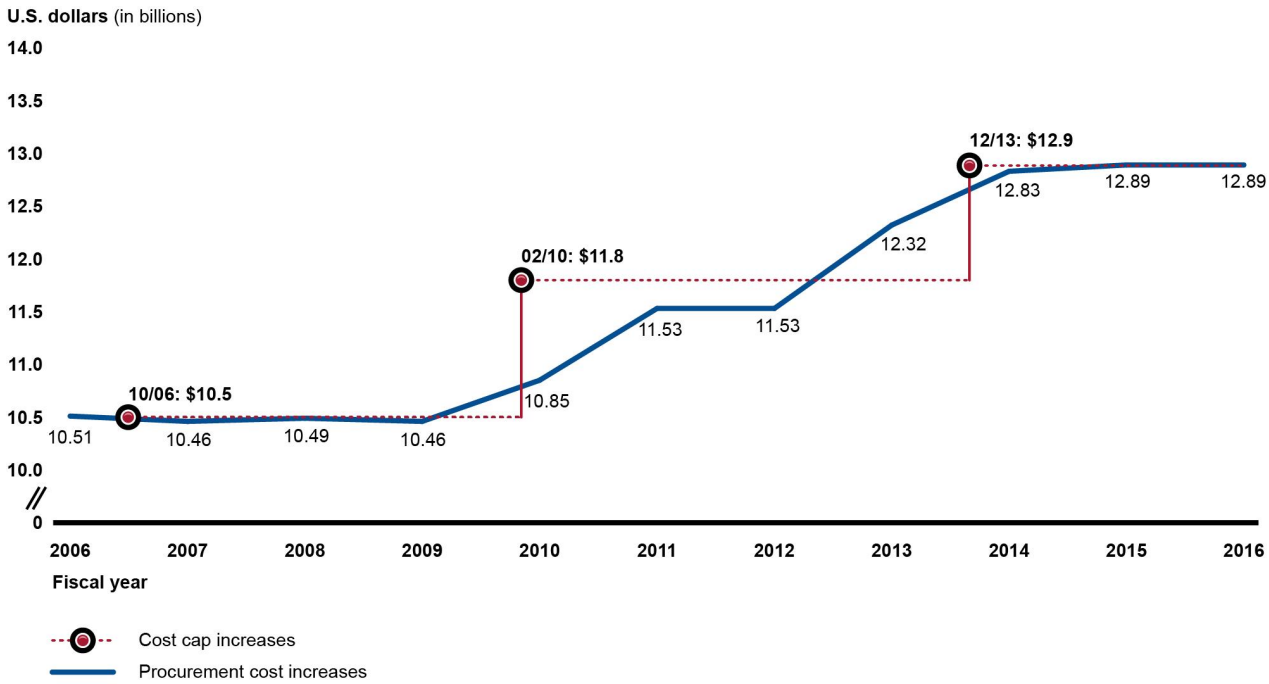
Source: GAO analysis of Navy data. | GAO-16-84T

The burden of completing technology development now falls during the most expensive phase of ship construction. I view this situation as latent concurrency in that the overlap between technology development, testing, and construction was not planned for or debated when the program was started. Rather, it emerged as a consequence of optimistic planning. Concurrency has been made more acute as the Navy has begun testing the key technologies that are already installed on the ship, even as land based testing continues. Moreover, the timeframes for post-delivery testing, i.e. the period when the ship would demonstrate many of its capabilities, are being compressed by ongoing system delays. This tight test schedule could result in deploying without fully tested systems if the Navy maintains the ship's ready-to-deploy date in 2020.

The issues described above, along with material shortfalls, engineering challenges, and delays developing and installing critical systems, drove inefficient out-of-sequence work, which resulted in significant cost increases. This, in turn, required the Navy to seek approval from Congress to raise the legislative cost cap, which it attributed to

construction cost overruns and economic inflation (as shown in figure 2 below).

Figure 2: CVN 78 Procurement Costs and Congressional Cost Cap Increases



Source: GAO analysis of U.S. Navy budget data. | GAO-16-84T

Along with costs, the Navy’s estimates of the number of labor hours required to construct the ship have also increased (see table 2).

Table 2: CVN 78 Planned vs. Actual Ship Construction Costs (2007-2015)

2007	2015
\$10.5 billion	\$12.9 billion
42.7 million labor hours estimated to complete ship	49.9 million labor hours estimated to complete ship
= Fully constructed ship at delivery	= Incomplete ship at delivery
	Work to be completed post-delivery:
	<ul style="list-style-type: none"> • 367 compartments • Correction of certain deficiencies • Installation of mission-oriented systems

Source: GAO analysis of Navy data | GAO-16-84T

Recalling that in 2007, the Navy’s estimate was 2 million hours lower than the shipbuilder’s, the current estimate is a big increase. On the other hand, it is more in line with a first-in-class ship like CVN 78; that is to say, it was predictable. To manage remaining program risks, the Navy deferred some construction work and installation of mission-related systems until after ship delivery. Although this strategy may provide a funding reserve in the near term, it still may not be sufficient to cover all potential cost risks. In particular, as we reported in November 2014, the schedule for completing testing of the equipment and systems aboard the ship had become increasingly compressed and continues to lag behind expectations. This is a particularly risky period for CVN 78 as the Navy will need to resolve technical deficiencies discovered through testing—for critical technologies or the ship—concurrent with latter stage ship construction activities, which is generally more complex than much of the work occurring in the earlier stages of construction.

Risks to the ship’s capability we identified in our August 2007 report have also been realized. We subsequently found in September 2013 and November 2014 that challenges with technology development are now affecting planned operational capability beyond the ship’s delivery (as shown in table 3).

Table 3: CVN 78 Planned vs. Actual Capabilities at Delivery (2007-2015)

2007	2015
<ul style="list-style-type: none"> • CVN 78 would be able to conduct full flight operations with all carrier aircraft types • The ship would conduct full operations with a reduced manning profile • Projected CVN 78 manpower would be sufficient to meet increased sortie generation rate 	<ul style="list-style-type: none"> • CVN 78 is scheduled to begin flight operations in July 2016, according to Navy officials—4 months after delivery—with one fixed-wing aircraft type • Poor reliability of key systems, including EMALS and AAG, will likely require additional personnel • Additional personnel will be needed to meet the surge sortie generation rate

Source: GAO analysis of Navy data and prior GAO reports | GAO-16-84T

Specifically, CVN 78 will not demonstrate its increased sortie generation rate due to low reliability levels of key aircraft launch and recovery systems before it is ready to deploy to the fleet. Further, required reductions in personnel remain at risk, as immature systems may require more manpower to operate and maintain than expected. Ultimately, these limitations signal a significant compromise to the initially promised capability. The Navy believes that, despite these pressures, it will still be able to achieve the current \$12.9 billion congressional cost cap. While this remains to be seen, the Navy’s approach, nevertheless, results in a

more expensive, yet less complete and capable ship at delivery than initially planned. Even if the cost cap is met, it will not alter the ultimate cost of the ship. Additional costs will be borne later—outside of CVN 78's acquisition costs—to account for, for example, reliability shortfalls of key systems. In such cases, the Navy will need to take costly actions to maintain operational performance by adding maintenance personnel and spare parts. Reliability shortfalls, in turn, will drive ship life cycle cost increases related to manning, repairs, and parts sparing. Deferred systems and equipment will at some point be retrofitted back onto the ship.

Business Case for Follow-On Ship Assumes Ambitious Efficiency Gains

Although increases have already been made to the CVN 79's cost cap and tradeoffs made to the ship's scope, it still has an unrealistic business case. In 2013, the Navy requested congressional approval to increase CVN 79's cost cap from \$8.1 billion to \$11.5 billion, citing inflation as well as cost increases based on CVN 78's performance. Since the Ford-class program's formal system development start in 2004, CVN 79's planned delivery has been delayed by 4 years and the ship will be ready for deployment 15 months later than expected in 2013.

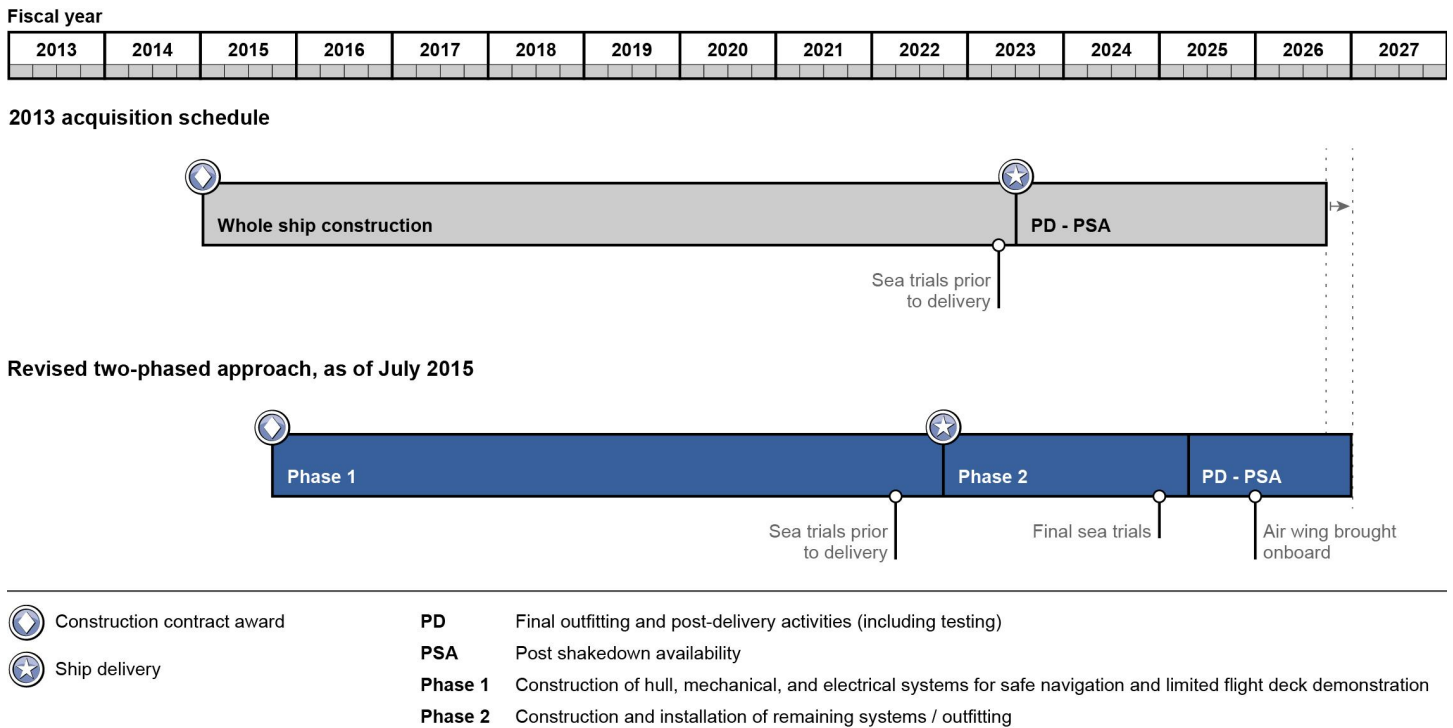
The Navy recently awarded a construction contract for CVN 79 which it believes will allow the program to achieve the current \$11.5 billion legislative cost cap. Similar to the lead ship, the business case for CVN 79 is not commensurate with the costs needed to produce an operational ship. By any measure, CVN 79 should cost less than CVN 78, as it will incorporate important lessons learned on construction sequencing and other efficiencies. While it may cost less than its predecessor, CVN 79 is likely to cost more than estimated. As we reported in November 2014, the Navy's strategy to achieve the cost cap: 1) relies on optimistic assumptions of construction efficiencies and cost savings; (2) shifts work—including installation of mission systems—needed to make the ship fully operational until after ship delivery; and (3) delivers the ship with the same baseline capability as CVN 78, with the costs of a number of planned mission system upgrades and modernizations postponed until future maintenance periods. Even with ambitious assumptions and planned improvements, the Navy's current estimate for the CVN 79 stands at \$11.5 billion—already at the cost cap. For perspective, the Director of the Department of Defense's (DOD) Cost Assessment and Program Evaluation office projects that the Navy will exceed the congressional cost cap by about \$235 million. The Congressional Budget Office estimates for CVN 79 are even higher; at a total cost of over \$12.5

billion—which, if realized, would be over \$1 billion above the current congressional cost cap.

Similar to CVN 78, the Navy is assuming the shipbuilder will achieve efficiency gains that are unprecedented in aircraft carrier construction. While the shipbuilder has initiated significant revisions in its processes for building the ship that are expected to reduce labor hours, the Navy's cost estimate for CVN 79 is predicated on an over 9 million labor hour reduction compared to CVN 78. For perspective, this estimate is not only lower than the 42.7 million hours originally estimated for CVN 78, it is 10 percent lower than what was achieved on CVN 77, the last Nimitz-class carrier. Previous aircraft carrier constructions have reduced labor hours by 3.2 million hours at most. Further, the Navy estimates that it will save over \$180 million by replacing the dual band radar in favor of an alternative radar system, which it expects will provide a better technological solution at a lower cost. Cost savings are assumed, in part, because the Navy expects the radar to work within the current design parameters of the ship's island. However, the Navy has not yet awarded a contract to develop the new radar solution. If design modifications are needed to the ship's island, CVN 79 costs will increase, offsetting the Navy's estimate of savings. Again for perspective, the Navy initially planned to install DBR on CVN 77 and it has taken the Navy over 10 years to develop the DBR, which is still not yet through testing.

Finally, achieving the legislative cost cap of \$11.5 billion is predicated on executing a two-phased delivery strategy for CVN 79, which will shift some construction work and installation of the warfare and communications systems to after ship delivery. By design, this strategy will result in a less capable and less complete ship at delivery—the end of the first phase—as shown in figure 3 below:

Figure 3: Comparison of CVN 79's September 2013 and July 2015 Revised Acquisition Schedules



Source: GAO analysis of Navy data. | GAO-16-84T

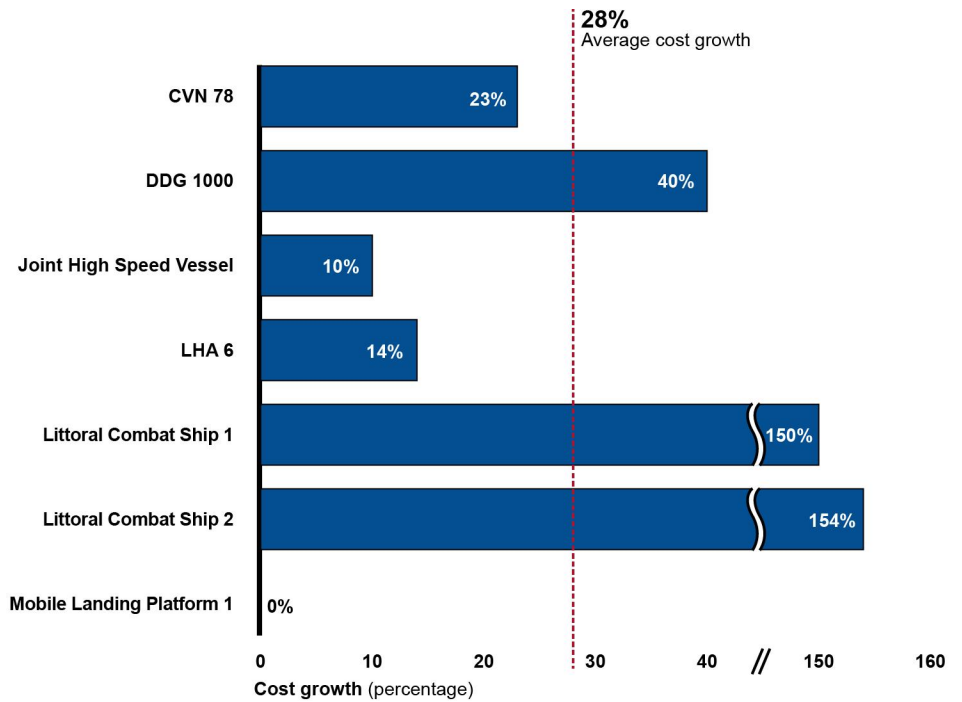
According to the Navy, delaying procurement and installation of warfare and communications systems will prevent obsolescence before the ship's first deployment in 2027 and allow the Navy to introduce competition for the ship's systems and installation work after delivery.

As we reported in November 2014, the Navy's two-phased approach transfers the costs of a number of known capability upgrades, including decoy launching systems, torpedo defense enhancements, and Joint Strike Fighter aircraft related modifications, previously in the CVN 79 baseline to other (non-CVN 79 shipbuilding) accounts, by deferring installation to future maintenance periods. While such revisions reduce the end cost of CVN 79 in the near term, they do not reduce the ultimate cost of the ship, as the costs for these upgrades will eventually need to be paid—just at a later point in the ship's life cycle.

Ford Class Program Emblematic of Incentives Which Discourage Implementing Sound Acquisition Practices

That CVN 78 will deliver at higher cost and less capability, while disconcerting, was predictable. Unfortunately, it is also unremarkable, as it is a typical outcome of the weapon system acquisition process. Along these lines, what does the CVN 78's experience say about the acquisition process and what lessons can be learned from it? In many ways, CVN 78 represents a familiar outcome in Navy shipbuilding programs. Across the shipbuilding portfolio, cost growth for recent lead ships has been on the order of 28 percent (see figure 4).

Figure 4: Cost Growth in Program Budgets for Recent Lead Ships (Authorized to Start Construction between Fiscal year 2005 to Fiscal year 2011)



Source: GAO analysis based on Navy budget documentation. | GAO-16-84T

Note: In cases where a lead and follow-on ship costs were budgeted in a single year we attributed the planning cost to the lead ship and then split the remaining costs between the two. Also, we depicted LCS 1 and LCS 2 as lead ships because each ship was constructed at a different shipyard with different designs.

Figure 4 above further illustrates the similarity between CVN 78 and other shipbuilding programs authorized to start construction around the same time. Lead ships with the highest percentages of cost growth, such as the Littoral Combat Ships and DDG 1000, were framed by steep programmatic challenges. Similar to the CVN 78, these programs have been structured around unexecutable business cases in which ship construction begins prior to demonstrating key knowledge, resulting in costly, time-consuming, and out-of-sequence work during construction and undesired capability tradeoffs.

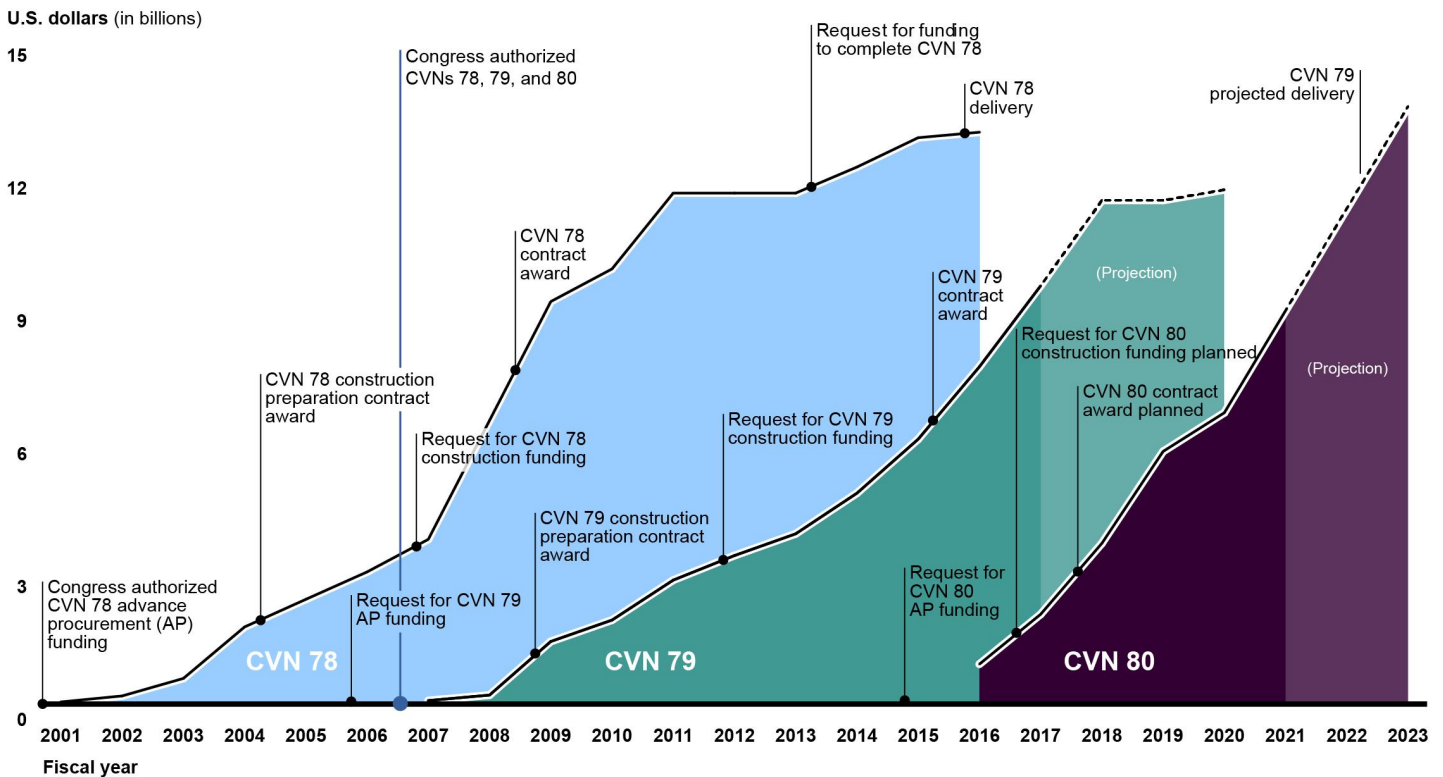
Such outcomes persist even though DOD and Congress have taken steps to address long-standing problems with DOD acquisitions. These reforms emphasize sound management practices—such as realistic estimating, thorough testing, and accurate reporting—and were implemented to enhance DOD’s acquisition policy, which already

provided a framework for managers to successfully develop and execute acquisition programs. Today these practices are well known. However, outcomes of the Ford-class program illustrate the limits of focusing on policy-and-practice related aspects of weapon system development without understanding incentives to sacrifice realism to win support for a program.

Strong incentives encourage deviations from sound acquisition practices. In the commercial marketplace, investment in a new product represents an expense. Company funds must be expended and will not provide a return until the product is developed, produced, and sold. In DOD, new products represent a revenue, in the form of a budget line. A program's return on investment occurs as soon as the funding is initiated. The budget process results in funding major program commitments before knowledge is available to support such decisions. Competition with other programs vying for funding puts pressure on program sponsors to project unprecedented levels of performance (often by counting on unproven technologies) while promising low cost and short schedules. These incentives, coupled with a marketplace that is characterized by a single buyer (DOD), low volume and limited number of major sources, create a culture in weapon system acquisition that encourages undue optimism about program risks and costs. To the extent Congress funds such programs as requested, it sanctions—and thus rewards—optimism and unexecutable business cases. To be sure, this is not to suggest that the acquisition process is foiled by bad actors. Rather, program sponsors and other participants act rationally within the system to achieve goals they believe in. Competitive pressures for funding simply favor optimism in setting cost, schedule, technical, and other estimates.

The Ford-class program illustrates the pitfalls of operating in this environment. Optimism has pervaded the program from the start. Initially, the program sought to introduce technology improvements gradually over a number of successive carriers. However, in 2002, DOD opted to forgo the program's evolutionary acquisition strategy, in favor of achieving revolutionary technological achievements on the lead ship. Expectations of a more capable ship were promised, with cost and schedule goals that were out of balance with the technical risks. Further, the dynamics of weapon system budgeting—and in particular, shipbuilding—resulted in significant commitments made well in advance of critical acquisition decisions, most notably, the authorization to start construction. Beginning in 2001, the Ford Class program began receiving advanced procurement funding to initiate design activities, procure long-lead materials, and prepare for construction, as shown in figure 5 below.

Figure 5: Ford Class Funding and Major Milestones



Source: GAO analysis of U.S. Navy budget data. | GAO-16-84T

By the time the Navy requested funding for construction of CVN 78 in 2007 it had already received \$3.7 billion in advance procurement. It used some of these funds to build 13 percent of the ship’s construction units.⁴ Yet, at that time the program had considerable unknowns—technologies were immature and cost estimates unreliable. Similarly, in 2013, Congress had already appropriated nearly \$3.3 billion in funding for CVN 79 construction. This decision was made even though the Navy’s understanding of the cost required to construct and deliver the lead ship was incomplete. A similar scenario exists today, as the Navy is requesting funding for advanced procurement of CVN 80, while also constructing CVN 78 and CVN 79. While these specifics relate to the Ford-class

⁴ By comparison, CVN 77 received approximately \$919 million in advance procurement funding.

carrier, the principles apply to all major weapon system acquisitions. That is, commitments to provide funding in the form of budget requests, Congressional authorizations, and Congressional appropriations are made well in advance of major program commitments, such as the decision to approve the start of a program. At the time the funding commitments are made, less verifiable knowledge is available about a program's cost, schedule, and technical challenges. This creates a vacuum for optimism to fill. When the programmatic decision point arrives, money is already on the table, which creates pressure to make a "go" decision, regardless of the risks now known to be at hand.

The environment of Navy shipbuilding is unique as it is characterized by a symbiotic relationship between buyer (Navy) and builder. This is particularly true in the case of aircraft carriers, where there is only one domestic entity capable of constructing, testing, and delivering nuclear-powered aircraft carriers. Consequently, the buyer has a strong interest in sustaining the shipbuilder despite shortfalls in performance. Under such a scenario, the government has a limited ability to negotiate favorable contract terms in light of construction challenges and virtually no ability to walk away from the investment once it is underway.

Concluding Remarks

The experiences of the Ford-class program are not unique—rather, they represent a typical acquisition outcome. The cost growth and other problems seen today were known to be likely in 2007—before a contract was signed to construct the lead ship. Yet CVN 78 was funded and approved despite a knowingly deficient business case; in fact, the ship has been funded for nearly 15 years. It is too simplistic to look at the program as a product of a broken acquisition process; rather it is indicative of a process that is in equilibrium. It has worked this way for decades with similar outcomes: weapon systems that are the best in the world, but cost significantly more, take longer, and perform less than advertised. The rules and policies are clear about what to do, but other incentives force compromises of good judgment. The persistence of undesirable outcomes such as cost growth and schedule delays suggests that these are consequences that participants in the process have been willing to accept. It is not broken in the sense that it is rational; that is, program sponsors must promise more for less in order to win funding approval. This naturally leads to an unexecutable business case. Once funded and approved, reality sets in and the program must then offer less for more.

Where do we go from here? Under consideration this year are a number of acquisition reforms. While these aim to change the policies that govern weapon system acquisition, they do not sufficiently address the incentives that drive the behavior. As I described above, the acquisition culture in general rewards programs for moving forward with unrealistic business cases. Early on, it was clear that the Ford-class program faced significant risks due to the development, installation and integration of numerous technologies. Yet, these risks were taken on the unfounded hope that they were manageable and that risk mitigation plans were in place. The budget and schedule did not account for these risks. Funding approval—authorizing programs and appropriating funds are some of the most powerful oversight tools Congress has. The reality is once funding starts, other tools of oversight are relatively weak—they are no match for the incentives to over-promise. Consequently, the key is to ensure that new programs exhibit desirable principles before they are approved and funded. There is little that can be done from an oversight standpoint on the CVN 78. In fact, there is little that can be done on the CVN 79, either. Regardless of how costs will be measured against cost caps, the full cost of the ships—as yet unknown—will ultimately be borne. For example, while the Joint Precision Approach and Landing System has been deferred from the first two ships, eventually it will have to be installed on them to accept the F-35 fighter. The next real oversight opportunity is on the CVN 80, which begins funding in fiscal year 2016.

Going forward, there are two acquisition reform challenges I would like to put on the table. The first is what to do about funding. Today, DOD and Congress must approve and fund programs ahead of major decision points and key information. With money in hand, it is virtually impossible to disapprove going forward with the program. There are sound financial reasons for making sure money is available to execute programs before they are approved. But they are also a cause of oversold business cases. Second, in the numerous acquisition reform proposals made recently, there is much for DOD to do. But, Congress, too, has a role in demanding realistic business cases through the selection and timing of the programs it chooses to authorize and fund. What it does with funding sets the tone for what acquisition practices are acceptable.

Mr. Chairman and Members of the Committee, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

GAO Contact and Staff Acknowledgments

If you or your staff has any questions about this statement, please contact Paul L. Francis at (202) 512-4841 or FrancisP@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. GAO staff who made key contributions to this testimony are Diana Moldafsky, Assistant Director; Charlie Shivers; Burns C. Eckert; Laura Greifner; Kelsey Hawley; Jenny Shinn; Ozzy Trevino; Abby Volk; and Alyssa Weir.

Appendix I: Prior GAO Recommendations for Ford Class Carriers and Department of Defense (DOD) Responses and Subsequent Actions

In August 2007 and, again, in September 2013, we recommended actions the Navy could take to improve CVN 78's business case. Further, in our September 2013 report, we also made recommendations to improve the Navy's management of CVN 79's costs and schedule. As shown below, few actions have been taken to address our most pressing recommendations for the lead and follow-on ship:

GAO Report	GAO Recommendations	DOD Response and actions
GAO-07-866	<ul style="list-style-type: none"> Improve the realism of CVN 78's budget estimate. Improve Navy's cost surveillance capability. 	While the department agreed with our recommendations in concept, it has not fully taken action to implement them. The CVN 78 cost estimate continues to reflect undue optimism.
GAO-13-396	<ul style="list-style-type: none"> Conduct a cost-benefit analysis on required CVN 78 capabilities, namely reduced manning and the increased sortie generation rate prior to ship delivery. Update the CVN 78 test plan before ship delivery to allot sufficient time after ship delivery for land based testing to complete prior to shipboard testing. Adjust the CVN 78 planned post-delivery test schedule to ensure that system integration testing is completed before IOT&E. Defer the CVN 79 detail design and construction contract until land-based testing for critical systems was complete and update the CVN 79 cost estimate on the basis of actual costs and labor hours needed to construct CVN 78 during the recommended contract deferral period of CVN 79. 	<ul style="list-style-type: none"> DOD agreed with the need for a cost-benefit analysis, but did not plan to fully assess CVN 78 capabilities until the completion of operational testing after ship delivery. DOD agreed with our recommendation to update the CVN 78 test plan before delivery and has since updated the test and evaluation master plan (TEMP). However, it did not directly address our recommendation related to ensuring that sufficient time is allotted to complete land-based testing prior to beginning integrated testing. DOD partially agreed with our recommendation to adjust the CVN 78 planned post-delivery schedule but current test plans still show significant overlap between integrated test events and operational testing. DOD disagreed with our recommendation to defer the award of the CVN 79's detail design and construction contract. However, shortly after we issued our report, the Navy postponed the contract award citing the need to continue contract negotiations. While DOD did not agree to defer the CVN 79 contract as recommended, it did agree to update the CVN 79 cost estimate on the basis of CVN 78's actual costs and labor hours. DOD has updated CVN 79's budget estimate which we note is based on optimistic assumptions.

Source: GAO | GAO-16-84T

Appendix II: Accessible Data

Accessible Text and Data Tables

Accessible Text for Figure 1: Delays in CVN 78 Program Events, from 20073 to July 2015

2007 CVN 78 timeline:

- **2004:** (1) Construction preparation contract award;
- **2005:** (2) Start fabrication;
- **2008: Contract award;**
- **2009:** (3) Dual Band Radar completes land-based testing; (4) Electromagnetic Aircraft Launch System completes land-based testing;
- **2010:** (5) Advanced Arresting Gear completes land-based testing;
- **2011:** (6) Shipboard testing begins;
- **2013: Launch;**
- **2015:** (7) Integration testing begins; **Ship delivery;**
- **2016:** (8) Initial operational test and evaluation begins.

2015 CVN 78 timeline:

- **2004:** (1) Construction preparation contract award;
- **2005:** (2) Start fabrication;
- **2008-2009: Contract award;**
- **2013: Launch;**
- **2014:** (6) Shipboard testing begins;
- **2015:** (3) Dual Band Radar completes land-based testing;
- **2016:** (4) Electromagnetic Aircraft Launch System completes land-based testing; **Ship delivery;** (7) Integration testing begins;
- **2017:** (5) Advanced Arresting Gear completes land-based testing;
- **2018:** (8) Initial operational test and evaluation begins.

Source: GAO analysis of Navy data. | GAO-16-84T

Data Table for Figure 2: CVN 78 Procurement Costs and Congressional Cost Cap Increases

U.S. dollars (in billions)

Fiscal year	Procurement cost increases	Cost cap increases
2006	10.51	10.5 (October 2006)
2007	10.46	N/A
2008	10.49	N/A
2009	10.46	N/A
2010	10.85	11.8 (February 2010)
2011	11.53	N/A
2012	11.53	N/A

Fiscal year	Procurement cost increases	Cost cap increases
2013	12.32	12.9 (December 2013)
2014	12.83	N/A
2015	12.89	N/A
2016	12.89	N/A

Source: GAO analysis of U.S. Navy budget data. | GAO-16-84T

Accessible Text for Figure 3: Comparison of CVN 79’s September 2013 and July 2015 Revised Acquisition Schedules

2013 Acquisition schedule:

- **2015:** Construction contract award;
- **2015-2023: Whole ship construction;**
- **2023:** Sea trials prior to delivery;
- **2023:** Ship delivery;
- **2023-2027: PD - PSA.**

Revised two-phased approach, as of July 2015:

- **2015:** Construction contract award;
- **2015-2022: Phase 1;**
- **2022:** Sea trials prior to delivery;
- **2022: Ship delivery;**
- **2022-2025: Phase 2;**
- **2025:** Final sea trials;
- **2025-2027: PD - PSA;**
- **2026:** Air wing brought onboard.

Source: GAO analysis of Navy data. | GAO-16-84T

Legend: PD = Final out fitting and post-delivery activities (including testing); PSA = Post shakedown availability; Phase 1 = Construction of hull, mechanical, and electrical systems for safe navigation and limited flight deck demonstration; Phase 2 = Construction and installation of remaining systems / outfitting.

Data Table for Figure 4: Cost Growth in Program Budgets for Recent Lead Ships (Authorized to Start Construction between Fiscal year 2005 to Fiscal year 2011)

	Cost growth (percentage)
CVN 78	23%
DDG 1000	40%
Joint High Speed Vessel	10%
LHA 6	14%
Littoral Combat Ship 1	150%
Littoral Combat Ship 2	154%
Mobile Landing Platform 1	0%
Average cost growth	28%

Source: GAO analysis based on Navy budget documentation. | GAO-16-84T

Note: In cases where a lead and follow-on ship costs were budgeted in a single year we attributed the planning cost to the lead ship and then split the remaining costs between the two. Also, we depicted LCS 1 and LCS 2 as lead ships because each ship was constructed at a different shipyard with different designs.

Data Table for Figure 5: Ford Class Funding and Major Milestones

U.S. dollars (in billions)

Fiscal year	CVN 78	CVN 79	CVN 80	Major milestone
2001	21.7	N/A	N/A	Congress authorized CVN 78 advance procurement (AP) funding
2002	157.0	N/A	N/A	N/A
2003	552.5	N/A	N/A	N/A
2004	1,715.4	N/A	N/A	CVN 78 construction preparation contract award
2005	2,338.5	N/A	N/A	N/A
2006	2,957.4	N/A	N/A	Request for CVN 79 AP funding
2007	3,693.2	52.8	N/A	Congress authorized CVNs 78, 79, and 80; Request for CVN 78 construction funding
2008	6,378.2	176.3	N/A	CVN 78 contract award
2009	9,062.8	1,386.9	N/A	CVN 79 construction preparation contract award
2010	9,799.8	1,869.8	N/A	N/A
2011	11,512.3	2,772.3	N/A	N/A
2012	11,512.3	3,327.1	N/A	Request for CVN 79 construction funding
2013	11,512.3	3,818.1	N/A	Request for funding to complete CVN 78
2014	12,100.4	4,735.7	N/A	N/A

Appendix II: Accessible Data

Fiscal year	CVN 78	CVN 79	CVN 80	Major milestone
2015	12,763.4	5,955.1	N/A	CVN 79 contract award; Request for CVN 80 AP funding
2016	12,887.2	7,589.8	874.7	CVN 78 delivery
2017	N/A	*9,418.8	2,000.8	Request for CVN 80 construction funding planned
2018	N/A	*11,347.8	3,602.6	CVN 80 contract award planned
2019	N/A	*11,347.8	5,678.6	N/A
2020	N/A	*11,586.2	6,551.9	N/A
2021	N/A	N/A	*8,858.6	N/A
2022	N/A	N/A	*11,165.3	CVN 79 projected delivery
2023	N/A	N/A	*13,472.0	N/A

Source: GAO analysis of U.S. Navy budget data. | GAO-16-84T

Note: * = Projection.

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