Congressional Budget Office
Nonpartisan Analysis for the U.S. Congress

Acquisition Costs of the Navy's Medium Landing Ship

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In fiscal year 2025, the Department of the Navy plans to start construction of the medium landing ship (LSM), a new small amphibious ship.[1] Amphibious warfare ships transport and deploy Marine Corps units in a range of small to large operations. Previously called the light amphibious warship (LAW), the new ship is expected to transport and deploy Marine littoral regiments—small Marine Corps units armed with antiship or antiair missiles—in and around a theater of operations, particularly the western Pacific.

Many facets of the program remain uncertain, such as the number of ships the Navy wants to buy as well as the design and capabilities of the ship. Senior Navy and Marine Corps leaders have called for between 18 and 35 ships. Equally uncertain is the overall cost of the program, because the Navy's estimates have varied widely in its last three shipbuilding plans and budget submissions.

In this report, the Congressional Budget Office examines the potential acquisition costs of the program.

- By CBO's estimates, an 18-ship LSM program would cost between $6.2 billion and $7.8 billion in 2024 (inflation-adjusted) dollars, or $340 million to $430 million per ship. The ranges in those estimates reflect the range of full-load displacements—4,500 tons to 5,400 tons—in preliminary designs that shipbuilders submitted to the Navy. (Full-load displacement measures the weight of the water a ship displaces when carrying its crew, stores, cargo, ammunition, fuel, and other liquids.)
- CBO's estimates, which are derived from a CBO model that uses a ship's weight to calculate its costs, range from two to roughly three times the Navy's estimates for the 8 ships the service wants to buy between 2025 and 2029. On the basis of the Navy's estimated cost per ship—roughly $150 million—an 18-ship LSM program would probably cost $2.6 billion in 2024 dollars.
- CBO estimates the cost of a 35-ship LSM program at between $11.9 billion and $15.0 billion in 2024 dollars, depending on the final size of the ship. The estimated cost per ship is the same as that for an 18-ship program. In a larger program, the cost-saving effects of learning would be almost equally offset by the real (inflation-adjusted) cost growth in the shipbuilding industry that would occur over the longer period it would take to purchase the additional ships.[2]

The agency's estimates are based on a ship designed as a hybrid between an amphibious warfare ship and a ship built to commercial standards. Ships built to military standards have stronger hulls and internal compartments, more shock-hardened systems, and more safety features and equipment, among other things, than commercial ships. If the Navy changed the LSM's design to make it equivalent to an amphibious warfare ship, then each LSM could cost between $475 million and $600 million, adding between $2 billion and $3 billion to the costs of an 18-ship program and between $5 billion and $6 billion to the costs of a 35-ship program. Conversely, if the LSMs were designed to more commercial standards, then the costs could be much less—from $110 million to $140 million per ship, reducing costs by $4 billion to $8 billion for an 18-ship program and by $5 billion to $10 billion for a 35-ship program.

1. For more detailed information about the LSM program, see Ronald O'Rourke, *Navy Medium Landing Ship (LSM) (Previously Light Amphibious Warship [LAW]) Program: Background and Issues for Congress*, Report R46374, version 62 (Congressional Research Service, December 20, 2023), http://tinyurl.com/5t4payx6.

2. Congressional Budget Office, *How CBO Estimates the Cost of New Ships* (April 2018), www.cbo.gov/publication/53785.

Notes: Unless this report indicates otherwise, all years referred to are federal fiscal years, which run from October 1 to September 30 and are designated by the calendar year in which they end. All ship tonnage numbers are expressed as long tons, which are also known as imperial tons or displacement tons.

This report does not address potential operation and support costs, nor does it analyze or assess the viability of the Marine Corps' concept of operations.

The Navy's Medium Landing Ship Program

The medium landing ship is a key component of the Marine Corps' Expeditionary Advanced Base Operations concept and the service's ongoing efforts to redesign itself as part of Force Design 2030.[3] The ship is intended to transport, deploy, and, if necessary, resupply and redeploy Marine littoral regiments—small Marine Corps units armed with antiship or antiair missiles—in and around a theater of operations, particularly in the western Pacific and in any potential conflict with China.

The Department of the Navy first proposed the program now known as the LSM in 2020 and requested research and development funds for the ship in its 2021 budget. The first ship was scheduled to be procured in 2023, but recent budget submissions have delayed the start until 2025.

In a brochure for potential shipbuilders, the Navy and the Marine Corps indicated that they would like the LSM to have the following characteristics:

- Length of 200 feet to 400 feet;
- Draft of 12 feet;
- Transit speed of 14 knots with a range of 3,500 nautical miles;
- Ability to beach on a 1:40 slope (where the surface of the beach rises by 1 foot for every 40 feet as the ship approaches the shore);
- Crew of 70 Navy sailors;
- Payload capacity of 50 marines and 648 short tons;
- Cargo space of at least 8,000 square feet;
- Crane, off-load ramp, and helicopter landing pad;
- Self-defense armament of two 30-millimeter guns and six .50-caliber guns; and
- Service life of 20 years.

The Navy's brochure did not indicate the displacement of the ship. According to information the Navy provided to CBO, in designs currently under consideration, the ship's displacement ranges from 4,500 tons to 5,400 tons when fully loaded, or 2,900 tons to 3,600 tons in lightship displacement, which is the weight of the water a ship displaces without its crew, stores, cargo, ammunition, fuel, and other liquids.[4] The ship's maximum length of 400 feet is an important design specification, because the LSM's expected home ports are not suitable for longer ships.

By comparison, the Navy's other amphibious warfare ships and amphibious landing craft are vastly different in size. The San Antonio class LPD-17 and the America class LHA-6 are large amphibious warfare ships that displace 25,000 tons to 45,000 tons when fully loaded and are capable of deploying many marines and aircraft in an amphibious operation (see Table 1). At the other end of the spectrum, the LCU-1700, a small utility landing craft that displaces only 435 tons, is designed to help move large pieces of equipment from amphibious warfare ships to the shore and back again. (It also appears strikingly similar to the Navy's notional designs of the LSM but on a much smaller scale.) At 42,000 tons to 50,000 tons, the Navy's principal combat logistics ships—the Lewis and Clark class T-AKE-1 dry cargo ship and the John Lewis class T-AO-205 oiler—are larger than the LPD-17s and about the same size as the LHAs. As a final point of comparison, the Spearhead T-EPF-1 is a small transport ship that displaces about 2,500 tons; it is designed to go very fast and support a variety of Navy missions.

Uncertainty in the LSM Program

Although the Navy has provided the LSM's notional design characteristics to potential shipbuilders, considerable uncertainty remains about the ship's capabilities, size, and survivability features—and, consequently, its costs. In 2021, the Navy partnered with five companies to develop concepts for the ship and formulate a preliminary design: Austal Shipbuilding, Bollinger Shipbuilding, Fincantieri Marinette Marine, VT Halter Marine (now owned by Bollinger and renamed Bollinger

3. General David H. Berger, Commandant of the Marine Corps, *Force Design 2030: Annual Update* (June 2023), https://tinyurl.com/y9u4hyzy (PDF); and Andrew Feickert, *U.S. Marine Corps Force Design 2030 Initiative: Background and Issues for Congress*, Report R47614, version 3 (Congressional Research Service, June 30, 2023), http://tinyurl.com/ytsktksj.

4. In its March 2024 budget justification book for 2025, the Navy reports a much smaller full-load displacement, 2,552 tons, than it reported to CBO a month earlier. In response to CBO's inquiry about that discrepancy, the Navy stated that the displacement reported in the budget book does not represent the most current information about the potential design of the ship. See Department of the Navy, *2025 Shipbuilding and Conversion, Navy* (March 2024), https://tinyurl.com/yc2c8xmx.

Table 1.

Characteristics of Selected Amphibious Warfare and Support Ships

	America LHA-6	San Antonio LPD-17	San Antonio LPD-17 Flight II	LCU-1700	Spearhead T-EPF-1	Lewis and Clark T-AKE-1	John Lewis T-AO-205
Type	Amphibious	Amphibious	Amphibious	Amphibious	Expeditionary	Combat logistics	Combat logistics
Year of authorization	2007	1996	2018	2016	2008	2000	2016
Displacement (long tons)							
Full-load	43,745	25,600	25,300	435	2,460	42,000	49,600
Lightship	29,300	19,000	17,760	263	1,630	25,620	22,530
Dimensions (feet)							
Length	855	684	684	139	338	689	746
Beam	118	105	105	32	94	106	106
Draft	28	23	23	7	13	30	34
Crew size	1,204	396	383	14	42	172	125
Sustained speed (knots)	22	22	22	8	35	20	20
Service life (years)	40	40	40	30	20	40	40

Data source: Congressional Budget Office, using data from the Department of the Navy. See www.cbo.gov/publication/60071#data.

Lightship displacement is the weight of the water the ship displaces when it is without its crew, stores, cargo, ammunition, fuel, and other liquids. Full-load displacement is the weight of the water the ship displaces with all of those items included.

LCU = utlity landing craft; LHA = amphibious assault ship; LPD = amphibious transport dock; T-AKE = dry cargo ship; T-AO = fleet oiler; T-EPF = expeditionary fast transport.

Mississippi), and TAI Engineers, a ship design firm that would partner with a shipyard to build its design.

The different ship designs being proposed by those firms contribute to the program's uncertainty. The size of the ships ranges from a full-load displacement of 4,500 tons to 5,400 tons, and thus their cargo capacity varies as well. (The Navy wants the LSM to have at least 8,000 square feet of cargo space, but some of the designs offer more.) In January 2024, the Navy issued a request for proposals for the next step of the acquisition process; bids will be based on the ship's lengthy list of specifications and construction standards, which may or may not be consistent with the preliminary designs. The Navy is now awaiting formal submissions, and it plans to award the contract for the program to one company early in fiscal year 2025.

A central issue that remains unclear is the LSM's concept of operations. Specifically, do Navy and Marine Corps leaders expect the ships to deploy and resupply their marines only before a war has started, such as when a crisis is building? Or would the ships also redeploy and resupply marine units during a conflict, when those ships would be potentially vulnerable to detection and attack by opposing military forces? A ship that is not expected to face enemy fire in a conflict could be built to a lesser survivability standard, with fewer defensive systems than a ship that would sail in contested waters during a conflict. Recent experiments by the Marine Corps suggest that the naval services are still determining what the capabilities of the LSM will be.[5]

Some uncertainty also remains about how to characterize the ship. In the Navy's 2023 shipbuilding plan, the LSMs were grouped with amphibious warfare ships. In the 2024 shipbuilding plan, the ships were described as "expeditionary" and were grouped with support ships. One Marine Corps general explicitly described it as a warship, even though the service may experiment with some commercial designs to refine the war-fighting concept.[6] Both CBO and the Congressional Research Service categorize the LSM as an amphibious warfare ship, although a much smaller one, in the same way that the Navy separates its surface combatants into large and small ship categories. The designation matters because the ship will be crewed by Navy sailors rather than civilian mariners, who operate most of the Navy's support ships.

5. Gidget Fuentes, "Marine Corps Begins Water Testing for Future Landing Ship Concept," *USNI News* (February 26, 2024), https://tinyurl.com/5furcyb6.

6. Richard R. Burgess, "Navy's Light Amphibious Warship Will Be a 'Great Enabler' for Marine Littoral Regiments, General Says," *Seapower* (August 19, 2022), http://tinyurl.com/mryjvt7r.

Table 2.

CBO's Estimates of the Cost of the Navy's Medium Landing Ship

Millions of dollars

	Low estimates	High estimates
2024 dollars		
Lead ship (fiscal year 2025)	460	560
18-ship program	6,200	7,800
35-ship program	11,900	15,000
Then-year dollars		
Lead ship (fiscal year 2025)	460	570
18-ship program	6,900	8,700
35-ship program	14,600	18,400

Data source: Congressional Budget Office. See www.cbo.gov/publication/60071#data.

The low and high estimates for ship costs reflect the range of the lightship displacements of 2,865 long tons to 3,612 long tons in the preliminary designs of the medium landing ship that shipbuilders submitted to the Navy.

Determining how the LSM will be constructed is a key factor in estimating its cost. The Navy states that the ship will be built to mostly commercial standards but with the survivability and recoverability features of an amphibious warfare ship. Those features include adjustments to a commercial ship design that would strengthen the ship, shock-harden several of its critical areas or systems, provide better firefighting features, and protect the ship's magazine, among other things. In formulating estimates for the LSM, the Navy uses cost-estimating relationships that borrow from amphibious warfare ships, combat logistics ships, and commercial ships. (Cost-estimating relationships use the costs of different parts, systems, or sections of existing ship programs to help estimate the costs of the same or similar components of a new ship to develop its overall cost estimate.)

The number of LSMs the Navy will buy is a source of significant uncertainty in estimates of the program's overall cost. Navy and Marine Corps leaders have discussed programs as small as 18 ships and as large as 35 ships. That range is also based on the Navy's December 2022 *Amphibious Forces Requirements Study*, a classified document that was submitted to the Congress in January 2023 but did not explain the basis for the size of the range. Some documents, such as the Chief of Naval Operations' *Navigation Plan 2022*, set the number at 18 ships.[7] Marine Corps leaders have often cited 35 LSMs, explaining that each of their three planned Marine littoral regiments would need 9 ships to transport and deploy the unit and that an additional 8 ships would be needed to compensate for ships that are in maintenance.[8] The Navy's 2023 and 2024 shipbuilding reports suggested programs with 18 to 33 ships but without explaining the basis for the different numbers. The 2025 shipbuilding plan, released in mid-March 2024, indicates a goal of buying 18 LSMs.

The total cost of the program—as opposed to the average cost of individual ships—will largely be determined by the number of LSMs the Navy ultimately buys.

Acquisition Costs of the LSM Program

By CBO's estimates, the first LSM would cost $460 million to $560 million, and the average cost of a class of 18 or 35 ships would be between $340 million and $430 million per ship—or about $120 million per thousand tons. Thus, a total program of 18 ships would cost between $6.2 billion and $7.8 billion to acquire, whereas a program of 35 ships would cost between $11.9 billion and $15.0 billion (see Table 2).

The range in the estimates represents the lowest and highest lightship displacements of the LSMs in the Navy's preliminary designs. All other factors, such as rate, learning, and construction standards, are the same.[9] The average ship cost of an 18-ship program and a 35-ship program is nearly the same. Although the cost of the later ships in a 35-ship program would benefit from more learning, that learning would be offset by the real growth in costs in the naval shipbuilding industry that would occur over the longer period it would take to purchase the additional ships.[10]

7. Chief of Naval Operations, *Navigation Plan 2022* (July 2022), https://tinyurl.com/46fmj4e6 (PDF).

8. Ronald O'Rourke, *Navy Medium Landing Ship (LSM) (Previously Light Amphibious Warship [LAW]) Program: Background and Issues for Congress*, Report R46374, version 62 (Congressional Research Service, December 20, 2023), p. 5, https://tinyurl.com/5t4payx6.

9. Rate is the reduction in average overhead costs that occurs as a shipyard builds multiple ships of the same type simultaneously. Learning refers to the efficiencies shipyards gain as they produce additional ships of a given type.

10. Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2024 Shipbuilding Plan* (October 2023), pp. 26–27, www.cbo.gov/publication/59508.

These estimates are higher than CBO's estimates in its analysis of the Navy's 2024 shipbuilding plan. The estimates are higher now largely because CBO received updated information about the preliminary LSM designs, which indicated that lightship displacements are now larger than they were when CBO developed its estimates for its analysis of the shipbuilding plan.

Uncertainty in the LSM program could lead to either higher or lower costs than in CBO's estimate. For example, if the Navy made changes to the design of the ships that made them more equivalent to amphibious warfare ships than to commercial ships, then the LSMs could cost between $475 million and $600 million each, on the basis of the range of displacements discussed earlier. Conversely, ships built to largely unimproved commercial standards could cost $110 million to $140 million each. In addition, if the Navy made changes to the design of the ships that made them even larger than the ships in the preliminary designs, then they would be more expensive to build, even without changes to the construction standards. Conversely, smaller ships would be less expensive—but substantially smaller ships would probably not meet the Navy's goals for the ship. Finally, if the Navy wanted to buy the ships faster and decided to use a second builder so that it could buy as many as 4 ships per year, average ship costs would be higher. Each shipbuilder would produce a lead ship, and later ships would benefit less from learning. Conversely, if the Navy awarded the contract to a single shipbuilder capable of building more than 2 ships per year, average costs would be less.

How CBO Estimated the LSM Program's Acquisition Costs

CBO estimated the costs of the new LSMs in the same way that it estimates the costs of new ships in its analysis of the Navy's annual shipbuilding plan.[11] Specifically, CBO relies primarily on information about the cost-to-weight ratio of similar ships acquired in the past. The agency uses the cost per thousand tons of lightship displacement and then adjusts its estimates to reflect the effects of rate and learning. CBO applied those adjustments to the estimated cost of the first ship of the class to estimate the cost for all subsequent LSMs. The agency's estimates include the expectation that costs of labor and materials continue to grow at a rate that is 1 percentage point faster in the naval shipbuilding industry than in the economy as a whole—the rate at which such costs have grown for the past several decades.[12]

A challenge in estimating the cost of the LSM is that good historical analogies are lacking for what the Navy describes as a hybrid ship that mixes commercial construction standards with military standards and features like those for an amphibious warfare ship. For example, an existing class of an Aegis-capable destroyer provides a good analogy for estimating the cost of a new class of an Aegis-capable destroyer. But since the LSM is not an amphibious ship or a commercial or logistics support ship, using the LPD-17 as a cost analogy would probably lead to an estimate that is too high, whereas using the T-AO-205 oiler would probably lead to an estimate that is too low.

The difference in the cost by weight of an amphibious ship and a ship built to commercial standards (similar to the Navy's combat logistics ships) is considerable. Despite their size differences, the cost per thousand tons of the first LHA-6, LPD-17, and LCU-1700 ranged from about $160 million per thousand tons to $210 million per thousand tons (see Figure 1).[13] By contrast, the T-AKE-1 and T-AO-205 combat logistics ships cost about $40 million per thousand tons for the first ships of those classes. The T-EPF-1 transport ship was not built with the same construction standards as an amphibious ship but was designed for high speed. Building speed into Navy ships is expensive, and thus its cost per thousand tons was comparable to that of an amphibious ship even though its construction standards are more like those of a logistics support ship.

CBO used costs from the lead LPD-17 and the lead T-AO-205 oiler to develop its estimate for the lead LSM. The agency assumed that delivery of ships in an 18-ship program and a 35-ship program would follow a schedule

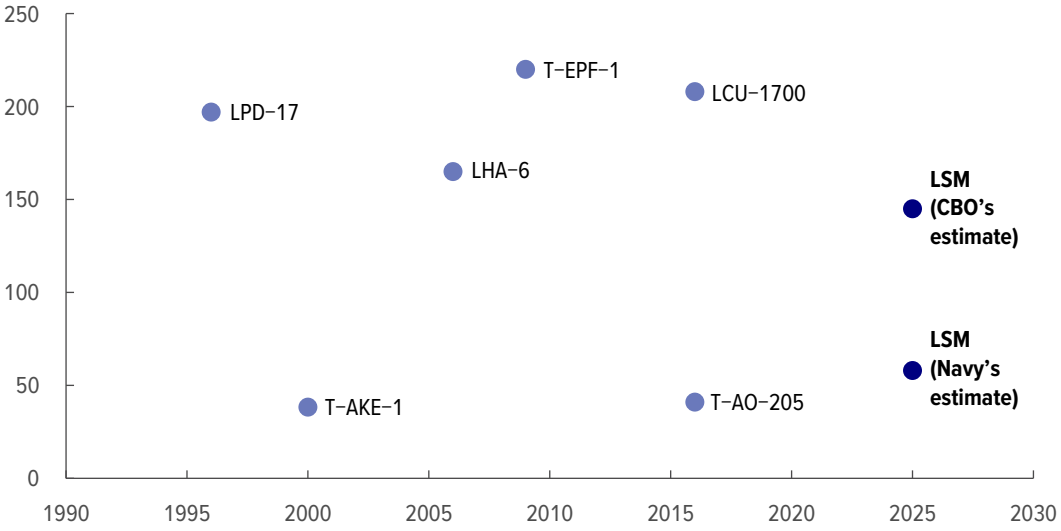
11. For an explanation of how CBO combines the different factors in its cost model, as well as a detailed example of that process applied to a particular ship, see Congressional Budget Office, *How CBO Estimates the Cost of New Ships* (April 2018), www.cbo.gov/publication/53785.

12. Congressional Budget Office, *The Shipbuilding Composite Index and Its Rates of Change Compared With Economywide Inflation Rates* (April 2024), www.cbo.gov/publication/59026.

13. Swiftships, the builder of the first LCU-1700, has had difficulty in building the landing craft, and the Navy is terminating its contract with the company. However, CBO still considers the cost of the first LCU to be a reasonable potential cost analogy for the LSM program because its cost by weight is almost the same as that of the first LPD-17 or the first T-EPF. As another point of comparison, the Army's light maneuver support vessel, which has a mission similar to that of the LCU-1700, also has an average cost by weight similar to that of an amphibious ship.

Figure 1.

Cost of Lead Ships per Thousand Tons, 1995 to 2025



Data source: Congressional Budget Office, using data from the Department of the Navy. See www.cbo.gov/publication/60071#data.

The lead ship is the first ship of its class.

LCU = utility landing craft; LHA = amphibious assault ship; LPD = amphibious transport dock; LSM = medium landing ship; T-AKE = dry cargo ship; T-AO = fleet oiler; T-EPF = expeditionary fast transport.

similar to that specified in the Navy's 2024 shipbuilding plan: The first ship would be purchased in 2025, the second in 2026, and then the reminder at a rate of 2 ships per year starting in 2027. CBO's estimate incorporated the assumption that all ships would be built by the same shipyard.

The Navy's Recent Estimates of the LSM Program's Acquisition Costs

Over the past three years, the Navy's published cost estimates for the LSM have varied widely. In the 2023 Future Years Defense Program (FYDP), which covered the years 2023 to 2027, the Navy estimated that the lead ship would cost $247 million in then-year dollars. After removing the effects of inflation, that amount was $233 million in 2024 dollars. The next 3 ships averaged $150 million each in 2024 dollars. The Navy's estimates for the same ships were lower under the 2024 FYDP: The Navy priced the lead ship at $188 million in then-year dollars, which equaled $177 million in 2024 dollars, or 24 percent lower than its estimate in 2023. The average price of the next 5 ships was about $150 million in then-year dollars and $134 million in 2024 dollars. The Navy specified that its estimates of the costs of those ships used commercial design standards, which do not have significant survivability and recoverability features.

The estimates in the Navy's 2023 and 2024 shipbuilding plans followed a pattern similar to that in the FYDP: The estimates for 2024 were lower than those in the previous year. Each shipbuilding plan presented three alternatives for the Congress to consider. With respect to the LSM program, the Navy would build 25 ships under Alternative 1, 18 or 19 ships under Alternative 2, and 33 ships under Alternative 3.[14] (Those numbers are roughly consistent with statements by Navy and Marine Corps leaders about building 18 to 35 LSMs.) The average cost per ship under the Navy's 2023 shipbuilding plan was about $250 million in 2024 dollars. Under the 2024 shipbuilding plan, the average cost per ship—for those same shipbuilding schedules—fell to about $190 million, a reduction of 23 percent.

14. Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2024 Shipbuilding Plan* (October 2023), www.cbo.gov/publication/59508, and *An Analysis of the Navy's Fiscal Year 2023 Shipbuilding Plan* (November 2022), www.cbo.gov/publication/58447; Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2024* (March 2023), https://tinyurl.com/5dxbpzcj (PDF), and *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2023* (April 2022), https://tinyurl.com/2n65s8zv (PDF).

In the recently released 2025 FYDP, which covers the years 2025 to 2029, the Navy slightly increased its cost estimate for the LSM to account for incorporating survivability and recoverability features into the design. The Navy expects the lead ship to cost $268 million in then-year dollars, or $252 million in 2024 dollars. The average cost of the next 7 ships would be less than $150 million each in 2024 dollars. Extrapolating the Navy's FYDP costs to an 18-ship program would result in an average cost of about $140 million for each ship after the lead ship. On a cost-by-weight basis, that price would make the ship only slightly more expensive than a combat logistics ship. Although the Navy released its 2025 shipbuilding plan in mid-March 2024, the cost details for the LSM were not yet available to CBO when this report was written.

The Congressional Budget Office prepared this report at the request of the Senate Armed Services Committee. In keeping with CBO's mandate to provide objective, impartial analysis, the report makes no recommendations.

Eric J. Labs prepared the report, with guidance from David Mosher. Michael Bennett and Caroline Dorminey provided useful comments. Bradley Martin of the Rand Corporation commented on an earlier draft. The assistance of external reviewers implies no responsibility for the final product; that responsibility rests solely with CBO.

Jeffrey Kling and Robert Sunshine reviewed the report. Rebecca Lanning edited it, and R. L. Rebach created the graphics and prepared the text for publication. The report is available at www.cbo.gov/publication/60071.

CBO seeks feedback to make its work as useful as possible. Please send comments to communications@cbo.gov.

Phillip L. Swagel
Director