

Defense Modernization Plans through the 2020s

Addressing the Bow Wave

A Report of the CSIS International Security Program

AUTHOR

Todd Harrison

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1 | Introduction

Since the enactment of the Budget Control Act (BCA) of 2011, much attention has been paid to the near-term effects of budgetary constraints on national defense. What has received less attention are the looming budgetary challenges defense faces beyond the BCA budget caps and the Defense Department’s five-year budget planning horizon. Many weapons programs will be at or near their peak years of funding requirements at roughly the same time in the 2020s. For example, the Department of Defense (DoD) currently plans to have modernization programs underway for all three legs of the nuclear triad (nuclear-capable bombers, intercontinental ballistic missiles, and ballistic missile submarines) at the same time, in addition to many other modernization programs for conventional forces. These modernization programs, if not altered from current plans, will require either an increase in defense spending or a reallocation of resources within the defense budget.

When the next administration takes office in January 2017, it will need to make many difficult choices to rationalize long-term defense modernization plans with the resources available. Understanding these long-term modernization plans—and the budgets associated with them—is important because the sooner adjustments are made the less disruptive and costly they will be. Some modernization areas have steep funding increases planned while other areas have flat or declining long-term plans. Smoothing the modernization bow wave presents an opportunity to rebalance and realign defense programs with the strategic priorities of a new administration.

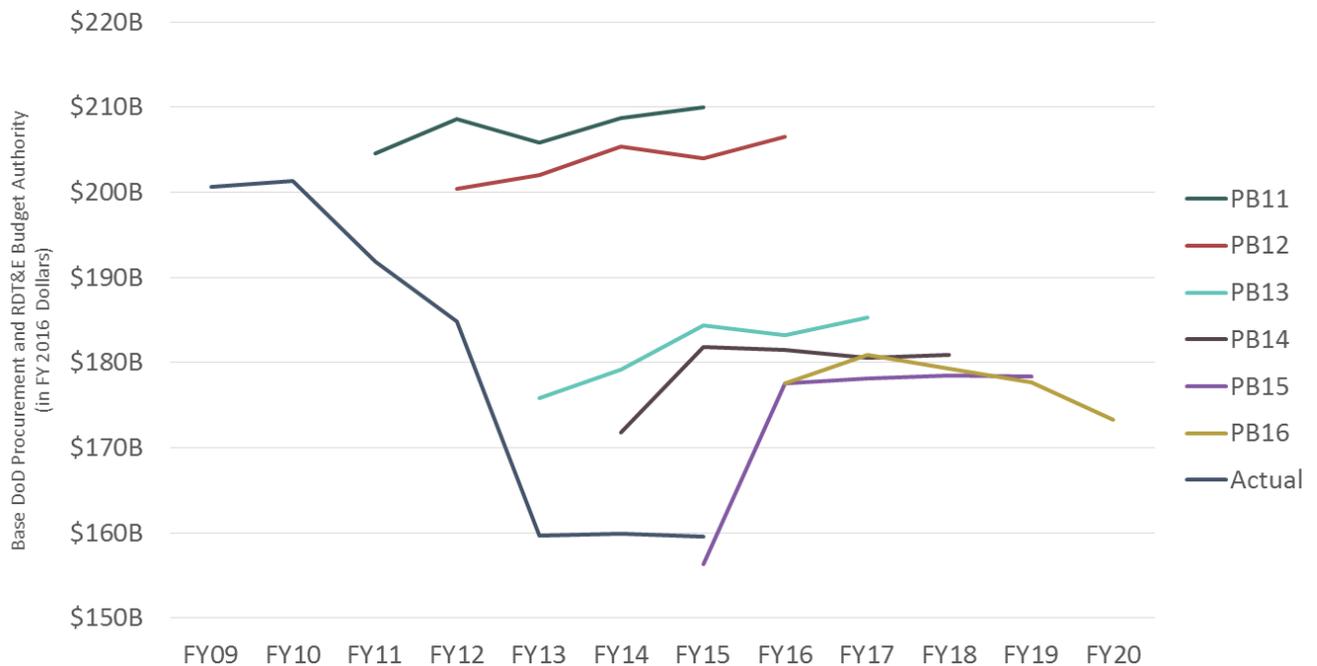
Understanding the Bow Wave

The phrase “modernization bow wave” is commonly used to describe long-term defense modernization plans that depend on a significant increase in future funding. A modernization bow wave typically forms as the overall defense budget declines and modernization programs are delayed or stretched into the future. As this happens, the underlying assumption is that funding will become available to cover these deferred costs, often peaking just beyond the five-year planning horizon. The “bow wave” metaphor is appropriate because, much like the bow wave pushed in front of a ship, the modernization bow wave is routinely pushed further into the future with each successive budget cycle as projected funding increases do not materialize as expected. Just as a large bow wave slows a ship by diverting its energy, carrying a large modernization bow wave is a drag on defense because it leads to program instability and inefficient procurement practices that weaken the buying power of defense dollars.

This pattern of behavior appears to be at work in the Defense Department’s recent modernization plans. Figure 1 shows the future years defense program (FYDP) projections for modernization funding—the combination of procurement and research, development, test, and evaluation (RDT&E) accounts—in the last six president’s budget

(PB) requests for the base DoD budget.¹ Because the FYDP only projects funding five years into the future, these projections do not show when the bow wave will crest. What is notable is that each year the budget request projects that modernization funding will grow in the future, albeit from progressively lower levels, even as the actual level of modernization funding is declining or flat. This suggests that programs are being deferred and a modernization bow wave is building just beyond the FYDP.

Figure 1: Modernization Funding Projected in Recent President’s Budget Requests



Causes of the Modernization Bow Wave

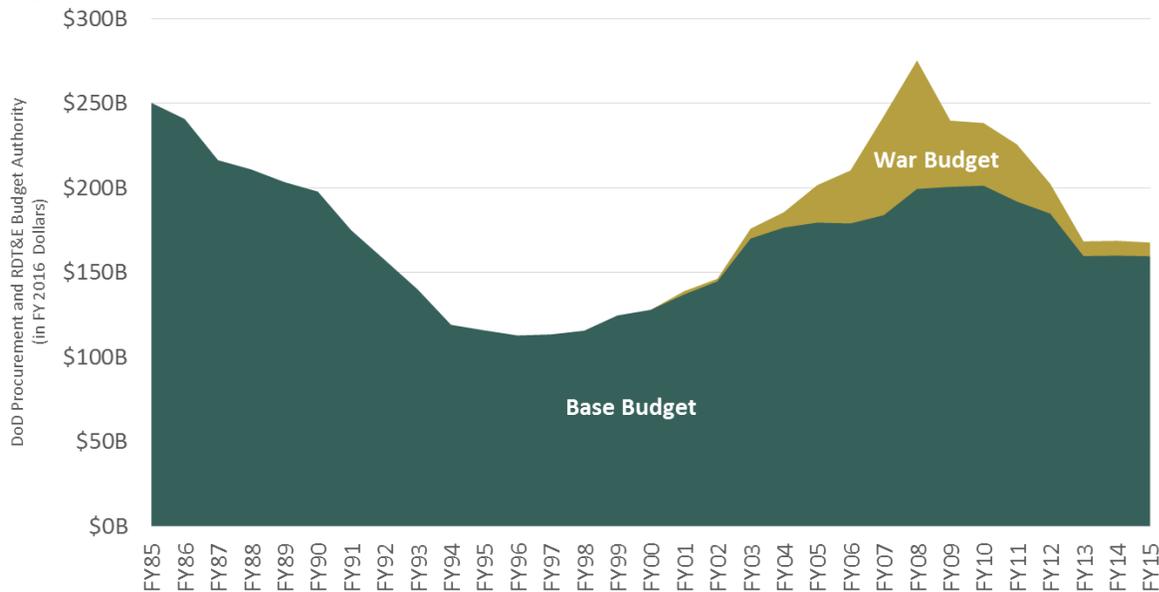
Much of the decline in modernization funding shown in Figure 1 can be attributed to the enactment of the Budget Control Act. The BCA put in place caps on the defense and nondefense discretionary budgets, which for defense represented a cumulative reduction of roughly \$1 trillion over 10 years (in then-year dollars) compared to the planned level of spending in the president’s FY 2012 budget request. Since the BCA’s enactment, the Obama administration has reduced its future budget projections each year, including the reductions in modernization funding shown in Figure 1. However, the administration has not produced a budget and FYDP that fits within the BCA budget caps, and Congress, for its part, has revised the budget caps three times since they were

¹ The base DoD budget does not include supplemental war-related funding, often referred to as Overseas Contingency Operations (OCO) funding. While OCO funding is intended to cover the incremental cost of contingency operations, some procurement and RDT&E funding that arguably belonged in the base budget has migrated into the OCO budget.

enacted. The gap between the defense budget request and the BCA budget caps has been a main source of uncertainty and program instability in defense acquisitions over the past four years and has contributed to the growing list of deferred programs.

Another important factor contributing to the formation of a modernization bow wave during this drawdown is the buildup that preceded it. While total DoD modernization funding peaked at \$275 billion (in FY 2016 dollars), a level higher than the peak during the Reagan administration, much of this was due to war-related procurements.² The base budget for modernization did not grow as much, peaking at 20 percent below the high of the 1980s. War-related procurements were largely used to fund replacements for equipment damaged or destroyed in Iraq and Afghanistan and for new equipment to satisfy urgent operational needs for these conflicts, such as Mine Resistant Ambush Protected (MRAP) vehicles and Predator / Reaper Unmanned Aerial Vehicles (UAVs). The rapid procurement of MRAPs, for example, created the spike in war-related procurement funding in FY 2008, shown in Figure 2. As U.S. forces returned from Iraq and Afghanistan, much of the new equipment did not. Many MRAP vehicles, for example, were given to partner forces or destroyed and sold for scrap. And some newly purchased aircraft, such as the C-27J cargo plane, were promptly retired from the inventory. For the most part, war-related acquisition funding was not used to modernize and recapitalize the inventory of equipment.

Figure 2: Base and War-Related Modernization Funding



Within DoD’s base budget for modernization, a number of factors also conspired to create what was arguably a hollow buildup. Many major acquisition programs planned during the buildup were truncated before the full quantity had been procured due to cost overruns and poor performance. The F-22 program, for example, originally planned

² All adjustments for inflation in this study use the GDP Chained Price Index published by OMB in Historical Table 10.1 of the annual budget request.

to procure 750 aircraft but was stopped at 187.³ Many other programs were canceled while still in development, as shown in Table 1. While not an exhaustive list, the funding

Table 1: Some of the Major Programs Canceled in Development during 2000s

Program	Service / Agency	Sunk Costs (in then-year dollars)	Follow-On or Replacement
Future Combat Systems (FCS)	Army	\$18.1B	Superseded by the Ground Combat Vehicle Program, which was also canceled
RAH-66 Comanche Armed Reconnaissance and Attack Helicopter	Army	\$7.9B	Superseded by the Armed Reconnaissance Helicopter, which was also canceled (see below)
National Polar-orbiting Operational Environmental Satellite System (NPOESS)	Air Force / National Oceanic and Atmospheric Administration (NOAA)	\$5.8B	Superseded by the Defense Weather Satellite System, which was also canceled and will be restarted as the Weather Satellite Follow-On
Airborne Laser	Air Force	\$5.2B ⁴	Canceled, no replacement identified
Future Imagery Architecture (FIA) Electro-Optical Imagery Satellites	National Reconnaissance Organization (NRO)	\$4B ⁵	Original program was classified, current status unknown
VH-71 Presidential Helicopter	Marine Corps	\$3.7B	Restarted as the VH-92A Presidential Helicopter
Expeditionary Fighting Vehicle (EFV)	Marine Corps	\$3.3B	Superseded by the Amphibious Combat Vehicle (ACV) program and interim upgrades to existing AAVs
Transformational SATCOM (TSAT)	Air Force	\$3.2B	Deferred in favor of buying more Advanced Extremely High Frequency (AEHF) satellites
XM2001 Crusader Self-Propelled Howitzer	Army	\$2.2B	Superseded by the Non-Line-of-Sight Launch System (NLOS-LS), which was part of the FCS program but then spun off and later canceled separately.
E-10 Multi-sensor Command and Control Aircraft (MC2A)	Air Force	\$1.9B	Canceled and later superseded by the Joint Surveillance Target Attack Radar System (JSTARS) Replacement Program
Space Based Infrared Systems (SBIRS) – Low	Air Force	\$1.5B	Superseded by the Space Tracking and Surveillance System (STSS) funded through the Ballistic Missile Defense System (BMDS) program
Space Radar	Air Force	\$0.6B	Canceled in favor of alternative airborne systems
Advanced SEAL Delivery System (ASDS)	Navy	\$0.6B	Superseded by the Joint Multi-Mission Submersible, which was also canceled.
Armed Reconnaissance Helicopter	Army	\$0.5B	Deferred in favor of using a mix of UAVs and AH-64Es
Aerial Common Sensor	Army / Navy	\$0.4B	Deferred in favor of the P-8 for the Navy and upgrades to existing aircraft for the Army
CG(X) Next Generation Cruiser	Navy	\$0.2B	Deferred in favor of buying additional DDG 51 destroyers
CSAR-X Combat Rescue Helicopter	Air Force	\$0.2B	Restarted as the Combat Rescue Helicopter (CRH)
Next Generation Bomber	Air Force	\$0.1B	Restarted as Long Range Strike – Bomber (LRS-B)

³ Jeremiah Gertler, *Air Force F-22 Fighter Program* (Washington, DC: Congressional Research Service, 2013), 3, <https://www.fas.org/sgp/crs/weapons/RL31673.pdf>.

⁴ Air Force Technology, “Airborne Laser System (ABL) YAL 1A, United States of America,” <http://www.airforce-technology.com/projects/abl/>.

⁵ Philip Taubman, “In Death of Spy Satellite Program, Lofty Plans and Unrealistic Bids,” *New York Times*, November 11, 2007, <http://www.nytimes.com/2007/11/11/washington/11satellite.html?pagewanted=all&r=1>.

for just this sample of 18 major programs terminated in the 2000s while still in development reveals more than \$59 billion spent without any fielded systems to show for it. As indicated in the table, many of these canceled programs were later restarted or replaced by new acquisition programs, and at least five of these follow-on programs have since been canceled as well. While many of these cancellations were arguably justified due to requirements creep, cost overruns, evolving warfighter needs, and many other factors, the cumulative effect of successive acquisition starts, stops, and restarts is a key contributor to hollow buildup of the 2000s and the current modernization bow wave.

Breaching the Bow Wave

Unlike a ship's bow wave, the modernization bow wave cannot be pushed into the future indefinitely. Some legacy systems cannot have their service lives extended any longer—if they are not modernized, force levels will have to be reduced. The current fleet of *Ohio*-class ballistic missile submarines, for example, have already had their service lives extended from 30 years to 42 years, and Navy leaders have indicated it is not practical to extend their lives further due to structural limitations.⁶ Other types of systems whose lives can be extended may become increasingly obsolete or expensive to maintain without significant upgrades, and these upgrades can, in some cases, cost nearly as much as buying replacement systems.

Difficult choices lie ahead if the modernization bow wave proves too steep to climb. The purpose of this study is to quantify the current modernization bow wave, looking beyond the FYDP through the 2020s. The following chapter details the projected acquisition costs of major programs, including programs currently planned and those likely to be started over the next 15 years (FY 2016 to FY 2030). Chapter 3 examines complicating factors that could make it more difficult to execute modernization plans as currently envisioned, including funding instability, potential cost overruns, industrial base concerns, and acquisition oversight capacity. The fourth chapter explores options for smoothing the bow wave and mitigating some of these risks, and the final chapter summarizes key conclusions from the analysis.

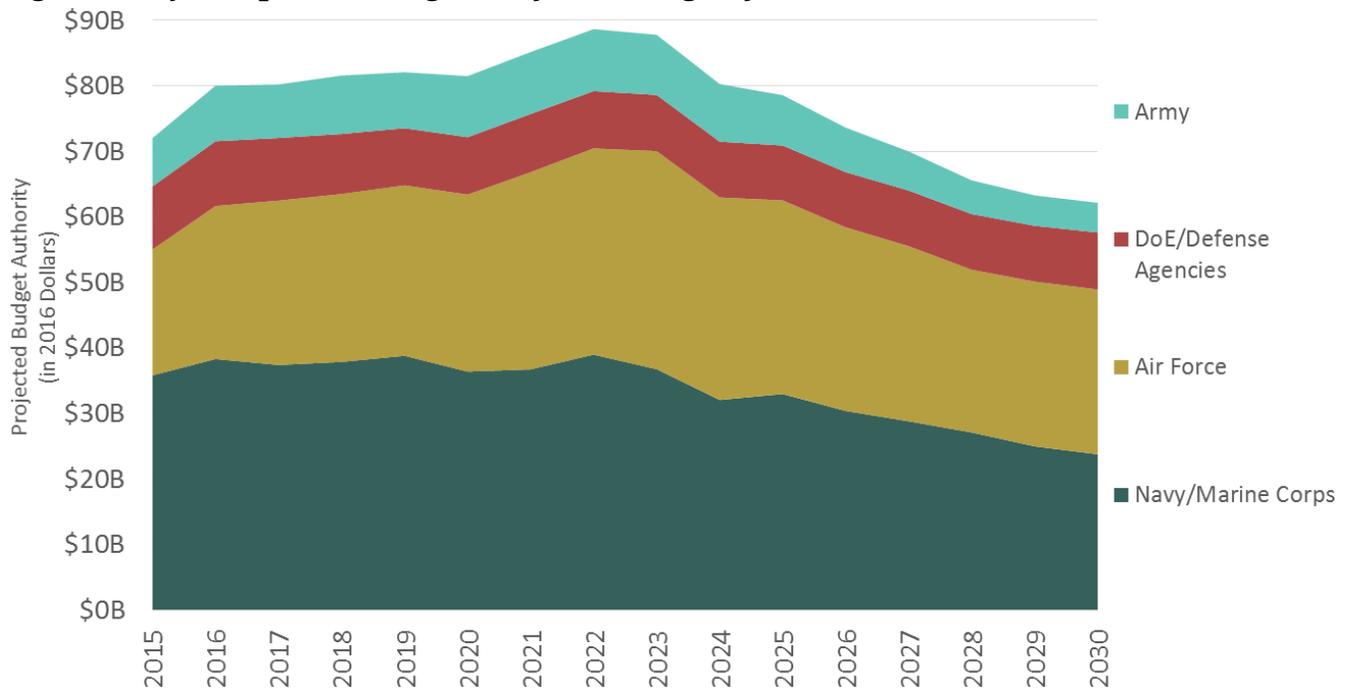
⁶ Ronald O'Rourke, *Navy Ohio Replacement (SSBN[X]) Ballistic Missile Submarine Program: Background and Issues for Congress* (Washington, DC: Congressional Research Service, 2015), 2, <https://www.fas.org/sgp/crs/weapons/R41129.pdf>.

2 | Quantifying the Bow Wave

More than 120 major acquisition programs are either currently in progress or planned to start over the next 15 years. This chapter details the current and projected acquisition budgets for major programs using data drawn from a variety of unclassified sources, primarily DoD’s most recent Selected Acquisition Reports (SARs) from December 2014, the FY 2016 president’s budget request, and the 30-year aviation and shipbuilding plans submitted to Congress in 2015. Where data was not available through official documents, particularly for follow-on programs that are anticipated but not yet in the early development stage, estimates are based on prior programs and other publicly available information.

This chapter does not include “black” or classified programs or individual estimates for the hundreds of smaller acquisition programs since they do not typically provide long-term modernization plans that can be analyzed to the same degree of detail as major acquisition programs. These other acquisition programs typically consume 55 to 60 percent of the total modernization budget. This analysis also does not include the operation and maintenance or personnel costs associated with major weapon systems and instead focuses exclusively on modernization costs.

Figure 3: Major Acquisition Programs by Service/Agency

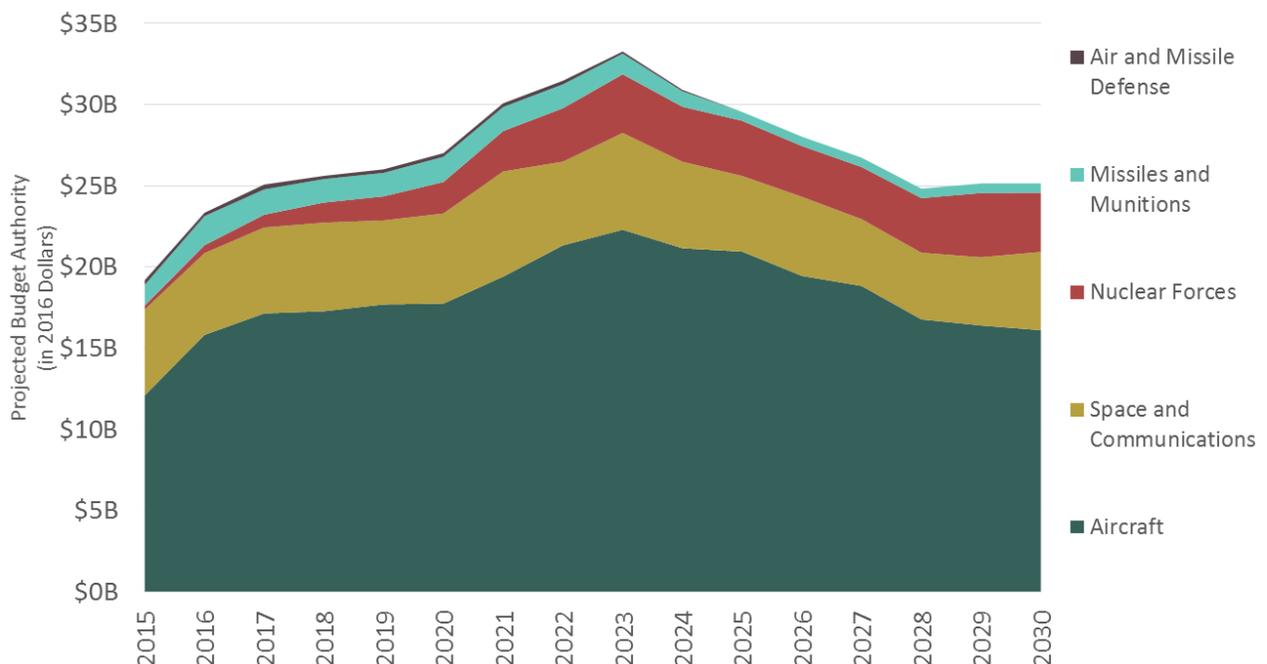


Current plans for major acquisition programs appear to follow the typical pattern of a modernization bow wave. These plans project that funding will increase by 23 percent, adjusting for inflation, from the FY 2015 level, and the peak in funding occurs in FY 2022—just beyond the current five-year planning horizon. However, this modernization bow wave is not evenly distributed across the Services and defense-related agencies nor is it evenly distributed over time. As shown in Figure 3, much of the projected increase in modernization funding is driven by Air Force modernization programs. In contrast, Navy and Marine Corps modernization funding remains relatively flat through the early 2020s and then declines in the later part of the decade. And the overall increase occurs largely in two steps, with major increases planned from FY 2015 to FY 2016 and from FY 2020 to FY 2022.

Air Force Modernization Plans

The Air Force is the largest contributor to the overall modernization bow wave. As shown in Figure 4, funding for Air Force major acquisition programs is projected to grow by 73 percent in real terms from FY 2015 to its projected peak in FY 2023. This growth is driven primarily by aircraft programs. The Air Force’s three largest programs in terms of funding are the F-35A Joint Strike Fighter, Long Range Strike – Bomber (LRS-B), and KC-46A aerial refueling tanker. Not coincidentally, the Air Force has stated that these three programs are also its top overall acquisition priorities.¹

Figure 4: Air Force Major Acquisition Programs

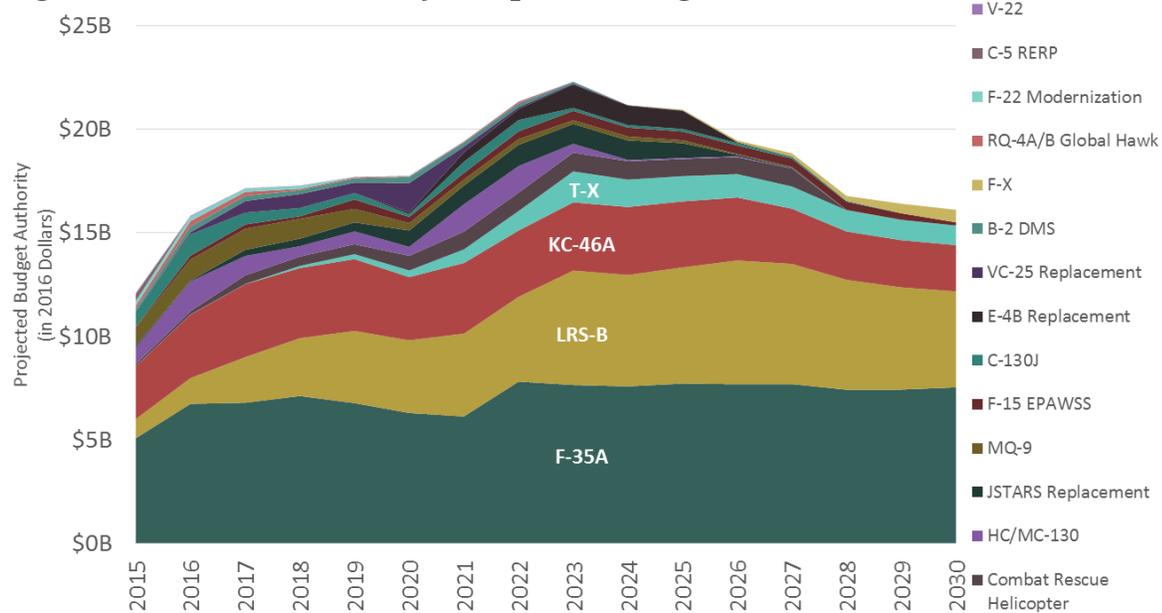


¹ U.S. Department of Defense (DoD), Department of the Air Force, *Fiscal Year 2016 Budget Overview* (Washington, DC: DoD, February 2015), 5–7, <http://www.saffm.hq.af.mil/shared/media/document/AFD-150421-011.pdf>.

The challenge for the Air Force is not only funding these three programs simultaneously but also funding the other major aircraft acquisitions planned for the same period, shown in Figure 5. In the 2020s, the Air Force plans to be at full rate production on the F-35A, KC-46A, and Combat Rescue Helicopter; ramping up production of the LRS-B and a new Advanced Pilot Trainer (T-X); and replacing the E-4B National Airborne Operations Center, E-8 Joint Surveillance Target Attack Radar System (JSTARS), HC/MC-130 aerial refueling tanker and transport, and VC-25 Presidential Aircraft. The cost of major Air Force aircraft programs is projected to peak in FY 2023 at nearly twice the FY 2015 level of funding, adjusting for inflation, and is a driving factor behind the overall defense modernization bow wave. The Air Force aircraft modernization programs shown in Figure 5 account for more than half of the overall modernization bow wave for major acquisition programs.

Beyond aircraft modernization, the Air Force is also planning to replace the Minuteman III Intercontinental Ballistic Missile (ICBM) with the Ground Based Strategic Deterrent (GBSD) program, shown in Figure 4 in the nuclear forces category. Air Force space programs are also in a state of flux, with major decisions pending over the next few years for follow-on constellations for Advanced Extremely High Frequency (AEHF) system, Spaced Based Infrared System (SBIRS), and GPS III. For the purposes of estimation, each of these satellite programs is assumed to pursue follow-on programs that incrementally evolve current designs rather than starting new programs, with procurements timed to replace current satellites as they reach the end of their design lives. If the Air Force elects to begin new-start satellite programs instead, it could create a modernization bow wave for space systems beyond what is presented here.

Figure 5: Air Force Aircraft Major Acquisition Programs²

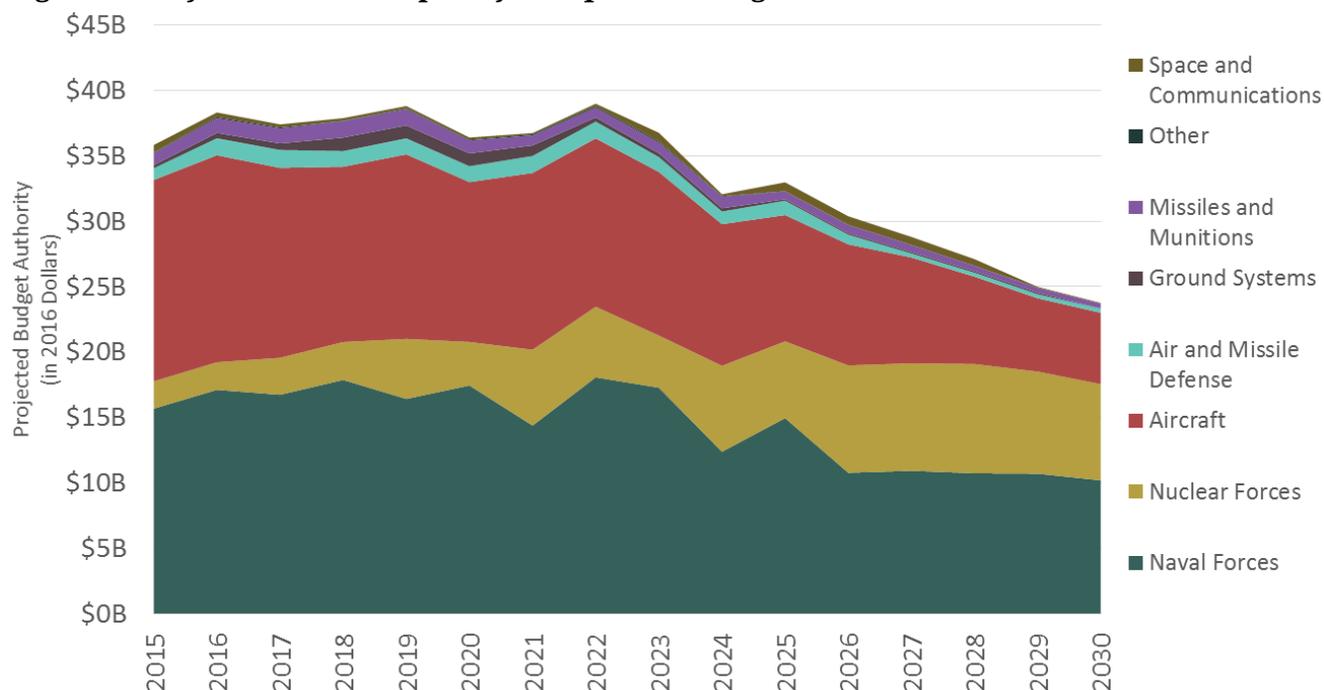


² F-15 EPAWSS stands for the F-15 Eagle Passive Active Warning Survivability System; C-5 RERP stands for the C-5 Reliability Enhancement and Reengineering Program.

Navy and Marine Corps Modernization Plans

Current plans for Navy and Marine Corps modernization, shown in Figure 6, do not indicate a significant bow wave of programs. Instead, these plans project a significant decline in funding over the next 15 years that counteracts some of the growth in the other Services' modernization plans. Funding for Navy and Marine Corps major acquisition programs is projected to stay at roughly the current level through FY 2022 and then decline by about one-third from FY 2022 to FY 2030, driven mainly by a decline in aircraft procurements. Funding in the naval forces category also declines, but it is more than offset by growth in the Ohio Replacement program, which is categorized under the nuclear forces category for the purposes of this analysis.

Figure 6: Navy and Marine Corps Major Acquisition Programs

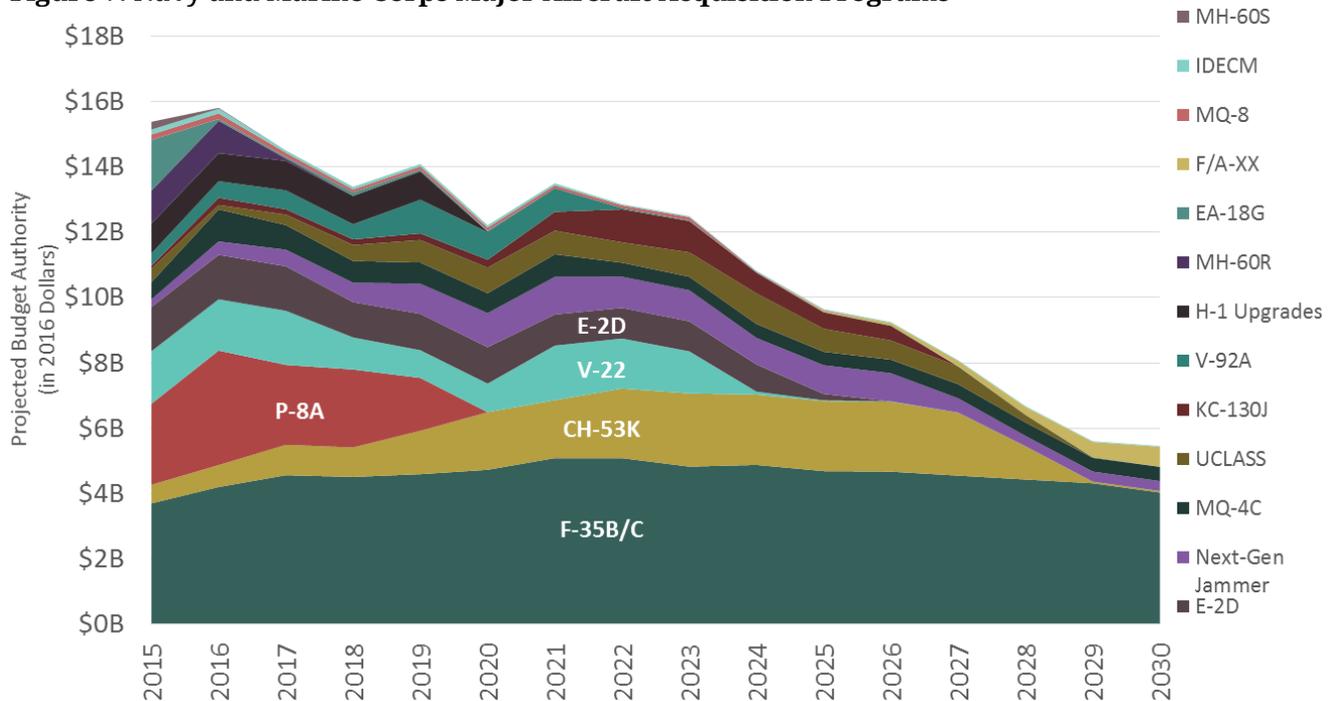


The decline in Navy and Marine Corps aircraft funding is primarily due to several current programs reaching the end of planned procurements. As shown in Figure 7, the P-8A, V-22, E-2D, H-1 Upgrade, EA-18G, and MH-60R programs are all scheduled to end between now and the mid-2020s and few new programs are planned to ramp up during that time.³ The most notable exception is the Marine Corps CH-53K program, which is planned to replace the current fleet of CH-53E Super Stallions. The CH-53K contributes to the overall modernization bow wave, with peak funding in FY 2023, but it is more than counteracted by other Navy and Marine Corps aircraft programs ending around the

³ The exception is the Navy's Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) program. Funding for UCLASS is based on the Navy's FY 2016 budget request and projections beyond the request based on a requirement for 24 aircraft able to operate in "moderately contested" airspace. If the Navy elects to buy more than 24 aircraft or an all-aspect stealth design, the costs could increase considerably.

same time. Funding for the F-35B/C remains fairly steady in the Navy budget over the next 15 years, and with the decline in other major acquisition programs in the late 2020s it will eventually consume the vast majority of aircraft acquisition funding in the Navy's budget.

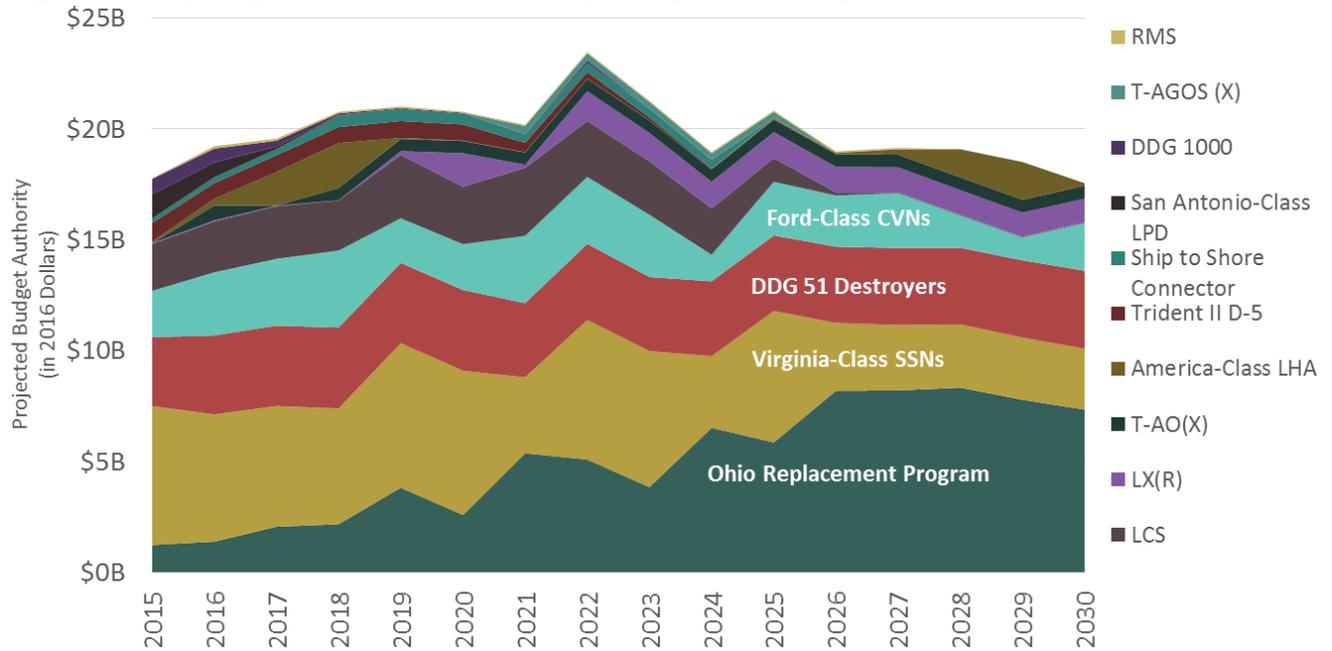
Figure 7: Navy and Marine Corps Major Aircraft Acquisition Programs⁴



Funding for naval forces, which includes all shipbuilding programs except the Ohio Replacement program, declines in part due to a planned reduction in the procurement rate of *Virginia*-class attack submarines. According to the Navy's 30-year shipbuilding plan, the number of *Virginia*-class subs procured will fall from two to one in each year that an Ohio Replacement sub is due for procurement, partially offsetting the increase in funding required for the Ohio Replacement program, as shown in Figure 8. The Littoral Combat Ship (LCS) program will also reach the end of its planned procurements around the same time, with the last of the frigate version of LCS being procured in FY 2025. Procurement of DDG 51 destroyers, however, will continue at a rate of two per year throughout this period.⁵

⁴ IDECM stands for Integrated Defensive Electronic Countermeasures.
⁵ "Document: Navy's 30-Year Shipbuilding Plan to Congress for Fiscal Year 2016," *USNI News*, 2015, 6, <http://news.usni.org/2015/04/03/document-navys-30-year-shipbuilding-plan-to-congress-for-fiscal-year-2016>.

Figure 8: Navy Ship and Nuclear Forces Major Acquisition Programs⁶

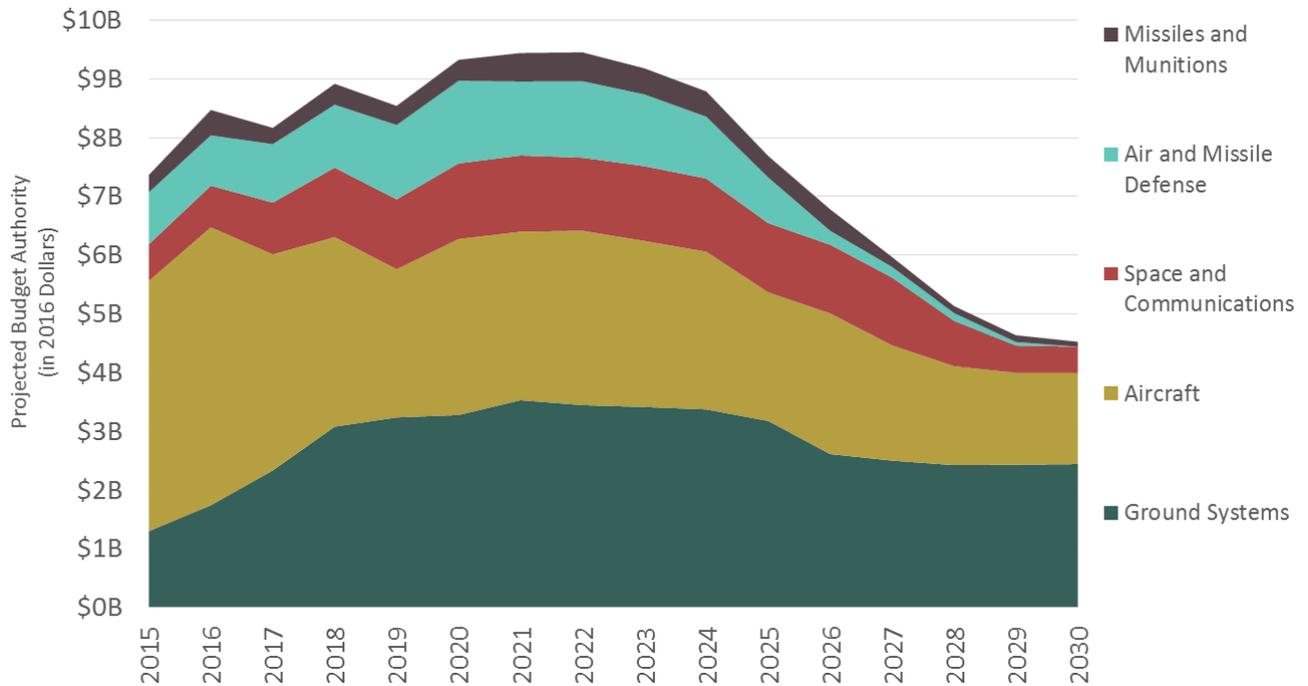


Army Modernization Plans

The Army’s budget for major acquisition programs is projected to increase 28 percent in real terms from FY 2015 to the peak in FY 2022. The Army’s plans indicate a significant bow wave in funding for ground systems, shown in Figure 9, but this increase is balanced in part by a sharp reduction in aircraft procurements. The decline in aircraft funding is due to several major aircraft programs that are slated to end, including the MQ-1C Grey Eagle, CH-47F Chinook, A-64E Apache, and the UH-60M Black Hawk programs, each of which is planned to conclude between now and the mid-2020s. The major aircraft acquisitions for the Army projected beyond these are the Improved Turbine Engine Program (ITEP) to upgrade the engines on Apache and Black Hawk helicopters, and the Future Vertical Lift program to develop a new family of helicopters.

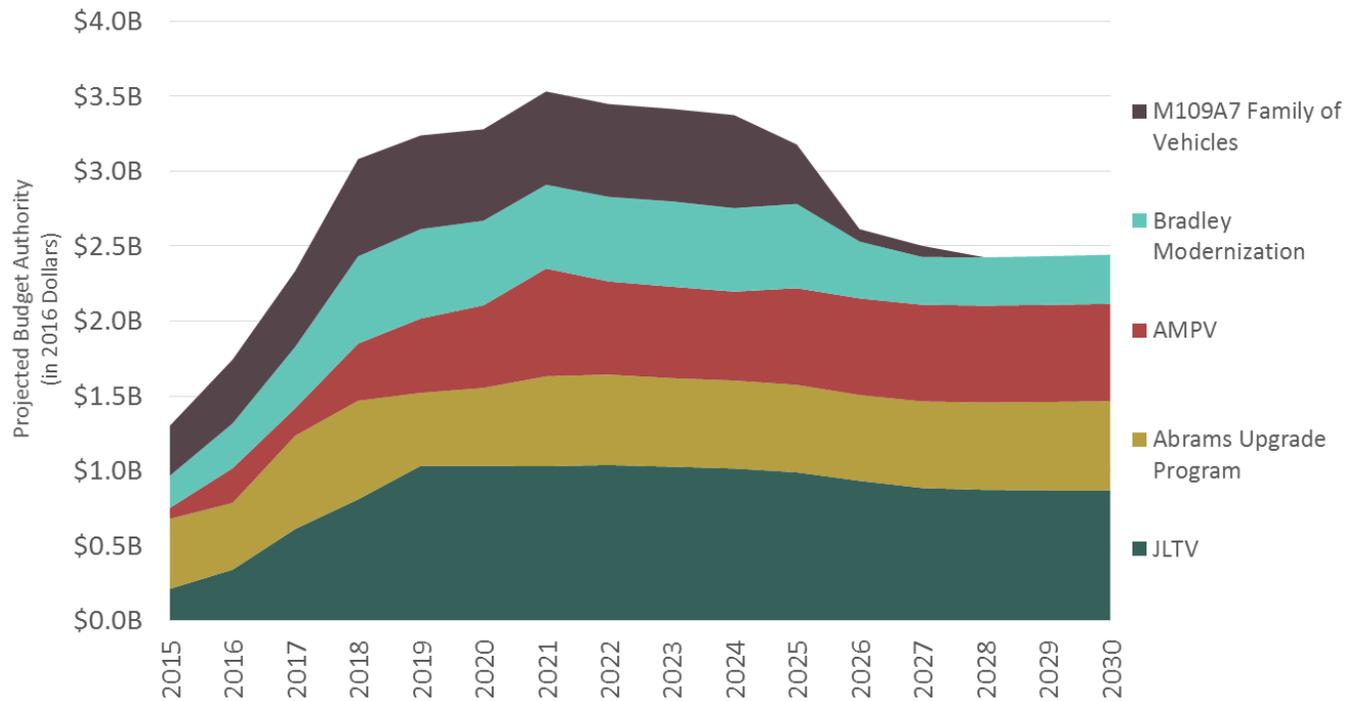
⁶ RMS stands for Remote Minehunting System.

Figure 9: Army Major Acquisition Programs



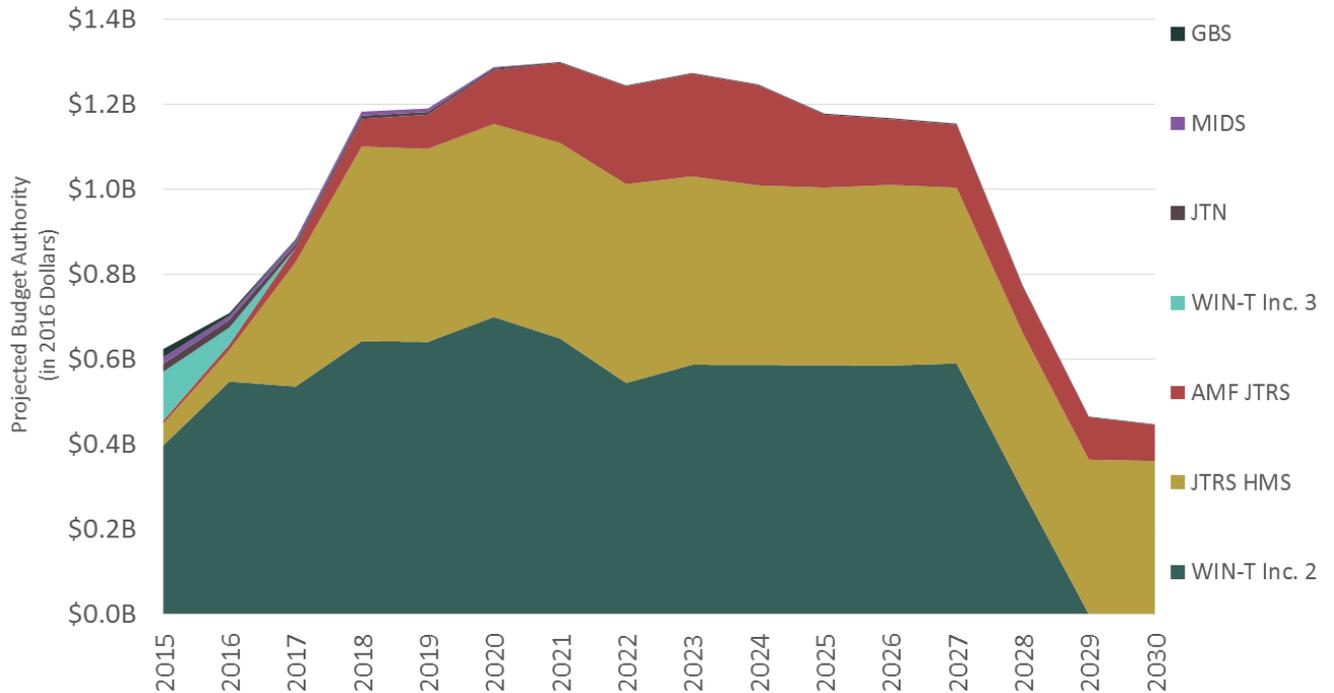
Funding for Army ground systems has dropped to a low point in recent years due to the cancellation of Future Combat Systems, the cancellation of the follow-on Ground Combat Vehicle program, and the winding down of MRAP procurements. However, the Army plans to ramp up funding for five major vehicle programs over the next five years, as shown in Figure 10. The largest of these programs is the Joint Light Tactical Vehicle (JLTV), a replacement for the Humvee. The program plans to reach full rate production of 2,200 vehicles per year by FY 2021 (not including Marine Corps procurements) and continue production through FY 2040. The Army is also developing the Armored Multi-Purpose Vehicle (AMPV), with low rate production planned to begin in FY 2020 and a total planned procurement of 2,897 vehicles. Programs are also planned to replace the Paladin self-propelled Howitzer, to upgrade Abrams tanks, and to modernize the fleet of Bradley Infantry Fighting Vehicles. Together these programs will increase funding for the Army’s major ground systems nearly threefold between FY 2015 and FY 2021.

Figure 10: Army Ground Systems Major Acquisition Programs



The Army has several modernization programs for communications systems planned as well. The Warfighter Information Network – Tactical (WIN-T) plans to continue fielding Increment 2 capabilities, shown in Figure 11, but Increment 3 of the program was canceled in the FY 2016 budget request. The Army also plans to ramp up production of two variants of the Joint Tactical Radio System (JTRS): the Handheld, Manpack, and Small Form Fit (HMS) radio and the Airborne, Maritime, and Fixed (AMF) radio. Having already experienced cost overruns, schedule slips, and many program changes, these three major Army communications programs are poised to more than double in funding between FY 2015 and FY 2021.

Figure 11: Army Communications Major Acquisition Programs⁷

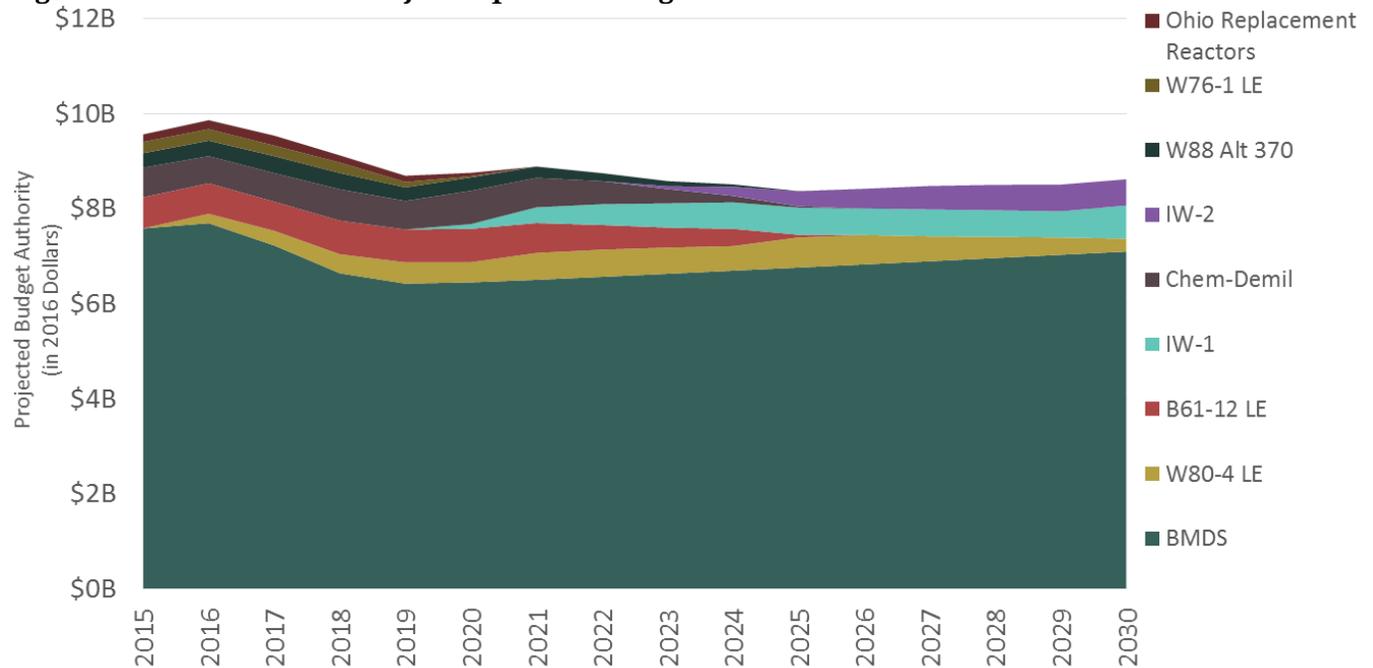


MDA, NNSA, and Other Agency Modernization Plans

Other major acquisition programs not funded through the Services include programs in the Missile Defense Agency (MDA) and the Department of Energy’s National Nuclear Security Administration (NNSA). These programs, shown in Figure 12, project relatively steady funding throughout the 2020s. The largest of these is the Ballistic Missile Defense System (BMDS), a collection of missile defense-related programs funded through MDA. BMDS includes: theater missile defense systems such as SM-3 interceptors and Terminal High Altitude Area Defense (THAAD) batteries; the Ground Based Midcourse Defense (GMD) program for national missile defense; and sensors such as the AN/TPY-2 radar. The Selected Acquisition Report for BMDS submitted to Congress each year only includes projected funding through the end of the FYDP, but funding is assumed to continue in future years at roughly the same level.

⁷ GBS stands for Global Broadcast Service; MIDS stands for Multifunctional Information Distribution System; and JTN stands for Joint Tactical Network.

Figure 12: MDA and NNSA Major Acquisition Programs



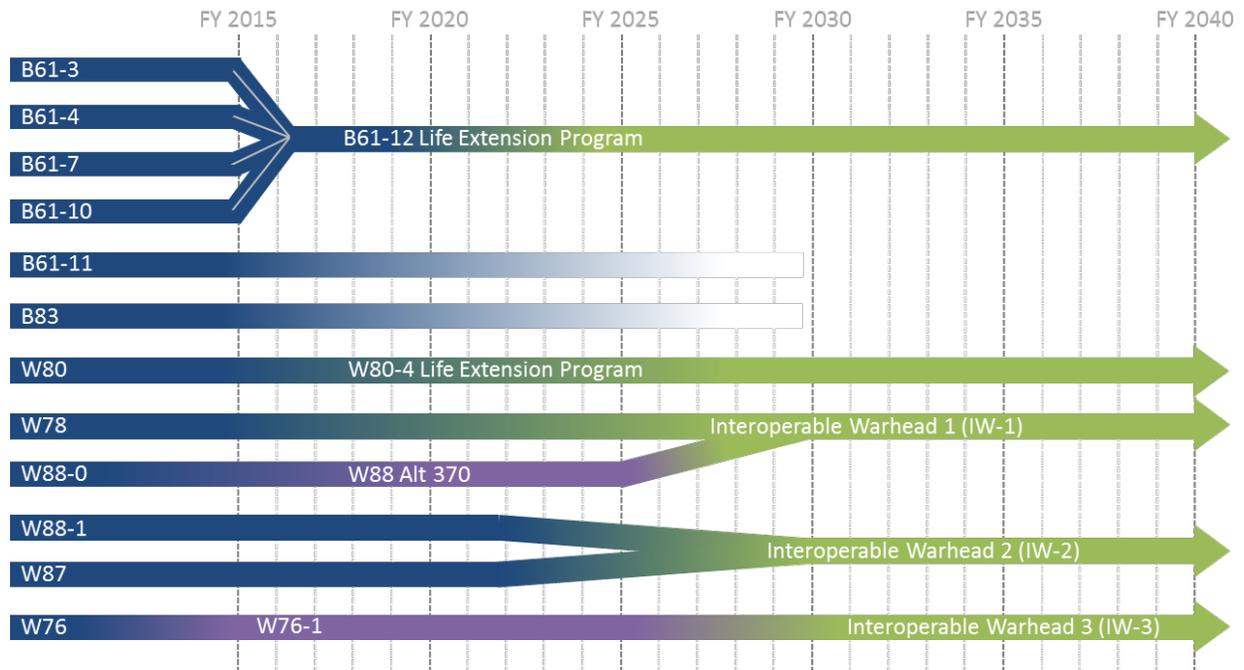
The NNSA has a number of major acquisition programs planned over the next 15 years to modernize and extend the lives of the nuclear bombs and warheads currently in the arsenal. Known as “3+2,” the plan uses life-extension programs to consolidate 12 warhead variants into five. Four bomb variants (B61-3, B61-4, B61-7, and B61-10), shown in Figure 13, will be consolidated into the B61-12. Similarly, five ballistic missile warheads (W76-0, W76-1, W88, W78, and W87) will be consolidated into three new interoperable warhead designs (IW-1, IW-2, and IW-3). The W80 cruise missile warhead will be modernized by the W80-4 program, and the B83-1 megaton-class weapon and the B61-11 ground-penetrating weapon will eventually be eliminated from the arsenal.⁸ Some of these warheads, such as the W88-0 and the W76, will need interim upgrades before they can be consolidated, which increases the near-term modernization funding required.

The major NNSA modernization programs that require funding over the next 15 years are the W80-4, B61-12, IW-1, IW-2, W88 Alt 370, and W76-1. Because the schedules for these programs are deliberately staggered, overall funding for warhead modernization programs remains relatively stable between \$1.6 and \$1.8 billion annually from FY 2016 to FY 2030. The NNSA also funds nuclear reactors for Navy ships, and funding for development of the Ohio Replacement reactor is included in Figure 12. Funding for other NNSA activities, such as the continued operation of research labs and the Mixed Oxide

⁸ *Hearing on Fiscal Year 2013 National Defense Budget Request for Atomic Energy Defense Activities and Nuclear Force Programs, Before the Senate Armed Services Subcommittee on Strategic Forces, 112th Congress (April 17, 2012) (statement of Assistant Secretary of Defense for Global Strategic Affairs Madelyn R. Creedon), <http://docs.house.gov/meetings/AS/AS29/20131029/101355/HHRG-113-AS29-Wstate-CreedonM-20131029.pdf>.*

(MOX) Fuel Fabrication Facility for plutonium disposal, is not included because these activities do not fit the characteristics of a major defense acquisition for the purposes of this analysis.

Figure 13: NNSA Nuclear Weapons Modernization Programs⁹



⁹ Figure from Todd Harrison and Evan Montgomery, *The Cost of U.S. Nuclear Forces: From BCA to Bow Wave and Beyond* (Washington, DC: Center for Strategic and Budgetary Assessments, August 2015), 23, <http://csbaonline.org/publications/2015/08/the-cost-of-u-s-nuclear-forces-from-bca-to-bow-wave-and-beyond/>.

3 | Risks and Challenges in the Bow Wave

As the previous chapter demonstrates, the projected modernization bow wave is primarily due to a subset of major acquisition programs—particularly Air Force aircraft programs—that are planning considerable increases in funding over the next seven years. While this modernization bow wave would be challenging on its own, several complicating factors may make the situation more problematic for policymakers. In particular, this chapter examines how funding instability due to the BCA budget caps and the potential for cost overruns in some programs could make it more difficult to execute long-term plans and maintain support for programs in Congress. It also considers the effects of consolidation on the industrial base’s ability to execute a large number of major acquisition programs simultaneously and whether the acquisition workforce is properly sized for effective oversight of these programs.

Funding Instability

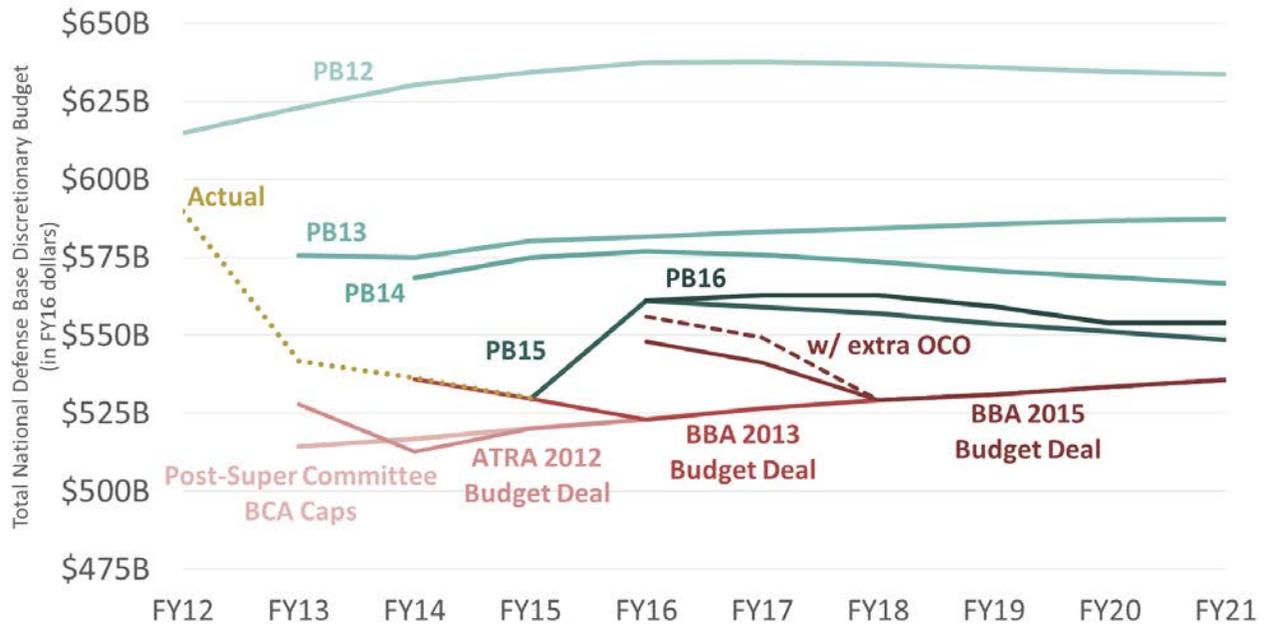
Since the BCA was enacted in August 2011, the president’s budget requests and the budget caps have gradually converged. The proposed defense budget has moved closer to the budget cap level in each successive budget request since FY 2012, with the notable exception of the FY 2016 request. Congress has also modified the budget caps three times since they were enacted, shown in Figure 14, each time raising the caps closer to the requested level. The first modification was the American Taxpayer Relief Act (ATRA) of 2012, which raised the defense budget cap by roughly \$13 billion for FY 2013 and paid for this relief in part by reducing the defense budget cap in FY 2014.¹ Nearly a year later, Congress passed the Bipartisan Budget Act (BBA) of 2013, which increased the budget caps for defense by \$22 billion in FY 2014 and \$9 billion in FY 2015.² Congress recently enacted a third change to the BCA, the Bipartisan Budget Act (BBA) of 2015, which increased the defense budget caps by \$25 billion in FY 2016 and \$15 billion in FY 2017. The most recent budget deal also added extra war funding, which does not count against the budget caps, effectively boosting the defense budget by another \$8 billion in FY 2016 and at least \$8 billion in FY 2017.³

¹ U.S. Congress, Senate Committee on Finance, *Summary of Provisions in The American Taxpayer Relief Act of 2012*, 20, <http://www.finance.senate.gov/legislation/download/?id=1d20ea4a-bf7e-41f5-9fb9-94ff6a721016>.

² U.S. Congress, House Committee on Budget, *Summary of the Bipartisan Budget Act of 2013*, December 10, 2013, 1, <http://budget.house.gov/uploadedfiles/bba2013summary.pdf>.

³ U.S. Congress, House Committee on Budget, *Summary of the Bipartisan Budget Act of 2015*, 1–2, <http://docs.house.gov/meetings/RU/RU00/CPRT-114-RU00-D001.pdf>.

Figure 14: Convergence of President’s Budget Requests and Revised BCA Budget Caps



These bipartisan agreements raised the budget caps for FY 2013 to FY 2017 by a cumulative \$97 billion, but the caps remain unmodified for FY 2018 to FY 2021 and a significant gap persists between the administration’s plans and the funding allowed by the budget caps, which means that more funding instability may be in store for the future. It is reasonable to assume that another budget deal could be reached that raises the caps for FY 2018 and beyond, but the budget deals that have been reached in the past only provided relief for one or two years at a time and were enacted only after significant political crises—the government shutdown in October 2013 and House Speaker John Boehner’s abrupt resignation in October 2015. Lurching from one fiscal crisis to the next makes it difficult to plan and execute long-term modernization programs and requires a high degree of programmatic agility. When programs are forced to alter their plans at the last moment, at times in the middle of the fiscal year, it can create costly delays, force contract modifications, and lead to costly overruns.

Cost Overruns

The funding data presented in the previous chapter does not include unanticipated cost growth in acquisition programs. Both DoD and DoE have a long and well-documented history of cost growth in acquisition programs due to a variety of factors, including overly optimistic initial cost estimates, changes in quantities, and requirements instability. A 2008 RAND report examined 35 major DoD acquisition programs and found that for the programs it examined the average cost growth in development was 57 percent and the average growth in procurement costs (excluding quantity changes) was

34 percent.⁴ An earlier RAND study of 68 major acquisition programs found an average total cost growth of 46 percent, adjusted for quantity changes.⁵ One of the findings in both of these studies is that the largest cost overruns tend to occur early when programs are in development. Once a program is well into production, major cost overruns become less likely.

Data also suggests that programs that begin in a period of declining resources may be more likely to experience significant cost overruns. A 2014 study by the Institute for Defense Analyses examined cost growth in 151 major acquisition programs from FY 1969 to FY 2007. It found a correlation between the magnitude of growth in program acquisition unit cost (PAUC) and the budgetary environment in which the program was initiated. Programs that passed milestone B (the official start of a program) in a period of declining defense budgets had significantly higher cost overruns. In the downward phase of the last two budget cycles (FY 1970 to FY 1980 and FY 1987 to FY 2002), the average growth in PAUC was 35 percent and 53 percent, respectively. In comparison, the average cost growth in the upward phase of these budget cycles (FY 1981 to FY 1986 and FY 2003 to FY 2007) was 12 percent and 7 percent, respectively.⁶

Several of the major acquisition programs contributing to the current modernization bow wave have already experienced significant cost overruns. These programs include SBIRS (212 percent), F-35 (51 percent), C-130J (31 percent), CH-53K (25 percent), and WIN-T Increment 2 (21 percent).⁷ These cost overruns are already reflected in current projections for the bow wave, and because the programs are now farther along in development it is less likely they will experience significant additional cost overruns. Many other programs in the current modernization bow wave, however, are still in the early stages of development and are therefore at higher risk of cost growth. For example, the Ground Based Strategic Deterrent and the Ohio Replacement programs have not yet reached Milestone B, and programs like LRS-B have only recently passed Milestone B.

According to the 2008 RAND study, errors in initial cost estimates are the single-largest reason for cost growth in development programs. This is driven, in part, by the confidence level DoD uses in its cost estimates, typically around 50 percent. A cost estimate with a confidence level of 50 percent means that there is a 50 percent chance the program will exceed its estimated cost, assuming no other changes to the program. If the confidence levels are correct and roughly half of the programs in DoD's acquisition portfolio exceed their baseline cost estimates and the other half fall below their estimates, then overruns should be balanced out with underruns. But the data suggest

⁴ Joseph G. Bolten et al., *Sources of Weapon System Cost Growth: Analysis of 35 Major Defense Acquisition Programs* (Santa Monica, CA: RAND, 2008), 28–29, http://www.rand.org/content/dam/rand/pubs/monographs/2008/RAND_MG670.pdf.

⁵ See Mark V. Arena et al., *Historical Cost Growth of Completed Weapon System Programs* (Santa Monica, CA: RAND, 2006), http://www.rand.org/content/dam/rand/pubs/technical_reports/2006/RAND_TR343.pdf.

⁶ David L. McNicol and Linda Wu, *Evidence on the Effect of DoD Acquisition Policy and Process on Cost Growth of Major Defense Acquisition Programs* (Alexandria, VA: Institute for Defense Analyses, September 2014) 5, <http://www.acq.osd.mil/parca/docs/ida-p5126.pdf>.

⁷ U.S. Department of Defense, “Selected Acquisition Report (SAR) Summary Tables” (Washington, DC: DoD, March 18, 2015), <http://www.acq.osd.mil/ara/sar/SST-2014-12.pdf>.

that the number and magnitude of overruns often exceeds underruns. Accounting for changes in quantities, some two-thirds of the major acquisition programs currently listed in the Selected Acquisition Reports have so far experienced cost growth above their baseline estimates. Moreover, the programs that overrun their estimates often exceed them by a wide margin (e.g., SIBRS and F-35) while programs that fall below estimates do so more modestly. This is because there is a limit to how much a program can fall below its cost estimate—costs cannot be less than zero—yet there is no limit, barring management action, to how much a program can overrun its estimate.

Cost overruns are a significant risk for the modernization bow wave because some of the largest new acquisition programs are using cost estimates with confidence levels of 50 percent, such as LRS-B and JLTV. This presents a significant risk because overruns in just a few large programs would add significantly to overall costs and extend the peak period of funding in the modernization bow wave. Cost overruns can also cause programs to lose support within the military and in Congress, leading to programs being canceled or curtailed, as occurred in the 2000s for many of the programs listed in Table 1. Canceled or curtailed programs do not resolve the modernization bow wave unless accompanied by a corresponding reduction in roles and missions; they merely delay the problem and often lead to an even steeper bow wave in the future.

Industrial Base Concerns

Another risk in the modernization bow wave is that the defense industrial base may not be sufficient to execute the programs currently planned. When defense spending fell during the 1990s, significant consolidation occurred within the industrial base. As a recent study by CSIS's Jesse Ellman and Jacob Bell notes, the "Big 6" defense primes (Boeing, Lockheed Martin, Northrop Grumman, General Dynamics, Raytheon, and United Technologies Corporation) garnered less than 20 percent of total contract obligations for defense products in 1990, but by 1999 these firms had increased their market share to nearly 45 percent. This shift came largely at the expense of medium-sized defense firms, which fell from 28 to 20 percent of contract obligations over the same period, and large defense firms, which fell from 35 to 21 percent.⁸ Thus, the 1990s consolidation was largely a result of the Big 6 firms buying or merging with medium and large firms.⁹

Ellman and Bell also note that as the defense budget began to grow in the 2000s, consolidation did not end but rather took a different form. The Big 6's share of contracts fluctuated but ultimately returned to 43 percent, roughly the same level as 1999. Contracts going to medium-sized firms, however, continued to decline from 20 to 14 percent by 2014, while contracts awarded to large firms increased from 21 to 30 percent. The data suggest that a second wave of consolidation occurred mainly from large firms

⁸ Medium-sized firms are defined as having less than \$3 billion in annual revenues but being larger than a qualifying small business in the Federal Procurement Data System (FPDS). Large firms are defined as firms not included in the Big 6 but having more than \$3 billion in annual revenues.

⁹ Jesse Ellman and Jacob Bell, *Analysis of Defense Products Contract Trends, 1990–2014* (Washington, DC: Center for Strategic and International Studies, October 2015), 26–28, http://csis.org/files/publication/151020_Ellman_AnalysisDefenseProductsContractTrends1990-2014_Web.pdf.

buying or merging with medium-sized firms. As of 2014, more than 70 percent of contract obligations for products now go to large firms and the Big 6 combined.¹⁰

The consolidation, however, was not uniform across all sectors of the defense industrial base. As Ellman and Bell note, “consolidation was particularly pronounced for Aircraft, and is almost entirely the result of the merger between Boeing and McDonnell Douglas Aircraft.” Since the Boeing-McDonnell Douglas merger occurred, the aircraft sector of the defense industrial base has remained highly consolidated, with some three-quarters of contract obligations going to the Big 6 firms in most years and more than 95 percent going to the Big 6 and large firms combined.¹¹

Consolidation within the aircraft sector could have significant ramifications for the modernization bow wave because the single-largest contributor to the bow wave is Air Force aircraft programs. Not surprisingly, the three largest Air Force aircraft modernization programs are split among three main aircraft primes: F-35 (Lockheed Martin), KC-46A (Boeing), and LRS-B (Northrop Grumman).¹² The Air Force appears to be at risk of “vendor lock-in”—long-term, localized monopolies with current vendors. Vendor lock-in makes it difficult for new firms to enter the market and reduces the military’s ability to drive down costs and promote innovation.

Beyond the aircraft sector, a risk for DoD is that the overall industrial base may not have the capacity required to execute a large number of major programs simultaneously due to recent downsizing within firms. Lockheed Martin, for example, reduced its workforce from more than 140,000 employees in 2010 to 112,000 in 2015.¹³ The defense market also has many barriers to entry for new firms, including regulatory compliance requirements, high capital costs in some sectors, and political resistance to foreign firms. To a certain extent, DoD capitalizes its own industrial base by funding research and development programs for major weapon systems and paying for the construction and operation of production facilities as needed. Depending on the trajectory of the overall U.S. economy and the pull of commercial markets on defense firms, some defense companies could have difficulty attracting the capital needed to expand for an influx of new programs, making them more dependent on the government for support.

Oversight Capacity

Proper oversight of acquisition programs is important to ensure they remain on schedule and produce weapon systems that meet the needs of users. It stands to reason that more acquisition programs and a greater amount of acquisition funding should increase the

¹⁰ Ibid.

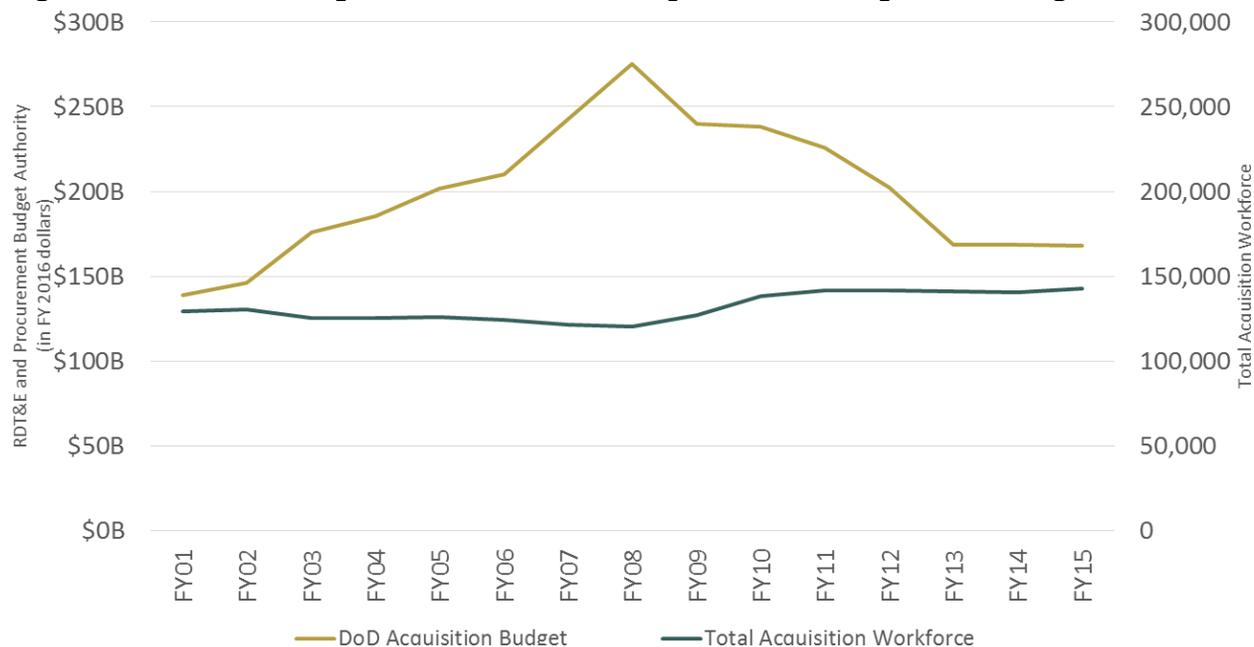
¹¹ Ibid., 28–29.

¹² The LRS-B contract award to Northrop Grumman is pending on protest as of this writing.

¹³ See Lockheed Martin, “Lockheed Martin Announces Fourth Quarter and Year-End Results,” news release, January 28, 2010, <http://www.lockheedmartin.com/us/news/press-releases/2010/january/earnings-4q-2009.html>; and Lockheed Martin, “Lockheed Martin Reports Fourth Quarter and Full Year 2014 Results,” news release, January 27, 2015, <http://www.lockheedmartin.com/us/news/press-releases/2015/january/0123hq-earnings.html>.

oversight workload of the acquisition workforce. But as Figure 15 demonstrates, the size of the acquisition workforce does not automatically grow and contract in response to changes in the acquisition budget—it requires a deliberate management decision. In the most recent buildup, the acquisition budget nearly doubled while the size of the acquisition workforce declined by 7 percent (or 9,000 personnel). Ironically, when the acquisition budget began to decline in FY 2009, the size of the acquisition workforce began growing, adding 21,000 personnel from FY 2008 to FY 2011.

Figure 15: Size of the Acquisition Workforce Compared to the Acquisition Budget¹⁴



The acquisition workforce did not grow in the early 2000s because the Defense Department made a management decision to accommodate the increased acquisition oversight workload by outsourcing some of this work to industry. For example, the Future Combat Systems (FCS) program used a Lead Systems Integrator (LSI) contractor and the Transformational Satellite Communications System (TSAT) program used a lead Systems Engineering and Integration (SE&I) contractor. In each case, the LSI and SE&I contractors were empowered to handle many functions that had previously been the responsibility of personnel in the acquisition workforce, such as requirements generation, source selection, and testing, which alleviated the need to increase the size of the acquisition workforce.¹⁵

¹⁴ “Defense Acquisition Workforce Key Information” (PowerPoint, Human Capital Initiatives, March 31, 2015), 7, <https://dap.dau.mil/workforce/Documents/FY15Q2/Overall%20Key%20Information%20FY15Q2.pdf>.

¹⁵ For more details on the use of LSI contractors, see Valerie Bailey Grasso, *Defense Acquisition: Use of Lead System Integrators (LSIs)—Background, Oversight Issues, and Options for Congress* (Washington, DC: Congressional Research Service, October 8, 2010), <https://www.fas.org/sgp/crs/natsec/RS22631.pdf>.

This approach, however, was not without problems. Many of the programs that used LSI and SE&I contractors had massive cost and schedule overruns. The two example programs cited above, FCS and TSAT, were both terminated due (in part) to poor program performance and cost growth. These acquisition strategies also raised concerns about potential conflicts of interest where the LSI or SE&I contractor could bid for other contracts on that program, putting it in the position of providing oversight of itself. In 2009, the pendulum began to shift away from outsourcing back toward using the acquisition workforce. In the same speech in which former Secretary of Defense Robert Gates canceled both FCS and TSAT, he also initiated a program to increase the size of the acquisition workforce.¹⁶ Congress also passed the Weapon Systems Acquisition Reform Act of 2009, which among other things prohibited organizational conflicts of interest with LSIs.¹⁷ It does not appear that Congress or the military is interested in outsourcing acquisition oversight authority to contractors again through the use of LSI and SE&I contracts.

As the Defense Department attempts to breach the modernization bow wave in the coming years, it must be mindful of the risks involved and learn from recent experiences. Not only could each of these risk factors add to the size and duration of the modernization bow wave, these risks could compound one another. Funding instability and insufficient acquisition oversight, for example, can contribute to cost overruns—a risk that is particularly acute for major acquisition programs in the early stages of development. Cost overruns can in turn drive funding instability if Congress and the Services begin to lose confidence in poor-performing programs and withhold funding. The compounding of risks can lead to what has been termed the “vicious circle” of acquisitions where “each attempt to resolve problems in the acquisition process creates new problems” and ultimately leads to acquisition failures.¹⁸

¹⁶ Secretary Robert Gates, “Gates Press Briefing on the Defense Budget, April 2009” (transcript, Council on Foreign Relations, April 6, 2009), <http://www.cfr.org/defense-budget/gates-press-briefing-defense-budget-april-2009/p19046>.

¹⁷ *Weapon Systems Acquisition Reform Act of 2009*, HR 2101, 111th Cong., 1st sess., *Congressional Record* 155, <http://www.gpo.gov/fdsys/pkg/PLAW-111publ23/html/PLAW-111publ23.htm>.

¹⁸ Maj Gen Thomas Taverney, “Resilient, Disaggregated, and Mixed Constellations,” *Space Review*, August 29, 2011, <http://www.thespacereview.com/article/1918/1>.

4 | Approaches to Fund the Bow Wave

If the risks outlined in the preceding chapter are not successfully mitigated, the funding required to execute the modernization bow wave could peak at a higher level and last several years longer than currently projected. Even if these risks are effectively mitigated, a substantial increase in funding is needed to carry out the modernization plans as currently projected. Three approaches are presented in this chapter that capture a range of options for funding the modernization bow wave: increasing the defense budget; finding offsetting cuts in other parts of the defense budget; and rebalancing among major acquisition programs. While these approaches are not mutually exclusive and could be executed in some combination, the purpose of this analysis is to quantify the magnitude of the choices involved for each approach.

Increase the Budget

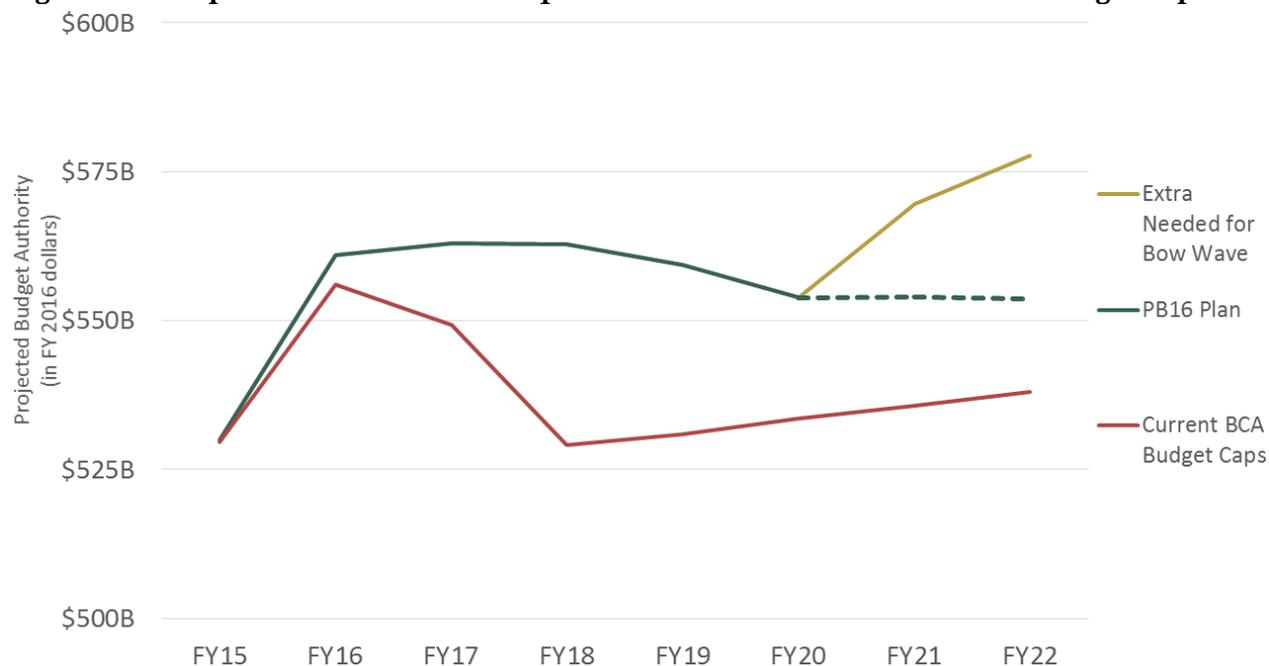
The preferred option from a military perspective is to increase the budget sufficiently to accommodate the modernization bow wave. The total magnitude of the modernization bow wave depends not just on the major acquisition programs detailed in Chapter 2 but also the many smaller acquisition programs that make up the remainder of the acquisition budget. In the FY 2016 budget request, these smaller programs account for an average of 57 percent of the total acquisition budget over the FYDP. Assuming this ratio of small to major programs remains relatively steady throughout the bow wave, total modernization funding would peak in FY 2022 at \$232 billion in then-year dollars, a 22 percent real increase from the FY 2015 level of modernization funding and roughly the same as the previous peak in base modernization funding in FY 2010. Factoring in other projected costs in the defense budget beyond just modernization, the total increase in the national defense budget required to reach the peak of the modernization bow wave in FY 2022 is 9 percent, adjusting for inflation, relative to FY 2015. Importantly, this assumes all other costs, such as military personnel, operation and maintenance, and military construction, only grow as planned in the FY 2016 request (an optimistic assumption) and force levels continue to decline as currently planned.¹

However, calculating the growth in funding required relative to the FY 2015 level does not tell the entire story. DoD has already factored much of this growth into its current budget plans, as shown in Figure 16, and the BCA budget caps currently in effect provide steady growth above inflation from FY 2018 to FY 2021. The annual funding required to execute the modernization bow wave is 4.3 percent higher, in real terms, than the FY

¹ Growth in military personnel and operation and maintenance costs have historically exceeded inflation. The FY 2016 budget request assumes that the efficiency and cost-reduction measures in the budget request are enacted and produce the savings anticipated. A more likely scenario is that many of these planned efficiencies do not materialize and Congress continues to limit DoD's ability to cut costs through the retirement of legacy weapons and compensation reform.

2022 funding projected in the most recent budget request. Relative to the current budget caps, extended linearly to FY 2022, the required increase is 7.4 percent.

Figure 16: Comparison of Bow Wave Requirements to Current Plans and BCA Budget Caps



A 9 percent real increase relative to the budgetary low point reached in FY 2015 is modest compared to previous defense budget cycles—especially considering that the budget caps already provide a 1.6 percent increase through FY 2022. In the 2000s buildup, the base national defense budget increased by 58 percent in real terms, and in the 1980s buildup it grew by more than 70 percent. The BCA budget caps, however, could limit such growth over the next five years.

DoD Comptroller Mike McCord has noted that despite Congress repeatedly increasing the budget caps, the caps have acted as an “anchor” on the defense budget, pulling the topline level of funding down each year below the president’s request.² To meet the peak of the bow wave in FY 2022 requires a sustained effort to increase funding above the current budget caps, totaling a cumulative \$130 billion from FY 2017 to FY 2021. In comparison, the net increase in the defense budget caps from the three budget deals to date (covering FY 2013 to FY 2017) has totaled \$97 billion, including the additional war funding granted for FY 2016 and FY 2017.

While the budget caps have been an anchor on the defense budget, they have also served as a floor for defense. Since the BCA was enacted, there has been little discussion of cuts

² Mike McCord and Todd Harrison, “Beyond the Budget Deal: A Conversation with DoD Comptroller Mike McCord” (event, Center for Strategic and International Studies, Washington, DC, November 30, 2015), <http://csis.org/multimedia/video-beyond-budget-deal-conversation-dod-comptroller-mike-mccord>.

below the budget cap level. At the peak of the bow wave in FY 2022, the defense budget will effectively have the floor pulled out from under it while also being cut loose from its anchor. The question then becomes one of political forecasting—will the budget soar without its anchor or fall without its floor?

The answer may depend on factors that have little to do with defense. A number of other issues are projected to create a difficult fiscal environment for policymakers in the 2020s. The Congressional Budget Office’s August 2015 budget update projects that the federal government will spend more on interest on the national debt than it does on total national defense by FY 2024. Between FY 2015 and FY 2025, the combined costs of interest on the debt and the big three mandatory spending programs—Social Security, Medicare, and Medicaid—will grow from 57 percent of the federal budget to 68 percent. Much of this growth is driven by the Baby Boomer generation moving into retirement—a demographic bulge that will put additional pressure on defense and nondefense spending in the discretionary budget for decades to come.³

Cut Other Programs within the Defense Budget

Another option to fund the modernization bow wave is to offset increases in major acquisition programs by cutting other programs and activities within the defense budget. One way of doing this would be to make cuts in force structure beyond those currently planned. The list below provides a few examples of the approximate savings (in FY 2016 dollars) that could be achieved from cutting major elements of force structure, including all associated personnel, readiness, and infrastructure-related funding.⁴ If the budget is constrained to the current budget cap level, for example, then some combination of these force structure elements could be cut to free up the 7.4 percent of the budget (or \$40 billion in FY 2016 dollars) needed to support current modernization plans by FY 2022.

- 1 Brigade Combat Team (Active Component): \$1.7–1.8 billion annually
- 1 Carrier Strike Group and associated Air Wing: \$2.8–3.0 billion annually
- 1 Air Force Fighter Wing (Active Component): \$1.8–2.6 billion annually
- 1 Marine Infantry Regiment (Active Component): \$0.3 billion annually

Beyond force structure, funding could also be reduced for science and technology investments and smaller acquisition programs. As shown in Figure 17, science and technology (S&T) funding—defined as basic research, applied research, and advanced technology development—has remained relatively stable during the recent budget cycle, hovering between \$10 and \$15 billion annually (in FY 2016 dollars). Cutting S&T funding

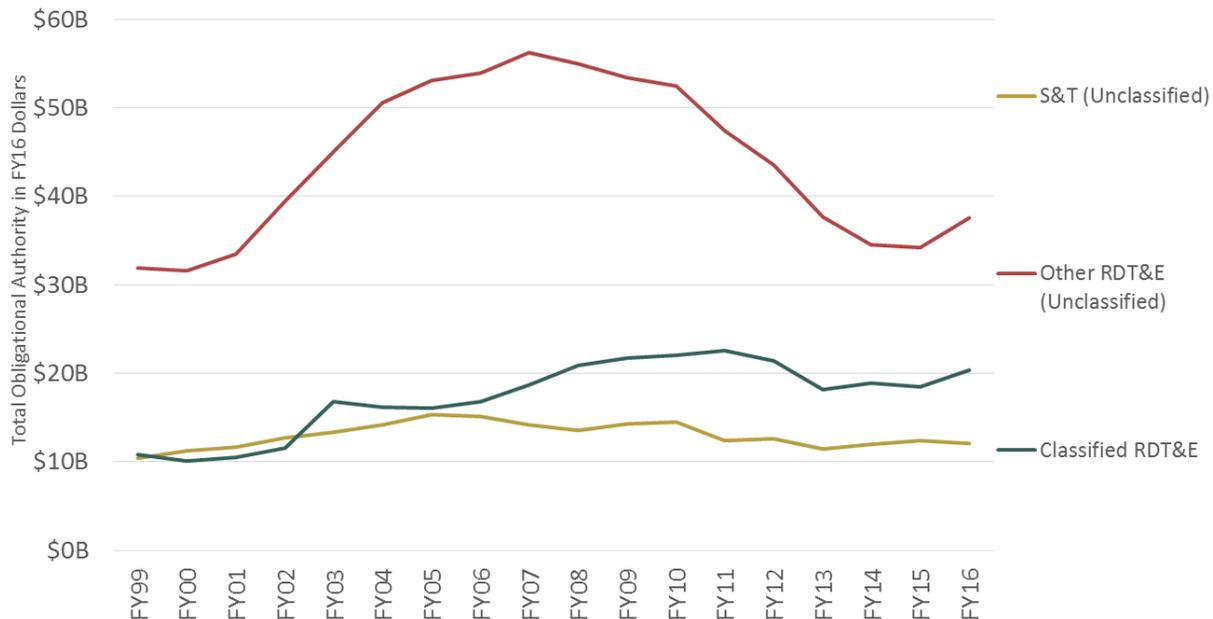
³ Tables 1-1, 1-2, and 1-3 from “An Update to the Budget and Economic Outlook: 2015 to 2025” (Congressional Budget Office, August 2015), <https://www.cbo.gov/publication/50724>.

⁴ The example force structure costs provided are from Mark Cancian, Clark Murdock, and Ryan Crotty, *Alternative Defense Strategies in a Post-Capped Environment* (Washington, DC: Center for Strategic and International Studies, January 2016).

by one-third, for example, would yield savings of roughly \$4 billion annually, but this would not be without consequences. S&T funding supports the long-term development of innovative technologies to maintain the military’s technological edge and is used to support many university and government research labs across the country.

Smaller acquisition programs could also be reduced to fund the increases planned in major acquisition programs. Because smaller programs comprise a more significant portion of the acquisition budget—\$96 billion in FY 2015 or 57 percent—a reduction of just 10 percent would yield nearly \$10 billion annually. Many of these smaller programs, however, fund systems that integrate with or support the operations of major weapon systems, such as various logistics systems needed to support deployed forces. Cutting these force enablers could therefore undermine some of the investments in major acquisition programs.

Figure 17: Science and Technology (S&T) Funding in the DoD Budget



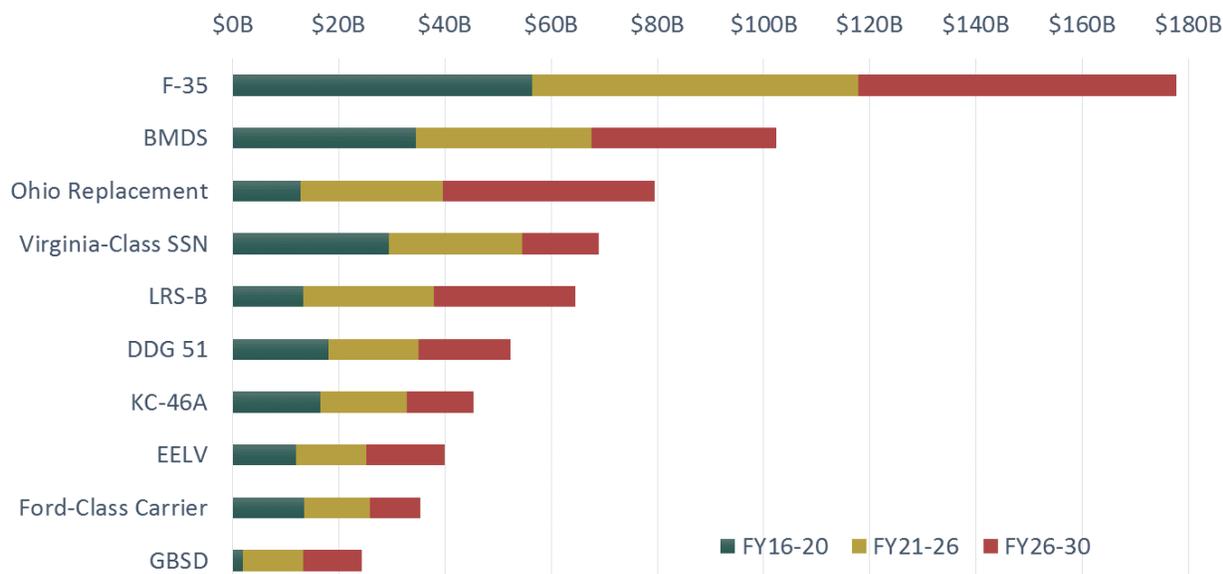
Rebalance Among Major Acquisition Programs

In many respects, a more challenging approach for resolving the modernization bow wave is to make tradeoffs among major acquisition programs. Fifty-nine percent of major acquisition program funding from FY 2016 to FY 2030 goes to the top 10 programs.⁵ As shown in Figure 18, the top 10 acquisitions include programs for recapitalizing each leg of the nuclear triad, the Navy’s top four shipbuilding programs, and the Air Force’s top three acquisition priorities. Notably, no Army programs are in the

⁵ This does not include funding budgeted prior to FY 2016 or funding projected after FY 2030.

top 10, despite funding for Army ground systems being projected to increase significantly in the bow wave.

Figure 18: Top 10 Acquisition Programs by Projected Funding between FY 2016 and FY 2030⁶
 Projected Budget Authority for FY 2016 to FY 2030 (in 2016 Dollars)



Many options are possible to delay, slow, or terminate these programs in various combinations, and nearly all involve significant strategic consequences—a discussion of which is beyond the scope of this study. Below are a few example changes that could be made to some of the largest programs and the budgetary relief these changes would provide. These are not recommendations or a comprehensive list of alternatives; rather, this list is intended to serve as an example of the types of choices that could be made and the magnitude of impact each would have on the modernization bow wave.

The F-35 program is by far the largest acquisition program currently planned, with a projected buy of 2,457 aircraft through the mid-2030s. One option to help mitigate the bow wave is to slow the projected rate of production for the F-35. Current plans call for increasing the procurement to 120 aircraft per year by FY 2022. Reducing the rate to 80 aircraft per year, for example, would save roughly \$4 billion annually in the early 2020s, accounting for the loss of efficiencies in production. If the total quantity of aircraft procured is held constant, the production run would have to be extended by several years into the late 2030s.

The three major programs intended to recapitalize each leg of the nuclear triad—Ohio Replacement, LRS-B, and Ground-Based Strategic Deterrent (GBSD)—may compete with one another for funding because they are large programs overlapping in time supporting the nuclear deterrence mission. An important distinction among these programs is that

⁶ EELV stands for Evolved Expendable Launch Vehicle.

the bomber is a dual-use system that would likely be procured regardless of the nuclear mission, while Ohio Replacement and GBSB are being procured exclusively for the nuclear mission. Since each of these programs is still in early development, one option is to slip the development schedules. Delaying Ohio Replacement by five years, for example, would save between \$2 and \$4.5 billion annually in the early 2020s at the peak of the bow wave. Slipping the LRS-B program by five years would reduce funding required in the early 2020s by between \$2.3 and 3.6 billion annually. Likewise, delaying GBSB by five years would yield savings in the early 2020s averaging \$2 billion annually.

Conventional weapons platforms are also part of the trade space of options. The Navy could, for example, extend the rate at which *Ford*-class carriers are built to one every six years rather than every five years. It could also reduce the planned production rate of DDG 51 destroyers from two per year to one per year in the early 2020s. Together, these reductions would reduce funding required at the peak of the bow wave by less than \$2 billion.

5 | Conclusions

The new administration taking office in 2017 will inevitably reassess the topline level of funding needed for defense in light of the evolving security environment, the overall health of the federal budget, and the looming need to modernize DoD's inventory of equipment. With modernization programs beginning or already underway for each leg of the nuclear triad and major components of the conventional force, a number of choices will need to be made early in a new administration. This study finds that while the bow wave of programs currently planned is challenging, especially given the BCA budget caps that remain in effect through FY 2021, it is not insurmountable. In comparison, the current modernization bow wave crests at roughly the same level as the previous peak in acquisition funding in FY 2010, not including war-related funding.

The next administration could work with Congress to raise the BCA budget caps sufficiently to fund the anticipated growth in modernization costs over the next five years. Such an increase, however, would come as the overall federal budget is increasingly strained and deficits are projected to increase. Beyond this decade, Social Security and Medicare costs are projected to increase rapidly in the 2020s as more of the Baby Boomer generation moves into retirement. Thus, pressures from other parts of the federal budget could limit the willingness of a new administration and Congress to increase the defense topline, forcing policymakers to look within the defense budget for savings.

More work can always be done to root out waste and inefficiency in the Defense Department, but it would be unwise for the new administration to count on efficiencies and reforms to free up the necessary funding for modernization programs. DoD has tried to make such cuts in prior budget requests, such as reforming military compensation, closing excess bases, and retiring legacy weapons that are increasingly expensive to operate and maintain. These changes have been repeatedly rebuffed or limited by Congress, constraining DoD's ability to manage its resources effectively.

A prudent approach for the new administration would be to reexamine modernization plans within the defense budget and the balance of funding among programs to ensure funding priorities align with strategic priorities. None of the example options explored in Chapter 4 to slow or reduce major acquisition programs would be easy or without risks, and these reductions should not be contemplated without analyzing the strategic consequences. But without adjustments to major acquisition programs, attempting to carry out current modernization plans within either the BCA budget caps or the FY 2016 president's budget request would necessitate further reductions in force structure or readiness funding—reductions the Defense Department and Congress are likely to resist given current demands on the force.

Another factor a new administration should consider is the opportunity costs of current modernization programs. Some 59 percent of the funding for major acquisition

programs over the next 15 years is locked into just 10 programs—all of which are Air Force and Navy acquisitions primarily intended to support high-end conventional and nuclear conflict. Allocating such a large portion of the budget to a specific set of capabilities could shortchange other mission areas and lead to further reductions in force structure. It could also reduce the military’s strategic agility by crowding out investments in new and emerging technologies and limiting the pace of transition to future operating concepts. None of these choices are easy, and the future remains as uncertain as ever; but making hard choices among weapon systems is the essence of peacetime defense strategy.¹

¹ See Bernard Brodie, *Strategy in the Missile Age* (Princeton, NJ: Princeton University Press, 1959), 361.

| About the Author

Todd Harrison is the director of defense budget analysis and a senior fellow in the International Security Program at CSIS. He leads the Center's efforts to provide in-depth, nonpartisan research and analysis of defense funding issues. He also provides expert analysis on space security and other key national security issues. Mr. Harrison joined CSIS from the Center for Strategic and Budgetary Assessments, where he was a senior fellow for defense budget studies. He has authored publications on trends in the overall defense budget, defense acquisitions, military compensation, military readiness, the cost of nuclear forces, military space systems, and the cost of the wars in Iraq and Afghanistan. He frequently contributes to print and broadcast media and has appeared on CNBC, CNN, NPR, Al Jazeera English, and Fox News. He has been a guest lecturer for organizations and teaches a class on the defense budget at George Washington University's Elliott School of International Affairs and classes on military space systems and the defense budget at Johns Hopkins University's School of Advanced International Studies. He is a term member of the Council on Foreign Relations and was named one of the Defense News 100 Most Influential People in U.S. Defense.

Mr. Harrison previously worked at Booz Allen Hamilton, where he supported clients across the Department of Defense, assessing challenges to modernization initiatives and evaluating the performance of acquisition programs. Prior to Booz Allen, he worked in the aerospace industry developing advanced space systems and technologies and served as a captain in the U.S. Air Force Reserves. He is a graduate of the Massachusetts Institute of Technology with both a B.S. and an M.S. in aeronautics and astronautics.

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