Major Element of the Force Structure

Other Department of the Navy Units and Activities

	Total	Direct	Indirect	Overhead
		Ballistic and Guided Missile Submarines		
Military Personnel per Unit	660	320	80	260
Annual Cost per Unit (Millions of 2017 dollars)	170	70	40	50
		P-3 and P-8 Maritime Patrol Aircraft Squadrons[a]		
Military Personnel per Unit	1,890	630	500	750
Annual Cost per Unit (Millions of 2017 dollars)	330	110	70	150
		Seabee Construction Engineers		
Total Military Personnel	14,200	8,550	0 [b]	5,650
Total Annual Cost (Millions of 2017 dollars)	1,860	720	0 [b]	1,150
		Navy Special-Operations Forces		
Total Military Personnel	16,440	9,900	0 [b]	6,550
Total Annual Cost (Millions of 2017 dollars)	2,370	1,050	0 [b]	1,330
		Marine Corps Special-Operations Forces		
Total Military Personnel	3,530	2,130	0 [b]	1,410
Total Annual Cost (Millions of 2017 dollars)	490	210	0 [b]	280
		Rest of the Navy		
Total Military Personnel	37,990	22,860	0 [b]	15,120
Total Annual Cost (Millions of 2017 dollars)	6,550	3,490	0 [b]	3,060
		Rest of the Marine Corps		
Total Military Personnel	770	460	0 [b]	310
Total Annual Cost (Millions of 2017 dollars)	230	160	0 [b]	60

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest 10 personnel or $10 million; more detailed information is presented in Appendixes A and B.

a. Notional squadrons of 12 aircraft (actual squadrons vary in size).

b. In the analytic framework used for this report, other units and activities are generally considered to not have any units supporting them and thus to not have any indirect personnel or costs.

Although the vast majority of the Navy's and Marine Corps' units are connected with ships and Marine expeditionary forces (MEFs), the Department of the Navy includes a number of other units that are not directly related to ships and MEFs. Together, those units account for 16 percent of the department's operation and support.

The Navy's 14 **ballistic missile submarines** (all from the Ohio class) are similar to other naval vessels in most respects. However, they carry nuclear weapons and are the Navy's contribution to the U.S. nuclear deterrent, so their number is normally determined by national nuclear policy and by the outcomes of arms control negotiations rather than by the considerations that affect other U.S. military units.[31] In its budget documents, the Navy combines ballistic missile submarines and **guided missile submarines,** which are 4 former ballistic missile submarines that have been converted to launch Tomahawk cruise missiles and to support special operations. Those guided missile submarines are less subject to arms control considerations than the ballistic missile submarines are.

The Navy's fleet of approximately 90 **maritime patrol aircraft** consists of land-based, long-range aircraft equipped with a variety of sensors and weapons. They are capable of monitoring large areas of the ocean, improving the Navy's ability to find and track other nations' ships and submarines. They are also capable of conducting limited attacks on ships and submarines. The older P-3 model patrol aircraft are currently being replaced by newer P-8 model aircraft. The Navy is also in the process of fielding an unmanned long-range patrol aircraft, the MQ-4 Triton, which is based on the airframe of the Air Force's RQ-4 Global Hawk (discussed in Chapter 4).

The Navy's **construction engineers,** referred to as Seabees, provide a variety of engineering services to the Navy. They have the ability to build or improve bases in theaters where the infrastructure and basing options are poor. In that role, Seabees have contributed greatly to the success of past U.S. military operations in distant theaters. Because the United States has often intervened in countries with poor infrastructure—and because deploying U.S. forces can place great strain on the ports and air bases that receive them—the capability to improve that infrastructure has typically been highly valuable, although less recognized than some of the service's other capabilities. Unlike most of the Navy's forces, a relatively large percentage of Seabees are in the Naval Reserve.

The Navy and Marine Corps also maintain **special-operations forces,** which are trained, equipped, and overseen by the Department of Defense's Special Operations Command (SOCOM). They focus on such missions as unconventional warfare, special reconnaissance, counterterrorism, or the training of foreign militaries. The forces overseen by SOCOM are discussed in more detail in Chapter 5, which deals with defensewide activities.

By the Congressional Budget Office's estimate, about 38,000 military personnel and $6.5 billion a year are devoted to **units and activities of the Department of the Navy other than those described in this chapter.** They consist of a variety of smaller organizations providing specialized capabilities; examples include the Navy's and Marine Corps' contributions to various joint commands and defensewide organizations, as well as some miscellaneous command-and-control functions.

31. Arms control agreements can affect not only the number of ballistic missile submarines in the fleet but also the number of Trident missiles that each submarine carries and the number of warheads on each Trident missile. Ballistic missile submarines are generally considered to be the best available element of U.S. nuclear forces for ensuring that the nation maintains a "second-strike" nuclear capability—that is, it would be extremely difficult for an enemy to destroy ballistic missile submarines that were at sea, so those submarines would most likely be available to retaliate against any nuclear attack.

Special Topic

Integration of the Navy and Marine Corps

Amphibious operations offer perhaps the most iconic image of the close relationship between the Navy and the Marine Corps, with Navy ships carrying Marine Corps units into battle. However, the two "sea services" are integrated on a much deeper level than that in their day-to-day operations.

This report follows conventional usage in talking about Navy ships and Marine Corps combat units, but in reality, many Navy ships have Marine Corps personnel onboard as part of their crew (although that practice is becoming less widespread than it used to be).[32] In some cases, larger Marine Corps units—such as entire squadrons of aircraft within carrier air wings—provide a significant share of a ship's combat power. Similarly, Marine Corps units include some Navy personnel; for example, all medical personnel assigned to Marine Corps units are members of the Navy. Thus, nearly all large Navy and Marine Corps units are actually a mix of personnel from both services.

For the purposes of this analysis, the extent to which the support and administrative structures of the Navy and Marine Corps are intertwined makes it impossible to determine which of the costs and personnel dedicated to sustaining the Department of the Navy's (DoN's) combat units should be allocated to the Navy and which to the Marine Corps. Such intertwining is pervasive. For example, the U.S. Naval Academy produces officers for both the Navy and Marine Corps, and the training establishments for weapon systems that both services operate, such as F/A-18 aircraft, are largely integrated as a single establishment within DoN. For those reasons, this analysis focuses on the department rather than on each of its services individually.

Functions that are performed by civilians are performed by DoN civilians—there are no Navy or Marine Corps civilians (although DoN personnel can be assigned to Navy or Marine Corps organizations). DoN organizations staffed by DoN civilians are responsible for many administrative duties that support both services, such as management of the Navy's and Marine Corps' budgets. For weapon systems used by both services, DoN generally integrates functions such as procurement and depot maintenance.[33]

The strong interrelationship between the Navy and the Marine Corps is based on tradition: The need to provide soldiers onboard ships was the original reason for the existence of a Marine Corps. That tight interweaving is usually described as having a variety of positive effects. The most prominent effect is that it helps to produce a common culture in the two sea services that promotes trust and cooperation. Such close integration is also seen as a natural extension of the expeditionary nature common to the two services—the routine, frequent peacetime deployments that both services are accustomed to conducting are distinct from the more limited peacetime deployments traditionally practiced by the Army and the Air Force. Another natural complement between the sea services is that the Navy's greatest limitation as a combat force is its limited ability to project power ashore, and the Marine Corps provides that ability to the Navy. Similarly, the Navy provides the means to convey Marine units to operations.

The benefits of the Navy and Marine Corps' integration are sometimes contrasted (by implication if not explicitly) with the historical relationship between the Army and the Air Force. Since 1947, when the Air Force was created by splitting off the Army Air Corps from the Army, the Air Force has made a great effort to differentiate itself from the Army as a separate and distinct service, with separate and distinct missions, culture, weapon systems, and warfighting doctrine. At times, those separate cultures have

32. Historically, shipboard detachments of marines were used for several purposes, such as deterring potential mutineers; allowing ships to make small landings; repelling or initiating boarding actions; and, during the Cold War, guarding nuclear weapons. Providing shipboard detachments was the primary function of the Marine Corps during the 18th and 19th centuries, but that function declined in importance during the 20th century. Today, the use of shipboard detachments is greatly reduced, in part because of the need for marines in the ground combat operations in Iraq and Afghanistan.

33. For example, all of DoN's aircraft are purchased through the Aircraft Procurement, Navy, appropriation. Separating that appropriation into "blue" (Navy) and "green" (Marine Corps) funding—as some analysts do when trying to describe each service's spending independently—requires detailed knowledge of specific programs, multiple assumptions, and significant analytic effort.

led the Air Force and the Army to disagree in important ways about military operations, particularly about the Air Force's provision of close air support to Army ground combat units.[34] Some observers (and Army personnel) have argued that the Air Force is reluctant to provide as much close air support as Army ground combat units need, preferring to wage separate air campaigns largely disconnected from ground combat operations. However, other observers say that such differences are overstated and that the Air Force has always supported Army units during combat operations (regardless of their specific views about the nature of joint operations and the role of airpower at the time). Compared with those two services, the Navy and Marine Corps appear to coordinate operations more smoothly and be less inclined to try to conduct operations separately.

34. "Close air support" generally refers to attacks by combat aircraft on enemy forces that are in contact with U.S. ground forces (often conducted at the request of those ground forces)—as opposed to air attacks on fixed installations, enemy forces not in contact with U.S. ground forces, or other targets.

Special Topic

Forcible-Entry Capability

Forcible entry occurs when a military force gains access to enemy territory that cannot be reached from adjacent land areas. Three main types of forcible-entry operations exist, each performed by specialized forces:

- Airborne assault, in which troops parachute into an area from fixed-wing aircraft;
- Air assault, in which troops attack from helicopters; and
- Amphibious assault, in which troops are carried to shore on naval landing craft.

Unlike conventional ground operations, in which troops advance from friendly terrain into adjacent enemy terrain, forcible-entry operations focus on giving troops access to enemy territory that is behind the enemy's lines, far from friendly territory, on hostile islands, or otherwise not accessible to conventional ground forces.

History and Nature of Forcible-Entry Operations. The value of forcible-entry capability was demonstrated in many dramatic ways in World War II. Amphibious assaults were central to the conduct of the war in the Pacific, where the United States fought Japan across a string of island chains and archipelagos and made plans to assault the island nation of Japan. In the European theater, the lack of any Allied-controlled territory on the mainland of Western Europe made amphibious assaults into North Africa, Sicily, mainland Italy, and the French province of Normandy crucial to the overall goal of invading and defeating Germany. Forcible-entry operations by air were not feasible in the Pacific because of the great distances between islands, but the European theater saw several major airborne assaults (in conjunction with amphibious assaults in Sicily and Normandy). During the Korean War, a major amphibious assault at Inchon demonstrated the power of forcible-entry operations to change the course of a conflict.

Helicopters were not developed enough during earlier wars to perform air-assault operations, but in the Vietnam War, the Army employed air-assault tactics frequently. Air assaults were generally used to rapidly bring large concentrations of Army forces into contact with Viet Cong and North Vietnamese Army units, which often preferred to avoid direct confrontation with U.S. troops. Since then, the Army's air-assault forces have relied on helicopters for mobility in most conflicts in which those forces have been used. The Marine Corps' amphibious forces also include an air-assault component of helicopters and tilt-rotor aircraft. In an amphibious operation, the air assault would most likely be conducted in coordination with an assault by Marine forces in Navy landing craft.

The brigade combat teams (BCTs) of the Army's 82nd Airborne Division and the Air Force's fleet of large cargo aircraft are the main elements of the U.S. force structure necessary for airborne assaults. The BCTs of the Army's 101st Airborne Division and the Army's cargo and utility helicopters are the main elements necessary for air assaults. And the Marine Corps' ground forces, helicopters, and landing craft, along with the Navy's amphibious ships and landing craft, are the main elements of the force structure needed for amphibious assaults. In addition, U.S. special forces have conducted all three types of forcible-entry operations on many occasions—though on a much smaller scale—to gain access to hostile territory.

Under certain circumstances, the U.S. military has combined elements of its forcible-entry capability in other ways. For example, during the war in land-locked Afghanistan, Marine Corps forces conducted an air assault on the city of Kandahar from amphibious ships more than 600 miles away in the Indian Ocean. And when the United States prepared to invade Haiti in support of an ousted president in the mid-1990s, the military planned to conduct the invasion using Army air-assault forces (infantry and helicopters) transported on Navy aircraft carriers. More recently, the Department of Defense has explored the concept of "sea basing," in which Navy ships would serve as the rear area of a theater during a conflict—performing all logistics functions for a force on shore—and would be connected to ground forces in combat by a "bridge" of aircraft and landing craft.[35]

35. See Congressional Budget Office, *Sea Basing and Alternatives for Deploying and Sustaining Ground Combat Forces* (July 2007), www.cbo.gov/publication/18801.

Advantages and Disadvantages of Forcible-Entry Operations. The major advantage of forcible-entry operations is that, under some circumstances, it is impossible to fight an adversary without them. Enemy-held islands, or other territories that do not have a land border with a friendly state, are inaccessible to conventional ground operations. In addition, forcible-entry capabilities can be important for gaining major combat advantages through surprise and mobility (as in the Inchon landing). Scenarios in which such capabilities could be useful in the future include possible operations in North Korea or the Strait of Hormuz (for a description of such scenarios, see Appendix C). On a smaller scale, the use of helicopters for air-assault operations has allowed U.S. forces to operate relatively freely in the mountainous landscape of Afghanistan, avoiding some of the limitations that the country's poor infrastructure and rugged terrain would otherwise impose.

One of the main drawbacks of forcible-entry operations is that, if conducted in the face of strong opposition, they can be extremely dangerous, and if unsuccessful, they have the potential to result in heavy losses. During World War I, the troops taking part in Britain's amphibious assault at Gallipoli were unable to penetrate inland, and they suffered enormous casualties from combat and illness before their beachhead was evacuated. In World War II, Britain's 1st Airborne Division suffered a casualty rate of about 80 percent during Operation Market Garden, an unsuccessful airborne assault intended to penetrate German lines as part of the Allies' invasion of Germany. And in 1980, an air assault intended to rescue Americans held hostage in Iran was aborted well before reaching its target after most of the helicopters committed to the mission were lost because of mechanical failure or accidents.

Even when forcible-entry operations succeed in taking the intended enemy territory, their difficulty can be so great as to outweigh the benefits. For instance, when U.S. forces invaded the Pacific island of Peleliu during World War II, they were unprepared for the intensity of Japanese resistance and suffered numerous casualties, far in excess of the island's strategic value.[36] Also during that war, Allied forces that staged an amphibious assault at Anzio, Italy, were isolated in a small pocket near their beachhead for a long period, unable to break out, and were largely irrelevant to the battle for Italy.[37]

To be feasible, forcible-entry operations require a number of preconditions to be met. Airborne- and air-assault operations require control of local airspace, and amphibious operations require control of local airspace and local waters. Surprise is necessary to reduce risk, and major operations must occur either close enough to friendly ground forces to allow them to link up or close enough to a port to allow follow-on forces to be deployed. (In some more limited operations, capturing an airfield may be sufficient to allow follow-on forces to be deployed.)

The majority of units and equipment associated with the United States' forcible-entry capability have the ability to perform other roles as well. Apart from some additional training and equipment, the Army's air-assault and airborne BCTs are almost identical to other Army light BCTs, and they are routinely used interchangeably with other light BCTs in conventional operations. Similarly, the Army's cargo and utility helicopters can be used for a wide variety of missions besides air assaults. And the Marine Corps' ground and air forces have been used extensively for combat in conventional operations. In most respects, the only significant additional units and equipment (and thus cost) involved in maintaining forcible-entry capabilities is the Navy's fleet of amphibious ships and specialized landing craft. (The Marine Corps' landing craft are not designed exclusively for amphibious assaults; they also serve as armored personnel carriers for Marine ground forces operating on shore, although they are less useful in that role than conventional personnel carriers.)

36. See Center for Military History, *Western Pacific, 15 June 1944–2 September 1945* (October 2003), www.history.army.mil/brochures/westpac/westpac.htm.

37. See Center for Military History, *Anzio, 22 January–24 May 1944* (January 2010), www.history.army.mil/brochures/anzio/72-19.htm.

Special Topic

Naval Shipborne Aviation

Naval shipborne aviation consists of the squadrons that make up carrier air wings and the shipboard helicopters on surface combatants. Carrier air wings are composite units with several types of aircraft; their per-unit costs and personnel were presented in an entry, "Aircraft Carriers," on page 52. Likewise, the costs and personnel for shipboard helicopters on surface combatants were shown in an entry, "Surface Combatants," on page 56. In this section, the Congressional Budget Office breaks out the personnel and costs for those same Navy aircraft by the type of aircraft—rather than by the type of ship they are associated with—and describes the roles that each kind of aircraft plays.

	Total	Direct	Indirect	Overhead
		F/A-18 Fighter/Attack Aircraft Squadron		
Military Personnel per Unit	780	260	210	310
Annual Cost per Unit (Millions of 2017 dollars)	160	60	40	60

All units presented under this topic are notional squadrons of 12 aircraft (actual squadrons vary in size).

In all of the tables under this topic, "direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. The numbers shown in these tables are rounded to the nearest 10 personnel or $10 million.

F/A-18s are multirole fixed-wing aircraft capable of attacking other planes in the air or targets on the ground. Two varieties are currently in use: the older C/D model and the newer E/F model that is based on it. The F/A-18E/Fs are significantly larger and more capable than their predecessors, with a longer range, greater payload capacity, and improvements to their electronics and other systems. The fleet of F/A-18s is the mainstay of naval shipborne aviation, providing the vast majority of the Navy's ability to strike targets. (Most other naval aircraft are used for support purposes, as described below.) The Marine Corps also operates F/A-18s. Some are used aboard aircraft carriers as integral parts of a carrier air wing; others are used to support Marine Corps operations from air bases on land. The Navy and Marine Corps plan to field 542 F/A-18s in 2017; that inventory is scheduled to decline to 522 in 2021 as F-35 aircraft begin to replace older F/A-18s.

	Total	Direct	Indirect	Overhead
		EA-18G Electronic Attack Aircraft Squadron		
Military Personnel per Unit	1,420	480	380	570
Annual Cost per Unit (Millions of 2017 dollars)	240	80	50	110

EA-18G aircraft are a variant of the F/A-18F, specialized for jamming an enemy's transmissions (electronic warfare) and for attacking an enemy's air defenses. (They have largely replaced the Navy's older fleet of EA-6B aircraft, which performed the same roles.) In the 1990s, with the retirement of the Air Force's fleet of EF-111s, the Department of Defense decided to make the Navy responsible for providing all electronic warfare support to U.S. forces. Thus, EA-18Gs support operations not only by aircraft carriers and Marine Corps units but also by the Air Force. The Navy plans to field an average of 96 EA-18Gs over the 2017–2021 period.

	Total	Direct	Indirect	Overhead
		F-35 Fighter Aircraft Squadron		
Military Personnel per Unit	260	90	70	100
Annual Cost per Unit (Millions of 2017 dollars)	150	80	50	20

Because F-35s are not yet in full operational service, their actual costs may differ from the planned costs included in the Department of Defense's budget documents, on which these estimates are based.

The Department of the Navy is acquiring a new fighter aircraft, the F-35, also known as the Joint Strike Fighter. It is being produced in two variants for the department: The B version will offer short-takeoff, vertical-landing capability to the Marine Corps (that capability is discussed in more detail in the special-topic entry on Marine Corps aviation below), and the C version will be capable of taking off from and landing on aircraft carriers. The F-35Cs will replace the Navy's current F/A-18C/Ds, performing the same missions. Although they are expected to be superior to those F/A-18C/Ds in many ways, the largest improvement they will offer is providing the Navy with a low-observable (or "stealthy") attack aircraft. The Navy and Marine Corps plan to field 97 F-35s by 2021, replacing older F/A-18s.

	Total	Direct	Indirect	Overhead
		H-60 Helicopter Squadron		
Military Personnel per Unit	1,000	330	270	400
Annual Cost per Unit (Millions of 2017 dollars)	170	50	30	80

The Navy uses H-60 helicopters for a variety of purposes, such as moving passengers, supplies, and small loads of cargo. Their combat roles include antisubmarine warfare and anti–surface warfare. Helicopters are very well suited to antisubmarine warfare because they can move rapidly to several locations and deploy cheap, disposable, floating sonar sensors. (Determining the position of an enemy submarine requires triangulation, so relying on multiple sonars in the water is generally more effective than using a single shipboard sonar.) Navy surface combatants usually have one or two SH-60 helicopters (antisubmarine variants of the H-60) onboard, and aircraft carriers have a squadron of up to eight helicopters. Although they have traditionally been specialized for antisubmarine warfare, some models of the H-60 can be equipped with anti–surface-ship weapons, such as Hellfire missiles. In that configuration, helicopters are useful for operations against small boats, such as antipiracy missions. The Navy plans to field 236 H-60 helicopters throughout the 2017–2021 period.

	Total	Direct	Indirect	Overhead
		C-2 Transport Aircraft Squadron		
Military Personnel per Unit	1,140	380	300	450
Annual Cost per Unit (Millions of 2017 dollars)	190	60	40	90
		E-2 Surveillance Aircraft Squadron		
Military Personnel per Unit	1,240	410	330	490
Annual Cost per Unit (Millions of 2017 dollars)	230	80	50	100

C-2s and E-2s are specialized aircraft that support the operations of aircraft carriers. C-2s are small transport planes used to bring supplies and personnel to and from an aircraft carrier while it is under way. E-2s are variants of the C-2 that are specialized to serve as platforms for airborne radar; such radar greatly improves the ability of a carrier strike group to detect and engage aerial and surface targets. In using radar to detect targets at long range, ships (or other platforms on the surface) are intrinsically limited by the curvature of the Earth. (Radar, like visible light, has a horizon below which any target cannot be seen.) By flying high, aircraft can increase the range at which they can detect targets. For the same reason, the Air Force uses E-3 surveillance aircraft for its operations. The Navy plans to continue to field 25 C-2 and 45 E-2 aircraft through 2021.

Special Topic

Marine Corps Aviation

The Marine Corps' aviation units are organized into squadrons that make up Marine aircraft wings. Those air wings are composite units with several types of aircraft. Their per-unit costs and personnel are presented in the entry about Marine Corps infantry battalions on page 65 as the aircraft complement to a battalion. In this section, the Congressional Budget Office breaks out the personnel and costs for those same Marine Corps aircraft by type of aircraft and describes the roles that each type of aircraft performs. The discussion excludes the Marine Corps' F/A-18 fighter/attack aircraft, which are discussed in the special-topic entry about naval shipborne aviation on page 74.

	Total	Direct	Indirect	Overhead
		AV-8B Attack Aircraft Squadron		
Military Personnel per Unit	960	250	330	380
Annual Cost per Unit (Millions of 2017 dollars)	180	50	50	80

All units presented under this topic are notional squadrons of 12 aircraft (actual squadrons vary in size).

In all of the tables under this topic, "direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. The numbers shown in these tables are rounded to the nearest 10 personnel or $10 million.

AV-8Bs are fixed-wing aircraft with short-takeoff, vertical-landing (STOVL) capability that are intended mainly to attack targets on the ground. Unlike conventional fixed-wing aircraft, they do not need long runways at an air base to take off or arrestor hooks on an aircraft carrier to land. Instead, they can perform a rolling takeoff from a short runway and can land vertically, like a helicopter. Those qualities allow AV-8Bs to be based in locations with limited infrastructure for aircraft or to be based on LHA- or LHD-type amphibious ships (which have much smaller flight decks than aircraft carriers and no catapults or arresting wires). However, those capabilities also necessitate a very specialized form of aircraft design, which requires design compromises that make STOVL aircraft less capable in certain respects—especially range and payload capacity—than other fixed-wing aircraft of similar size.

The Marine Corps intends to replace its current fleet of AV-8Bs with the F-35B variant of the Joint Strike Fighter, which will have a similar STOVL capability (and similar limitations compared with other versions of the F-35). The Marine Corps' use of STOVL aircraft has long been the subject of criticism. One reason is that most Marine air operations are conducted from land bases that do not require STOVL capability. Another reason is that STOVL aircraft are costly to design, expensive to order in the relatively small quantities that the Marine Corps uses, and less capable in many ways than equivalent aircraft with conventional landing capabilities. The Marine Corps accepts those trade-offs to obtain fixed-wing air support that it can operate from amphibious ships or from small bases on shore. The Marine Corps plans to field 80 AV-8Bs in 2017; that inventory is scheduled to decline to 48 in 2021 as F-35 aircraft begin to replace AV-8Bs.

	Total	Direct	Indirect	Overhead
		H-1 Utility and Attack Helicopter Squadron		
Military Personnel per Unit	860	220	300	340
Annual Cost per Unit (Millions of 2017 dollars)	130	30	30	70

The H-1 series of helicopters consists of two types: UH-1s, utility helicopters capable of transporting small loads of cargo and personnel, and AH-1s, attack helicopters that provide fire support to Marine Corps ground forces. (Despite their different roles, the AH-1 began its life as a modified UH-1, and the Marine Corps often combines the budgets for the two types of helicopters.) In addition to being generally useful for all kinds of operations, variants of the H-1 are included in the Marine expeditionary units (MEUs) embarked on amphibious assault ships. (AH-1s, as attack helicopters, do not transport personnel or equipment but rather escort the transport aircraft and, if necessary, attack any hostile forces at the landing zone.) The Marine Corps plans to field an average of 232 H-1 helicopters during the 2017–2021 period.

	Total	Direct	Indirect	Overhead
		V-22 Medium-Lift Aircraft Squadron		
Military Personnel per Unit	760	200	260	300
Annual Cost per Unit (Millions of 2017 dollars)	150	40	40	60

The Marine Corps recently replaced its CH-46 medium-lift helicopters with V-22 tilt-rotor aircraft. Like H-1 series helicopters, V-22s are included in the MEUs embarked on amphibious assault ships and are essential to the Marine Corps' ability to transport personnel and equipment to specific locations. They are larger aircraft than UH-1 helicopters, with much greater transport capacity. The V-22 had a relatively long and difficult development cycle, but it is now operational and provides longer range and greater speed than the older CH-46 helicopters. In most air assault operations, the V-22 fleet would carry the majority of Marine Corps personnel. The Marine Corps plans to field about 240 V-22 tilt-rotor aircraft by 2021.

	Total	Direct	Indirect	Overhead
		CH-53 Heavy-Lift Helicopter Squadron		
Military Personnel per Unit	960	250	330	380
Annual Cost per Unit (Millions of 2017 dollars)	190	60	60	80

The CH-53 heavy-lift helicopter is the final air component of the Marine Corps' amphibious assault capability. By far the largest and most powerful transport helicopter that the Marine Corps possesses, the CH-53 can carry pieces of equipment by air that are too big for any other aircraft in a MEU. The Marine Corps is planning to replace its older CH-53 helicopters with a new CH-53K model, which would be capable of carrying even larger loads. The fleet of heavy-lift helicopters would transport the majority of equipment and supplies in most air assault operations. The Marine Corps plans to field 136 CH-53 helicopters throughout the 2017–2021 period.

	Total	Direct	Indirect	Overhead
		KC-130 Transport/Tanker Aircraft Squadron		
Military Personnel per Unit	980	330	260	390
Annual Cost per Unit (Millions of 2017 dollars)	160	50	30	80

KC-130 tankers are modified C-130 transport aircraft that are capable of refueling the Marine Corps' fixed-wing aircraft and helicopters while they are in flight, greatly extending the operating range of those aircraft. KC-130s retain many of the characteristics of the base C-130 airframe and can be used as transport aircraft when not needed for aerial refueling. They can also support ground operations in some circumstances. For example, during the initial invasion of Afghanistan, Marine Corps forces conducted a long-range air assault on Kandahar and received fuel for their ground vehicles and equipment from KC-130s. (In addition, the Marine Corps is acquiring weapons kits that can be used to turn KC-130s into armed attack aircraft, but that will be a secondary role not given to all KC-130s.) Unlike the majority of Navy and Marine Corps aircraft, KC-130s are too large to be based on aircraft carriers or amphibious ships; they must operate from air bases on land instead. The Marine Corps plans to field an average of 71 KC-130 tankers during the 2017–2021 period.

CHAPTER

4

Department of the Air Force

Overview

The Department of the Air Force includes the Air Force's active component, the two parts of the service's reserve component—the Air Force Reserve and the Air National Guard—and all federal civilians employed by the Air Force. It is the smallest of the three military departments in terms of both number of personnel and operation and support (O&S) budget.

The Air Force is responsible for the majority of the U.S. military's air power. However, each of the military services has a substantial number of aircraft; thus, the Air Force's specialty is not simply providing air power but providing a wide range of capabilities and types of aircraft. In addition, the Air Force is responsible for most of the U.S. military's space assets and for the ground-based ballistic missiles that carry about one-third of the United States' deployed nuclear weapons.[1]

The Air Force operates a fleet of aircraft of widely varying sizes that are designed to accomplish a broad array of missions. Types of aircraft unique to the Air Force include long-range bombers, large transport aircraft, and large tanker aircraft. (The other services operate a number of smaller cargo and tanker aircraft, but the Air Force's are bigger and more numerous.) The Air Force also operates a large number of fighter and attack aircraft; aircraft that provide capabilities for airborne command and control, intelligence, reconnaissance, and surveillance (ISR), and electronic warfare (EW); and helicopters and tilt-rotor aircraft for combat rescue and special-operations missions. In addition, the Air Force operates a fleet of unmanned air systems (drones) that can carry equipment for ISR and EW missions as well as weapons to attack ground targets. Because the Air Force's aircraft are expected to operate mainly from established air bases, their designs do not have to give up performance capabilities in exchange for specialized adaptations, such as the ones that enable the Navy's aircraft to operate from aboard ships. The Air Force is also responsible for most of the military's space systems that provide important support to the entire Department of Defense (such as Global Positioning System satellites).

Combat units in the Air Force are generally organized as squadrons of aircraft. Those squadrons vary widely in size—with anything from 8 to 24 aircraft being common—as well as in types of aircraft. Such variation makes it difficult to provide a single measure of force structure for the Air Force similar to an Army brigade combat team or a Navy carrier strike group. For consistency, the Congressional Budget Office focused in this analysis on notional squadrons of 12 aircraft each.[2] The Air Force's planned numbers of aircraft and personnel equate to roughly 220 such squadrons during the 2017–2021 period (see Table 4-1). The Air Force also includes support units (the vast majority of which are used to support combat operations by aircraft squadrons) and administrative units (almost all of which exist to create or maintain the service's combat units and support units).

1. As noted in Chapter 3, the Navy's ballistic missile submarines carry roughly the other two-thirds of the United States' deployed nuclear weapons. Air Force bombers can also carry nuclear weapons, but because of the conventions used in arms control agreements, bombers are counted as carrying very few such weapons (officially, just one nuclear warhead each). Those conventions reflect a judgment that bombers are less dangerous in a crisis because they take much longer to reach their targets than ballistic missiles do and they can be recalled after they have been launched, which is not the case for ballistic missiles.

2. CBO decided to use a notional squadron of 12 aircraft as a standard measure simply to provide a normalized "apples to apples" way of comparing the sizes of different fleets of aircraft (and changes to those fleets over time). Actual counts of Air Force squadrons do not provide such a measure. A simple count of the number of official "slots" in each fleet would provide the same benefit analytically and is a fairly common way of describing the Air Force's fleets. Had CBO used that metric, its estimates for the personnel and costs of each type of Air Force aircraft would be the same as those presented here but divided by 12 in each case.

Table 4-1.

Number of Major Combat Units in the Air Force, 2017 and 2021

	2017	2021
Tactical Aviation Squadrons	101	100
Bomber Squadrons	9	9
Airlift Squadrons	42	43
Air Refueling Squadrons	36	36
Unmanned Air System Squadrons	35	30

Source: Congressional Budget Office, using data from the Department of Defense's 2017 budget request.

All units presented are notional squadrons of 12 aircraft (actual squadrons vary in size).

In addition, the Air Force contains some smaller organizations that provide capabilities unrelated to aircraft or space systems. The most noteworthy include squadrons of Minuteman ballistic missiles, special-operations forces, and squadrons of construction engineers.

Distribution of Air Force Personnel

Of the nearly half a million military personnel serving in the Air Force as a whole, 29 percent are in support units and 37 percent are in combat units (see Table 4-2). The rest belong to units that perform various overhead functions, such as training and maintenance.

More than the other services, the Air Force integrates the personnel from its active and reserve components very tightly—in many cases, it is misleading to treat the Air Force as composed of separate active- and reserve-component units. Many Air Force units are "multi-compo" (multiple component) units, made up of personnel and equipment from both the active and the reserve components. In other cases, equipment assigned to one component may be operated by personnel from the other component. About one-third of the Air Force's aircraft are assigned to the reserve component, which more closely resembles the Army's practice than that of the Navy or Marine Corps. The Air Force's reserve component is also unusual in that its pilots, unlike reservists in the other services, are frequently more experienced than their active-component counterparts.[3]

Such tight integration—combined with the way in which budget information is presented in DoD's Future Years Defense Program (in which units must be classified as belonging to one component or the other, even when that is not strictly the case)—limited CBO's ability to produce meaningful estimates of costs for active- or reserve-component squadrons. Instead, the costs presented in this report for Air Force squadrons represent those of "average" squadrons, even though there may be no actual squadrons with those precise sizes and costs.[4]

Command Levels and Units

Today's Air Force typically does not operate with formations larger than squadrons. In the past, the service relied more heavily on wings (groups of three squadrons, with 24 aircraft per squadron). It also experimented with a larger formation, called an air expeditionary force, composed of several different types of squadrons. Currently, however, the Air Force generally deploys a group of squadrons organized for a specific mission, with higher-level commands such as wings used to provide command and control for the deployed squadrons. As noted above, squadron sizes vary greatly, making counts of squadrons a somewhat misleading measure of force structure, which is why CBO translated all Air Force units into notional 12-aircraft squadrons for this analysis.[5]

3. Statistically, the most important determinant of a pilot's proficiency is total hours spent flying during a career. Pilots in the Air Force's reserve component are almost always former active-duty military pilots, many of whom have gone on to careers in civilian aviation; as a result, they have often spent more hours flying than active-component pilots.

4. For example, about one-quarter of the Air Force's fleet of C-17 cargo aircraft is assigned to the reserve component. However, cargo aircraft are commonly crewed by personnel from both the active and the reserve components, so it would not be accurate to treat one-quarter of C-17 squadrons as being in the reserve component and the other three-quarters as being in the active component (in actuality, about 90 percent of the personnel assigned to C-17 squadrons are reserve-component personnel). For that reason, CBO calculated per-unit costs for this report by estimating the cost of a single notional C-17 squadron rather than by estimating one cost for the C-17s assigned to the reserve component and another cost for the C-17s assigned to the active component. Although that approach almost guarantees that the estimated cost of a notional squadron does not reflect the cost of any actual squadron, if the Air Force made large cuts or additions to its forces that were not disproportionately targeted toward one component or the other, CBO's notional cost would approximate the average savings or additional cost per squadron cut or added.

5. Today, larger aircraft, such as cargo lifters and bombers, are generally grouped into smaller squadrons, whereas tactical aircraft tend to be grouped into larger squadrons. However, squadron sizes are not standardized even for specific types of aircraft. For example, although fighter aircraft are often described as organized into squadrons of 24 aircraft, the Air Force actually organizes F-16s in squadrons of 15, 18, or 24 aircraft.

Table 4-2.

Average Distribution of the Department of the Air Force's Military Personnel, 2017 to 2021

Number of Personnel

	Active Component	Reserve Component	Total
Combat Units	98,000	86,000	184,000
Support Units	100,000	40,000	141,000
Overhead[a]	119,000	48,000	167,000
Total	**317,000**	**174,000**	**491,000**

Source: Congressional Budget Office, using data from the Department of Defense's 2017 budget request.

Numbers may not add up to totals because of rounding.

a. "Overhead" refers to administrative units as well as to personnel not assigned to any unit.

Support units in the Air Force have also evolved over time. In the past, a wing was a relatively fixed organization with a definite support structure, organized into several functional groups, such as an operations group or an aircraft maintenance group. Although modern wings still have functional support groups, those groups vary in size depending on the numbers and types of squadrons they need to support (which also differ in size and type). Moreover, detachments can be split off from those groups fairly easily to support individual squadrons when they deploy. Thus, in practice (if not in formal structure), the Air Force has shifted to using a number of smaller, more flexible kinds of support units that are capable of supporting individual squadrons rather than entire wings.

One reason that is cited for the decline of the wing and the rise of the squadron as the Air Force's main element of force structure is that traditional tactical fighter wings were large and homogenous (generally composed of a single type of aircraft). As tactical aircraft became more expensive, more capable, and less numerous, 72-aircraft wings came to be seen as relatively inflexible, cumbersome units. Similarly, as the Air Force began conducting more sophisticated operations with different types of aircraft working together, mixed forces (a "composite wing") became more useful than forces consisting of just one type of aircraft. In a sense, that shift has brought the Air Force closer to the way in which the other services handle aviation. For example, most of the Army's aircraft are in aviation brigades that contain more than one type of helicopter; the Navy has always used composite carrier air wings, which include several smaller squadrons of mixed aircraft types; and the Marine Corps has long used Marine aircraft wings that are intended to be divided into smaller, task-organized groups for deployments.

At various times in the past decade, the Air Force has suggested a new form of higher-level organization: an air expeditionary force or, more recently, an air and space expeditionary task force. So far, however, those formations appear to be largely administrative conveniences (essentially, lists made in advance of disparate units that would be deployed together for an operation) intended to bring some predictability to the deployment of Air Force units. In practice, the Air Force appears to be evolving toward a system more like that of the Marine Corps, in which actual deployments involve task-organized formations drawn from standing units. Current Air Force doctrine supports creating ad hoc squadrons or wings during deployments. For example, a deployed force of fewer than 700 personnel would warrant having one squadron, but if that force grew to exceed 700 personnel, commanders would be expected to form a second squadron and split assets and responsibilities between the two.

Like the other military services, the Air Force differentiates between the total number of fixed-wing aircraft it has and the number of official "slots" for those aircraft in its force structure. For instance, a squadron of 12 aircraft is intended to be able to operate that many aircraft at all times (in other words, it has 12 slots, called the primary aircraft authorization). But it may have more aircraft assigned to it (called the primary mission aircraft inventory) so the squadron can continue to operate at full strength even if some of those aircraft require extended maintenance or are otherwise unavailable. Similarly, the services have many aircraft that are not assigned to combat units—some are at maintenance depots, some are assigned to training squadrons, and some may be in storage to serve as replacements if aircraft are lost in the future. For those reasons, a service's total aircraft inventory is greater than its primary aircraft authorization levels. (For example, the United States purchased 21 B-2 bombers but maintains 16 slots for B-2s in the force structure.) In this report, all aircraft numbers represent primary aircraft authorizations.

Strengths and Limitations of U.S. Air Forces

Each type of aircraft has its own strengths and weaknesses, but overall, Air Force squadrons are exceptionally powerful units. Very few other countries' air forces have sufficient combat power to consider challenging U.S. control of the air; in many of the conflicts that the United

States has engaged in over the past few decades, opponents have chosen to safeguard their air forces by keeping them grounded for the duration of the conflict. In addition, few nations currently have ground-based air defenses capable of seriously hindering U.S. air operations. The United States has faced only limited competition from hostile fighter aircraft since 1950 (when China intervened in the Korean War), and it has been able to overcome every opposing country's air-defense systems. In the majority of U.S. conflicts since World War II, U.S. air forces have been able to operate essentially at will, either from the beginning of the conflict or a short time thereafter, once the opponent's air defenses had been destroyed.[6] (For a discussion of those and other past military operations, see Appendix C.)

The United States has historically had a lower threshold for using air and naval forces in combat than for using ground forces. And although flexibility and response time have made aircraft carriers a commonly used option for conducting aerial attacks in small interventions, Air Force aircraft have played a role in almost every U.S. conflict since the service was created. Through international agreements, the United States has access to an extensive network of air bases around the world. In addition, the Air Force's tanker fleet is capable of extending the range of Air Force aircraft to allow attacks on almost any possible hostile country. Air Force squadrons can also be deployed more quickly than ground forces, and their ability to fly at high speeds to distant locations allows them to put virtually any location at risk of attack (provided that its air defenses have been sufficiently degraded or can be avoided).

Views on the use of air power have long fallen into two major camps, one focused on strategic airpower (generally associated with the Air Force) and the other focused on tactical airpower (generally associated with the other military services). Both schools of thought agree that the first priority in any air campaign is to destroy enemy fighter aircraft and air-defense systems to ensure that U.S. air forces can operate freely in enemy airspace. Beyond achieving air superiority, however, the two schools have very different views on the form that airpower should take and the way it should be used in a conflict; they also have very different historical records. (The terms "strategic airpower" and "tactical airpower" originated from a time when the former was largely synonymous with long-range bombers and the latter with fighters. Modern aircraft have blurred that distinction, so those terms might be more accurately called "strategic use of airpower" and "tactical use of airpower." However, CBO uses the more common terms here for simplicity.)

Strategic Airpower. Strategic airpower is a catchphrase for attempts to use air power to win a conflict directly—independent of naval and ground forces—either by severely limiting an opponent's ability to conduct effective military operations or by coercing the opponent's leaders into acceding to U.S. demands. In that school of thought, the main way to achieve those ends is generally through bombardment of "strategic" targets, such as command-and-control assets, infrastructure, or key components of an adversary's economy. Consequently, proponents of strategic airpower have historically favored long-range bombers (although it is possible to employ tactical aircraft to attack strategic targets) and have regarded attempts to use airpower to influence ground battles as a diversion from the primary air campaign of a conflict.

The effectiveness of strategic airpower has been hotly debated for decades. Proponents cite a number of theories and point to various examples—such as the ending of World War II after U.S. nuclear attacks on Japan and the 1999 air campaign intended to force Serbia to withdraw from Kosovo—as evidence that air forces can win wars largely independent of naval or ground campaigns. Proponents generally also assert that having the ability to win wars through the use of strategic airpower is a highly appealing strategy given U.S. preeminence in the air and the tendency of airpower to result in fewer U.S. casualties than traditional ground campaigns. (Some advocates of strategic airpower also contend that, in an era of precision munitions, an air campaign can result in fewer enemy civilian casualties as well, making it a more humanitarian option than a ground campaign. That position is controversial, however.)

The use of air forces alone to conduct strikes on opposing states, without the commitment of U.S. or allied ground forces, has had mixed results in achieving the United States' strategic goals. Although air strikes or cruise missile strikes by themselves have sometimes been able to achieve more limited U.S. goals, opponents of strategic

6. A notable exception was the Vietnam War, in which the U.S. military did not maintain a vigorous effort to neutralize North Vietnam's air defenses. Despite those defenses, the United States was able to conduct substantial air operations.

airpower point to numerous operations without ground forces in which the United States failed to achieve its aims. Examples include U.S. bombing of North Vietnam between 1969 and 1973 and cruise missile attacks in Afghanistan and Sudan in 1998 (Operation Infinite Reach). Some theorists have argued that the credible threat of attack by ground forces is a necessary component of a strategy focused on strategic air attacks. In recent years, the United States has often sought out local ground forces to assist in operations that do not involve U.S. ground forces, as it did in Afghanistan in 2002 and Libya in 2011 and as it has recently tried to do in Syria.

Tactical Airpower. Tactical airpower is a catchphrase for attempts to use air power in support of naval and ground forces, to assist in winning a conflict by amplifying the power of those forces (generally through attacks on an opponent's ground forces or naval vessels). Proponents of tactical airpower have historically favored short-range fighter aircraft (although bombers can be used in this role as well) and have regarded attempts to use air power to prosecute a separate air campaign as a diversion from the primary naval or ground campaign in a conflict.

Tactical airpower is often described as having a powerful synergy with ground forces. The reason is that methods for defending against ground forces make an opponent more vulnerable to attacks from the air, and methods for defending against attacks from the air make an opponent more vulnerable to ground forces. During the combat phase of Operation Iraqi Freedom, for example, DoD sources frequently illustrated that synergy when describing how U.S. ground forces could pressure Iraqi units to respond to their assaults. Hostile ground forces are more vulnerable to airpower when they are moving (because soldiers are not protected by field fortifications, vehicles travel in clusters on roads, and so forth), whereas they can sometimes resist aerial attack very effectively when they are stationary. But if they are trying to defend against mobile U.S. ground forces, hostile ground forces may need to move to protect key locations or to keep from being surrounded. In a similar vein, hostile ground forces can resist aerial attack much more easily if they are widely dispersed, but such dispersion makes it much harder for them to resist attack from other ground forces. Those synergies mean that combining tactical airpower with ground forces makes the application of tactical airpower much more effective than it would be otherwise. Tactical airpower has also long been thought to be decisive in naval combat. Examples include the United States' experience in such World War II battles as Pearl Harbor and Midway and Britain's experience during the Falklands War.[7]

Although strategic and tactical airpower can be seen as competing approaches, U.S. air forces have used a hybrid approach during recent conflicts, attacking the sorts of targets favored by both groups of airpower proponents. Part of the reason is that modern U.S. air operations have generally been limited not by the number of air assets available (which would force the military to make choices between competing sets of targets) but instead by the amount and quality of information that can be gathered about prospective targets.

What This Chapter Covers

The rest of this chapter presents CBO's analysis of the following major elements of the Air Force's force structure (listed here with the percentage of the Department of the Air Force's O&S costs that they account for):

- Tactical aviation squadrons (33 percent); see page 86.
- Bomber squadrons (10 percent); see page 89.
- Airlift squadrons (15 percent); see page 92.
- Air refueling squadrons (14 percent); see page 96.
- Unmanned air systems (6 percent); see page 100.
- Other units and activities of the Department of the Air Force, such as intercontinental ballistic missiles and special-operations forces (21 percent); see page 103.

This chapter also examines one topic of special concern to the Air Force: the modern U.S. military's strike capability, which allows many different types of aircraft to attack and destroy a wide range of ground targets; see page 105.

7. The Navy and Air Force have had few opportunities to cooperate in large-scale naval battles since World War II, partly because of the absence of significant naval opponents since then and partly because of the capability and large quantity of U.S. naval aircraft. However, in recent years, the two services have developed an "Air-Sea Battle" concept to develop ways to integrate their forces in future conflicts.

Major Element of the Force Structure

Air Force Tactical Aviation Squadrons

	Total	Direct	Indirect	Overhead
		A-10 Attack Aircraft Squadron		
Military Personnel per Unit	1,190	350	440	400
Annual Cost per Unit (Millions of 2017 dollars)	230	80	60	90
		F-15 Fighter Aircraft Squadron		
Military Personnel per Unit	1,540	430	590	520
Annual Cost per Unit (Millions of 2017 dollars)	300	100	80	120
		F-16 Fighter Aircraft Squadron		
Military Personnel per Unit	1,250	450	370	420
Annual Cost per Unit (Millions of 2017 dollars)	220	70	50	100
		F-22 Fighter Aircraft Squadron		
Military Personnel per Unit	2,390	430	1,150	810
Annual Cost per Unit (Millions of 2017 dollars)	470	120	160	190
		F-35 Fighter Aircraft Squadron[a]		
Military Personnel per Unit	2,940	430	1,510	1,000
Annual Cost per Unit (Millions of 2017 dollars)	570	130	210	230

All units presented here are notional squadrons of 12 aircraft (actual squadrons vary in size).

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest 10 personnel or $10 million; more detailed information is presented in Appendixes A and B.

a. Because F-35s are not yet in full operational service, their actual costs may differ from the planned costs included in the Department of Defense's budget documents, on which these estimates are based.

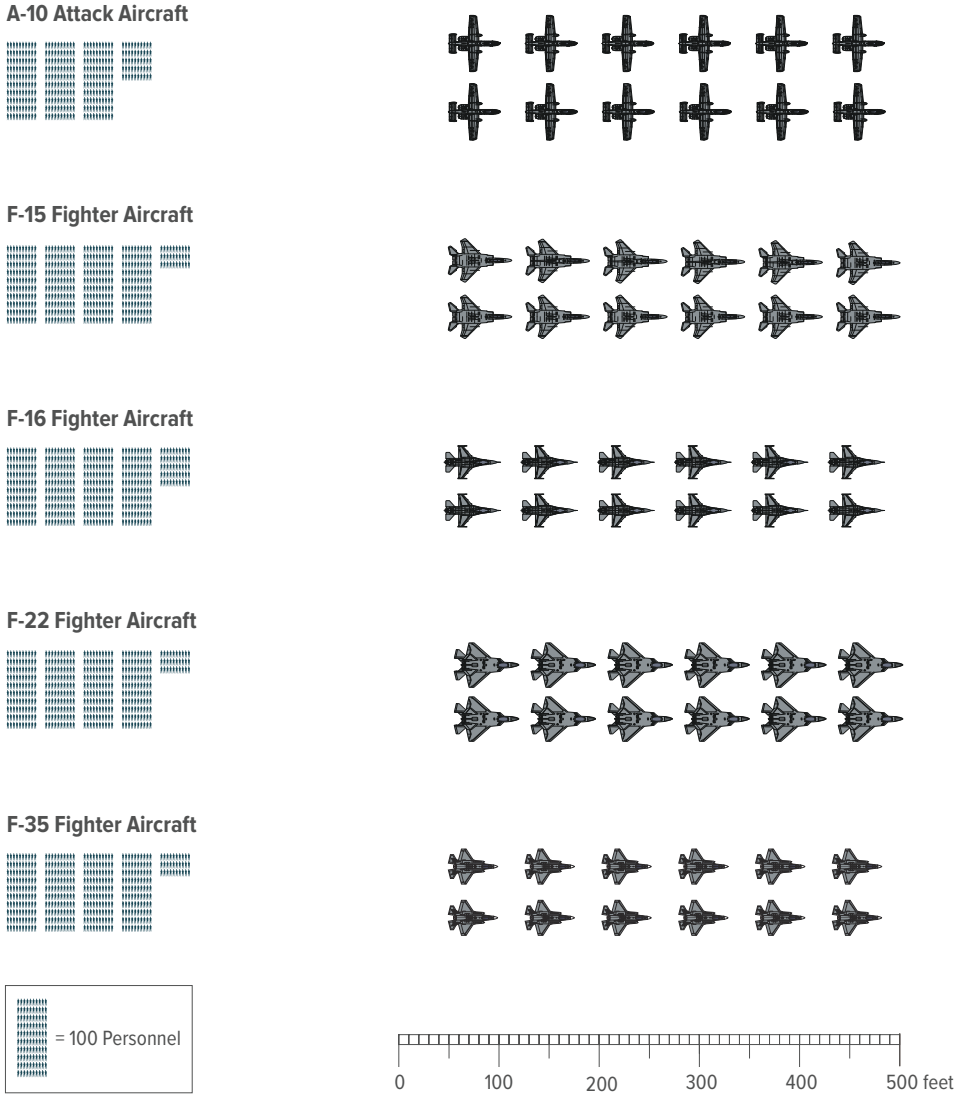
Tactical aircraft, which make up the majority of the Air Force's combat fleet, consist of relatively small aircraft designed to engage in air-to-air combat (fighters), to strike targets on the ground (attack aircraft), or both (multirole aircraft, which the Air Force designates as fighters).

Current and Planned Structure. Between its active and reserve components, the Air Force plans to field the equivalent of about 101 notional 12-aircraft squadrons of tactical aviation in 2017, consisting of 185 attack aircraft (A-10s) and 1,019 fighter aircraft (294 F-15s, 537 F-16s, 157 F-22s, and 31 F-35s). The number of notional squadrons is expected to decline slightly in the next few years, mostly because of the planned retirement of the A-10 fleet, and then rise back to 100 squadrons by 2021 as production of F-35s increases. (For an example of the structure of a tactical aviation squadron, see Figure 4-1.) Tactical aviation accounts for about 33 percent of the Air Force's total operation and support funding.

Purpose and Limitations. In the past, most types of tactical aircraft were highly specialized for either air-to-air or air-to-ground combat. Today, those two forms of combat

Figure 4-1.

Aircraft and Personnel in Notional Air Force Tactical Aviation Squadrons



Source: Congressional Budget Office, using data from the Department of Defense.

All units presented here are notional squadrons of 12 aircraft (actual squadrons vary in size).

are still the main roles for the Air Force's tactical aviation fleet, but the most numerous type of aircraft in the fleet is a multirole aircraft (the F-16). Only a small portion of the tactical aviation fleet consists of purely attack aircraft (A-10s). Moreover, the Air Force's newest air-to-air fighter (the F-22) was designed with some ground-attack capability. The emphasis on multirole aircraft is likely to continue in the future with the introduction of the F-35, which was designed primarily to attack ground targets but has air-to-air capability as well. (The ground-attack mission is discussed in detail in the special-topic entry about strike capability on page 105.)

Despite their versatility, multirole fighters are most likely to be used for specific missions according to their individual strengths. For example, F-22 fighters are considered best suited to perform the most difficult air-to-air combat missions, and F-16s and F-35s are best suited to carry out ground-attack missions.

A-10 attack aircraft have almost no air-to-air combat ability; they were designed mainly to provide air support for friendly ground forces (by attacking hostile ground forces engaged in combat). The A-10 is noteworthy for its large cannon, a 30-millimeter (mm) Gatling gun designed for

attacking armored combat vehicles. (By comparison, other types of Air Force tactical aircraft have a 20 mm Gatling gun.) A-10s have good visibility from the cockpit and can fly relatively slowly, factors that give pilots an excellent view of the battlefield they are supporting. However, in recent years, the Department of Defense proposed retiring the A-10 fleet, arguing that those aircraft cannot withstand modern air defenses and are too expensive to maintain in the force.[8]

F-15 fighter aircraft come in several versions, including the C model ("Eagle"), intended mainly for air-to-air combat, and the E model ("Strike Eagle"), intended mainly for ground-attack missions. Until the introduction of the F-22, the F-15C was the Air Force's primary vehicle for achieving air superiority in a theater of operations; it is still considered a highly capable fighter plane. The F-15E model is a relatively large strike aircraft—by the standards of tactical aviation—with a fairly long range and large capacity for carrying bombs and extra fuel.

F-16 fighters are the most numerous aircraft in the Air Force's tactical aviation fleet. Originally designed as a low-cost air-to-air fighter that could operate only during daylight hours, the F-16 has evolved into a very effective multirole fighter that can operate at any time of the day. F-16s are relatively small and lightweight, with a correspondingly limited range and payload capacity. Part of the F-16 fleet has been upgraded with specialized equipment for attacking and suppressing enemy air-defense systems.

F-22 fighters are the Air Force's newest aircraft designed specifically for air-to-air combat. They incorporate "stealth" design characteristics that make them difficult to observe with radar, and they are generally considered the most capable air-to-air combat aircraft being fielded by any nation. The F-22 was initially designed with limited ground-attack capability, but the Air Force has been modifying the aircraft to improve that capability.[9]

The F-35A, the Air Force's variant of the Joint Strike Fighter, is currently in production but is not slated to enter service until 2017 (the first few aircraft are now being used for testing and training). The F-35 is intended to replace the A-10 and F-16 as the Air Force's main tactical strike platform. The largest improvement it provides is stealth; once fielded, it will give the Air Force a large fleet of hard-to-observe strike aircraft. The F-35A will also be capable of air-to-air combat, although not to the same degree as the F-22. Capabilities that the F-35A will not offer are a cannon comparable to that of the A-10 and the slow flying speed useful for finding and attacking ground targets.[10]

Past and Planned Use. The Air Force's tactical aircraft have been used extensively in almost every conflict in which the United States has taken part since the 1940s. Likewise, most potential scenarios for future conflicts are likely to include the heavy use of tactical aviation. In general, tactical aircraft are responsible for securing U.S. control of the air (by destroying an opponent's air forces and air defenses) and for supporting U.S. war efforts by attacking ground targets. In a few cases, such as the enforcement of "no-fly zones," securing U.S. control of the air is the sole mission. That mission is overwhelmingly the responsibility of Air Force tactical aviation.

8. Through prohibitions in national defense authorization acts, the Congress has so far not allowed the Air Force to carry out plans to retire the A-10 fleet. In its 2017 budget request, the Air Force did not propose to retire the A-10 fleet as rapidly.

9. Generally speaking, for a combat aircraft to be stealthy, the bombs, missiles, and other ordnance it carries must fit inside an internal bay rather than being carried externally. The F-22's internal bays are small relative to the size of many air-to-ground weapons (and the aircraft has no external mounting points for such ordnance). Thus, even after it has been upgraded for strike missions, the F-22 will carry smaller amounts of air-to-ground ordnance than other tactical fighters can.

10. Like the F-22, the F-35A will have to carry ordnance in a relatively small internal bay to retain its stealth characteristics, although the aircraft's bay has been sized to accommodate most types of air-to-ground weapons. Unlike the F-22, the F-35 has external mounting points available, so if stealth is not necessary (as may be the case after hostile air defenses have been suppressed), the F-35 can carry an ordnance load comparable to that of other tactical aircraft.

Major Element of the Force Structure

Air Force Bomber Squadrons

	Total	Direct	Indirect	Overhead
		B-52 Bomber Aircraft Squadron		
Military Personnel per Unit	3,830	1,310	1,220	1,300
Annual Cost per Unit (Millions of 2017 dollars)	740	270	170	300
		B-1B Bomber Aircraft Squadron		
Military Personnel per Unit	3,980	940	1,680	1,350
Annual Cost per Unit (Millions of 2017 dollars)	810	270	230	310
		B-2 Bomber Aircraft Squadron		
Military Personnel per Unit	8,660	2,120	3,600	2,940
Annual Cost per Unit (Millions of 2017 dollars)	1,840	670	490	680

All units presented here are notional squadrons of 12 aircraft (actual squadrons vary in size).

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest 10 personnel or $10 million; more detailed information is presented in Appendixes A and B.

The Air Force's bomber fleet has two main roles: delivering nuclear weapons and performing strikes with conventional weapons. (Those strike missions are discussed in more detail at the end of this chapter, and the nuclear weapons capability of the U.S. military is discussed in the next chapter.) Historically, the Air Force viewed the delivery of nuclear weapons as the primary purpose of long-range bombers, with conventional strikes as a secondary role. However, events since the collapse of the Soviet Union have generally increased the emphasis on conventional strike missions for the bomber fleet. One of the Air Force's three types of long-range bombers, the B-1B, is no longer capable of delivering nuclear weapons and is now devoted entirely to conventional strike missions. In addition, many of the Air Force's B-52s are slated for conversion to a conventional-only configuration to comply with the New START arms control treaty.

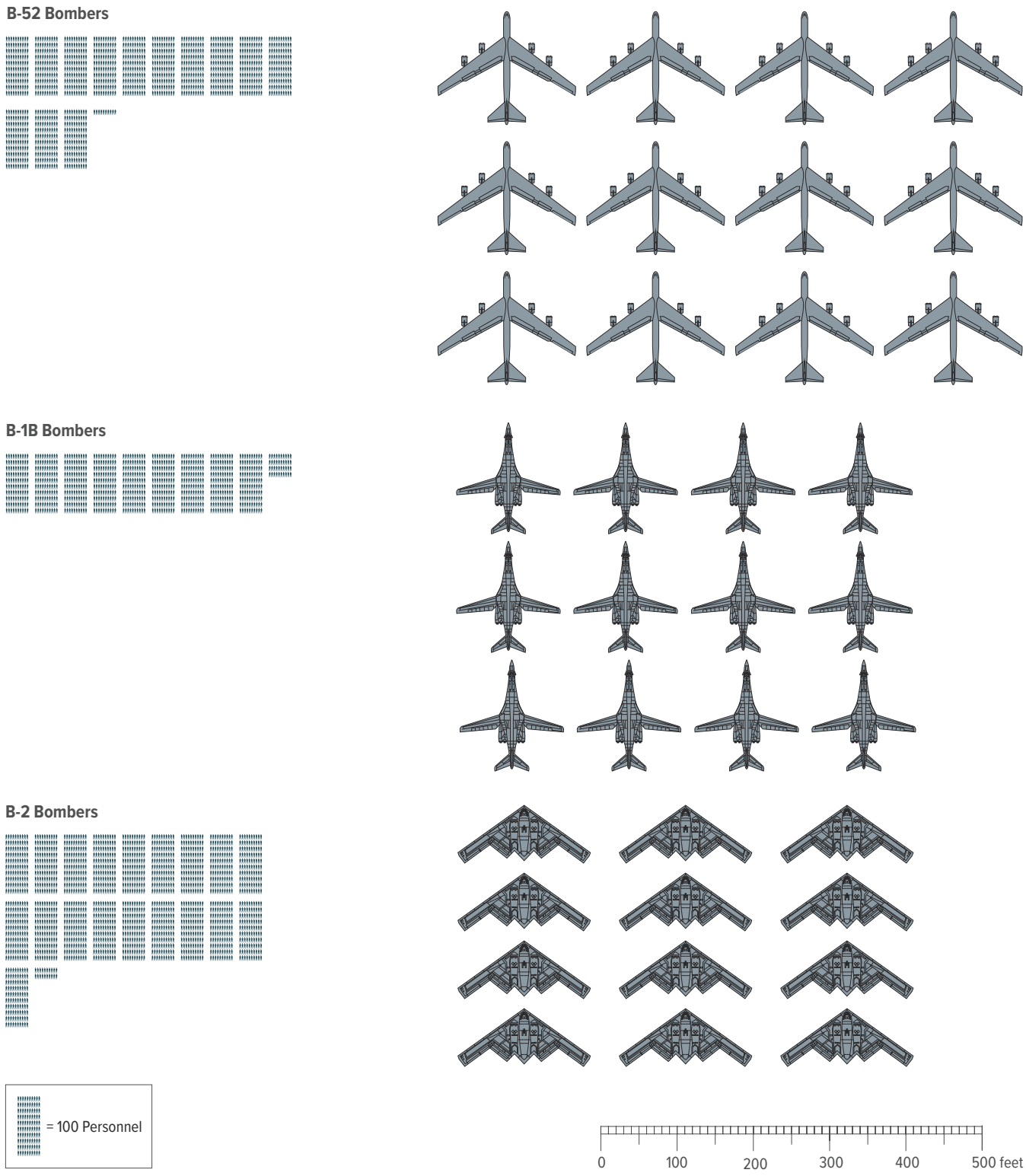
Current and Planned Structure. Between its active and reserve components, the Air Force plans to field the equivalent of about 9 notional 12-aircraft squadrons of long-range bombers in 2017, consisting of 45 B-52s, 51 B-1Bs, and 16 B-2s. It has no plans to change the number of notional squadrons through 2021. (For an example of the structure of a bomber squadron, see Figure 4-2.) Bombers account for about 10 percent of the Air Force's total operation and support funding.

Purpose and Limitations. Unlike tactical aviation, bombers are large aircraft that can travel long distances and loiter above an area for an extended period without refueling (characteristics referred to as endurance) and can deliver a large payload of munitions. Those capabilities make bombers especially well-suited to performing strike missions—their long range allows them to be based relatively far from the theater of operations (freeing up space in closer air bases for shorter-range aircraft); their loitering time lets them remain in an area longer, allowing them to respond more rapidly to requests from ground forces for air support; and their large load of munitions enables them to provide substantial air support before needing to return to bases to rearm.

The enormous weapons payload of the bomber fleet allows it to contribute a very substantial share of the U.S. military's capability to strike targets, despite its relatively small numbers. For example, a B-1B can carry 84 500-pound bombs in a single sortie, whereas an F-16

Figure 4-2.

Aircraft and Personnel in Notional Air Force Bomber Squadrons



Source: Congressional Budget Office, using data from the Department of Defense.

All units presented here are notional squadrons of 12 aircraft (actual squadrons vary in size).

could carry 12, although an F-16 typically flies more sorties per day and thus could deliver those 12 bombs more often. However, the Air Force can capitalize on bombers' large payloads only on missions in which enough targets can be identified to use the number of weapons carried.

B-52s are the oldest of the Air Force's bombers, dating to the 1960s.[11] The Air Force plans to keep them in service at least through 2040. B-52s have the ability to carry a great variety of weapons and have the longest unrefueled endurance of the Air Force's bomber fleet. Because of their age, however, B-52s would probably have trouble penetrating modern air-defense systems and thus are best suited to operating in undefended airspace or to delivering cruise missiles from outside defended airspace.[12]

The B-1B fleet is younger than the B-52 fleet, having been built in the 1980s. Although B-1Bs were designed to deliver nuclear weapons, the United States modified them to remove that capability in order to comply with arms control treaties. Today, B-1Bs are intended only to perform conventional strikes. Although they incorporate some features that make them harder to observe than B-52s, they are not considered as capable of surviving in hostile airspace as the more recent B-2s. Nevertheless, the Air Force has used B-1Bs to conduct air strikes in hostile airspace in recent operations—the B-1B fleet delivered more bombs in Operation Iraqi Freedom than any other type of aircraft—albeit often with support from other aircraft.

B-2s are the newest and most modern U.S. bombers. Built in the late 1980s and the 1990s, they are notable for the extensive stealth design features that help them penetrate hostile airspace undetected, and they are considered more difficult to target and attack than other U.S. bombers. However, unlike with other bombers, the Air Force is reluctant to deploy B-2 squadrons to bases overseas, preferring to have them conduct strikes directly from their base in Missouri. Two reasons, according to the Air Force, are the planes' demanding maintenance requirements (associated with the special radar-absorbing coating on the outside of the aircraft) and the need for atmospherically controlled hangars. Nevertheless, the B-2 can be deployed overseas, if necessary, and has been on occasion. In practice, flying most missions from U.S. bases means that B-2 sorties are extremely long and demanding, which limits the number of sorties that the small B-2 fleet (16 aircraft) can conduct to those in which stealth is most essential.

Past and Planned Use. Air Force bombers have been employed with increasing frequency in modern U.S. conflicts. Their use was relatively limited in Operation Desert Storm—B-52s delivered cruise missiles during the initial wave of strikes and conducted some bombing missions afterward—but at the time, the Air Force still saw bombers as primarily dedicated to nuclear missions. Since then, with the collapse of the Soviet Union, bombers have been used in larger roles in more conflicts. For example, the B-1B fleet was first employed for conventional air strikes during the 1990s enforcement of no-fly zones over Iraq; later it was used during operations in Kosovo, in Operations Enduring Freedom and Iraqi Freedom, and in the subsequent occupations of Afghanistan and Iraq. The B-2 fleet was first employed for conventional strikes in Kosovo and was also used during Operations Enduring Freedom and Iraqi Freedom. (It is not clear whether B-2s played a role in the subsequent occupations of Afghanistan and Iraq.) B-52s have often been mentioned as being particularly useful during the occupations of Afghanistan and Iraq because their large fuel load allows them to remain on station, waiting for requests for fire support, for long periods.

11. The earliest models of the B-52 were introduced in the 1950s, but those models have since been retired.

12. Although B-52s have sometimes been used to launch cruise missiles from outside heavily defended airspace, that role is generally performed by the Navy, which has extensive capability to fire Tomahawk cruise missiles from long range.

Major Element of the Force Structure

Air Force Airlift Squadrons

	Total	Direct	Indirect	Overhead
		C-130 Cargo Aircraft Squadron		
Military Personnel per Unit	2,120	800	590	720
Annual Cost per Unit (Millions of 2017 dollars)	360	110	80	170
		C-5 Cargo Aircraft Squadron		
Military Personnel per Unit	2,430	780	820	830
Annual Cost per Unit (Millions of 2017 dollars)	430	130	110	190
		C-17 Cargo Aircraft Squadron		
Military Personnel per Unit	1,390	450	460	470
Annual Cost per Unit (Millions of 2017 dollars)	270	90	60	110

All units presented here are notional squadrons of 12 aircraft (actual squadrons vary in size).

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest 10 personnel or $10 million; more detailed information is presented in Appendixes A and B.

The Air Force's fleet of cargo aircraft exists to "airlift" (transport by air) personnel and equipment between or within theaters of operations. Intertheater transport is generally conducted by the larger, longer-range, and more expensive C-5 and C-17 aircraft. Intratheater transport is usually performed by the smaller, shorter-range, and less expensive C-130 aircraft, although the C-17 was designed to operate from shorter runways, making it an option for transport missions between theaters as well.

Current and Planned Structure. Between its active and reserve components, the Air Force plans to field the equivalent of about 42 notional 12-aircraft squadrons of cargo aircraft in 2017, consisting of 292 C-130s, 39 C-5s, and 172 C-17s. That total number is planned to increase slightly, to 43 squadrons, by 2021. (For an example of the structure of such a squadron, see Figure 4-3 on page 94.) Cargo aircraft account for about 16 percent of the Air Force's total operation and support funding.

To supplement its airlift capabilities, the Air Force runs a program called the Civil Reserve Air Fleet (CRAF). Under that program, U.S. civilian air carriers that operate certain models of aircraft receive preferential access to air transport contracts with the Department of Defense; in return, those carriers allow the Air Force to use their aircraft for military transport missions in times of conflict. The CRAF program ensures that the Air Force has a large reserve of transport aircraft available in situations in which it may need more airlift capability than its own fleet can provide. Most eligible U.S. civilian airlines participate in the CRAF program, which generally gives the Air Force access to an additional 400 intertheater transport aircraft and 100 intratheater transport aircraft (although the numbers vary over time).

Because CRAF aircraft are designed for civilian use, they are not suitable for certain military missions, such as transporting the largest armored vehicles. But for some purposes, such as carrying passengers, CRAF aircraft are frequently a better alternative in times of conflict than the Air Force's transport aircraft.

Purpose and Limitations. The primary advantage of moving cargo and passengers by air is that it is much faster than transport by sea. In many scenarios for possible conflicts, the use of air transport would let U.S. forces reach a theater of operations within a day, rather than the weeks that sea transport might require. In addition,

aircraft can move supplies to almost any portion of the globe, whereas many theaters of operations (such as Afghanistan) are far from the sea and would require additional land transportation to move personnel and cargo from ports to the theater. Even in an ongoing operation, the speed and responsiveness of air transport can be extremely valuable in providing logistics support—for example, being able to bring in crucial supplies on a day's notice is preferable to needing a month's notice.

To minimize deployment times, virtually all U.S. military personnel are deployed to and from theaters of operations by air. Moving cargo, however, by air has two major disadvantages. First, cargo aircraft are much more expensive to purchase and operate than the equivalent amount of sea transport capacity. Second, although air transport is less subject to geographical constraints than sea transport, it can be subject to infrastructure constraints, such as limited numbers or quality of airfields. Because the United States has a large fleet of cargo aircraft (and has access to an even larger fleet through the CRAF program) but often operates in regions with poor infrastructure, the Air Force's ability to airlift equipment is frequently limited not by how many cargo aircraft it has but by the quality and quantity of airports available in the theater of operations. Many countries and regions do not have enough airports with the capacity to accommodate the flow of large cargo aircraft the military might need. Often, there are few airports, with small numbers of airstrips of insufficient size or strength and limited facilities for cargo operations. The Air Force has engineering units that can improve the capacity of those airports over time. Nevertheless, in most potential conflicts outside highly developed areas (such as Western Europe, Japan, or South Korea), the capacity of local airports tends to be the factor that limits cargo volume.[13]

Past and Planned Use. The Air Force's cargo aircraft have been employed extensively in every U.S. conflict in the modern era. Notable examples include the use of those aircraft to rapidly deploy elements of the 82nd Airborne Division to Saudi Arabia in 1990 after the Iraqi invasion of Kuwait and the parachuting of special-forces personnel into Afghanistan in 2001 during the early phases of U.S. operations there. The U.S. military has relied especially heavily on air transport throughout its operations in Afghanistan because that country is landlocked, with the closest access to seaports being in neighboring Pakistan.

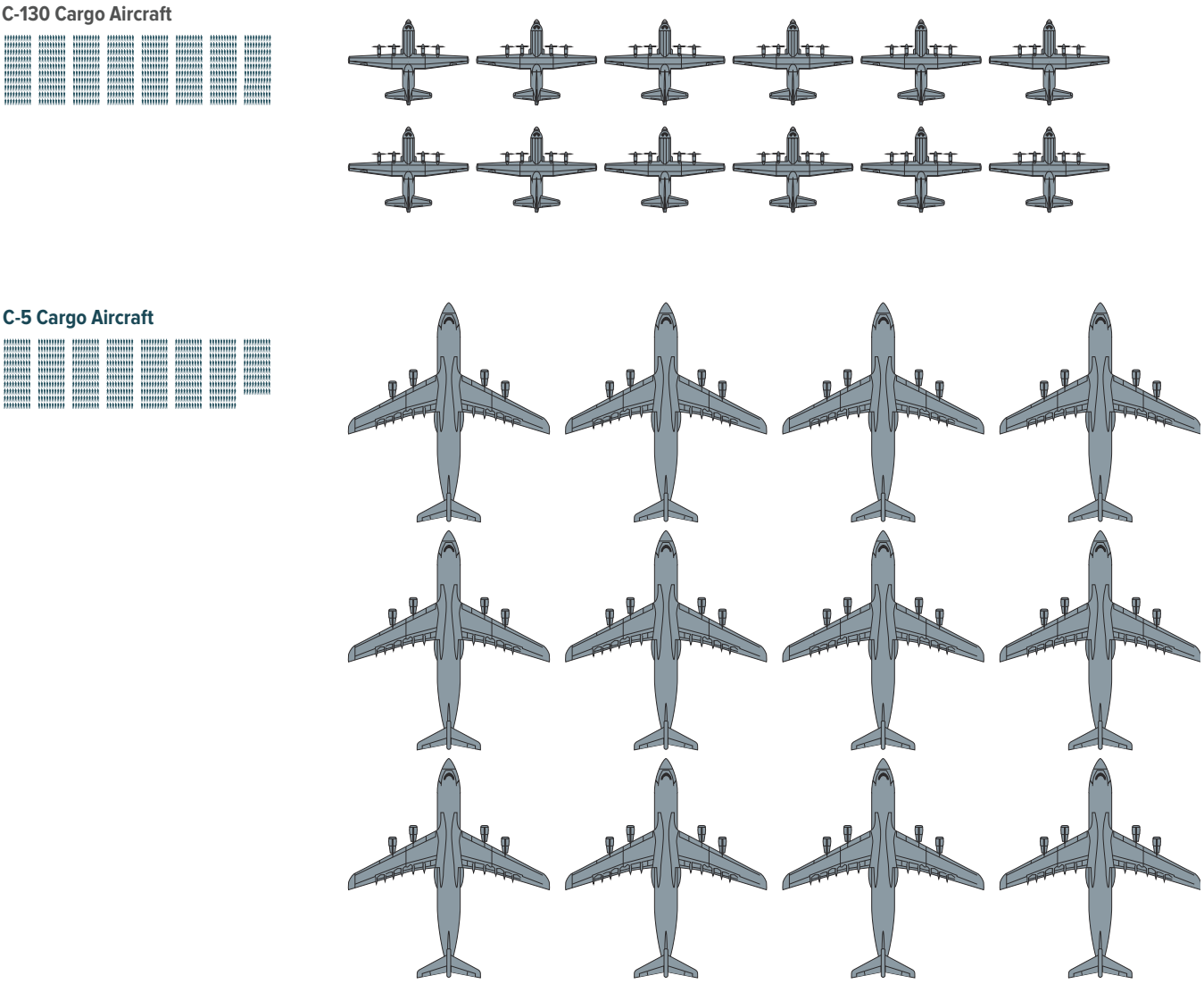
Most of DoD's potential scenarios for future conflicts envision heavy reliance on air transport. DoD has set several goals over the years for the amount of air transport capability it needs. The analytic measure generally used to assess the capacity of the airlift fleet is ton-miles per day (the ability to transport 1 ton of cargo 1 mile every day). That measure can be difficult to translate into numbers of aircraft because it depends greatly on the characteristics of a given scenario.[14] In general, however, because the U.S. military's ability to transport cargo to a theater of operations is more likely to be limited by the infrastructure in that theater than by the number of aircraft in the Air Force's inventory, a larger inventory of cargo aircraft would allow the United States to support more operations simultaneously or to reduce reliance on CRAF aircraft. Conversely, a smaller inventory of cargo aircraft would either lessen the Air Force's ability to support large operations in multiple theaters simultaneously or require greater reliance on CRAF aircraft.

13. In cases in which a friendly government seeks U.S. protection from hostile neighbors, it is possible to improve infrastructure during peacetime in anticipation of a possible conflict. For example, Saudi Arabia cooperated with the United States to improve its infrastructure for sea and air transport in the 1980s and 1990s so U.S. forces could respond more effectively if the country was threatened.

14. Broadly speaking, scenarios involving more distant locations require more transport aircraft to move a force of a given size in a given amount of time. Thus, the number of transport aircraft needed to respond to a crisis in, say, Southeast Asia would be larger than the number needed to respond to a crisis in Latin America. As a result, the number of transport aircraft that the U.S. military needs depends critically on where DoD foresees crises emerging.

Figure 4-3.

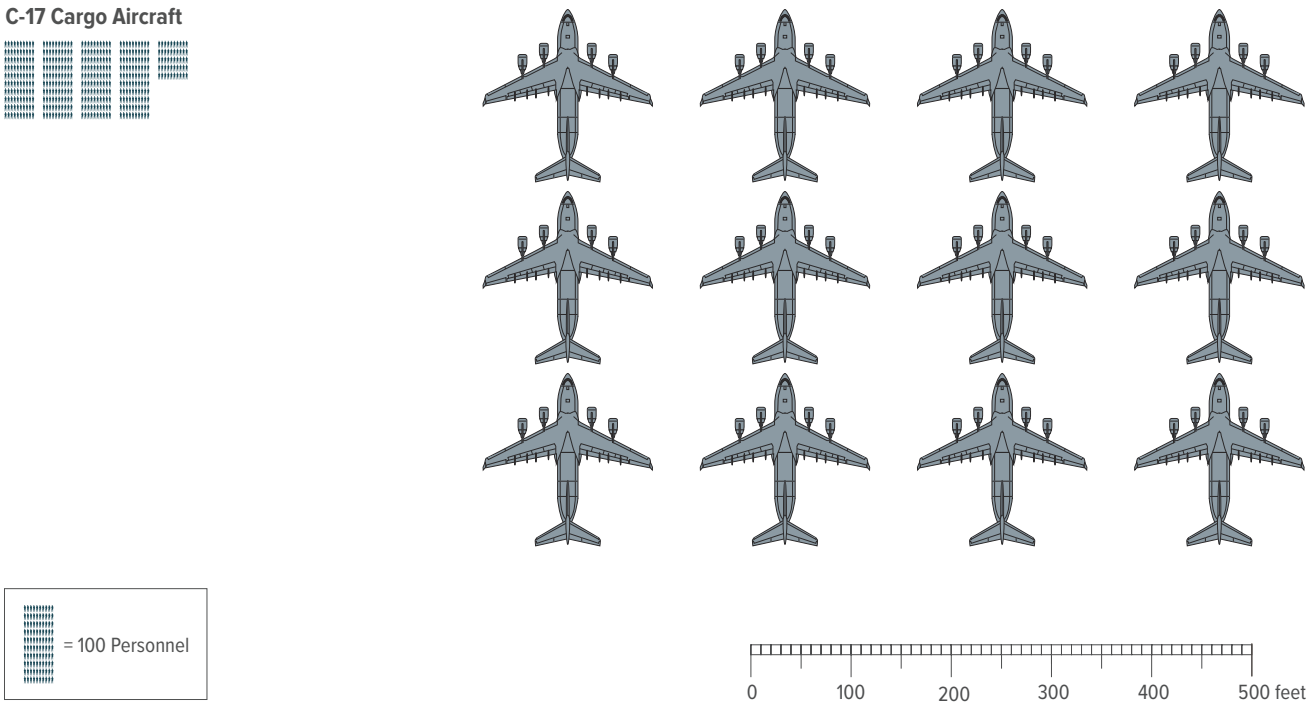
Aircraft and Personnel in Notional Air Force Airlift Squadrons



Continued

Figure 4-3. Continued

Aircraft and Personnel in Notional Air Force Airlift Squadrons



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

All units presented here are notional squadrons of 12 aircraft (actual squadrons vary in size).

Major Element of the Force Structure

Air Force Air Refueling Squadrons

	Total	Direct	Indirect	Overhead
		KC-135 Tanker Aircraft Squadron		
Military Personnel per Unit	1,930	610	660	650
Annual Cost per Unit (Millions of 2017 dollars)	360	110	90	150
		KC-10 Tanker Aircraft Squadron		
Military Personnel per Unit	3,140	900	1,170	1,060
Annual Cost per Unit (Millions of 2017 dollars)	580	180	160	250
		KC-46 Tanker Aircraft Squadron[a]		
Military Personnel per Unit	1,070	640	70	360
Annual Cost per Unit (Millions of 2017 dollars)	180	80	10	80

All units presented here are notional squadrons of 12 aircraft (actual squadrons vary in size).

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest 10 personnel or $10 million; more detailed information is presented in Appendixes A and B.

a. Because KC-46s are not yet in full operational service, their actual costs may differ from the planned costs included in the Department of Defense's budget documents, on which these estimates are based.

The tanker fleet exists primarily to refuel the Air Force's other aircraft while they are in flight. Although the fleet was originally established to refuel strategic bombers on long-range nuclear strike missions into the Soviet Union, tankers have proved valuable for refueling tactical aircraft in almost every U.S. operation of the post–Cold War era. In addition, all of the Air Force's tankers are capable of transporting cargo as a secondary mission.

Current and Planned Structure. Between its active and reserve components, the Air Force plans to field the equivalent of about 36 notional 12-aircraft squadrons of tanker aircraft in 2017, consisting of 357 KC-135s, 54 KC-10s, and 16 KC-46s. The number of notional squadrons is set to remain roughly steady through 2021 as KC-46 tankers are introduced and some KC-10s are retired. (For an example of the structure of a tanker squadron, see Figure 4-4 on page 98.) Tanker aircraft account for about 14 percent of the Air Force's total operation and support funding.

Purpose and Limitations. Without aerial refueling, tactical aircraft would typically have ranges of only a few hundred miles, so they would have to be based close to their areas of operations, would have less ability to loiter in a location for very long during a mission, and in some cases would have to reduce the weight of the weapons they carried. With aerial refueling, by contrast, the endurance (range and loitering time) of tactical aviation is limited largely by pilots' endurance, and aircraft can be fully loaded with weapons. Those differences increase the utility of tactical aircraft during a conflict in various ways:

- In many theaters, infrastructure constraints limit how many tactical aircraft the United States can deploy near an area of operations. Aerial refueling expands the number of bases from which tactical aircraft can reach a given area, allowing the United States to use more tactical aircraft in a conflict than it could otherwise.[15]

15. Similarly, naval aircraft operating from carriers would be unable to reach areas of operations far inland, such as Afghanistan, without aerial refueling by Air Force tankers. The Navy currently relies on a system known as "buddy tanking" that uses some of the fighter aircraft in a carrier air wing to refuel other fighter aircraft. However, using tactical aircraft in that way offers a much more limited ability to expand the range of tactical aircraft.

- An aircraft's fuel consumption increases when it carries a heavy load of weapons; aerial refueling can reduce the need to make trade-offs between the number of weapons an aircraft can carry and the distance it can carry them.[16]

- In many types of missions, it is beneficial for tactical aircraft to be able to loiter, on call, until needed so they can respond more rapidly to requests from ground forces for air support. Aerial refueling can enhance the U.S. military's effectiveness in those types of missions by allowing tactical aircraft to loiter for longer periods.

- In some large theaters, tactical aircraft would be unable to reach distant targets at all without aerial refueling.

Bombers are larger than tactical aircraft and have longer ranges, but aerial refueling offers some of the same benefits to bomber missions. For example, B-2 bombers require specialized basing infrastructure that makes them difficult to deploy overseas. But with aerial refueling, B-2 bombers can strike targets anywhere in the world from their base in Missouri.

The Air Force's transport aircraft generally do not require aerial refueling, although it is possible and might improve the efficiency of airlift operations in some situations. Aerial refueling also helps U.S. deployments to overseas theaters indirectly by allowing some shorter-range aircraft to "self-deploy" (be flown themselves to the theater) rather than needing to be carried there on a cargo plane or ship.

One limitation of the current aerial refueling fleet is that its tankers are large and slow with few defenses. During a conflict in which the United States had not yet neutralized an opponent's fighter aircraft, tankers would be vulnerable to attack. In practice, however, the United States has not faced any major aerial threats since the end of the Cold War, so that limitation has not been significant.

Another drawback of the U.S. tanker fleet results from the use of two different, and incompatible, methods of aerial refueling. The Navy and Marine Corps employ "probe and drogue" refueling systems on their tankers, fixed-wing aircraft, and rotary-wing aircraft, whereas the Air Force employs a "boom" refueling system on its tankers, tactical aircraft, and bombers.[17] Many Air Force tankers are also equipped to allow for probe-and-drogue refueling, so they can refuel tactical aircraft from the Navy and Marine Corps during operations. However, the need to accommodate both systems in joint operations requires the Air Force to equip some tankers to make them capable of both methods—at a higher cost than would be necessary otherwise—and to coordinate to ensure that the correct types of tankers are assigned to support the correct types of aircraft.

Past and Planned Use. The Air Force's tanker aircraft have been used extensively in every major U.S. conflict since the 1960s. Tankers were especially important in operations such as the invasion of Afghanistan, in which the United States had very limited access to air bases near the area of operations, so aerial refueling was vital to enable the Air Force's tactical aircraft and the Navy's carrier aircraft to attack targets in the theater. Many of the Department of Defense's potential scenarios for future conflicts also envision heavy reliance on aerial refueling.

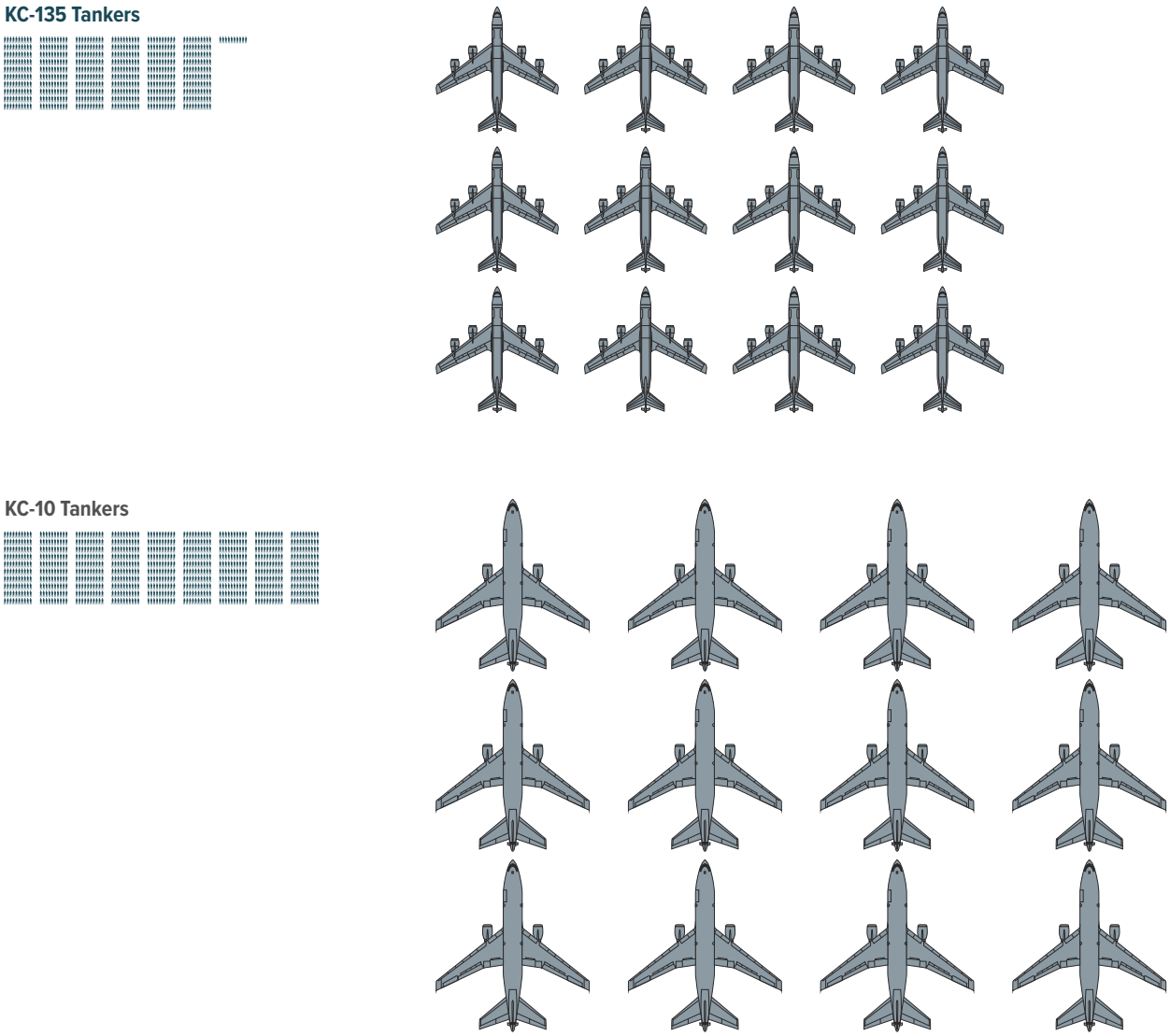
Although the Air Force's tanker fleet is large, it tends to be quite old. The bulk of the fleet consists of KC-135s built in the 1950s and 1960s. (Until the end of the Cold War and Operation Desert Storm in 1991, the Air Force mainly saw tankers as useful for supporting a nuclear attack on the Soviet Union rather than for supporting tactical aviation in ongoing conflicts.) Leaders of the Air Force have often stated that KC-135s are too old and need to be replaced immediately, but many analysts have suggested that those tankers are in good enough shape to continue serving for many years. Consequently, the major issue relating to the future of the tanker fleet is not its size but the speed with which the Air Force should replace the KC-135 with the new KC-46, which is in development.

16. For example, one specific trade-off is that most tactical aircraft can carry external fuel tanks to extend their range, but those tanks add weight to the aircraft, reduce the number of weapons it can carry, and decrease its in-flight performance. It is generally considered preferable to minimize the number and size of external fuel tanks, and aerial refueling often allows that.

17. In probe-and-drogue systems, the tanker tows a hose with a receptacle at the end, and the receiving aircraft has a probe that fits into the receptacle. Such systems are relatively lightweight, can be fitted on smaller aircraft, and can refuel more than one small plane at a time. They are also the only option for refueling rotary-wing aircraft. In boom systems, by contrast, the tanker has a boom that fits into a receptacle on the receiving aircraft. Those systems are relatively heavy, are only fitted on larger tankers, and can refuel just one aircraft at a time. However, they also transfer fuel more quickly and are the preferred method for refueling large planes, such as bombers or cargo aircraft.

Figure 4-4.

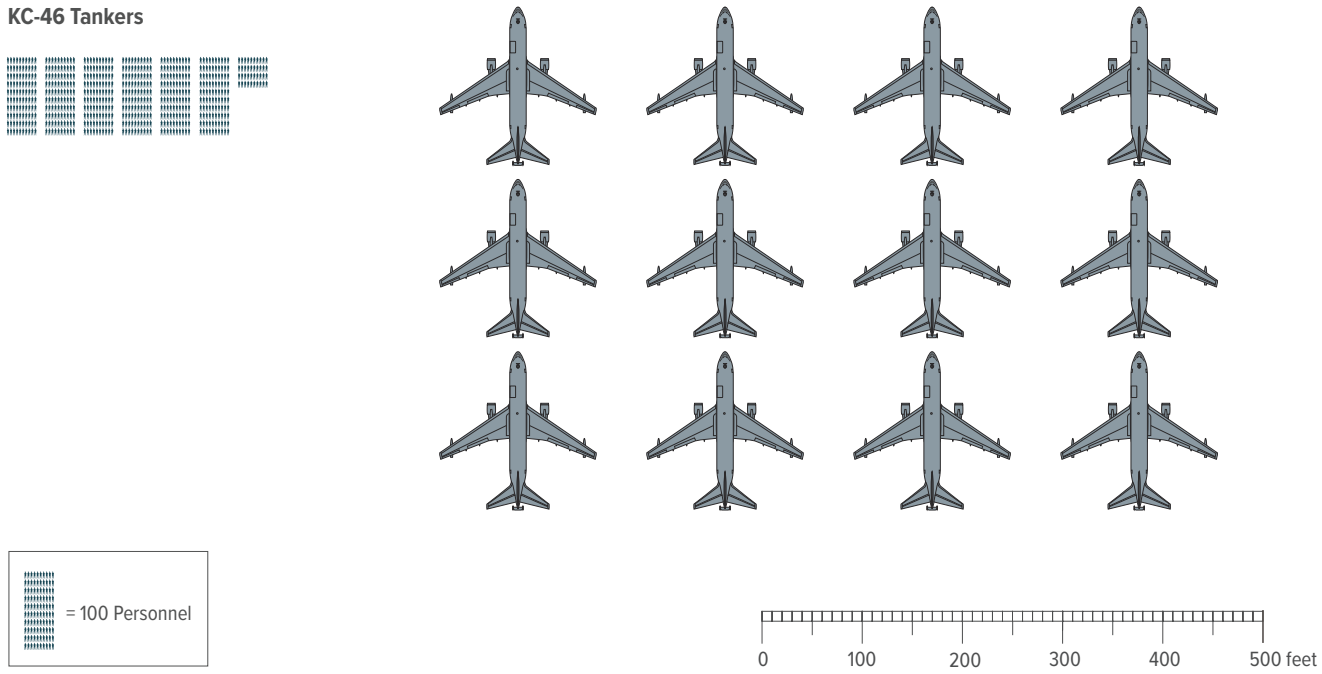
Aircraft and Personnel in Notional Air Force Air Refueling Squadrons



Continued

Figure 4-4. Continued

Aircraft and Personnel in Notional Air Force Air Refueling Squadrons



Source: Congressional Budget Office, using data from the Department of Defense.

All units presented here are notional squadrons of 12 aircraft (actual squadrons vary in size).

Major Element of the Force Structure

Air Force Unmanned Air System Squadrons

	Total	Direct	Indirect	Overhead
		MQ-1 "Predator" Squadron		
Military Personnel per Unit	260	90	80	90
Annual Cost per Unit (Millions of 2017 dollars)	70	40	10	20
		RQ-4 "Global Hawk" Squadron		
Military Personnel per Unit	1,840	470	750	630
Annual Cost per Unit (Millions of 2017 dollars)	440	190	100	140
		MQ-9 "Reaper" Squadron		
Military Personnel per Unit	920	340	270	310
Annual Cost per Unit (Millions of 2017 dollars)	160	50	40	70

All units presented here are notional squadrons of 12 aircraft (actual squadrons vary in size).

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest 10 personnel or $10 million; more detailed information is presented in Appendixes A and B.

The Department of Defense uses unmanned air systems (UASs)—also known as unmanned aerial vehicles or drones—mainly for surveillance and intelligence gathering. Each of the military departments operates a variety of unmanned aircraft, but the Air Force's models tend to be larger and to possess greater endurance and payload capacity.

Current and Planned Structure. Between its active and reserve components, the Air Force plans to field about 75 notional 12-aircraft UAS squadrons in 2017. Those aircraft consist of 110 MQ-1s, 36 RQ-4s, and 279 MQ-9s. The number of notional squadrons is expected to decline to 30 by 2021 as the Air Force retires its MQ-1s. (For an example of the structure of a UAS squadron, see Figure 4-5.) Unmanned air systems account for about 6 percent of the Air Force's total operation and support funding.[18]

In addition to those aircraft, the Air Force has acknowledged that it operates at least one other type of UAS, a stealthy aircraft called the RQ-170. The quantities and characteristics of that system remain classified.

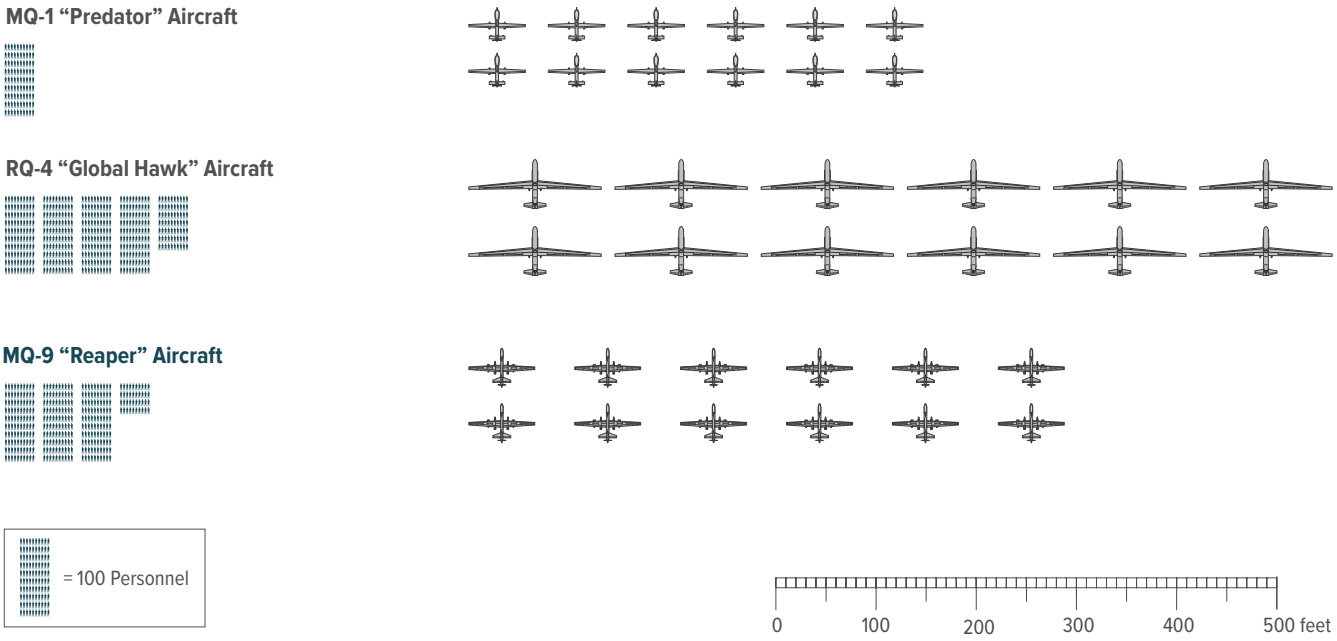
Purpose and Limitations. The Air Force's unmanned aircraft are used primarily for surveillance. In addition, MQ-1s and MQ-9s can be armed with a few missiles or small bombs to conduct limited strike operations. An example of that capability is the United States' well-publicized use of unmanned aircraft to kill suspected terrorists in Pakistan, Yemen, Somalia, and other countries. (Little information about such attacks has been released publicly, but it appears that many of those attacks have been conducted by the Central Intelligence Agency rather than by DoD. Those drones form a separate UAS fleet from the Air Force's and are not covered in this report.)

Today's drones have several advantages: They are generally less expensive to buy than manned aircraft, they can fly very long missions without being limited by the endurance of human aircrews, and they can operate without putting a pilot at risk of injury, capture, or death. Disadvantages of drones include their vulnerability to air defenses and the lack of a human onboard to address split-second issues in ways that might not be possible by a

18. For more information about such systems, see Congressional Budget Office, *Policy Options for Unmanned Aircraft Systems* (June 2011), www.cbo.gov/publication/41448.

Figure 4-5.

Aircraft and Personnel in Notional Air Force Unmanned Air System Squadrons



Source: Congressional Budget Office, using data from the Department of Defense.

All units presented here are notional squadrons of 12 aircraft (actual squadrons vary in size).

remote operator. Not all of those factors are inherent to unmanned systems; rather, they have resulted from the state of available technology and from specific choices about what capabilities the military needed during the past decade and a half—the span over which most of today's drones were purchased.

If desired, it should be possible to design a drone with fewer of those disadvantages. However, improved capability almost always means higher cost. For example, current unmanned aircraft are generally less expensive than manned aircraft largely because their airframes were designed for fairly low-performance, undemanding flight; basically, they need to be able to carry a package of sensors (and, in many cases, a few weapons) to a target area and have enough fuel to loiter there for extended periods. They are not expected to have high speed and maneuverability, to carry heavy payloads, or to operate in defended airspace like many manned combat aircraft—characteristics that can significantly increase costs. Unmanned aircraft with those more advanced capabilities have been proposed, including an unmanned version of a new long-range bomber. But such advanced drones are not expected be low-cost aircraft.

In their current configuration, most of the Air Force's unmanned aircraft are intended to operate mainly in undefended airspace and would generally not be capable of surviving engagements with modern air defenses. Thus, they would have limited utility in a high-intensity conventional conflict; they are most useful in low-intensity and unconventional conflicts, such as the occupations of Iraq and Afghanistan and counterterrorism missions.

According to publicly available accounts, drones have been very effective at attacking small numbers of targets in counterterrorism operations. However, their use by the United States to kill suspected terrorists has generated public controversy (in some cases because drone strikes have killed people other than the intended targets). In particular, the use of unmanned aircraft to attack targets in countries with which the United States is not at war (such as Pakistan) risks generating significant hostility to the United States in those countries. In addition, the strategic utility of targeted killings is not clear—many organizations are resilient enough to quickly replace leaders and other personnel who are killed, so occasionally eliminating members of an organization may not significantly

reduce its long-term effectiveness. At the same time, however, the security measures that many terrorist groups appear to take to avoid drone strikes also degrade the groups' effectiveness in various ways. For example, senior leaders who are in hiding cannot freely direct their subordinates because such communication puts them at risk of being detected and killed.[19]

Past and Planned Use. The United States has had small numbers of unmanned aircraft for many decades, but the widespread deployment of highly capable unmanned air systems is a fairly recent phenomenon. The MQ-1 and RQ-4 were developed in the 1990s and fielded in the 2000s, and the MQ-9 was developed in the 2000s and fielded in the 2010s. Despite their recent introduction, those unmanned aircraft have been used heavily in recent operations, particularly in the war on terrorism and the occupations of Iraq and Afghanistan. Although efforts to arm unmanned surveillance aircraft began before the invasions of Afghanistan and Iraq, the current widespread practice of arming drones to attack ground targets appears to have evolved from their extensive use in those conflicts. Mounting weapons on an unmanned surveillance aircraft has proved to be particularly useful in counterinsurgency and counterterrorism operations because it has enabled DoD to attack small, mobile targets as soon as they are detected and identified without having to summon another aircraft to carry out the attack (such "fleeting" targets would often be lost before the strike aircraft could arrive). For missions requiring substantial firepower, however, the strike capacity offered by today's drones, though useful, is minor compared with that of tactical aircraft or bombers.

For the immediate future, unmanned air systems will probably continue to be particularly useful in two types of situations. First, as part of U.S. counterterrorism operations, DoD is likely to remain responsible for monitoring many different theaters over a very large area for suspected terrorists, insurgents, and militants. Having access to large numbers of relatively low-cost and long-duration aerial sensors, such as those provided by unmanned aircraft, has proved extremely useful in that role. Second, in higher-intensity operations, the Air Force's unmanned aircraft have the potential to increase the rate at which ground targets can be detected and identified. That potential, when combined with the increased capacity to strike targets that has resulted from the widespread adoption of precision-guided munitions (as described at the end of this chapter), could increase the rate at which targets can be destroyed.

For the more distant future, the Air Force is likely to continue pursuing advances in the capabilities of drones, particularly their ability to face the advanced air defenses postulated in some of DoD's planning scenarios. (The Navy is already grappling with that issue as it tries to field a drone that can operate from aircraft carriers. It faces a choice between a relatively inexpensive unmanned aircraft, akin to the Air Force's MQ-9, that is optimized for surveillance and a more advanced system that is capable of penetrating advanced air defenses and conducting both surveillance and strike missions.) Unmanned aircraft may also be considered an option as the Air Force begins to define requirements for its next-generation air superiority aircraft, which is tentatively slated to be fielded in the 2030s.

19. As an example, Mohammed Omar, former leader of the Taliban, was dead for two years before his death became widely known, even to some members of the Taliban itself. Possibly because of the threat of drone strikes, Omar had been secluded from contact with his organization (and the rest of the world) as a security measure. Such extreme seclusion prevents a leader from freely directing and controlling an organization.

Major Element of the Force Structure

Other Department of the Air Force Units and Activities

	Total	Direct	Indirect	Overhead
		Minuteman III Missile Squadron[a]		
Military Personnel per Unit	2,040	690	650	690
Annual Cost per Unit (Millions of 2017 dollars)	380	130	90	160
		RED HORSE Construction Engineers		
Total Military Personnel	19,340	12,780	0 [b]	6,560
Total Annual Cost (Millions of 2017 dollars)	2,170	660	0 [b]	1,520
		Air Force Special-Operations Forces		
Total Military Personnel	24,070	15,900	0 [b]	8,170
Total Annual Cost (Millions of 2017 dollars)	3,730	1,840	0 [b]	1,890
		Rest of the Air Force		
Total Military Personnel	49,010	32,370	0 [b]	16,630
Total Annual Cost (Millions of 2017 dollars)	10,000	6,160	0 [b]	3,840

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest 10 personnel or $10 million; more detailed information is presented in Appendixes A and B.

a. Squadron of 50 Minuteman missiles.

b. In the analytic framework used for this report, other units and activities are generally considered to not have any units supporting them and thus to not have any indirect personnel or costs.

Although the majority of the Air Force's units are connected with aircraft squadrons, the service includes a number of other units with special capabilities that are not directly related to aircraft squadrons. Together, those units account for 21 percent of the Department of the Air Force's operation and support funding.

Minuteman III ballistic missiles armed with nuclear warheads are the Air Force's land-based contribution to the U.S. nuclear deterrent (in addition to the air-based contribution provided by long-range bombers capable of carrying nuclear weapons). Land-based ballistic missiles are generally considered to have the fastest response time of any system for delivering nuclear weapons, and they are deployed in dispersed, hardened silos that would require an adversary to use a relatively large number of nuclear weapons to destroy the entire Minuteman force. Bombers, by contrast, can be vulnerable to air defenses, and ballistic missile submarines can be attacked by ships or other submarines before they launch their missiles or while they are in port.

As with all strategic nuclear forces, the number of Minuteman missiles is generally determined by national nuclear policy and by the outcomes of arms control negotiations rather than by the considerations that typically apply to other military units. Such agreements can affect not only the number of ballistic missiles that the Air Force deploys but also the number of warheads on each Minuteman missile. The United States has an inventory of 450 deployed Minuteman III missiles, but current plans call for reducing that number to 400 by 2018 to comply with the New START treaty.

Air Force **construction engineers**, known as RED HORSE (Rapid Engineer Deployable Heavy Operational Repair Squadron Engineers) squadrons, provide a variety of engineering services to the Air Force. In the past, they have contributed to the success of U.S. military operations in distant theaters by building or improving air bases in places with poor infrastructure and few basing options. Because the United States has often intervened in countries with limited infrastructure—and because the deployment of U.S. forces can place great demands on the ports and air bases that receive them—the ability to improve that infrastructure has typically been highly valuable, despite its relatively low visibility. The majority of RED HORSE personnel are in the Air Force's reserve component.

The Air Force also maintains **special-operations forces**, which are trained, equipped, and overseen by the Department of Defense's Special Operations Command (SOCOM). They focus on such missions as unconventional warfare, special reconnaissance, counterterrorism, and the training of foreign militaries. The forces overseen by SOCOM are discussed in more detail in Chapter 5, which deals with defensewide activities.

By the Congressional Budget Office's estimate, about 49,000 military personnel and $10.0 billion a year are devoted to **units and activities of the Department of the Air Force other than those described in this chapter.** They include a variety of smaller organizations providing capabilities that are neither aircraft squadrons nor organized in support of aircraft squadrons. An important example is the Air Force's space infrastructure, which includes the service's constellations of Global Positioning System communications, weather, and missile-warning satellites. Other examples include the Air Force's contributions to various joint commands and defensewide organizations, as well as some command-and-control and intelligence functions.

Special Topic

The U.S. Military's Strike Capability

Many of the military assets available to the Department of Defense can be thought of as almost generic tools able to attack and destroy a wide variety of enemy targets. That ability, called strike capability, is a marked departure from past practice. Previously, U.S. forces were more specialized in their ability to attack a given type of target, and that specialization often restricted their ability to perform more than a few specific types of missions. Today, the array of systems that exist to identify and destroy targets provides DoD with a unified strike capability that, in most conflicts, is limited more by the ability to gather information about hostile targets than by any other factor.

The full array of U.S. strike assets includes cruise missiles (Air Force and Navy); artillery, rockets, and attack helicopters (Army and Marine Corps); bombers (Air Force); fixed-wing tactical aircraft (Air Force, Navy, and Marine Corps); and armed unmanned air systems (Air Force and Army). To receive information about targets, those assets depend on a vast network of sensors and communications—everything from requests by infantry for fire support to imagery from satellites. The ability to gather information about potential targets and communicate it to versatile strike assets is at the heart of the current U.S. strike system—allowing military commanders to treat a theater of operations as essentially a single list of targets and a single list of assets available to destroy those targets. The two lists can be centrally managed by commanders to match the "supply" of strike assets with the "demand" of targets in a single system that will rapidly destroy all available targets.

The key developments that have produced the modern strike system have narrowed the differences not only between types of strike assets (particularly aircraft) but also between types of targets, thus greatly improving the capability of U.S. forces. As a result, in most recent conflicts, the United States has been able to destroy all known fixed infrastructure targets within the first few days of an operation. Subsequent attacks could then focus almost entirely on supporting ground forces, preventing previously destroyed targets from being rebuilt ("regenerated," in technical parlance), and attacking new targets that were not identified earlier. All of those activities depend crucially on intelligence and surveillance, which is why U.S. strike capability today is often constrained more by the ability to gather intelligence than by the ability to deliver weapons.

Developments That Have Reduced the Differences Between Types of Strike Assets. The evolution of the strike system has been particularly dramatic in the case of aircraft, which provide the majority of U.S. strike capability. Historically, tactical aircraft and bombers faced extreme challenges in attacking targets on the ground. Broadly speaking, they needed to be able to operate in potentially hostile airspace, possibly far from friendly bases; locate targets that might be moving or obscured; and attack them with relatively inaccurate weapons.

Those challenges led to the creation of highly specialized aircraft, capable of performing only a small range of tasks, as well as to highly specialized missions, reflecting the different problems involved in attacking different kinds of ground targets. As a result, there was little commonality between the sort of aircraft that could provide close air support (attacking hostile ground forces that were in contact with friendly ground forces) and the sort of aircraft that could perform strategic bombing (attacking enemy infrastructure or other fixed targets deep within a hostile state).

For example, the A-10 attack aircraft was designed mainly to support U.S. ground forces by destroying enemy armored forces. Originally, its weaponry included antitank guided missiles and armor-penetrating cannons; it depended primarily on the pilot spotting targets visually; its airframe was developed to operate efficiently at relatively low altitudes and speeds; its range was fairly short; and its defenses included armor to protect its pilot from antiaircraft guns. The B-1 bomber, in contrast, was designed mainly to penetrate Soviet airspace in a nuclear attack. Originally, its weaponry included nuclear-armed cruise missiles and bombs; it received information about its targets before takeoff; its airframe was developed for efficient cruising, with limited low-altitude flight; its range was relatively long; and its defenses included complex jamming systems to foil attacks by radar-guided missiles. Neither aircraft could perform the other's role, and the two would be treated very differently in operational usage.

In modern operations, however, both the A-10 and the B-1 can attack and efficiently destroy a wide variety of targets with conventional weapons, and they can substitute for each other in some circumstances. Although the two platforms still differ, with greater strengths in some specific roles, there is now substantial overlap in their capabilities and in the types of missions they can perform. Unlike the previous situation—in which the A-10 fleet would have been irrelevant in a nuclear attack and the B-1 fleet would have been irrelevant in a defense against armored forces—both fleets can be used in most current conventional combat operations. Four primary developments have led to that convergence:

- The U.S. military's recent ability to quickly achieve air supremacy in a conflict, which gives all strike aircraft a much better chance of surviving their missions;
- The widespread use of tankers for aerial refueling, which greatly improves the range of all strike aircraft;
- The development of better methods for spotting targets and communicating information about them, which greatly improves the ability of all strike aircraft to find their targets; and
- The development of relatively affordable and accurate precision munitions, which greatly improves the ability of all strike aircraft to actually destroy their targets.

Today, the major differences between the strike capabilities of most U.S. combat aircraft relate to their electronics and software rather than to traditional design factors such as range, speed, or payload capacity. Effective strike missions require aircraft that are capable of accepting up-to-date information about a target from a wide range of sources, carrying the most modern munitions, and communicating targeting information to those munitions. Such aircraft, if properly supported, can effectively attack almost any ground target in a modern conflict.

Although the developments listed above have had the greatest consequences for aircraft, most of them have affected other strike assets as well. For instance, the Army's and Marine Corps' attack helicopters have benefitted from almost all of those developments in much the same way that fixed-wing aircraft have. In addition, the Army's artillery is vastly more capable when equipped with affordable and accurate munitions that are provided with high-quality targeting data.

DoD and many outside observers have cautioned that the freedom U.S. forces have had to strike targets in recent conflicts might not exist in future conflicts against more competent or well-armed opponents. The effectiveness of the U.S. strike system depends on several factors that opponents could disrupt. As examples, an effective method of jamming Global Positioning System (GPS) signals could degrade the effectiveness of U.S. munitions, and the loss of air superiority could imperil strike aircraft and greatly limit the use of aerial refueling.

Developments That Have Reduced the Differences Between Types of Targets. Before the creation of cheaper and more accurate munitions that could receive targeting information from many sources, the limitations of sensors and weapons meant that attacking different types of targets required very different approaches. Whether a target was mobile or stationary, situated close to friendly forces or not, and heavily armored or not were all crucial factors in determining how challenging the target would be to destroy and how it would be attacked.

Traditional unguided bombs (now often referred to as "dumb" bombs) were notoriously difficult to hit targets with. As a result, attacking a fixed target generally required having several aircraft drop large loads of bombs to increase the chances of a close hit—and even then, multiple attacks were frequently necessary before a target was destroyed. Mobile targets were often impossible to destroy with any certainty in such a manner, armored targets (even when stationary) could not reliably be hit closely enough to penetrate their armor, and the inaccuracy of weapons led to sharp restrictions on using them in proximity to friendly ground forces and noncombatants. Previous U.S. efforts to improve munitions frequently focused on developing specialized warheads and sensors that could attack a specific type of target more effectively, but in many cases they were too expensive to field in large numbers.

Many modern precision munitions incorporate specialized sensors, such as radar or infrared guidance systems, but they are notable for their heavy reliance on GPS guidance sets, which are cheaper than other types of guidance systems. By itself, GPS guidance is usually accurate enough for attacks on stationary targets, and munitions with other sensors are usually accurate enough for attacks

on mobile targets.[20] Crucially, the ability to accept GPS targeting data from other sources means that any strike asset equipped with such munitions, connected to communications networks, and able to pass target coordinates to the munitions can effectively attack the target. For example, a U.S. bomber pilot need not see enemy infantry in contact with U.S. ground forces to engage that enemy; instead, the bomber can receive targeting data from the U.S. ground forces and attack the target they have identified.

When provided with accurate targeting data, such modern munitions are precise enough that a single bomb has a good chance of destroying most types of ground targets. That ability in turn allows a single aircraft to destroy many targets, rather than requiring several aircraft to destroy a single target—an enormous increase in U.S. strike capability.

20. GPS guidance tends to be equally effective regardless of the type of target being attacked because munitions equipped with that guidance move toward a specific set of physical coordinates; if the target is at those coordinates, the munition will generally strike it.

CHAPTER

5

Defensewide Activities

Overview

The Department of Defense contains a number of organizations that are not part of the Departments of the Army, Navy, or Air Force. Instead, those defensewide organizations perform activities that support DoD as a whole. Such organizations employ some military personnel, but they do not directly fund those personnel, because all military personnel are part of one of the services.[1] However, they do employ and fund DoD civilian personnel—about 216,000, on average, over the 2017–2021 period, according to the DoD's budget plans.

Defensewide organizations fall into three broad categories:

- Organizations that make up DoD's highest levels of command and control—the Office of the Secretary of Defense, the Joint Staff (a headquarters staff at the Pentagon composed of personnel from all of the services that assists the Chairman of the Joint Chiefs of Staff), and the regional combatant commands (groups of personnel from multiple services that are responsible for U.S. military strategy in specific geographic areas, such as U.S. Africa Command and U.S. Pacific Command).

- Organizations that provide specialized military capabilities that are not specific to any one service—examples include Special Operations Command, the Missile Defense Agency, and the military intelligence agencies.

- Organizations that give administrative support to all of DoD—most notably, the Defense Health Program (DHP), which provides health care to service members, retired military personnel, and their dependents. Other such organizations operate schools for military dependents, run commissaries and exchanges (stores for military families), take care of payroll and finance activities, and provide telecommunications and logistics services. This category accounts for the largest share of defensewide operation and support (O&S) funding,

For this analysis, the Congressional Budget Office largely combined the first two categories of defensewide organizations. Most information about military intelligence activities is classified, so CBO could not describe their portion of DoD's budget in any detail.[2] The only organization from the first two categories whose budget CBO treated separately, for visibility, was Special Operations Command. All of the other organizations in those two categories were included either in the group "Classified Defensewide Funding" or in the group "Rest of the Defensewide Organizations."

For the third category, CBO distributed the costs of organizations that provide administrative support for DoD as a whole to the various units that generate the workload for those organizations. For example, CBO assigned the largest single defensewide cost—that of the Defense Health Program—to major combat units according to their numbers of active- and reserve-component personnel and their respective costs. Thus, the costs shown in the previous chapters for a major combat unit (or its support units or overhead activities) include that unit's portion of DHP costs. The DHP also funds health care for retired military personnel and their dependents, but CBO did not distribute that portion of the program's

1. Military personnel who work in defensewide activities, such as members of the Joint Staff and combatant commanders, are funded by the military service to which they belong. When service members are assigned to a defensewide activity, the activity tracks the costs incurred for those personnel through a system of DoD internal accounting credits that show the amounts that the military services must contribute to defensewide personnel costs.

2. DoD provides some insight into the classified portion of defensewide O&S spending in its publicly available budget materials, but that information relates only to the year for which the budget request is being made, not to the full five years covered in DoD's budget documents.

funding among units because it is not a cost of maintaining current units. Instead, that part of DHP funding is shown in a separate entry in this chapter.

Since the late 1970s, the share of its funding that DoD devotes to defensewide activities has been growing—not necessarily because the department is providing greater amounts of support (although in some cases, such as health care, it is) but generally because DoD is becoming a more fully integrated institution over time. Many of the functions now carried out by defensewide agencies were formerly performed by the individual services but have gradually been centralized. That trend is generally seen as positive and as especially appropriate for joint installations and activities. (There is no reason, for example, to believe that the Air Force is particularly well suited to operating commissaries for Air Force personnel in a way that another, more focused, organization would not be.)

One consequence of the growing share of funding devoted to defensewide activities is that the costs that a military department bears for sustaining its units do not reflect the full cost of those units because defensewide agencies incur some of those costs. Thus, simply looking at the Army's cost to sustain an infantry brigade combat team—without including the defensewide costs associated with such things as processing the unit's payroll, educating its dependents, or providing commissaries for its personnel—will understate the unit's true costs. CBO included such defensewide support as part of the cost of every unit, so the total cost of a military department's units in this analysis reflects those additional costs. As a result, the total cost that CBO attributes to the Army, for example, to sustain all of its units exceeds the Army's total O&S budget, whereas the amount of purely defensewide costs not attributed to any military department is much smaller than the defensewide O&S budget.

The rest of this chapter presents CBO's analysis of the following major defensewide activities:

- Special operations; see page 111.
- The Defense Health Program; see page 114.
- All of the other units and activities that support DoD as a whole, presented together; see page 116.

This chapter also examines two topics of special concern to the Department of Defense:

- The structure of the U.S. military's nuclear forces; see page 117.
- The United States' missile defense capability; see page 120.

Major Element of the Force Structure

Special Operations

	Total	Direct	Indirect[a]	Overhead
		Army Special-Operations Forces[b]		
Total Military Personnel	45,100	32,370	0	12,730
Total Annual Cost (Millions of 2017 dollars)	7,210	3,190	0	4,020
		Navy Special-Operations Forces[b]		
Total Military Personnel	16,440	9,900	0	6,550
Total Annual Cost (Millions of 2017 dollars)	2,370	1,050	0	1,330
		Marine Corps Special-Operations Forces[b]		
Total Military Personnel	3,530	2,130	0	1,410
Total Annual Cost (Millions of 2017 dollars)	490	210	0	280
		Air Force Special-Operations Forces[b]		
Total Military Personnel	24,070	15,900	0	8,170
Total Annual Cost (Millions of 2017 dollars)	3,730	1,840	0	1,890
		Special Operations Command[c]		
Total Military Personnel	0	0	0	0
Total Annual Cost (Millions of 2017 dollars)	5,370	5,370	0	0

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest 10 personnel or $10 million; more detailed information is presented in Appendixes A and B.

a. In the analytic framework used for this report, special-operations units are considered to not have any units supporting them and thus to not have any indirect personnel or costs.

b. Funding for the services' special-operations units comes from each service's budget, so these numbers appeared in previous chapters in the entries for "Other Units and Activities." They are repeated here to provide a complete picture of the costs of the U.S. military's special-operations forces.

c. Funding for Special Operations Command (SOCOM) comes from the defensewide operation and maintenance budget. Like other defensewide organizations, SOCOM does not directly fund any military personnel of its own (because all military personnel are part of one of the services). No overhead costs are shown for SOCOM because such costs are apportioned on the basis of the number of military personnel in an activity.

The Department of Defense has traditionally distinguished between "special forces" (SF) and "special-operations forces" (SOF). Special forces are a fairly small set of units that perform direct-action missions (small, short-duration raids, ambushes, or assaults in hostile territory, such as the raid on Osama bin Laden's compound in Pakistan). SF units include the units most commonly associated in the public's mind with special operations, such as the Army's Green Berets and Rangers and the Navy's Sea, Air, and Land forces (known as SEALs). Special-operations forces encompass a larger set of units that include not only SF units but also personnel responsible for psychological operations, civil affairs, and other specialized activities, all of which are overseen by Special Operations Command (SOCOM)—the organization within DoD responsible for special-operations forces.

Each military service recruits personnel for its special-operations units, provides their initial training, and pays their salaries. SOCOM provides those units with specialized training and equipment. SOCOM also develops doctrine and strategy for special-operations units and is responsible for ensuring that all U.S. special-operations forces can be used in a unified way by a combatant commander (as opposed to having separate special-operations communities in each service that operate in their own ways and focus on their own limited missions).

Current and Planned Structure. DoD's special-operations forces consist of a broad array of diverse units. In all, the department plans to field an average of about 60,000 special-operations direct personnel over the 2017–2021 period.

Purpose and Limitations. SOF are intended to be versatile forces, capable of conducting a wide range of missions, including those that other military units would not be suited for. Among their multiple roles, the most important are considered to be direct action, special reconnaissance, foreign internal defense, and security-force assistance. The last two activities involve helping friendly governments improve their military capabilities (often in order to defeat insurgencies hostile to the United States); those missions generally require the largest commitments of SOF personnel and time. Thus, special-operations forces could be described as an exceptionally well-trained and well-equipped set of trainers for foreign militaries—capable, when needed, of performing combat roles as well.

SOF have numerous limits on their use, which relate to the extremely difficult missions they are often assigned. For example, direct-action missions generally require very good intelligence, as well as a situation in which a small force, operating with the benefit of surprise, can achieve a highly valuable objective. Even so, direct-action missions have a mixed record of success—SOCOM was created in the 1980s largely in response to the failure of special forces to rescue U.S. hostages in Iran. Where the conditions for direct action are not present, SF can function as highly trained light infantry, although that role is often considered a waste because it does not capitalize on the unique capabilities of special forces. That role has also been associated with poor outcomes on some occasions, such as in Mogadishu, Somalia, in 1993 (when what was supposed to be a short raid turned into an overnight confrontation with local militiamen that resulted in many SF casualties) and in Tora Bora, Afghanistan, in 2001 (when SF personnel failed in an attempt to capture Osama bin Laden).

When special-operations forces are performing their more common role of training foreign militaries, their effectiveness is limited by their host countries' willingness and ability to make use of that training. In general, it is difficult to assess how well a foreign country would combat an insurgency with or without the assistance of U.S. special-operations forces. Insurgencies are generally ended not through military force but through negotiated settlements; however, having a strong military often helps a government persuade insurgents to negotiate and strengthens the government's position during the negotiations. Another limitation associated with using SOF is that because they often assist countries that have relatively unstable or unpopular governments, their work risks associating the United States with the actions of those countries' militaries, as happened in El Salvador in the 1980s.

Past and Planned Use. Many of the missions for which special-operations forces are intended—as well as many of their past and current operations—are classified. A common complaint of both the SOF and intelligence communities is that because of the classified nature of their work, their failures are more visible than their successes, giving the public a distorted view of their value.

SOF have participated in all major U.S. combat operations since SOCOM was created. In most cases, their participation was not central to the outcome of those combat operations (largely because their role was limited to providing reconnaissance or carrying out small missions within the larger operation). However, in Operation Enduring Freedom in Afghanistan, SOF units played a leading role in the initial phases of ground combat by assisting Afghan rebel forces by calling in air strikes; conventional U.S. ground forces arrived only after the Taliban had lost control of much of the country. Since the invasion, SOF have been used extensively in and around Afghanistan, achieving a notable success with the direct-action mission of killing Osama bin Laden but experiencing more mixed results when employed as light infantry (as at Tora Bora).

SOF have also been widely used for activities other than major combat operations. Some of the largest commitments of U.S. special-operations forces for

foreign internal defense and security-force assistance have occurred in El Salvador, Colombia, Iraq, Afghanistan, the Philippines, and, more recently, the Horn of Africa and Trans-Saharan Africa. None of the foreign governments that received such assistance have been militarily overthrown by insurgents or terrorists, although some remain unstable. However, the government of Mali was overthrown by members of the country's military twice since U.S. assistance began, weakening the government in its fight against insurgents and exposing the United States to criticism about the effectiveness of its training. Some SOF commitments have also opened the United States to criticism because of the actions of the foreign militaries it has assisted (particularly those in Latin America).

SOCOM and other DoD sources frequently describe special-operations forces as crucial for antiterrorism missions. In essence, such missions are the same as traditional SOF missions except that the adversaries are terrorist groups rather than insurgents or other countries' militaries. Many of the SOF operations in countries mentioned above were antiterrorist missions. Special-operations forces have also participated in a wide variety of smaller missions, such as helping to evacuate noncombatants during a crisis or providing humanitarian assistance or disaster relief.

Major Element of the Force Structure

Defense Health Program

	Total	Direct	Indirect	Overhead
		Defense Health Program for Retirees		
Total Military Personnel	0	0	0	0
Total Annual Cost (Millions of 2017 dollars)	14,720	14,720	0	0

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest $10 million; more detailed information is presented in Appendixes A and B.

Defensewide organizations do not directly fund any military personnel of their own (because all military personnel are part of one of the services). In addition, in the analytic framework used for this report, defensewide organizations are considered to not have any units supporting them and thus to not have any indirect personnel or costs. No overhead costs are shown for the defensewide organizations because such costs are apportioned on the basis of the number of military personnel in an activity.

The Department of Defense offers medical and dental care to more than 9 million service members, military retirees, and eligible family members through the Military Health System (MHS) at an estimated cost of about $47 billion in 2016.[3] The MHS exists to ensure that service members are fit for deployment and to care for them if they are sick, injured, or wounded. The system also provides care for military families and retirees.

Current and Planned Structure. The cost of the MHS is accounted for in three major blocks of DoD's budget:

- The Defense Health Program—a defensewide activity that pays for nearly all of the civilian personnel associated with the MHS, as well as for contracts for private-sector care and purchases of medical supplies.[4]
- Funding for MHS military personnel—including the pay of service members associated with the MHS, which is funded by their military departments. (Together, those first two blocks make up the TRICARE system, which is responsible for providing care to active-duty service members and their families and military retirees and their families.)
- Accrual charges levied against the services for all military personnel—funds deducted from military personnel appropriations and credited to the Medicare-Eligible Retiree Health Care Fund, which reimburses military medical facilities for care provided to Medicare-eligible retirees and their family members and also covers most of the out-of-pocket costs of Medicare-eligible retirees and their family members who seek care from private-sector Medicare providers.

Although the Defense Health Program is the only portion of the Military Health System whose costs are included in the defensewide budget, the discussion below focuses on the MHS as a whole.

In the Congressional Budget Office's analysis, the system's costs for current service members and their families are included in the costs of the various elements of the force structure discussed in previous chapters, allocated in proportion to the number of military personnel employed by those elements. The $14.7 billion shown here covers only health care for military retirees and their families. CBO did not divide that cost among various elements of the force structure because it is not a cost of current forces and it cannot be altered by decisions about the future force structure. Instead, that cost results from prior decisions about the force structure that produced the current pool of retirees and from the policies and laws that govern health care benefits for military retirees. Lawmakers could change those laws, but in the past, they have been extremely reluctant to do so.

3. See Congressional Budget Office, *Long-Term Implications of the 2016 Future Years Defense Program* (January 2016), pp. 22–25, www.cbo.gov/publication/51050.

4. For a fuller discussion of the MHS, see Congressional Budget Office, *Approaches to Reducing Federal Spending on Military Health Care* (January 2014), www.cbo.gov/publication/44993.

The MHS is separate from the health care system operated by the Department of Veterans Affairs (VA), which has its own funding. VA provides health care to veterans who have service-connected disabilities or who meet certain other criteria. (It also provides cash payments that compensate for service-connected disabilities and GI Bill benefits that reimburse some of the costs of higher education for veterans.) The Military Health System is available to the roughly 2 million people who served long enough to retire from the military—typically for at least 20 years—and to their eligible family members. VA benefits, by contrast, are potentially available to the 22 million veterans who received honorable or general discharges from the military, regardless of whether they served long enough to retire. Therefore, military retirees may be eligible for VA health benefits, but veterans who did not serve long enough to retire from the military are not eligible for MHS benefits after they leave the service.

Purpose and Limitations. Providing health care is considered an important military function for several reasons:

- It cares for personnel who are involved in ongoing military operations.
- It represents a substantial portion of the total compensation package that military personnel receive and is thus important for recruiting and retaining service members.
- It plays a key role in maintaining the readiness of units by making sure that military personnel are healthy.
- It helps lessen some of the challenges of military life because service members can generally be assured of receiving quality medical care for themselves and their families even when they are deployed for an operation or stationed in a foreign country.
- It is widely seen as a moral duty to care for people who may risk their lives while serving their country.

The MHS accounts for a large portion of DoD's budget—about a quarter of the total operation and support budget—and has been growing rapidly in recent years.[5] Past analyses by CBO indicate that much of that cost growth has occurred for two reasons: Military retirees are increasingly choosing to use MHS services rather than to rely on health insurance provided by a subsequent employer (or their spouse's employer), and MHS beneficiaries generally use medical care at relatively high rates. Those beneficiaries face very low premiums or copayments for their care, and people tend to use a service more when they pay less for it themselves. As a result, DoD takes in fairly small revenues from MHS beneficiaries while experiencing the high costs that stem from their intensive use of care. DoD has put forward a number of proposals in recent years to increase the amount of cost sharing for MHS beneficiaries in an effort to reduce the costs of the system. So far, however, lawmakers have not been receptive to such proposals.[6]

Past and Planned Use. The vast majority of the MHS's workload results from providing health care to service members, retirees, and their eligible family members during peacetime. That workload is not expected to change appreciably anytime soon.

The MHS also provides health care for personnel who are involved in ongoing military operations, and it is likely to keep doing so as long as such operations include any risk of casualties.[7] Although that role is important, it requires less funding and creates less workload than the peacetime provision of health care.[8] The main reason is that deployed service members make up only a small portion of the system's total beneficiaries—not all service members are deployed at a given time, and family members and retirees are not deployed. In addition, the MHS often takes part in humanitarian missions of various sorts, such as providing medical assistance in the aftermath of natural disasters.

5. See Figure 2-3 in Congressional Budget Office, *Long-Term Implications of the 2016 Future Years Defense Program* (January 2016), p. 24, www.cbo.gov/publication/51050.
6. For a brief legislative history of such cost-sharing proposals, see Congressional Budget Office, *Costs of Military Pay and Benefits in the Defense Budget* (November 2012), Appendix C, www.cbo.gov/publication/43574.
7. Even operations that do not involve combat generate a need for medical care. Casualties include diseases and nonbattle injuries, which in many cases require more medical attention than battle injuries (even during active combat operations).
8. For more discussion of the effects of recent combat operations, see Congressional Budget Office, *Approaches to Reducing Federal Spending on Military Health Care* (January 2014), pp. 16–19, www.cbo.gov/publication/44993.

Major Element of the Force Structure

Other Defensewide Units and Activities

	Total	Direct	Indirect	Overhead
		Classified Defensewide Funding		
Total Military Personnel	0	0	0	0
Total Annual Cost (Millions of 2017 dollars)	14,540	14,540	0	0
		Rest of the Defensewide Organizations		
Total Military Personnel	0	0	0	0
Total Annual Cost (Millions of 2017 dollars)	4,060	4,060	0	0

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest $10 million; more detailed information is presented in Appendixes A and B.

Defensewide organizations do not directly fund any military personnel of their own (because all military personnel are part of one of the services). In addition, in the analytic framework used for this report, defensewide organizations are considered to not have any units supporting them and thus to not have any indirect personnel or costs. No overhead costs are shown for the defensewide organizations because such costs are apportioned on the basis of the number of military personnel in an activity

The Department of Defense includes a wide variety of other defensewide activities and organizations. A significant portion of their funding is classified, however, which prevents the Congressional Budget Office from providing any detail other than the amount of classified operation and maintenance funding that DoD discloses in its publicly available budget documents.[9] (Operation and maintenance funding is a subset of operation and support funding.)

The rest of the defensewide organizations, which represent a relatively small amount of DoD's O&S budget, fall into two groups:

- High-level command-and-control functions, such as the Office of the Secretary of Defense, the Joint Staff, and the combatant commands. Although they are fairly small, those organizations include civilian and military personnel from multiple military departments and have responsibilities that affect significant portions of DoD's mission.
- Miscellaneous activities that cannot be characterized as supporting any major combat units (and thus were not included in the costs for those units). Such activities include the Defense POW/MIA Office, which works to help U.S. prisoners of war and to locate personnel missing in action; the Defense Security Cooperation Agency, which works with foreign countries' militaries and oversees military aid and arms sales to other nations; and the Office of Economic Adjustment, which helps state and local governments deal with the economic consequences of cutbacks in defense industries or closures or expansions of military bases.

9. DoD's O-1 budget display presents the full amount of classified operation and maintenance funding for each military department and for defensewide activities, but only for a limited number of years and with no breakdown between intelligence and other classified activities or other details. See Office of the Under Secretary of Defense (Comptroller), *Department of Defense Budget, Fiscal Year 2017: Operation and Maintenance Programs (O-1), Revolving and Management Funds (RF-1)* (February 2016), http://comptroller.defense.gov/BudgetMaterials.aspx.

Special Topic

Nuclear Forces

	Total	Direct	Indirect	Overhead
		Ballistic and Guided Missile Submarines		
Military Personnel per Unit	660	320	80	260
Annual Cost per Unit (Millions of 2017 dollars)	170	70	40	50
		Minuteman III Missile Squadron[a]		
Military Personnel per Unit	2,040	690	650	690
Annual Cost per Unit (Millions of 2017 dollars)	380	130	90	160
		B-52 Bomber Aircraft Squadron[b]		
Military Personnel per Unit	3,830	1,310	1,220	1,300
Annual Cost per Unit (Millions of 2017 dollars)	740	270	170	300
		B-2 Bomber Aircraft Squadron[b]		
Military Personnel per Unit	8,660	2,120	3,600	2,940
Annual Cost per Unit (Millions of 2017 dollars)	1,840	670	490	680

Funding for the services' nuclear forces comes from each service's budget, so these numbers appeared in previous chapters in the entries for "Other Units and Activities" or "Bomber Squadrons." They are repeated here to provide a complete picture of the costs of the U.S. military's nuclear forces. For additional details, see Congressional Budget Office, *Projected Costs of U.S. Nuclear Forces, 2015 to 2024* (January 2015), www.cbo.gov/publication/49870.

"Direct" personnel and costs are associated with a major combat unit, "indirect" personnel and costs are associated with units that support the major combat unit, and "overhead" personnel and costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1. The numbers shown here are rounded to the nearest 10 personnel or $10 million; more detailed information is presented in Appendixes A and B.

a. Squadron of 50 Minuteman missiles.

b. Notional squadron of 12 aircraft (actual squadrons vary in size).

The U.S. strategic nuclear force has traditionally been seen as a triad consisting of land-based intercontinental ballistic missiles (ICBMs), sea-based ballistic missile submarines (SSBNs), and airborne bomber aircraft. All of those platforms are capable of delivering nuclear weapons over long distances.

Current and Planned Structure. As part of the nuclear force structure, the Navy plans to field 14 SSBNs and 4 guided missile submarines (SSGNs) in 2017.[10] It does not expect to change those numbers through 2021 (although the Department of Defense plans to reduce the number of active missile launch tubes on each SSBN from 20 to 16 by 2018 to comply with the New START arms control treaty). The Air Force intends to field 450 Minuteman III ICBMs in 2017, but current plans call for it to reduce that number to 400 by 2018 to comply with the New START treaty. The Air Force's B-52 and B-2 bombers are also capable of delivering nuclear weapons, but unlike SSBNs and ICBMs, they spend most of their time performing their conventional (nonnuclear) role. DoD plans to remove the ability of some B-52s to deliver nuclear weapons by 2018 to comply with

10. The Navy's budget documents group the 14 SSBNs with the 4 SSGNs, which are former SSBNs that have been converted to launch Tomahawk cruise missiles and to support special operations.

the New START treaty.[11] The nuclear warheads that missiles are armed with are funded mainly through Department of Energy accounts, which are not included in this analysis.

For the past 40 years, the U.S. nuclear force structure has been affected by the outcomes of arms control negotiations (although the United States always has the option to change its nuclear force structure unilaterally and has sometimes done so).[12] The most recent arms control agreement, the New START treaty, has been in effect since 2011 and limits the total numbers of deployed strategic missiles and bombers (700), deployed strategic nuclear warheads (1,550), and deployed and nondeployed strategic missile launchers and bombers (800). The United States currently exceeds those limits, but it has until 2018 to comply with the treaty.

Purpose and Limitations. In practice, the fundamental role of U.S. nuclear forces is to deter any nuclear attack on the United States, its allies, or its partners through the threat of a devastating counterattack. However, at various points in history, U.S. policymakers have also considered the possibility of using nuclear forces to initiate an attack on a hostile state, to deter nonnuclear attacks on the United States, or to deter nonnuclear attacks on U.S. allies. (In particular, much debate during the Cold War focused on whether nuclear weapons could deter a possible Soviet invasion of Western Europe.)

As a deterrent, nuclear forces are intended to allow the United States to retaliate with so much firepower that no rational enemy could possibly view a nuclear attack on the United States as a reasonable option. Deterrence is a theoretical approach for understanding the decisionmaking process of opponents, and there are several variations on the core theory. However, almost all of them agree that successful deterrence requires a credible commitment and capability to respond with overwhelming force to any nuclear attack. Some variations on the theory would add that there are no uses for nuclear forces other than deterrence—which suggests that the purpose of nuclear weapons is to not be used. If U.S. decisionmakers agree with such views, the main limitation of nuclear forces is that their only role is to provide a credible deterrent. Another limitation is that some nuclear-armed opponents might not be rational actors and thus might not be deterred by U.S. nuclear forces.[13] Finally, the use of nuclear weapons is limited by the fact that such use is considered by many people to be unacceptable in most circumstances.

Each part (or "leg") of the nuclear triad has unique strengths and weaknesses that complement those of the other legs, such that the full triad is generally considered much more powerful than a "pure" deterrent composed of only one type of system. Historically, most of the value of the triad lay in discouraging the Soviet Union from launching a nuclear first strike on the United States that would have destroyed the U.S. capability to respond with a second strike. In the present era, concerns about deterrence often focus more on smaller nuclear powers (such as North Korea) that have less sophisticated arsenals for delivering nuclear weapons. Those smaller powers cannot credibly threaten a first strike that would destroy the U.S. capability to respond. However, all recent U.S. nuclear policy statements have indicated a commitment to maintaining the full triad. Because each leg of the triad is aging, DoD has modernization programs in place for all three.

U.S. ICBMs and SSBN-launched missiles are armed only with nuclear warheads and cannot be used for any nonnuclear purpose. (Although DoD has considered arming those missiles with conventional warheads, it has not done so.) The bomber fleet, by contrast, has routinely been used in major conflicts to deliver conventional weapons. During the Cold War, bombers were seen mainly as a nuclear delivery platform, and the majority of the bomber fleet was usually on some form of standby, able to launch quickly in case it was needed to carry out nuclear strikes. In the post–Cold War era, bombers have

11. DoD also deploys short-range, smaller-yield nuclear weapons, known as tactical nuclear weapons. During the Cold War, all three military departments deployed such weapons, which numbered more than 10,000. They included bombs delivered by aircraft, artillery shells, torpedoes, land mines, sea-launched cruise missiles, and short-range surface-to-surface ballistic missiles. Today, only the Air Force deploys tactical nuclear weapons—bombs delivered by tactical aircraft. Those forces are not discussed here.

12. Recent arms control treaties have given the parties flexibility in meeting their obligations by specifying the total number of warheads or delivery systems allowed but letting each nation determine the mix of ICBMs, SSBNs, and bombers fielded.

13. That possibility is frequently raised in discussions of North Korea's and Iran's nuclear programs, as well as in hypothetical cases in which a terrorist group obtains a nuclear weapon.

been used extensively for conventional strikes, although the B-2 fleet and part of the B-52 fleet still routinely train for nuclear missions.

Past and Planned Use. The United States used two nuclear weapons against Japan in World War II but has not employed any nuclear weapons in combat since then. No other country has used nuclear weapons in combat. Supporters of the theory of deterrence point to the lack of nuclear exchanges as evidence that nuclear deterrence has been extremely successful. Nevertheless, as with all counterfactual examples, there is no way to prove that the U.S. nuclear deterrent was directly responsible for preventing a nuclear attack by the Soviet Union during the Cold War.

Special Topic

Missile Defense

The United States is currently operating a number of systems to protect itself and its allies from missile strikes. Those systems are generally developed and purchased by the Missile Defense Agency (MDA), and their acquisition costs are paid through the defensewide portion of the Department of Defense's budget. Once purchased, however, missile defense systems are operated by the services, and most of their operation and support (O&S) costs are included in the budgets of the relevant military departments. In this report, all of a department's O&S costs for missile defense are included in its chapter's entry for "Other Units and Activities" (under "rest of" the department).

Several missile defense systems do not significantly add to their service's O&S costs. For example, the Army fields Patriot missile battalions as part of its normal air-defense force structure, and the Navy fields Aegis cruisers and destroyers as part of its normal surface combatant fleet. Equipping those battalions and ships with advanced missiles capable of performing missile defense does not result in substantial new O&S costs to the Army or the Navy because those units existed already. If, in the future, missile defense missions caused more Patriot units to be created or more ships to be purchased, those forces' O&S costs might be more directly attributable to missile defense.

Other missile defense systems, such as the Ground-Based Midcourse Defense system and the Terminal High Altitude Area Defense system, incur additional O&S costs. However, those costs are very small compared with the costs of other elements of the force structure.

Current and Planned Structure. DoD has four major missile defense systems, which are designed to intercept threatening missiles in midair:

- The Ground-Based Midcourse Defense (GMD) system, which the Army operates from various land bases (primarily Fort Greely, Alaska), is designed to protect the United States against long-range ballistic missiles. That system is intended to intercept missiles during the midcourse part of their flight (the phase after a missile's rocket motor has stopped burning and accelerating the missile but before air resistance from reentry into the atmosphere has begun decelerating it). In that phase, missiles are at their maximum speed and are generally following predictable, parabolic paths.

- The Aegis Ballistic Missile Defense (BMD) system, a midcourse-phase interception system operated by the Navy from cruisers and destroyers, is designed to protect allies and U.S. forces from medium- and intermediate-range ballistic missiles.[14] DoD is developing a land-based variant of the Aegis system, as well as an interceptor capable of targeting missiles during the terminal phase of their flight (when air resistance from reentry has begun decelerating them). Missiles in that phase are very close to their targets, which greatly reduces the time that missile defense systems have to react to them but also allows the use of relatively short-range and lower-cost interceptor missiles.

- The Terminal High Altitude Area Defense (THAAD) system, a terminal-phase interception system operated by the Army from mobile launchers, is designed to intercept short- and medium-range ballistic missiles as they near their targets.

- The Patriot Advanced Capability 3 (PAC-3) system, a terminal-phase interception system operated by the Army from mobile launchers, is similar to THAAD but is better suited to intercepting smaller short-range ballistic missiles. It can also intercept cruise missiles and aircraft.

The Missile Defense Agency has explored some other missile defense concepts and systems—and is likely to develop new systems in the future—but none of those other systems are deployed now or are likely to be deployed soon. MDA also invests heavily in command-and-control systems and sensors to support the missile defense mission. However, most of that spending comes from DoD's acquisition funding rather than from the O&S budget, so it is not included in this analysis.

14. Intermediate-range ballistic missiles have ranges between 3,000 and 5,500 kilometers; medium-range ballistic missiles, between 1,000 and 3,000 kilometers; and short-range ballistic missiles, fewer than 1,000 kilometers. Intercontinental ballistic missiles have ranges greater than 5,500 kilometers.

Purpose and Limitations. Missile defense systems are intended to defend against ballistic missiles fired at the United States, its allies, or its deployed forces. Ballistic missiles, which were developed during World War II, are initially powered by a rocket motor that boosts them high into the air; after that they coast on an arching (ballistic) trajectory, powered only by gravity as they fall to Earth toward their target. Ballistic missiles are very difficult to intercept once fired—their speed, high-altitude flight, and long range mean that developing weapon systems capable of destroying them in flight is extremely challenging. Those same characteristics have also made ballistic missiles a preferred delivery system for nuclear weapons (as discussed in the previous entry). The difficulty of defending against nuclear-armed ballistic missiles is one of the main reasons that the United States continues to rely heavily on deterrence to protect against nuclear attacks.

Intercontinental ballistic missiles (ICBMs) and the very similar submarine-launched ballistic missiles (SLBMs) present the greatest technical challenges to effective missile defense: Their very long range (between continents) requires extremely powerful engines, which accelerate them to very high speeds and loft them in very high ballistic arcs. Intermediate-range, medium-range, and short-range ballistic missiles are somewhat less challenging because they reach lower maximum speeds and usually fly at lower altitudes. In general, ICBMs and SLBMs are the most costly and difficult weapon systems to develop and are designed to deliver nuclear weapons, meaning that usually only the largest nuclear powers possess them. Short-range ballistic missiles are much less costly and difficult to develop, are fielded by many countries, and are generally armed with conventional explosive payloads rather than nuclear warheads. Medium-range ballistic missiles are more expensive and less plentiful than their short-range counterparts, and intermediate-range ballistic missiles are more costly and less common than medium-range missiles.

The first missile defense systems were developed by the United States and the Soviet Union in the 1960s and 1970s. They were designed to destroy a ballistic missile after its launch by detonating a nuclear warhead in its vicinity. However, because of the undesirability of using nuclear warheads, the United States began in the 1980s to extensively research ways to use conventional explosive or kinetic warheads to destroy ballistic missiles.[15] The initial Patriot missile system, which was fielded as an air-defense system in the 1980s, also possessed a limited ability to destroy short-range ballistic missiles. Since then, the United States has made significant technical progress in developing systems to destroy all types of ballistic missiles, and MDA now has systems capable of intercepting all of those types of ballistic missiles.

Effective missile defense remains highly challenging. As a result, analysts outside DoD have raised a number of concerns about the feasibility of missile defense in general and about the performance of current U.S. systems in particular—especially against an adversary that can field decoy warheads and other countermeasures to confuse defense systems. MDA has faced external criticism of its test programs and their results, and it is difficult to assess how effective the systems that DoD has fielded would be in an actual missile attack.

Even if all of its current systems perform as DoD plans, the GMD system intended to defend U.S. territory against missiles is designed to protect against attacks by very small numbers of long-range ballistic missiles—the sort of attack that might be launched by a so-called rogue state, such as North Korea or Iran. That system is not intended to defend the United States against attacks by large numbers of nuclear-armed missiles.

Past and Planned Use. During Operation Desert Storm in 1991, the Army used Patriot missiles to defend against Iraqi Scud missile attacks targeted at Saudi Arabia, Israel, and U.S. and coalition forces. The Army's missiles were early-model Patriots rather than the current PAC-3 design, and their effectiveness in actually shooting down Iraqi missiles has been the subject of debate. (Part of the difficulty in assessing their performance is that many engagements with Scud missiles ended up being near misses that may not have destroyed those missiles, resulting in an ambiguous operational record.) PAC-3 missiles were employed in 2003 during the invasion of Iraq with some success. None of the remaining systems in the current generation of U.S. missile defenses have been used in combat.

15. Unlike explosive weapons, kinetic weapons destroy their targets by hitting them at high speed. A kinetic warhead can be fairly small and thus easier to accelerate to high speed, but it requires much more accurate guidance than an explosive or nuclear warhead does.

Currently, two of the primary missions for U.S. missile defense systems are to protect the United States against a limited attack by North Korean nuclear-armed ICBMs (using the GMD system) and to protect U.S. forces and allies in Europe against an attack by Iranian nuclear-armed intermediate-range ballistic missiles (using ship- and land-based versions of the Aegis BMD system). Both of those missions involve countering a threat that has yet to emerge, because neither of those countries is currently believed to have effectively combined nuclear warheads and ballistic missiles, and neither has yet fielded missiles with sufficient range. It is also unclear whether missile defenses are required to counter those threats. U.S. nuclear forces may be sufficient to deter attacks, as they were during the Cold War, although it is possible that a reliable missile defense system could enhance the effectiveness of the existing U.S. nuclear deterrent. (The effect of missile defenses on deterrence is an extremely controversial topic.)

The main intended mission for the THAAD and PAC-3 systems is to defend deployed U.S. forces or U.S. allies against attacks by intermediate-, medium-, or short-range ballistic missiles. Such a mission is not speculative: Short-range ballistic missiles have proliferated widely and were used against U.S. forces in Operations Desert Storm and Iraqi Freedom.

APPENDIX

A

Size, Costs, and Number of U.S. Forces

This appendix shows, for quick reference, the total size and costs of each type of major combat unit in the Congressional Budget Office's analysis (see Table A-1). The table also shows how many of each type of unit the Department of Defense plans to have in its force each year from 2017 to 2021 as reported in DoD's 2017 Future Years Defense Program.

Table A-1.

Size, Costs, and Number of U.S. Forces

	Military Personnel per Unit	Annual Cost per Unit (Millions of 2017 dollars)	Number of Units				
			2017	2018	2019	2020	2021
Department of the Army							
Active-Component Armored Brigade Combat Team	17,450	2,610	9	9	9	9	9
National Guard Armored Brigade Combat Team	14,440	820	5	5	5	5	5
Active-Component Stryker Brigade Combat Team	17,180	2,560	7	7	7	7	7
National Guard Stryker Brigade Combat Team	14,230	800	2	2	2	2	2
Active-Component Infantry Brigade Combat Team	16,250	2,410	14	14	14	14	14
National Guard Infantry Brigade Combat Team	12,720	700	19	19	19	19	19
Active-Component Aviation Brigade	4,300	890	11	11	10	10	10
Reserve-Component Aviation Brigade	2,750	200	11	12	12	12	12
Army Special-Operations Forces	45,100 [a]	7,210 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Rest of the Army	12,570 [a]	3,180 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Department of the Navy							
Aircraft Carrier	6,590	1,180	11	11	11	11	11
Carrier Air Wing	4,860	910	10	10	10	10	10
Arleigh Burke Class Destroyer (DDG-51)	720	140	66	67	69	72	74
Ticonderoga Class Cruiser (CG-47)	550	110	22	22	22	20	20
Littoral Combat Ship	430	100	14	18	22	24	28
Zumwalt Class Destroyer (DDG-1000)	500	100	2	2	3	3	3
Attack Submarine[c]	390	140	51	52	50	51	51
Amphibious Ship[d]	1,450	270	35 [e]	35 [e]	35 [e]	35 [e]	35 [e]
Active-Component Marine Corps Infantry Battalion	5,780	740	24	24	24	24	24
Reserve-Component Marine Corps Infantry Battalion	4,370	470	8	8	8	8	8
Marine Corps Aircraft Complement	2,750	520	24	24	24	24	24
Ballistic and Guided Missile Submarines	660	170	18	18	18	18	18

Continued

Table A-1. Continued

Size, Costs, and Number of U.S. Forces

	Military Personnel per Unit	Annual Cost per Unit (Millions of 2017 dollars)	Number of Units 2017	2018	2019	2020	2021
Department of the Navy (Continued)							
P-3 and P-8 Maritime Patrol Aircraft Squadron[f]	1,890	330	8	8	8	8	8
Seabee Construction Engineers	14,200 [a]	1,860 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Navy Special-Operations Forces	16,440 [a]	2,370 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Marine Corps Special-Operations Forces	3,530 [a]	490 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Rest of the Navy	37,990 [a]	6,550 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Rest of the Marine Corps	770 [a]	230 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Department of the Air Force[f]							
A-10 Attack Aircraft Squadron	1,190	230	16	13	10	6	2
F-15 Fighter Aircraft Squadron	1,540	300	25	25	25	25	26
F-16 Fighter Aircraft Squadron	1,250	220	45	45	46	46	46
F-22 Fighter Aircraft Squadron	2,390	470	13	13	13	13	13
F-35 Fighter Aircraft Squadron[g]	2,940	570	3	5	7	10	14
B-52 Bomber Aircraft Squadron	3,830	740	4	4	4	4	4
B-1B Bomber Aircraft Squadron	3,980	810	4	4	4	4	4
B-2 Bomber Aircraft Squadron	8,660	1,840	1	1	1	1	1
C-130 Cargo Aircraft Squadron	2,120	360	24	24	23	24	24
C-5 Cargo Aircraft Squadron	2,430	430	3	3	3	3	3
C-17 Cargo Aircraft Squadron	1,390	270	14	15	16	16	16
KC-135 Tanker Aircraft Squadron	1,930	360	30	28	28	27	28
KC-10 Tanker Aircraft Squadron	3,140	580	5	5	4	3	2
KC-46 Tanker Aircraft Squadron[g]	1,070	180	1	3	4	5	6
MQ-1 "Predator" UAS Squadron	260	70	9	0	0	0	0
RQ-4 "Global Hawk" UAS Squadron	1,840	440	3	3	3	3	3
MQ-9 "Reaper" UAS Squadron	920	160	23	24	26	27	27
Minuteman III Missile Squadron[h]	2,040	380	9	9	9	9	9
RED HORSE Construction Engineers	19,340 [a]	2,170 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Air Force Special-Operations Forces	24,070 [a]	3,730 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Rest of the Air Force	49,010 [a]	10,000 [b]	n.a.	n.a.	n.a.	n.a.	n.a.

Continued

Table A-1. Continued

Size, Costs, and Number of U.S. Forces

	Military Personnel per Unit	Annual Cost per Unit (Millions of 2017 dollars)	Number of Units 2017	2018	2019	2020	2021
Defensewide Activities							
Special Operations Command	0 [i]	5,370 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Defense Health Program for Retirees	0 [i]	14,720 [b]	n.a.	n.a.	n.a.	n.a.	n.a.
Classified Defensewide Funding	0 [i]	14,540 [b]					
Rest of the Defensewide Organizations	0 [i]	4,060 [b]	n.a.	n.a.	n.a.	n.a.	n.a.

Source: Congressional Budget Office, using data from the Department of Defense's 2017 budget request.

n.a. = not applicable; UAS = unmanned air system.

a. Military personnel for these forces as a whole, rather than personnel per unit.

b. Annual cost for these forces as a whole, rather than cost per unit.

c. Because of data limitations, CBO could not estimate costs for different classes of attack submarines using the framework of this analysis.

d. Because of data limitations, CBO could not estimate costs for different classes of amphibious ships using the framework of this analysis. The costs shown here are average costs for ships only (they do not include the costs of the Marine units that would deploy on the ships).

e. Includes two command ships that are considered part of the amphibious fleet in the Department of Defense's budget documents.

f. Aircraft squadrons are notional squadrons of 12 aircraft (actual squadrons vary in size).

g. Because these aircraft are not yet in full operational service, their actual costs may differ from the planned costs included in the Department of Defense's budget documents, on which these estimates are based.

h. Squadron of 50 Minuteman missiles.

i. Defensewide organizations do not directly fund any military personnel of their own (because all military personnel are part of one of the services).

APPENDIX

B

Reconciling CBO's and DoD's Five-Year Tallies of Funding and Personnel

This appendix shows how the personnel numbers (see Table B-1) and costs (see Table B-2) for each type of major combat unit, as estimated by the Congressional Budget Office, sum to the totals for the Department of Defense's operation and support budget and military personnel reported in DoD's 2017 Future Years Defense Program. Supplemental data for Table B-1 and Table B-2 are available on CBO's website (www.cbo.gov/publication/51535).

Table B-1.

Five-Year Tallies of Units' Military Personnel, 2017 to 2021

	Five-Year Total of Units	Military Personnel per Unit				Total Military Personnel Over the 2017–2021 Period (In thousands)			
		Direct	Indirect	Overhead	Total	Direct	Indirect	Overhead	Total
Department of the Army									
Active-Component Armored Brigade Combat Team	45	4,200	9,090	4,160	**17,450**	189	409	187	**785**
National Guard Armored Brigade Combat Team	25	4,140	9,090	1,210	**14,440**	104	227	30	**361**
Active-Component Stryker Brigade Combat Team	35	4,440	8,590	4,150	**17,180**	156	301	145	**601**
National Guard Stryker Brigade Combat Team	10	4,450	8,590	1,190	**14,230**	45	86	12	**142**
Active-Component Infantry Brigade Combat Team	70	4,230	8,090	3,920	**16,250**	296	566	275	**1,137**
National Guard Infantry Brigade Combat Team	95	3,560	8,090	1,060	**12,720**	338	769	101	**1,208**
Active-Component Aviation Brigade	52	3,020	0	1,280	**4,300**	157	0	67	**224**
Reserve-Component Aviation Brigade	59	2,520	0	230	**2,750**	148	0	14	**162**
Army Special-Operations Forces	n.a.	32,370 [a]	0	12,730 [a]	**45,100** [a]	162	0	64	**226**
Rest of the Army	n.a.	8,860 [a]	0	3,710 [a]	**12,570** [a]	44	0	19	**63**
Department of the Navy									
Aircraft Carrier	55	3,200	760	2,620	**6,590**	176	42	144	**362**
Carrier Air Wing	50	1,630	1,300	1,930	**4,860**	81	65	97	**243**
Arleigh Burke Class Destroyer (DDG-51)	348	340	100	290	**720**	118	33	100	**251**
Ticonderoga Class Cruiser (CG-47)	106	250	90	220	**550**	26	9	23	**59**
Littoral Combat Ship	106	190	70	170	**430**	20	8	18	**46**
Zumwalt Class Destroyer (DDG-1000)	13	220	80	200	**500**	3	1	3	**7**
Attack Submarine [b]	255	190	50	150	**390**	48	12	39	**99**
Amphibious Ship [c]	175 [d]	710	170	580	**1,450**	123	29	101	**254**
Active-Component Marine Corps Infantry Battalion	120	1,490	1,990	2,300	**5,780**	179	239	276	**693**
Reserve-Component Marine Corps Infantry Battalion	40	2,070	560	1,740	**4,370**	83	22	70	**175**
Marine Corps Aircraft Complement	120	760	890	1,090	**2,750**	92	107	131	**330**
Ballistic and Guided Missile Submarines	90	320	80	260	**660**	29	7	24	**60**

Continued

Table B-1. Continued

Five-Year Tallies of Units' Military Personnel, 2017 to 2021

	Five-Year Total of Units	Military Personnel per Unit				Total Military Personnel Over the 2017–2021 Period (In thousands)			
		Direct	Indirect	Overhead	Total	Direct	Indirect	Overhead	Total
Department of the Navy (Continued)									
P-3 and P-8 Maritime Patrol Aircraft Squadron[e]	37	630	500	750	**1,890**	24	19	28	**71**
Seabee Construction Engineers	n.a.	8,550 [a]	0	5,650 [a]	**14,200** [a]	43	0	28	**71**
Navy Special-Operations Forces	n.a.	9,900 [a]	0	6,550 [a]	**16,440** [a]	49	0	33	**82**
Marine Corps Special-Operations Forces	n.a.	2,130 [a]	0	1,410 [a]	**3,530** [a]	11	0	7	**18**
Rest of the Navy	n.a.	22,860 [a]	0	15,120 [a]	**37,990** [a]	114	0	76	**190**
Rest of the Marine Corps	n.a.	460 [a]	0	310 [a]	**770** [a]	2	0	2	**4**
Department of the Air Force[e]									
A-10 Attack Aircraft Squadron	46	350	440	400	**1,190**	16	20	19	**55**
F-15 Fighter Aircraft Squadron	124	430	590	520	**1,540**	53	73	65	**191**
F-16 Fighter Aircraft Squadron	226	450	370	420	**1,250**	102	85	96	**282**
F-22 Fighter Aircraft Squadron	65	430	1,150	810	**2,390**	28	75	53	**156**
F-35 Fighter Aircraft Squadron[f]	37	430	1,510	1,000	**2,940**	16	57	37	**110**
B-52 Bomber Aircraft Squadron	19	1,310	1,220	1,300	**3,830**	25	23	24	**72**
B-1B Bomber Aircraft Squadron	21	940	1,680	1,350	**3,980**	20	36	29	**85**
B-2 Bomber Aircraft Squadron	7	2,120	3,600	2,940	**8,660**	14	24	20	**58**
C-130 Cargo Aircraft Squadron	118	800	590	720	**2,120**	95	70	85	**251**
C-5 Cargo Aircraft Squadron	16	780	820	830	**2,430**	13	13	13	**40**
C-17 Cargo Aircraft Squadron	76	450	460	470	**1,390**	35	35	36	**106**
KC-135 Tanker Aircraft Squadron	141	610	660	650	**1,930**	87	93	92	**272**
KC-10 Tanker Aircraft Squadron	18	900	1,170	1,060	**3,140**	17	22	20	**58**
KC-46 Tanker Aircraft Squadron[f]	20	640	70	360	**1,070**	13	1	7	**21**
MQ-1 "Predator" UAS Squadron	9	90	80	90	**260**	1	1	1	**2**
RQ-4 "Global Hawk" UAS Squadron	15	470	750	630	**1,840**	7	11	9	**28**
MQ-9 "Reaper" UAS Squadron	128	340	270	310	**920**	44	34	40	**118**
Minuteman III Missile Squadron[g]	45	690	650	690	**2,040**	31	29	31	**92**
RED HORSE Construction Engineers	n.a.	12,780 [a]	0	6,560 [a]	**19,340** [a]	64	0	33	**97**
Air Force Special-Operations Forces	n.a.	15,900 [a]	0	8,170 [a]	**24,070** [a]	80	0	41	**120**
Rest of the Air Force	n.a.	32,370 [a]	0	16,630 [a]	**49,010** [a]	162	0	83	**245**

Continued

Table B-1. Continued

Five-Year Tallies of Units' Military Personnel, 2017 to 2021

	Five-Year Total of Units	Military Personnel per Unit				Total Military Personnel Over the 2017–2021 Period (In thousands)			
		Direct	Indirect	Overhead	Total	Direct	Indirect	Overhead	Total
				Defensewide Activities[h]					
Special Operations Command	n.a.	0	0	0	**0**	0	0	0	**0**
Defense Health Program for Retirees	n.a.	0	0	0	**0**	0	0	0	**0**
Classified Defensewide Funding	n.a.	0	0	0	**0**	0	0	0	**0**
Rest of the Defensewide Organizations	n.a.	0	0	0	**0**	0	0	0	**0**
Five-Year Total						**3,780**	**3,653**	**2,946**	**10,379**
National Defense Budget Estimates for Fiscal Year 2017									**10,379**

Source: Congressional Budget Office, using data from the Department of Defense's 2017 budget request.

"Direct" personnel are associated with a major combat unit, "indirect" personnel are associated with units that support the major combat unit, and "overhead" personnel are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1.

Supplemental data for this table are available on CBO's website (www.cbo.gov/publication/51535).

n.a. = not applicable; UAS = unmanned air system.

a. Military personnel for these forces as a whole, rather than personnel per unit.

b. Because of data limitations, CBO could not estimate personnel numbers for different classes of attack submarines using the framework of this analysis.

c. Because of data limitations, CBO could not estimate personnel numbers for different classes of amphibious ships using the framework of this analysis. The numbers shown here are average personnel of ships only (they do not include the personnel of the Marine units that would deploy on the ships).

d. Includes two command ships that are considered part of the amphibious fleet in the Department of Defense's budget documents.

e. Aircraft squadrons are notional squadrons of 12 aircraft (actual squadrons vary in size).

f. Because these aircraft are not yet in full operational service, their actual personnel numbers may differ from the planned personnel numbers included in the Department of Defense's budget documents, on which these estimates are based.

g. Squadron of 50 Minuteman missiles.

h. Defensewide organizations do not directly fund any military personnel of their own (because all military personnel are part of one of the services). In addition, in the analytic framework used for this report, defensewide organizations are considered to not have any units supporting them and thus to not have any indirect personnel or costs. No overhead costs are shown for defensewide organizations because such costs are apportioned on the basis of the number of military personnel in an activity.

Table B-2.

Five-Year Tallies of Units' Costs, 2017 to 2021

	Five-Year Total of Units	Annual Cost per Unit (Millions of 2017 dollars)				Total Cost Over the 2017–2021 Period (Billions of 2017 dollars)			
		Direct	Indirect	Overhead	Total	Direct	Indirect	Overhead	Total
				Department of the Army					
Active-Component Armored Brigade Combat Team	45	500	840	1,280	**2,610**	22.3	37.7	57.5	**117.5**
National Guard Armored Brigade Combat Team	25	180	390	240	**820**	4.6	9.8	6.1	**20.5**
Active-Component Stryker Brigade Combat Team	35	500	790	1,280	**2,560**	17.4	27.7	44.6	**89.7**
National Guard Stryker Brigade Combat Team	10	190	370	240	**800**	1.9	3.7	2.4	**8.0**
Active-Component Infantry Brigade Combat Team	70	450	750	1,210	**2,410**	31.8	52.2	84.6	**168.5**
National Guard Infantry Brigade Combat Team	95	140	350	220	**700**	13.2	33.1	20.5	**66.7**
Active-Component Aviation Brigade	52	490	0	410	**890**	25.3	0	21.2	**46.5**
Reserve-Component Aviation Brigade	59	160	0	50	**200**	9.3	0	2.7	**12.0**
Army Special-Operations Forces	n.a.	3,190 [a]	0	4,020 [a]	**7,210** [a]	15.9	0	20.1	**36.1**
Rest of the Army	n.a.	2,000 [a]	0	1,180 [a]	**3,180** [a]	10.0	0	5.9	**15.9**
				Department of the Navy					
Aircraft Carrier	55	470	180	530	**1,180**	25.6	10.2	29.2	**65.0**
Carrier Air Wing	50	330	200	390	**910**	16.3	9.8	19.6	**45.7**
Arleigh Burke Class Destroyer (DDG-51)	348	60	20	60	**140**	19.8	8.2	20.2	**48.3**
Ticonderoga Class Cruiser (CG-47)	106	40	20	40	**110**	4.7	2.1	4.7	**11.5**
Littoral Combat Ship	106	40	20	30	**100**	4.7	2.1	3.7	**10.5**
Zumwalt Class Destroyer (DDG-1000)	13	40	20	40	**100**	0.5	0.2	0.5	**1.3**
Attack Submarine[b]	255	70	40	30	**140**	17.8	10.4	8.0	**36.2**
Amphibious Ship[c]	175 [d]	110	40	120	**270**	19.6	7.8	20.5	**47.9**
Active-Component Marine Corps Infantry Battalion	120	140	140	470	**740**	16.4	16.9	55.9	**89.3**
Reserve-Component Marine Corps Infantry Battalion	40	70	50	350	**470**	2.9	1.8	14.1	**18.8**
Marine Corps Aircraft Complement	120	160	140	220	**520**	19.7	16.5	26.6	**62.9**
Ballistic and Guided Missile Submarines	90	70	40	50	**170**	6.4	3.7	4.8	**14.9**

Continued

Table B-2. Continued

Five-Year Tallies of Units' Costs, 2017 to 2021

	Five-Year Total of Units	Annual Cost per Unit (Millions of 2017 dollars)				Total Cost Over the 2017–2021 Period (Billions of 2017 dollars)			
		Direct	Indirect	Overhead	Total	Direct	Indirect	Overhead	Total
Department of the Navy (Continued)									
P-3 and P-8 Maritime Patrol Aircraft Squadron[e]	37	110	70	150	**330**	4.2	2.5	5.7	**12.4**
Seabee Construction Engineers	n.a.	720 [a]	0	1,150 [a]	**1,860** [a]	3.6	0	5.7	**9.3**
Navy Special-Operations Forces	n.a.	1,050 [a]	0	1,330 [a]	**2,370** [a]	5.2	0	6.6	**11.9**
Marine Corps Special-Operations Forces	n.a.	210 [a]	0	280 [a]	**490** [a]	1.0	0	1.4	**2.5**
Rest of the Navy	n.a.	3,490 [a]	0	3,060 [a]	**6,550** [a]	17.4	0	15.3	**32.8**
Rest of the Marine Corps	n.a.	160 [a]	0	60 [a]	**230** [a]	0.8	0	0.3	**1.1**
Department of the Air Force[e]									
A-10 Attack Aircraft Squadron	46	80	60	90	**230**	3.5	2.7	4.3	**10.5**
F-15 Fighter Aircraft Squadron	124	100	80	120	**300**	12.6	10.0	15.0	**37.6**
F-16 Fighter Aircraft Squadron	226	70	50	100	**220**	15.4	11.5	22.1	**49.1**
F-22 Fighter Aircraft Squadron	65	120	160	190	**470**	8.0	10.3	12.2	**30.5**
F-35 Fighter Aircraft Squadron[f]	37	130	210	230	**570**	4.9	7.7	8.6	**21.2**
B-52 Bomber Aircraft Squadron	19	270	170	300	**740**	5.0	3.1	5.6	**13.8**
B-1B Bomber Aircraft Squadron	21	270	230	310	**810**	5.7	4.9	6.6	**17.2**
B-2 Bomber Aircraft Squadron	7	670	490	680	**1,840**	4.5	3.3	4.5	**12.3**
C-130 Cargo Aircraft Squadron	118	110	80	170	**360**	12.9	9.6	19.7	**42.1**
C-5 Cargo Aircraft Squadron	16	130	110	190	**430**	2.1	1.8	3.1	**7.0**
C-17 Cargo Aircraft Squadron	76	90	60	110	**270**	7.1	4.8	8.3	**20.2**
KC-135 Tanker Aircraft Squadron	141	110	90	150	**360**	16.1	12.7	21.3	**50.1**
KC-10 Tanker Aircraft Squadron	18	180	160	250	**580**	3.3	2.9	4.5	**10.7**
KC-46 Tanker Aircraft Squadron[f]	20	80	10	80	**180**	1.6	0.2	1.7	**3.5**
MQ-1 "Predator" UAS Squadron	9	40	10	20	**70**	0.3	0.1	0.2	**0.6**
RQ-4 "Global Hawk" UAS Squadron	15	190	100	140	**440**	2.9	1.5	2.2	**6.6**
MQ-9 "Reaper" UAS Squadron	128	50	40	70	**160**	7.0	4.7	9.3	**20.9**
Minuteman III Missile Squadron[g]	45	130	90	160	**380**	5.9	4.0	7.2	**17.1**
RED HORSE Construction Engineers	n.a.	660 [a]	0	1,520 [a]	**2,170** [a]	3.3	0	7.6	**10.9**
Air Force Special-Operations Forces	n.a.	1,840 [a]	0	1,890 [a]	**3,730** [a]	9.2	0	9.4	**18.7**
Rest of the Air Force	n.a.	6,160 [a]	0	3,840 [a]	**10,000** [a]	30.8	0	19.2	**50.0**

Continued

Table B-2. Continued

Five-Year Tallies of Units' Costs, 2017 to 2021

	Five-Year Total of Units	Annual Cost per Unit (Millions of 2017 dollars)				Total Cost Over the 2017–2021 Period (Billions of 2017 dollars)			
		Direct	Indirect	Overhead	Total	Direct	Indirect	Overhead	Total
				Defensewide Activities					
Special Operations Command	n.a.	5,370 [a]	0	0	**5,370** [a]	26.9	0	0	**26.9**
Defense Health Program for Retirees	n.a.	14,720 [a]	0	0	**14,720** [a]	73.6	0	0	**73.6**
Classified Defense Funding	n.a.	14,540 [a]	0	0	**14,540** [a]	72.7	0	0	**72.7**
Rest of the Defensewide Organizations	n.a.	4,060 [a]	0	0	**4,060** [a]	20.3	0	0	**20.3**
Five-Year Total						**694.2**	**352.6**	**701.3**	**1,748.1**
National Defense Budget Estimates for Fiscal Year 2017									**1,748.1**

Source: Congressional Budget Office, using data from the Department of Defense's 2017 budget request.

"Direct" costs are associated with a major combat unit, "indirect" costs are associated with units that support the major combat unit, and "overhead" costs are associated with the major combat unit's share of administrative or overhead activities. For more information, see Chapter 1.

Supplemental data for this table are available on CBO's website (www.cbo.gov/publication/51535).

n.a. = not applicable; UAS = unmanned air system.

a. Annual cost for these forces as a whole, rather than cost per unit.

b. Because of data limitations, CBO could not estimate costs for different classes of attack submarines using the framework of this analysis.

c. Because of data limitations, CBO could not estimate costs for different classes of amphibious ships using the framework of this analysis. The costs shown here are average costs for ships only (they do not include the costs of the Marine units that would deploy on the ships).

d. Includes two command ships that are considered part of the amphibious fleet in the Department of Defense's budget documents.

e. Aircraft squadrons are notional squadrons of 12 aircraft (actual squadrons vary in size).

f. Because these aircraft are not yet in full operational service, their actual costs may differ from the planned costs included in the Department of Defense's budget documents, on which these estimates are based.

g. Squadron of 50 Minuteman missiles.

APPENDIX

C

Military Operations and Planning Scenarios Referred to in This Report

In describing the past and planned use of various types of forces, this primer mentions a number of military operations that the United States has engaged in since World War II, as well as a number of scenarios that the Department of Defense (DoD) has used to plan for future conflicts. Those operations and planning scenarios are summarized below.

Military Operations

1950–1953: **Korean War.** U.S. forces defended South Korea (the Republic of Korea) from an invasion by North Korea (the Democratic People's Republic of Korea). North Korean forces initially came close to overrunning the entire Korean Peninsula before being pushed back. Later, military units from China (the People's Republic of China) intervened when U.S. forces approached the Chinese border. That intervention caused the conflict to devolve into a stalemate at the location of the current border between North and South Korea.

September 1950: **Inchon Landing.** U.S. marines led an amphibious assault on the South Korean port of Inchon. At the time, Inchon was well behind the North Korean military's lines, and the insertion of U.S. forces there contributed to the collapse and retreat of the North Korean invasion force.

1964–1975: **Vietnam War.** U.S. forces attempted to defend the government of South Vietnam (the Republic of Vietnam) from communist insurgents backed by North Vietnam (the People's Republic of Vietnam) and from military incursions by North Vietnam's ground forces. Ultimately, the United States withdrew ground forces from South Vietnam in 1973 and air support from the country in 1975. Subsequently, all of South Vietnam was conquered by North Vietnamese ground forces, uniting the two countries under a single government.

1965–1972, intermittently: **Bombing of North Vietnam.** Several U.S. bombing campaigns were conducted on the territory of North Vietnam during the war (as opposed to air operations in South Vietnam, which were essentially continuous in support of U.S. and South Vietnamese ground forces). The most notable campaigns included Operations Rolling Thunder, Linebacker, and Linebacker II.

1972: **Easter Offensive.** This offensive, launched by North Vietnamese ground forces, was largely defeated by South Vietnamese ground forces along with heavy air support from U.S. forces.

1975: **Spring Offensive.** This was the final offensive launched by North Vietnamese ground forces during the war. Unlike in the Easter Offensive, the United States did not provide air support to South Vietnamese ground forces, and North Vietnamese forces fully conquered South Vietnam.

1980: **Operation Eagle Claw.** U.S. special-operations forces attempted to rescue hostages held in Tehran in the wake of the Iranian revolution. The operation failed to meet any of its objectives.

1982: **Falklands War.** The United Kingdom recaptured the Falkland Islands from Argentina, which had occupied them. The campaign involved a U.K. naval task force that secured the seas around the Falklands prior to an amphibious assault by commandos and royal marines that retook the islands. The war included some of the few examples of modern naval combat since World War II: A U.K. nuclear submarine sank an Argentinian ship (the ARA *General Belgrano*), and Argentinian aircraft sank several U.K. ships (most notably, the HMS *Sheffield*) with bombs and cruise missiles.

1986: **Operation El Dorado Canyon.** Air Force and Navy aircraft bombed targets in Libya in response to terrorist attacks sponsored by the Libyan government.

1987: **USS *Stark* Incident.** During the Iran–Iraq War, an Iraqi fighter aircraft fired two cruise missiles at the USS *Stark,* a U.S frigate on patrol in the Persian Gulf. Both missiles hit the *Stark*, causing casualties and damaging the ship.

1990–1991: **Operation Desert Shield.** U.S. forces were deployed to Saudi Arabia to protect that country from a potential invasion by Iraq in the aftermath of Iraq's August 1990 invasion of Kuwait. The first U.S. ground troops deployed were the 82nd Airborne Division, but the deployment ultimately involved a large enough force to invade Iraq and liberate Kuwait (see **Operation Desert Storm,** below). The U.S. military also enforced a naval blockade of Iraq. During that blockade, two U.S. warships, the USS *Princeton* and USS *Tripoli,* were damaged by Iraqi sea mines.

1991: **Operation Desert Storm.** During Operation Desert Shield, the United States' goals shifted from defending Saudi Arabia from an Iraqi attack to removing Iraqi forces from Kuwait. Operation Desert Storm was the operation to liberate Kuwait and destroy Iraqi ground forces. After an air campaign lasting 42 days, the United States launched a ground campaign that achieved its primary goals within 4 days. This conflict saw the first use of the Patriot missile system to defend against Iraqi Scud missiles fired at Saudi Arabia and Israel.

1991–2003: **Operations Northern Watch and Southern Watch.** This pair of operations was the U.S. effort to maintain northern and southern no-fly zones over Iraq (intended to protect Iraqi Kurds and Shiites, respectively) between Operation Desert Storm and Operation Iraqi Freedom.

1992–1993: **Operation Restore Hope.** This operation was the U.S. military component of the United Nations' effort to restore order in Somalia to allow for the distribution of humanitarian aid. During the October 1993 battle of Mogadishu, a U.S. special-operations force was pinned down and isolated in Somalia's capital by hostile militias and suffered several casualties—an incident featured in the book and film *Black Hawk Down*. That incident eventually led the United States to abandon the operation.

1994–1995: **Operation Uphold Democracy.** Initially planned as a U.S. invasion of Haiti to overthrow the Haitian government, this operation became a peacekeeping mission after a diplomatic settlement was reached in which the leaders of the Haitian government agreed to step down.

1998: **Operation Infinite Reach.** Navy ships launched a series of strikes with Tomahawk cruise missiles at targets in Sudan and Afghanistan in response to the bombings of the U.S. embassies in Kenya and Tanzania earlier that year.

1999: **Operation Noble Anvil.** This was the U.S. contribution to the North Atlantic Treaty Organization's (NATO's) operations against Serbia, intended to force Serbia's leadership to relinquish control of the province of Kosovo. The majority of the operation consisted of a three-month bombing campaign against targets in Serbia and against Serbian military units in Kosovo. A diplomatic settlement was ultimately reached in which the Serbian leadership agreed to NATO's demands.

1999: **Task Force Hawk.** A component of the U.S. campaign against Serbia, this Army task force was originally intended to deploy a battalion of AH-64 attack helicopters to Tirana, Albania. For a variety of reasons, the task force grew in size, was slow to deploy, and never participated in the campaign.

2000: **USS *Cole* Bombing.** In this incident, a small boat loaded with explosives was used to launch a suicide attack against the destroyer USS *Cole* while it was docked in the port of Aden, Yemen. The resulting explosion blew a large hole in the hull of the *Cole*, killed 17 sailors, and wounded several others.

2001: **Operation Enduring Freedom.** Although this name technically applied to a wide variety of operations (also referred to as the Global War on Terror), the main component of this operation was the invasion of Afghanistan to oust the Taliban government and apprehend Osama bin Laden after the September 11, 2001, terrorist attacks in the United States. Major portions of the offensive involved U.S. special forces supporting Afghan ground forces of the Northern Alliance and an air assault by U.S. Marines on the city of Kandahar.

December 2001: **Battle of Tora Bora.** U.S. special forces attempted to capture Osama bin Laden and other

elements of the Al Qaeda leadership in a mountainous region of Afghanistan. Despite U.S. confidence that bin Laden was present in the region, he was not found, although it is unclear whether that outcome occurred because he was not present or because of operational missteps.

2001–Present: **Occupation/International Security Assistance Force.** Since Operation Enduring Freedom, the United States has continuously maintained military forces in Afghanistan (often as part of a NATO security assistance force) in an effort to support the Afghan government against insurgents, warlords, a resurgent Taliban, and other destabilizing elements (since 2015, under the name **Operation Freedom's Sentinel**). For much of that time, U.S. forces in Afghanistan consisted of between one and three brigades of ground troops, but those forces were temporarily increased in 2009 as part of a surge.

2003: **Operation Iraqi Freedom.** U.S. forces invaded Iraq with the goal of destroying the government of Saddam Hussein. Army and Marine forces advancing from Kuwait formed the bulk of the U.S. offensive power, but U.S. Army and Kurdish forces in the north of Iraq and an extensive U.S. air campaign were also key parts of the operation. After three weeks, U.S. forces captured Baghdad, and Saddam Hussein's government disintegrated, although some pockets of resistance remained.

2003–2011: **Occupation of Iraq.** The United States maintained military forces in Iraq for eight years after Operation Iraqi Freedom in an effort to support the Iraqi government against insurgents, loyalists of the former regime, local militias, and other destabilizing elements, especially during the Iraqi civil war of 2006 and 2007. For much of that time, U.S. forces in Iraq consisted of between 15 and 18 brigades of ground forces, but those forces were temporarily increased in 2007 as part of a surge.

2011: **Operation Neptune Spear.** U.S. special forces raided a compound in Abbottabad, Pakistan, with the intent to capture or kill Osama bin Laden. The raid was a success, and bin Laden was killed in the action.

2011: **Operation Odyssey Dawn.** This was the U.S. contribution to NATO's operations against Libya, intended to enforce a no-fly zone against the government of Muammar Gaddafi. The operation included cruise missile strikes and a naval blockade, but the majority of the campaign involved using tactical aviation to attack and destroy Libyan government military units. Libyan rebel groups captured and killed Gaddafi during the operation, ending his regime.

2014–Present: **Operation Inherent Resolve.** The United States is currently conducting air strikes against the Islamic State group (known variously as ISIS, ISIL, and Daesh) in Iraq and Syria. The United States has also committed a limited number of special forces to assist Kurdish groups fighting the Islamic State.

DoD Planning Scenarios

The Department of Defense uses scenarios for planning purposes to prepare for the types of conflicts that it considers especially relevant or challenging. Such scenarios are not war plans; they are descriptions of hypothetical conflicts that can be used in various types of analytic exercises rather than detailed plans that could be used in the event of an actual conflict. DoD's scenarios are not necessarily considered likely possibilities—some are useful as examples of worst-case planning, whereas others incorporate features that are considered important for understanding future developments in warfighting. Some of the scenarios that DoD uses involve the following areas:

North Korea. Scenarios for North Korea typically postulate an attack by that country's ground forces on South Korean territory that requires U.S. assistance to repel. North Korea is assumed to use ballistic missiles to try to complicate the U.S. response in various ways, such as by attacking ports and airfields in South Korea with chemical weapons to hinder the arrival of U.S. reinforcements or attacking the United States' allies in the region (such as Japan) to reduce diplomatic support for U.S. goals. Those scenarios allow DoD to consider a variety of issues, including how to provide missile defense to allies, how quickly U.S. forces can be deployed, and how to respond to the use of chemical weapons.

Strait of Hormuz. Scenarios for the Strait of Hormuz (the narrow waterway that connects the Persian Gulf to the Arabian Sea) typically postulate a conflict in which Iran attempts to use submarines, cruise missiles, and small boats to close the Persian Gulf to U.S. Navy warships and civilian shipping at the Strait of Hormuz. Those scenarios allow DoD to consider such factors as the difficulty of projecting naval power in coastal regions

(where defenders have many advantages), ways to counter nontraditional threats such as small boats, and other antiaccess challenges.

Taiwan. Scenarios for Taiwan typically postulate an attempt by China (the People's Republic of China) to force Taiwan (the Republic of China) to reunite with it or to prevent Taiwan from making a formal declaration of independence. China is assumed to use air strikes, cruise missiles, ballistic missiles, and possibly an amphibious attack against Taiwan, while attempting to use its air and naval forces to prevent the United States from defending Taiwan. Such scenarios allow DoD to plan for dealing with a powerful adversary that has a variety of advanced weapons, especially in a naval context. The naval angle is important because combat between modern warships has occurred only once since World War II (during the 1982 **Falklands War**), and the scarcity of such examples means that there is a great deal of uncertainty about what combat between warships might look like now.

South China Sea. Scenarios for the South China Sea typically postulate that the United States would respond to a request for military assistance from one or more of the countries that dispute the claims of sovereignty that China (the People's Republic of China) has made over several islands and their territorial waters in the South China Sea. In those scenarios, China is assumed to have used military force to resolve territorial disputes in its favor, and U.S. air and naval forces would be required to do one or more of the following: defend the opposing countries against Chinese attacks, remove the Chinese military presence from disputed islands, or restore freedom of navigation in the South China Sea. For the purpose of force planning, such scenarios resemble Taiwan scenarios, requiring similar forces against the same opponent in almost the same theater of operations. But they suggest different forms of peacetime preparation, including establishing cooperative agreements with the governments of countries that border the South China Sea, such as the Philippines or Vietnam.

Two Major Regional Conflicts or Major Theater Wars. In the 1990s, U.S. planners used a pair of scenarios (called major regional conflicts or, later, major theater wars) occurring at the same, or nearly the same, time as the formal benchmark for most planning decisions about the military's force structure. One scenario was the **North Korea** scenario described above. The other scenario was an Iraqi invasion of Kuwait and Saudi Arabia (essentially, a hypothetical variant of **Operations Desert Storm and Desert Shield** in which Iraq's offensive did not stop at the Saudi Arabia–Kuwait border). That pair of scenarios was DoD's planning framework, with some variations, for about a decade. It dominated the department's planning during the period between the collapse of the Soviet Union and the terrorist attacks of September 11, 2001.

List of Tables and Figures

Tables

Figures

About This Document

This Congressional Budget Office report was prepared at the request of the former Ranking Member of the Senate Committee on the Budget. In keeping with CBO's mandate to provide objective, impartial analysis, it makes no recommendations.

Adam Talaber of CBO's National Security Division prepared the report with guidance from David Mosher and Matthew Goldberg. David Arthur, Elizabeth Bass, Michael Bennett, Daniel Frisk (formerly of CBO), Bernard Kempinski, Eric Labs, and Carla Tighe Murray provided comments or fact-checked the report. Bernard Kempinski also created the unit graphics for Chapters 2, 3, and 4.

Sarah Jennings, Kent Christensen, Bill Ma, David Newman, Dawn Regan, and Matt Schmit of CBO reviewed earlier drafts of the report and provided comments, as did Douglas Elmendorf, formerly of CBO; Irv Blickstein and John Gordon of the RAND Corporation; Frank Lewis of the Department of Energy's National Nuclear Security Administration; and David McNichol of the Institute for Defense Analyses. (The assistance of external reviewers implies no responsibility for the final product, which rests solely with CBO.)

Jeffrey Kling and Robert Sunshine reviewed the report, and Christian Howlett edited it, with assistance from Kate Kelly. Maureen Costantino designed the cover and prepared the report for publication, with assistance from Jeanine Rees. An electronic version of the report is available on CBO's website (www.cbo.gov/publication/51535).

Keith Hall
Director

July 2016