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Key Points

Air Force aircraft present fundamentally unique, effective, and efficient policy options to U.S. leaders not found elsewhere in the Department of Defense (DOD) or the other military services.

The Air Force aircraft inventory is too small to meet current national security demands. It is time to chart a prudent path forward to enable the Air Force to grow the capacity it needs.

For too long, the DOD has made resource decisions within service-centric stovepipes. This impedes the ability to consider "best value" options and solutions in a holistic DOD-wide fashion.

Secretary of the Air Force Heather Wilson is correct, the Air Force does need to grow. Her target goal of 386 squadrons simply meets demand that already exists. This does not reflect surplus capacity. Failure to meet this goal will burn out existing resources with too many core mission areas registering as "high demand, low density." The current pilot crisis is a lead indicator of this problem.

The Force We Need:
Key Factors for Shaping the Air Force for the Future

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Abstract

Today, the United States Air Force is the smallest it has ever been since its founding as an independent military service in 1947. This dynamic now translates to fewer national security options presented to combatant commanders and decision makers, and increased risk at a time when threats are on the rise around the world. Potential U.S. adversaries and competitors understand this vulnerability, and have moved to take advantage of this opening.

While the nation possesses other military air assets in the Navy, Marine Corps, and Army, those are aviation arms designed to support the core functions of their respective services. Individually, they lack the scale, scope, and the capabilities necessary to facilitate independent, theater-wide, full-spectrum operations. The Air Force is unique in its organization to project range, mass, lethality, and survivable power in a theater-wide fashion, free from organic surface mission obligations.

The Air Force needs a force-sizing method to clearly articulate aircraft requirements, highlight any gaps that may exist or emerge, and help guide modernization decisions. Nor is a force-sizing model alone enough. Leaders need to ensure that resources are available to adequately build the Air Force the United States requires. If tradeoffs are required, then available funds must focus on mission areas that yield the most effective, efficient set of options.

Introduction

During a recent speech, Secretary of the Air Force Heather Wilson issued a warning: "We must see the world as it is. That is why the National Defense Strategy explicitly recognizes that we have returned to an era of great power competitions. We must prepare." World events back up this assertion in no uncertain terms. With China aggressively expanding its territorial zone of control in the Pacific Ocean far in excess of international norms and Russia pursuing overt acts of hostility in places like Ukraine and Syria, the global threat environment is growing to levels unseen since the Cold War. Nor are all challenges limited to great power competition. North Korea's possession of nuclear weapons and Iran's continued assertiveness in the Middle East are generating strategic-level threats from regional actors. Finally, persistent instability in places like the Middle East, Africa, and beyond continues to demand military attention. These combined pressures drove Wilson to conclude a fact long known throughout the defense community: "The Air Force is too small for what the nation expects of us."[1]

An undersized U.S. Air Force translates to fewer national security options, and the assumption of significantly increased risk at the strategic, operational, and tactical levels of conflict.

An undersized U.S. Air Force translates to fewer national security options and the assumption of significantly increased risk at the strategic, operational, and tactical levels of conflict. Fall back courses of action hazard ceding the initiative to potential adversaries, projecting forces vulnerable to attack, incurring high rates of attrition, while also increasing the likelihood of drawn-out wars, perhaps even defeat. The basic reality is that Air Force airpower provides a unique asymmetric advantage for the United States through its ability to strike targets anywhere on the globe, anytime; secure and maintain theater-wide air superiority; gather vital intelligence, surveillance, and reconnaissance (ISR) on a global scale; facilitate command and control of forces; and execute global mobility in a matter of hours. These attributes are vital to empowering successful, decisive strategies against highly capable adversaries.

While the U.S. possesses other military air assets in the Navy, Marine Corps, and Army, those forces are organized under aviation arms designed to support the core functions of their respective services. Individually, they lack the scale, scope, and the capabilities necessary to facilitate independent, theater-wide, full-spectrum operations. Naval carrier air wings are first and foremost focused on defending the ships of naval surface action battle groups. Their small size also limits their ability to project large scale, sustained airpower. Aircraft carrier availability rates govern the percentage of airplanes available to employ at any given time—a number normally less than 50 percent. Marine Corps aircraft are tied to Marine Air-Ground Task Forces (MAGTFs) and are generally not available for theater taskings. The same holds true for organic Army aviation assets with their function directly assigned to their Army organizational units. Regardless, the radius of an Army attack helicopter's average mission is quite limited, and they are highly vulnerable to anti-aircraft weapons in contested environments. The Air Force is unique in its organization to project range, mass, lethality, and survivable power in a theater-wide fashion, free from organic surface mission obligations. Combatant commands (COCOMs) understand this value, and it is a key reason why they place a high priority on Air Force aircraft and personnel. As one Air Force analysis recently detailed: "In the last five years, [Air Force Global Strike Command] has gone from supporting

one enduring COCOM requirement to an average of 12 annually, a 1,100-percent increase."[2] Given the Air Force's small bomber fleet of 157 aircraft, a record low number by historic standards, meeting this demand presents challenges. Nor is this a one-off situation, with nearly every Air Force mission set in high operational demand with fewer aircraft available to meet the spectrum of these requirements.

Recognizing the need to align available resources with demand, in 2018 Wilson articulated the requirement to grow operational Air Force squadrons from 312 to 386 by the 2025-2030 timeframe. In doing this, she explained, "It's not just getting larger—the way we fight will be different…how will we present multiple dilemmas for our adversaries."[3] This is an important statement, for fighting and winning against today's threats, and those in the future, is a very different proposition than fighting against past threats. Established methods of power projection must be challenged in the pursuit of more effective, efficient, and survivable concepts of operation. Accordingly, leaders must adopt the measure of merit of "cost-per-desired effect"—the actual enterprise mission expense associated with securing desired aims—versus the traditional upfront unit acquisition expense as a decision metric. For example, a stealth aircraft is far more cost-effective than the alternative of a strike package of over a dozen legacy aircraft to net the same objective at far greater risk. Additionally, it is important that leaders understand the qualities they need to acquire for a modern military. No longer is warfare driven by physical assets like airplanes, ships, tanks, and satellites. Instead, the operating paradigm must shift to focus on the ability to gather, process, and disseminate information to ensure that the most effective mix of assets will be at the right time and place to best net a desired effect while minimizing undue vulnerability. This stands as an imperative for success in the information age—a concept to achieve an intelligence, surveillance, reconnaissance; strike; maneuver; and sustainment complex often referred to as a combat cloud.

Potential adversaries have studied the established American way of war—forms of power projection which have generally remained static since the end of the Cold War.

Potential adversaries have studied the established American way of war—forms of power projection which have generally remained static since the end of the Cold War. These challengers have worked to both emulate the strengths and probe the weaknesses inherent in these methods. There is a reason why Russia, China, and many European nations are focused on developing fifth generation stealth fighters for their air forces. It is also why Chinese military leaders speak openly about using advanced anti-ship missiles to sink American aircraft carriers, with one recently mocking that "we'll see how frightened America is" in the face of such action.[4] Maintaining the status quo amidst such pressures is not a viable or sustainable option. Leaders must press forward with the charge of improving the effectiveness, efficiency, and survivability of U.S. military power.

The time to act is now, with the Air Force's present circumstances harkening back to a statement made by then-Secretary of Defense Donald Rumsfeld in the early years of the Afghanistan and Iraq wars—when the impact of a Cold War peace dividend saw the U.S. military stretched thin to meet combat requirements. "You go to war with the Army [Navy, Air Force, and Marines Corps] you have, not the Army [Navy, Air Force, and Marines Corps] you might want or wish to have at a later time."[5] While Rumsfeld did not win any popularity points with that blunt assessment, he was exactly correct. Modern conflicts emerge quickly,

move fast, are unpredictable, and victory often hinges on decisive, prudent power projection capabilities. Advanced combat aircraft like bombers, fighters, and tankers are not built overnight. The same holds true for the airmen who fly and maintain them. Training, building experience, and honing concepts of operation takes years. Decisions made today regarding the size and composition of U.S. military force structure will fundamentally govern the scale and scope of national security options available to leaders for decades to come.

With this in mind, the Mitchell Institute puts forward the following key policy recommendations:

- For the last three decades, the success or failure of U.S. military campaigns did not fundamentally threaten America's existential security interests. This dynamic is rapidly changing in an era defined by multiple peer-nation security challenges. The Department of Defense must address "high demand, low density" mission areas that tie directly to core aspects of the *2018 National Defense Strategy*, which stresses the importance of great power competition.
- Following Wilson's example, the Air Force must continue to highlight the gap that exists between available force structure capacity and real-world security requirements as articulated in the *National Defense Strategy*.
- The Air Force must develop and implement a force-sizing construct to ensure service leaders, defense officials, Congressional staff, and other stakeholders are afforded insight into the nature of these capacity gaps.
- Force growth requirements, as articulated by Wilson, are focused on meeting existing demands on the force. They do not represent surplus capacity. The Air Force must prioritize capabilities and capacity that address future requirements, not just meeting past needs. Finite funding and growing operational demands weighing on U.S. forces in ways not seen in decades demand qualities such as "combat cloud" functionality, range, stealth and fifth generation design characteristics, and improved readiness rates.
- Growth is not just about aircraft force structure. Pilot production, maintenance capacity, and effective logistics will also prove critical to yielding credible, sustainable combat power in the future.
- The Department of Defense clearly faces resource challenges. However, room for necessary investment can largely be found within existing budgets by conducting an honest review of roles and missions, and shifting from a "unit cost" acquisition metric to a "cost-per-desired effect" measure of capability merit.
- Finally, legacy operating constructs must be challenged from combatant commands to the military services. Past approaches executed through a given domain, or with certain assets, do not preclude the pursuit of more effective, efficient, survivable, and responsive mission alternatives.

History Affords Crucial Lessons

History offers many cautionary tales on the danger of failing to adequately prepare. When Hitler invaded Czechoslovakia in 1938, Great Britain possessed less than half a dozen Supermarine Spitfire fighters—the aircraft that was to prove crucial during the Battle of Britain. Despite efforts to surge production in the face of looming war, aggressive growth targets were hard to meet given the state of the industrial base after years' worth of interwar austerity measures. As Spitfire test pilot Jeffrey Quill explained, "…no firm in the industry was in a position to respond effectively to the sudden demand

for great expansion of its production capacity simultaneously with great forward strides in the technological field."[6] The same could be said for the current state of the U.S. aerospace industry, where a limited number of firms compete for an exceedingly small number of new production contracts.

On the eve of the Battle of Britain, England found itself in a precarious position. The Royal Air Force (RAF) Fighter Command possessed 446 operational fighters against 3,500 German Luftwaffe combat aircraft.[7] Experienced pilots were also in short supply. In the 10 days between August 8 and August 18, 1940, the RAF lost 154 pilots, with only 63 green airmen available from training squadrons to backfill casualties.[8] In the words of RAF Fighter Command's leader, Air Chief Marshal Hugh Dowding, experienced pilots "were like [gold dust], and each one lost had to be replaced by an untried man who for some time would be vulnerable until he acquired battle know-how. Fresh squadrons, moved in to replace the tired units, very often lost more aircraft and pilots than the formations they replaced."[9]

Nearly 80 years after the Battle of Britain, the U.S. Air Force finds itself confronting burgeoning threats with the smallest, oldest, and least ready aircraft inventory it has ever operated. On top of this, the service is grappling with a pilot shortfall that further complicates the situation.

The existential stakes of these perilous circumstances become shockingly clear at the height of the Battle of Britain. On September 15, 1940, with Britain facing one of the largest German attacks of the entire conflict, Prime Minister Winston Churchill visited an air defense command and control center responsible for directing RAF fighters against the attacking German forces. Watching the waves of incoming German attackers on the center's plotting boards, Churchill asked "What other reserves have we?" Air Vice Marshal Keith Park replied, "There are none."[10] Decades later, the story is often romanticized as an example of stoic airmen defending their nation against the odds. In actuality, it portrays a country teetering on the brink of disaster. A nation's very existence and the safety of its citizens deserve concerted, practical preparation, not a strategy based on hope, luck, and the thinnest of margins.

This historic example should not be treated as a relic. Nearly 80 years after the Battle of Britain, the U.S. Air Force finds itself confronting burgeoning threats with the smallest, oldest, and least ready aircraft inventory it has ever operated. On top of this, the service is grappling with a pilot shortfall that further complicates the situation. The drivers behind these circumstances are clear: a post-Cold War drawdown, an Air Force procurement holiday that extended from the 1990s well through the turn of the century, and budget shortfalls driven by the Budget Control Act of 2011 that were exacerbated by numerous congressional continuing resolutions. These challenges, combined with shortfalls in the other services, prompted the National Defense Strategy Commission to conclude in its November, 2018 report that "America is very near the point of strategic insolvency, where its 'means' are badly out of alignment with its 'ends.'"[11] Even warning that the U.S. "…might struggle to win, or perhaps lose, a war against China or Russia…[and is] particularly at risk of being overwhelmed should its military be forced to fight on two or more fronts simultaneously."[12]

World events unfold with utmost speed in the modern era. Contemporary weapon systems are incredibly complex, taking significant time to produce. Training skilled personnel is equally demanding. These factors preclude last minute surge options, even more so than in previous eras. Britain's strug-

gle to prepare for World War II was difficult. However, America's present challenge to build advanced capabilities in sufficient quantities, in a far more technologically complex era, and in far less time, presents a much more intimidating challenge. Wilson is right, the time to reset this imbalance is now. Whether her call for action is heeded will likely spell the difference between success and failure in confronting America's future challenges.

Air Force Airpower Affords Effective, Efficient, and Unique Policy Options

Given the number of competing priorities in the portfolio of the Department of Defense (DOD), it is important to ask: why does Air Force airpower matter? The answer centers upon one overriding factor: Air Force airmen and the combat aircraft they operate are wholly dedicated to securing desired mission objectives in the most effective, efficient fashion possible, while minimizing the projection of unnecessary vulnerability. Given the unique advantages of powered flight, this means combat aircraft can fly over and around opposing forces, securing desired effects at the heart (the "centers of gravity") of an opponent's war-making enterprise without having to fight through an enemy's fielded surface forces. Whether discussing striking a high-value terrorist leader in a hostile region, or a conventional military target deep behind enemy lines, the advantages afforded by going "over" not "through" are immense. Effects can be attained rapidly, on a global scale, and do not risk getting bogged down with resource-intense ancillary functions like occupying and securing territory in order to net ultimate objectives.

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ROOTS OF AIRPOWER

The origins of combat airpower date back to World War I, when airmen flying over the top of the bloody trenches looked down and determined that there must be a better way to attain victory than strategies based upon linear surface power projection, forced occupation, and attrition warfare. As airpower leader and pioneer Army Brig Gen William Mitchell explained in the aftermath of the conflict:

"Armies proved conclusively in the last war that they could not gain victory. For four years they faced each other across a lot of ditches in northern France and went backward and forward only a few miles. Millions of men were killed and wounded; billions of dollars were spent; natural resources became exhausted; lines of communication were destroyed or greatly impaired. All that happened only went to prove that the armies, following an entirely worn-out theory that they could advance and capture the vital centers of the enemy against an opposing army, had not taken a proper count of modern means of defense, such as the machine gun, the rapid-fire cannon and toxic gasses. By their ignorance of modern methods and devices, they brought the world to the verge of ruin."[13]

Seeking a more effective and efficient path to attaining victory, airmen proposed flying past the fielded enemy ground forces to strike the centers of gravity that sustained their power projection capacity. As Mitchell further explained: "The advent of airpower which can go straight to the vital centers and entirely neutralize or destroy them has put a completely new complexion on the old system of making war."[14]

Air Force aircraft also afford another advantage over their sister-service aerial counterparts: they are focused on combatant commander-directed missions unfettered from surface-support roles. This stands in contrast to Army aircraft that are organically tied to specific surface units; carrier-based naval aircraft that fly first and foremost to protect the carrier battle group and whose availability is governed by ship deployments; and Marine aviators, who are tied to the MAGTF. This is not to say that these other missions are not important. However, when making decisions regarding the scale and scope of air assets in each of the services, it is important to understand the opportunities and limiting factors associated with each

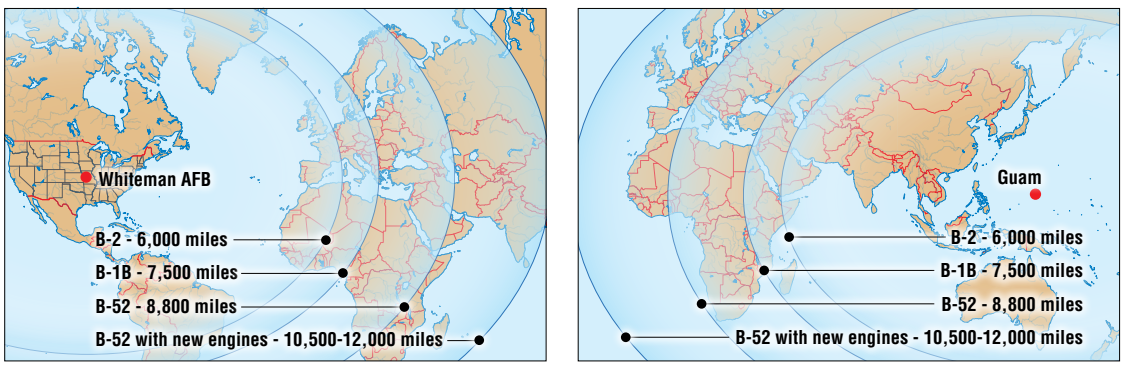
entity. To better understand this concept, it is helpful to explore three key Air Force mission sets: long range strike, air superiority, and close air support.

Long-Range Strike

The first category, long range strike, is fundamentally unique to the Air Force. Harnessing the service's bomber aircraft—the B-1B, B-2, B-52, and eventually the B-21—airmen can literally operate anywhere in the globe in a matter of hours with almost no basing constraints. Divisions of soldiers, ships at sea, and amphibious assault forces do not move nearly as quickly, taking weeks if not months to get into position. As former Air Force Secretary Donald Rice explained in the service's 1992 *Global Reach, Global Power* vision document: "Our global power ensures that our friends are not alone. With our responsiveness, potential adversaries understand that distance does not mean disinterest." A B-2 can fly 6,000 miles on internal fuel stores alone, with one refueling extending the bomber's reach to over 10,000 miles—the equivalent of flying from Seattle to London and back. A B-52 can fly 8,800 miles on a single tank of fuel, and a new re-engining program could expand the range upwards of 40 percent. The B-1B is also long-legged, able to range 7,500 miles without refueling. [15]

This means that bombers can literally cover every target on the globe from bases well outside an enemy's reach—effectively negating anti-access strategies. This also means they can provide a large volume of striking power when regional operating bases are not available. The former scenario is increasingly important given the investment countries like China and Russia are making in weapons and strategies that hold U.S. and allied operating facilities at risk. This advantage is useful given the declining number of permanent U.S. airbases available around the world. Overseas Air Force bases declined from 98 in 1956 to 30 by 1990, and stand at 13 today.[16] When a refueling is required, one air-to-air tanking can yield a disproportionally high impact to extending the combat power of the bomber in question, with thousands of miles gained per refueling. That is a major benefit given that the number of refueling aircraft available in each theater is one of the biggest limiting factors to the scale and scope of aerial power projection.

A bomber's advantage is not limited to range. These aircraft have tremendous payload carrying capacity that translates to dozens of independent effects per single mission. A B-2 can currently hold 80 GBU-38 Joint Direct Attack Munitions (JDAMs) at one time, a B-1B can haul 84 Mk 82 bombs, and a B-52 can deliver 45 Mk 82 bombs on a single sortie. Upgrades currently available could see the B-2, B-1B, and B-52 carry 192, 96, and 80 GBU-38 small diameter bombs (SDBs) respectively. This is a large amount of payload for a single aircraft to haul and yields outsized advantages in combat. Putting this sort of payload value in context, former National Security Advisor

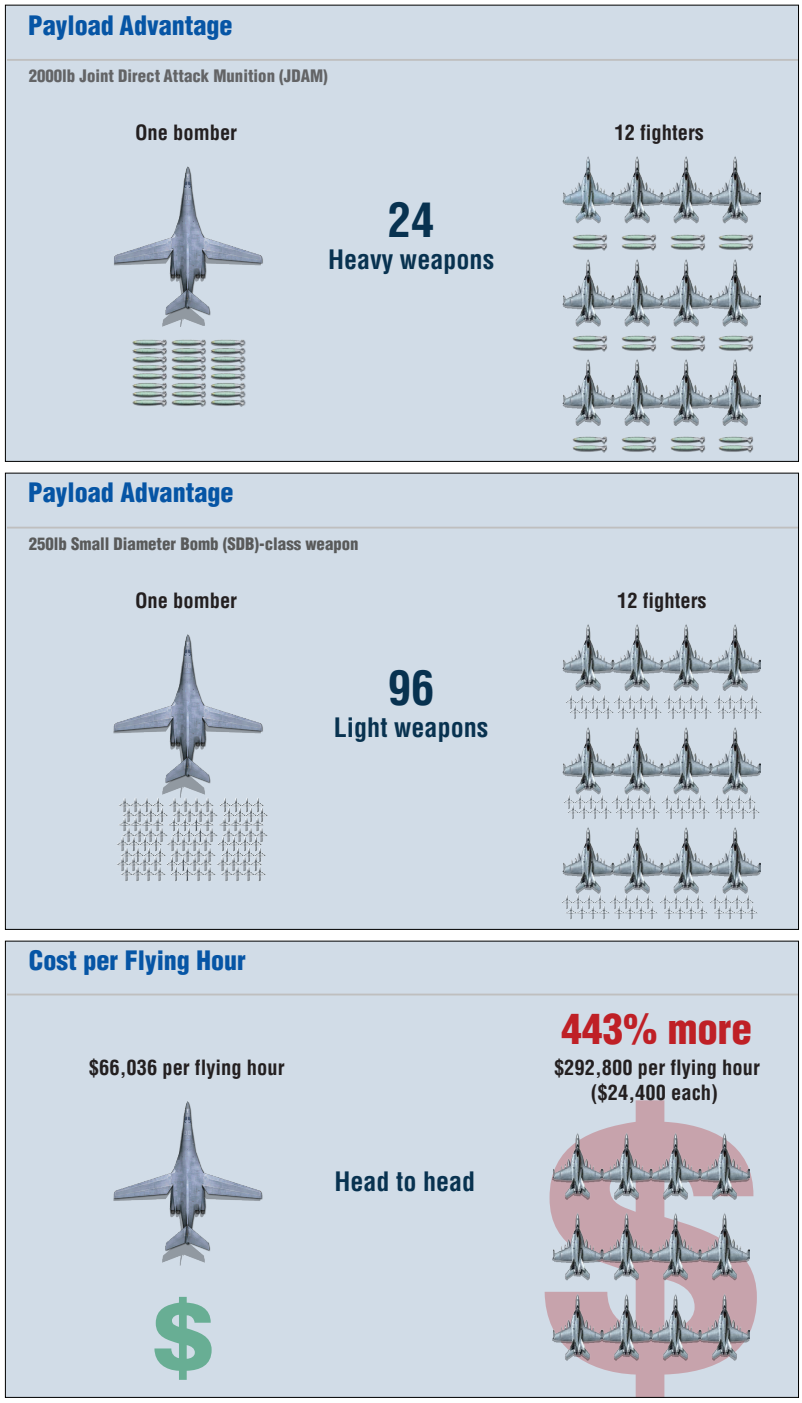


Source: Jane's All the World's Aircraft, U.S. Air Force, Northrop Grumman. Artwork: FoxbatGraphics

Figure 1: Bombers possess incredible range with their internal fuel stores, and aerial refueling further extends this reach. That is a key reason why they afford tremendous mission value. Achieving this sort of effect with alternate systems would drive far higher mission expense.

Brent Scowcroft explained that the B-52 "only represented four percent of the force [in Operation Desert Storm], but delivered [32] percent of the bomb tonnage—more than twice as much as the [U.S. Navy aircraft] carrier force combined."[17] This was not a one-off occurrence. In the opening phases of Operation Enduring Freedom, 24 Air Force bombers flew 11 percent of the strike sorties, but dropped 75 percent of the munitions.[18] Looking to the future, it is worth noting that conflicts against North Korea, Iran, and Russia would involve approximately 74,000, 82,000, and 250,000 potential aim points respectively.[19] That sort of requirement is going to demand a bomber's payload. Standoff-heavy options, such as cruise missiles, would prove price-prohibitive and rapidly exhaust available supplies.[20]

Figure 2: The services buy an aircraft once, but employ it for decades. Cost-per-effect is a far more accurate assessment of real-world expense, not per-aircraft acquisition cost. Given that the Air Force and Navy calculate cost per flying hour differently, this is a generous comparison, with the Super Hornet's expense rising further if unique factors regarding carrier-deployment and availability are included.



Sources: U.S. Air Force, Jane's All the World's Aircraft. Artwork: FoxbatGraphics.

The notion of mass payload also connects to the idea of cost-per-desired effect—getting the most combat power on target for the lowest cost. A bomber, while often labeled as "expensive" to acquire on a per-aircraft basis when compared to smaller aircraft, affords huge operational efficiency over its lifespan. For example, two B-1Bs flying Operation Inherent Resolve sorties could deliver more ordnance than 40 carrier-based F/A-18s operating from the Persian Gulf.[21] Nor is it just about counting aircraft tails, for the definition of cost also extends to associated personnel, logistics support, basing, and other considerations.

Finally, from a survivability perspective, stealth bombers, like the B-2 and eventually the B-21, afford the United States the unique option of securing effects in highly contested regions—an operating condition proliferating around the globe as high-end fighters, surface-to-air missile systems (SAMs), and integrated air defense systems (IADS) are acquired by more and more countries. Even legacy non-stealthy types, like the B-1B and B-52, while not affording the full spectrum protection of stealth, also allow survivable power projection thanks to their carriage of standoff munitions and ability to fly from bases outside established threat rings.

Air Superiority

The core mission of air superiority is a fundamental precondition for the successful employment of every form of joint force power projection. Ships at sea, forces on the ground, and non-stealthy aircraft like command and control airplanes, tankers, and transports will not remain operationally viable if subject to concerted aerial attack. While it is a proud accomplishment that no U.S. surface forces have been killed by an enemy aircraft since 1953, this long-established record has also encouraged a sense of complacency. Force planners and budgetary programmers have largely stopped factoring into force structure for attrition and loss that may occur against advanced foes. Leaders have also taken significant risk by underinvesting in the air superiority mission—most notably when former Secretary of Defense Robert Gates chose to curtail F-22 production at less than half the stated military requirement. Since then, modernization and readiness accounts for existing fighter aircraft have been neglected relative to growing threats. Assuming the presence of air superiority, but failing to invest in the tools necessary to assure this condition, is the situation the U.S. military finds itself in today. Resetting this situation means prioritizing fighter aircraft modernization through the F-35 and eventually the next generation air dominance aircraft (NGAD).

Non-Low Observable Legacy Fighters		Low Observable Fighters	
F-15C	235	F-22	186
F-15E	218	F-35	175
F-16	939		
Total	1392	Total	361

Non-Low Observable Legacy Bombers		Low Observable Bombers	
B-1B	62	B-2	20
B-52	75		
Total	137	Total	20

Figure 3: The current U.S. Air Force fighter and bomber inventory is too small to meet national defense strategy demands. A concerning shortfall of low-observable aircraft required for operations in defended airspace now exists, nor is there much force structure set aside for combat attrition. A large percentage of these aircraft would also not be available for combat, due to test, training, maintenance, and force rotation requirements.

In many ways, the present challenge to America's dominance in the sky can be traced back to Operation Desert Storm, when the world watched as the U.S. and its allies harnessed an air-centric strategy to win a rapid, decisive victory against Saddam Hussein's forces. Subsequent military operations in the 1990s and beyond repeatedly emphasized the critical advantage control of the sky afforded U.S. forces. Countries like Russia and China took note of the results and dedicated significant resources to emulating U.S. airpower strengths, while concurrently challenging the ability for competitors to freely project such power in the future. Nearly three decades later, the results of this effort are clear. China and Russia have developed an impressive set of airpower capabilities that seek to both project offensive power, while also bolstering a strong defense. Core facets of this effort include offensive bombers and missiles, fifth generation-type fighter aircraft, and advanced SAMs. Unilateral American dominance is something that cannot be taken for granted amidst these new capabilities.

To better understand these evolving threats, it is useful to examine China's recent military investments and operational trends. According to the DOD's 2018 edition of its annual report to Congress on Chinese military power:

> *…the PLA has been developing strike capabilities to engage its targets as far away from China as possible. Over the last three years, the PLA has rapidly expanded its overwater bomber operating areas, gaining experience in critical maritime regions and likely training for strikes against U.S. and allied targets.*[22]

Such operations are not benign. They represent deliberate actions to demonstrate Chinese power, normalize military presence in international regions, and hone operational power projection capabilities.

While current operations are being conducted with the cruise-missile equipped Chinese H-6 bomber—a legacy Soviet design[23]—in 2016, then-Peoples Liberation Army Air Force (PLAAF) commander, Gen Ma Xiaotain, stated that the Chinese were developing a new long-range stealth bomber.[24] The DOD estimates this type, now referenced as the Hong 20, could debut as soon as 2025 and have a range upwards of 5,000 miles.[25] On top of this, China possesses a large inventory of ballistic and cruise missiles that are designed to project large volleys of firepower.

Effectively managing these developing threats demands investment in U.S. air superiority capabilities and capacity.

When it comes to challenging U.S. and allied air operations, China has focused significant investment in modernizing its fighter inventory with fourth generation aircraft derived from Russia's Su-27 and Su-30, as well as indigenous designs like the J-10.[26] The Chinese are also developing fifth generation capabilities in the form of the J-20 and J-31 stealthy fighters.[27] According to the U.S.-China Economic and Security Review Commission, the J-31's capabilities "…could rival those of the U.S. F-35 fighter and challenge U.S. aircraft in the Western Pacific."[28] This finding is concerning on multiple levels. First and foremost, it demonstrates clear and decisive progress on the part of the Chinese military aerospace community. Second, if aircraft like the J-31 pose an eventual challenge to advanced types like the F-35, the impact they will have on legacy fourth generation types like the F-15, F-16, and F/A-18, will be stark.[29] Sources also suggest the Chinese are seeking to arm their new fifth generation fighters with highly advanced munitions, with the DOD stating that Chinese engineers "report successful testing of a solid-fuel ramjet missile engine and suggest this will enable the J-20 to carry future Mach 5, 300km range air-to-air missiles."[30]

The air domain challenge is not restricted to fighter aircraft. The DOD's annual China report explains the PLAAF "possesses one of the largest forces of advanced long-range SAM systems in the world…"[31] This arsenal consists of Russian designs like the SA-20 and SA-21 (also known as the S-400) as well as indigenous Chinese types such as the HQ-9. These systems are linked to airborne early warning and control aircraft "…to detect track and target threats in varying conditions, in larger volumes, and at greater distances… extend[ing] the range of China's integrated air defense systems network."[32] Ranges for these systems are impressive, reaching as far as 250 miles.[33] Based on a man-made island or on a ship, these weapons pose a far-reaching, dynamic threat that promises to rapidly complicate military operations throughout the Asia-Pacific region.[34]

Effectively managing these developing threats demands investment in U.S. air superiority capabilities and capacity. Fighters will prove crucial in engaging enemy aircraft and cruise missiles, while also joining bombers to strike SAM batteries, surface-to-surface missile targets, and critical centers of gravity. If the Air Force was asked to engage against such threats today, 120 combat-coded F-22s, a handful of F-35s, and 20 B-2s would be stretched exceedingly thin. Operating across vast distances, inventories already limited in number would be taxed even more when seeking to project power in a concerted, sustained fashion. Legacy aircraft like the F-15 and F-16 would certainly be compelled to join the fight, but high attrition would likely rapidly diminish the viability of these non-stealthy aircraft whose designs

date back to the early 1970s. While aircraft losses would certainly be difficult to absorb, losing the pilots would portend catastrophic consequences. With current pilot production already under pressure to meet peacetime demands (a combat-competent airman takes years to develop), the U.S. could find itself crippled by a lack of pilots. The same challenge holds true for the Navy's fleet of non-stealthy F/A-18s, which would be further hindered given the ability of a modern adversary to target an aircraft carrier. While land bases would certainly also face similar threats, these facilities have the obvious advantage of not being vulnerable to sinking.

FIGHTERS IN DECLINE

1990		2019	
F-4D/E	390	F-15C/D	235
F-15A/B/C/D	890	F-15E	218
F-16A/B/C/D	1613	F-16C/D	941
		F-22A	186
		F-35A	175
Total	2893	Total	1755

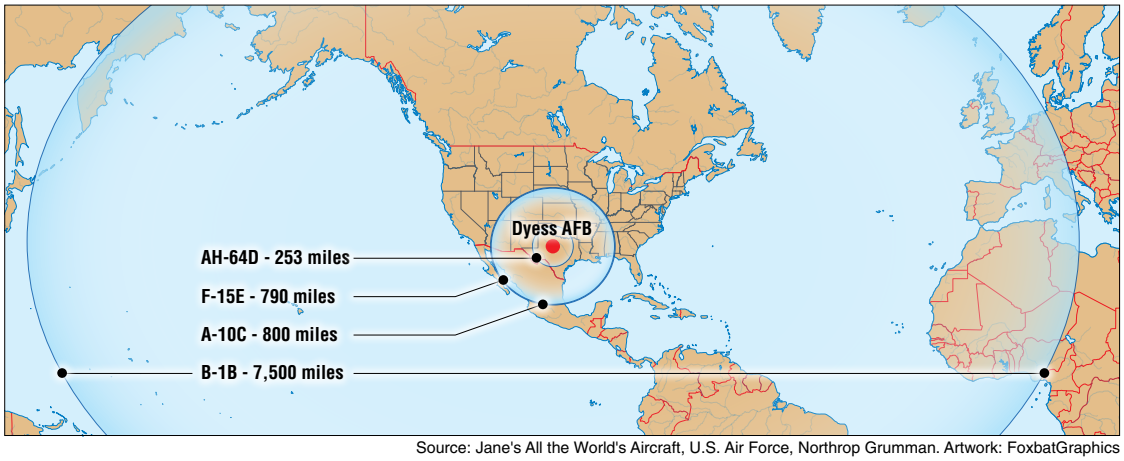
Figure 4: A snapshot of U.S. Air Force fighter inventories, from the end of the Cold War and the present day.

Countering these sobering factors depends on credible combat power. As the 2017 *Report to Congress of the U.S.-China Economic and Security Review Commission* explained, "If Beijing believes the risk of response to Chinese action is low, China may be tempted to risk brinksmanship to achieve its national objectives."[35] The challenges facing the Air Force—limited numbers of advanced aircraft and pilot shortfalls—are well known by adversaries like China. These shortfalls, paired with other U.S. military deficiencies, may explain China's aggressive reclamation and militarization of artificial features in international waters. The only response to check such action is to rebuild modern capabilities and operationally viable capacity—in short, to rebuild the proven concept of "peace through strength."

Close Air Support

The imperative behind the Air Force mission of close air support (CAS) is simple: empower surface forces by targeting enemy units within a defined zone of tactical employment. In many ways, this is one of the most emotionally satisfying of the Air Force's assigned missions due to the direct connection to saving friendly forces in real-time. At the same time, it is also important to understand that the Air Force's role in the CAS mission is one driven by unique capabilities. The range, speed, payload capacity, survivability, and situational awareness afforded by Air Force aircraft to conduct CAS is second to none.

Whether considering the venerable A-10, an MQ-9, F-15E, B-52, or a B-1B, Air Force aircraft that execute CAS sorties may reach separate points on a battlefield in a matter of minutes, or span across a theater on a



Source: Jane's All the World's Aircraft, U.S. Air Force, Northrop Grumman. Artwork: FoxbatGraphics

Figure 5: The range capabilities of U.S. Air Force aircraft in the close air support mission alone is second to none. This graphic demonstrates unrefueled combat ranges of several CAS aircraft. Given such a comparison, it remains puzzling why the Department of Defense sought the retire the A-10 at the very same time it was procuring new AH-64s. Planned retirements of the B-1B in the 2030s also seem odd given the combat air force capacity shortfall expected to impact the service in the out years.

single mission. This stands in stark contrast to other forms of force application used in conjunction with ground forces, like ground-based artillery or an attack helicopter. Taking this latter example in comparison, the Army's latest version of Apache attack helicopter, the AH-64E, has a stated range of 300 miles, a top speed of 166 miles per hour, and armament options that include 16 AGM-114 Hellfire missiles; 76 Hydra 70 2.75-inch rockets; and 1,200 30 mm M230 chain gun rounds.[36] By comparison, an A-10 has a range of 2,580 miles, a top speed of 517 miles per hour, and a set of armament options that include one 30 mm GAU-8/A seven-barrel Gatling gun; up to 16,000 pounds of mixed ordnance on eight under-wing and three under-fuselage pylon stations, including 500-pound Mk-82 and 2,000 pound Mk-84 bombs, incendiary cluster bombs, combined effects munitions, mine-dispensing munitions, AGM-65 Maverick missiles and laser-guided/electro-optically guided bombs; infrared countermeasure flares; electronic countermeasure chaff; jammer pods; 2.75-inch rocket pods; illumination flares; and AIM-9 Sidewinder air-to-air missiles.[37] Regarding the issue of survivability, during Operation Iraqi Freedom, from 2003 to 2009, 19 Apache helicopters were lost, the vast majority shot down by low-tech insurgent force ground fire after the end of major combat operations. During this same time, only one A-10 was lost—to a SAM during the initial phase of the war against Iraq's regular military forces.[38]

When the F-35 enters operational units in broader numbers, it too will bring attributes to the fight, like superior situational awareness, connectivity, and stealth.

The comparisons stack up differently depending on the attributes desired for a given engagement. An MQ-9 can afford over a day of non-stop persistent overwatch with the ability to employ kinetic force at a moment's notice when a target of interest or set of desired engagement conditions arise. A bomber like the B-1B or a B-52 can bring extended on-call loiter time and tremendous magazine depth to strike dozens of targets on a single mission. An F-15E or F-16 can bring speed and survivability into a challenging higher threat situation. When the F-35 enters operational units in broader numbers, it too will bring attributes to the fight, like superior situational awareness, connectivity, and stealth. The mission set comes down to matching given requirements with available aircraft at a certain place and time. Also, as opposed to Marine CAS aircraft wholly dedicated to their ground counterparts, Air Force aircraft in this category are nearly always available to the combined forces air component commander for tasking to any combatant commander mission priority.

There is also a logistics and sustainment consideration in a CAS comparison. Aircraft like the A-10, F-15E, F-16, and MQ-9 can operate from regional bases, most of which are established. Bombers can operate from anywhere in the world thanks to their extreme range. Helicopters, with limited speed and reach, require forward locations close to their zones of employment. The challenges associated with rapid combat deployment in such areas were illustrated by the Army's efforts to deploy 24 Apache helicopters to a base in Albania during the Operation Allied Force campaign of 1999. Setting up the base took 667,000 square meters of rock for 58 landing pads; 26,000 tons of support equipment including 24 support vans, 12 M-1 tanks, 42 Bradley fighting vehicles; 24 rocket defense systems; 37 utility helicopters; and 6,200 troops. Some 2,200 airlift sorties were required to get this infrastructure in theater. At the end of the deployment, the helicopters were never used, as the conflict was over by the time they were available for operations.[39] Such an undertaking proved incredibly expensive, and raised questions

regarding base defense in potentially hostile forward locations, demanded finite logistical support to deploy and sustain the forward location, and required too much time to be operationally relevant.

The overarching point of these comparisons is to highlight the issues of value and investment priorities. Close air support is a mission that stretches across all the military services. Aside from the Marines, whose attack helicopters and combat aircraft are fundamentally interlinked to their ground units through the MAGTF construct, it is important to think about what airframes afford the best value given desired mission effects.

To this point, after the Budget Control Act of 2011 drove the Air Force to recommend retiring the A-10 in 2014, the Army was still acquiring new AH-64 helicopters. From an effects-based perspective, this made little sense because the DOD was seeking to retire the more capable asset (the A-10) which was bought and paid for, while spending money on new, less capable attack helicopters. The important point to stress is that in joint force operations, when aircraft are employed, they are not restricted to service-centric stove pipes. They fly to support overarching joint operational objectives. It is in the combatant commander's best interest to possess the most effective, efficient, and survivable combat capabilities. That means, when Wilson called for an increase in force structure last September, her request should be considered in a holistic fashion. Are the capabilities in demand? Are they more effective, efficient, and survivable than other options of securing desired effects? If so, then those priorities should not be restricted to the Air Force. They should be DOD goals as well. Close air support via Air Force aircraft that span the entire inventory of force application airframes certainly falls into this category.

The important point to stress is that in joint force operations, when aircraft are employed, they are not restricted to service-centric stove pipes. They fly to support overarching joint operational objectives.

Looking to the Future

Burgeoning threat challenges demand the questioning of long-standing mission assumptions. For example, when considering maritime security missions in the Asia-Pacific region, it is important to think about aligning desired effects with the performance attributes each of the U.S. military services offer. Just because many of this region's threats reside and operate on water does not mean that is also where the solution must originate. Capital ships move at around 20 knots, they are increasingly vulnerable to attack, and are range limited in a certain time period. A ship's presence in a given area does not mean it is the best or sole option to facilitate a desired strategy, like sea denial—a mission with growing relevance in the Asia-Pacific area of responsibility. An aircraft, by comparison, can cover thousands of square miles during a single flight, use high-fidelity sensors to gain situational awareness, and employ a variety of weapons, both kinetic and non-kinetic, to achieve a desired result. A Global Hawk RQ-4, U-2 Dragon Lady, or MQ-9 Reaper can cover, on one sortie, orders of magnitude more surface area than a ship when patrolling over open water. Adding to this virtue, with the attribute of low observable stealth technology, aircraft like the B-2, F-22, F-35, and eventually the B-21 become enormously powerful assets in the conduct of maritime domain operations. They can harness their onboard sensors to gain necessary intelligence about enemy ships or maritime installations, approach the target in question without detection, strike, and depart with minimal vulnerability.

In the same regard, airpower should also be viewed for its high potential in the

increasingly important Arctic region. The U.S. has four main objectives in the Arctic: maintain free and open access to the commons; facilitate necessary support structure to promote commerce transit through the area; ensure resources are extracted in accordance with established law; and deter potential adversaries from taking hostile actions in the region while concurrently supporting the interests of allies and partners. Doing so will require the following military functions: robust ISR capacity to provide regional situational awareness; necessary weather data to facilitate multi-domain operations; search and rescue capabilities; the ability to rapidly project power to deter potential aggressors, as well as conditions-based use of force—this includes kinetic strike, electronic attack, and other means; and limited sea-based presence to facilitate ice breaking.

…while fifth generation aircraft are often best recognized for their stealthy designs, it is their ability to engage in this combat cloud construct that provides the most value.

Except for ice breaking, each one of these military functions can be executed most effectively, efficiently, and safely through aerospace operations using air and space craft. Arctic climatic conditions yield incredibly dangerous, hostile operating realities. Working from space and from the air, often with remotely piloted aircraft, will allow military personnel to attain desired effects without falling victim to the liabilities associated with surface operations. A ship at sea or soldiers on land dedicate most of their efforts to staying alive, not executing their assigned mission. Aerospace solutions circumvent challenges found on the surface and allow commanders to focus on achieving policy goals in a far more concerted fashion. These considerations tend to be overlooked in the discussions regarding U.S. interests in the Arctic that generally presume the Arctic is a maritime domain. Instead, the conversation needs to focus on how best to attain desired effects, not conflate the location of where most of those effects are being realized with their effector.

Looking past these traditional mission categories, there is an important attribute of the information age that has the potential to dramatically move beyond established military concepts of operation—the idea of operating as a completely integrated warfighting complex, or a "combat cloud." It is crucial to understand the Air Force is no longer purchasing aircraft in the traditional sense of airframes with mechanical mission functions dictated through its guns, missiles, and bombs. While the mechanical facets of combat aviation are still important, their ability to gather information, process the data into actionable information, and act in a cooperative fashion with other assets in a given region will stand as an increasingly vital capability.

To this point, while fifth generation aircraft are often best recognized for their stealthy designs, it is their ability to engage in this combat cloud construct that provides the most value. It is all about harnessing information to understand the battlespace and determine how to best secure desired effects, collaborate with other service and coalition systems in the region, and minimize the projection of unnecessary vulnerability. A B-21 behind enemy lines might sense a target of interest, understand that the munition best optimized to eliminate the target in question is available on a ship, provide the targeting data to that weapon, and then assess whether the desired effect was achieved. As Air Force Chief of Staff Gen David Goldfein explained: "If we are going to fight and win in wars of cognition, we've got to ask a different series of questions before starting an acquisition program on any platform, any sensor or any weapon… Does it connect? Good. Does it

share? Better. Does it learn? Perfect."[40] If a combat system cannot engage as part of the broader combat cloud concept, its value will be substantially compromised. This is an important consideration as the Air Force modernizes its aircraft inventory. Decision makers and leaders need to understand that they are no longer just buying airplanes. They are now acquiring highly sophisticated information-centric systems that happen to fly. In many ways, this is comparable to a rotary phone bolted to a wall 30 years ago being compared to a smart phone today. Both allow for voice communication, but the latter technology has fundamentally revolutionized what it means to communicate and share information. The same is happening in combat aviation as the combat cloud operating paradigm moves closer to actualization.

In the Vietnam War, the Air Force lost over half its F-105 fighter-bombers to enemy fire. With a highly compromised force, the Air Force was compelled to withdraw the F-105 from active combat service. Such losses in the modern era are unthinkable.

Capacity Matters

There comes a point where technology and training cannot overcome the numbers required to meet the needs of the United States' security strategy. One can go back and look at Winston Churchill's experience during the Battle of Britain to see parallels. No matter how capable the RAF's new Spitfires were, commanders also needed sufficient numbers to defeat the German aerial assault.

Nor is this a one-off example. In the opening phase of World War II, the precursor organization of the U.S. Air Force was nearly stretched to the breaking point. Reflecting on that history, Air Force Gen Curtis LeMay said that there was "nothing worse that I've found in life than going into battle ill-prepared or not prepared at all."[41] LeMay knew what he was talking about. During the opening days of World War II, he found himself in the middle of the Utah desert struggling to train the entire 301st Bomb Group with just three B-17s. Nearly everyone in the unit was a fresh recruit, and few were surprised when crew errors saw two of LeMay's bombers crash in a matter of weeks. Once in England, the green airmen were allotted two flights to learn the basics of formation flying. Their third sortie was a combat mission. Grueling conditions over the subsequent months would push these airmen to the brink, with heroism filling the void yielded by a dearth of preparation. Summing up the experience, LeMay said he hoped "no American has to go through that exercise again."[42]

Despite this sentiment, such circumstances would recur with regularity in the years following the Second World War. In the Korean War, the U.S. barely had enough F-86 fighters to secure necessary air superiority, while also meeting continental air defense commitments in the United States and Europe to counter the Soviet threat. In the Vietnam War, the Air Force lost over half its F-105 fighter-bombers to enemy fire. With a highly compromised force, the Air Force was compelled to withdraw the F-105 from active combat service. Such losses in the modern era are unthinkable. The aerospace industrial base is currently too small to rapidly backfill such demand, and the pilot training pipeline would prove wholly inadequate. This type of surge capacity was ceded in the years following the Cold War to achieve budget efficiencies.

In an era where conflict is bound to unfold rapidly, decisive action will be required immediately, and staying power may prove crucial when facing peer adversaries in a lengthy fight. It is therefore crucial to build a force that is sufficiently sized and aligned with the requirements of U.S. national security strategy. This stands in contrast to the present circumstances facing the Air Force as it confronts a burgeoning threat environ-

ment with an aircraft force of unprecedented age, readiness shortfalls, and small size, as well as a pilot crisis. During a 2017 hearing, then-Senate Armed Services Committee Chairman John McCain declared: "This is a full-blown crisis, and if left unresolved, it will call into question the Air Force's ability to accomplish its mission."[43] It is past time to build the Air Force America needs.

In many ways, the model for demand-driven expansion already exists. In the 1990s, the Air Force was challenged to set up a rotation of its aircraft to support the continuous demands of the no-fly zones over post-Gulf War Iraq—Operations Northern and Southern Watch—while at the same time maintaining other global commitments and carrying out combat actions. The initial ad hoc approach stretched available aircraft and associated personnel to the breaking point at first. The concept, known as the "Expeditionary Aerospace Force" (EAF) sought to meet the demand signal from combatant commanders, while also providing a viable rotation base to avoid burning out personnel and equipment. The Air Force first announced the planned evolution to the EAF concept in August 1998.

The biggest visible structural change was the introduction of the Air Expeditionary Force (AEF) as a means to manage Air Force aircraft and assets. Prior to this change, only 40 percent of the Air Force deployed, with 60 percent staying in garrison all the time.

The reason for the change to the EAF structure was the emerging global security environment of the late 1990s. The end of the Cold War precipitated the shift from the previous national security strategy of Soviet containment to one of engagement. This shift resulted in major force reductions, especially in overseas locations. As a result, the average airman was experiencing significantly higher deployments and operations tempo. In 1999 the Air Force conducted nearly 900 deployments while executing over 160 operations and exercises around the world. This expeditionary approach, while renewed and refocused, is strongly rooted in the history and traditions of airpower. It was further embodied in the core competencies of the Air Force and its central missions of providing timely and responsive land and space-based aerospace power. In turn, it facilitated the key concepts of military joint doctrine.[44]

The biggest visible structural change was the introduction of the Air Expeditionary Force (AEF) as a means to manage Air Force aircraft and assets. Prior to this change, only 40 percent of the Air Force deployed, with 60 percent staying in garrison all the time. The AEF spread the expeditionary experience to a much greater portion of the total Air Force. Operationally it moved beyond thinking in terms of sorties generated, instead determining what effects were desired. It was an innovative operational concept designed to achieve a lighter, leaner, and more lethal force. This approach addressed the high demands the "global engagement" strategy placed on the Air Force. These demands included maintaining high deployment tempos and multiple sustained forward operating locations while retaining rapid crisis response capability to assure readiness for the possibility of two major theater wars breaking out simultaneously.[45]

Each AEF is a "mini air force" and has sufficient numbers and types of aircraft and personnel to conduct core missions when called upon by combatant commanders (10 were necessary to meet the needs of the national defense strategy at the time). An AEF is a group of associated units that provide a cross section of aerospace capabilities. The AEF does not deploy *en masse*, rather it is a resource pool from which to draw the right mix of forces to accomplish a combatant command requirement. These task-organized forces were presented to theater commanders in the form of Aerospace Expeditionary Wings (AEWs), and their subsidiary groups, and squadrons. Elements from two AEFs

were either deployed on a rotational basis or on call with the remaining eight in sequence recovering from deployment, conducting proficiency training, or preparing to deploy. The AEF represented a well-defined package of Air Force aerospace power.

While the AEF model remains sound, budget pressures and corresponding force structure divestitures over the past decade strained the model, particularly when the Air Force leadership tried to accommodate Army rotation policies as both Operation Enduring Freedom and Operation Iraqi Freedom ground on by the late 2000s. The Air Force became so small that balanced force rotations were no longer possible, and the AEF concept was shifted to meet ground force demands. In many ways, this shift was one of the principal drivers behind the current pilot crisis, and resulted in reduced readiness to respond to major regional conflicts. People and equipment burned out at a rapid rate—the exact circumstances a sustainable rotation-based model was designed to prevent. As Goldfein explained in 2017: "We're making the mission happen, but we're having to do it, very often, on the backs of our airmen. The tension on the force right now is significant."[46] Two months later, Goldfein said that if the Air Force doesn't "find a way to turn this around, our ability to defend the nation [will be] compromised."[47]

With proper inventories of people and equipment, the Air Force could and should reconstitute a viable AEF construct. The EAF/AEF construct was built and applied as a force management tool. It never broke, it was simply under-resourced.

With proper inventories of people and equipment, the Air Force could and should reconstitute a viable AEF construct. The EAF/AEF construct was built and applied as a force management tool. It never broke, it was simply under-resourced. It is important to not conflate the cause and the effect. With demand for airpower on the rise, a balanced force rotation model will prove vital in ensuring mission demand can be met over the long haul in a viable, credible, and sustainable fashion. This construct can also be adapted as a force structure sizing tool for the Air Force as it connects the objectives of U.S. national security and defense strategy directly to the force structure necessary to reach those objectives. In fact, this tool aligns well with the numbers articulated by Wilson during her September 2018 pronouncement on the size of the Air Force necessary to implement current U.S. national security strategy.

Furthermore, and most important, the AEF construct used as a force-sizing methodology provides the Air Force a logical, relevant, and easily understandable means for the American people and Congress to comprehend the tie between the demands of the national security and defense strategy and the quantity and types of aircraft needed to execute them. Specifically, there are two tenets of American national security strategies over the last quarter century that have remained enduring through the presidential administrations of both political parties. One, the U.S. will maintain sufficient forces and capabilities to engage around the world to encourage, shape, and maintain regional peace and stability; and two, in the event the U.S. does need to fight, it will do so in an expeditionary fashion away from American territory in a manner that puts our adversary's value structures at risk, while maintaining the ability to win more than one major regional conflict at a time.

In order to be able to fulfill both of these tenets, the Air Force needs a set of robust, capable, and ready forces to establish a rotational base sufficient to sustain peacetime engagement operations. To do that, the Air Force can use its AEF structure to maintain sufficient numbers of rotational base forces.

There are two tenets of American national security strategy that have remained enduring. One, the U.S. will maintain sufficient forces to engage around the world to shape and promote peace and stability; and two, in the event the U.S. has to fight, it will do so in an expeditionary fashion that puts our adversaries at risk, while maintaining the ability to win more than one major conflict at a time.

With respect to the second major tenet of national security and defense strategies—the ability to win more than one major regional conflict at a time—historically, this has required five AEFs worth of capability per major regional conflict (or 10 AEFs). This second tenet was articulated explicitly in the early 1990s during the DODs "Bottom-Up Review" (BUR), and remains today although language in subsequent defense reviews cleverly reformulated the construct to match the reality of periodic defense budget cuts. Arbitrary budget constraints—not threats or strategy—have driven the most significant changes to the Pentagon's force-planning policies since the 1993 BUR.[48,49] The return to great power competition and growth of major regional threats such as Iran and North Korea have revitalized this important force-sizing concept.

As an illustrative example of how the AEF can work as a force-sizing mechanism, consider the bomber force through the lens of the AEF. With respect to the current U.S. defense strategy, there is a baseline, long-term requirement for one squadron of 12 combat-coded B-21s per AEF. This results in a requirement for 120 combat-coded B-21s—or 10 operational squadrons at 12 B-21s per squadron—for forward engagement and power projection. As a rule of thumb, approximately 25 percent of a total force of combat aircraft is also needed to support training and operations, and another 20 percent is nominally planned for an attrition reserve and backup aircraft inventory (BAI). These numbers result in a total requirement for 180 long-range, penetrating B-21s (120 combat coded; 30 for training; 30 for attrition reserve and BAI).

SQUADRON OF B-21s PER AEF	1
Combat Coded (CC)	120
Training (TF) and Test (CB)	30
Backup Inventory (BAI) and Attrition Reserve (AR)	30
Total Aircraft Inventory (TAI)	180

Source: U.S. Air Force

Figure 6: The AEF force-sizing construct used to establish the required force of 180 B-21s using the same mechanism.

At the same time, because of the enormous cost-effectiveness of legacy bombers for a range of missions and their highly relevant capabilities, the U.S. also needs a minimum of six non-penetrating long-range strike aircraft per AEF for operations in a standoff role, or for when permissive airspace is created. This reflects mission demand seen in regions such as Iraq, Syria, and Afghanistan over the past 17 years. It is also important to highlight that despite the age of these aircraft, their attributes would also see them engaging in a "non-penetrating" fashion against more advanced adversaries. Including training, attrition reserve, and backup aircraft inventory, that requirement equates to a total legacy bomber force of 90 (60 combat coded; 15 for training; 15 for attrition reserve and BAI). This would allow for five operational bomber squadrons. When viewed together, the Air Force needs a total bomber force of 270 bombers of all types, or 15 total operational bomber squadrons. Today, the Air Force possesses eight and a half bomber squadrons.

The same holds true for fighter aircraft. The AEF construct was actually used in one instance as a rationale for a particular aircraft—the F-22 Raptor. This construct established a revised requirement for the F-22 during the *2001 Quadrennial Defense Review* (QDR). Figure seven (next page) indicates how the force structure

Source: U.S. Air Force

SQUADRON OF F-22s PER AEF	1
Combat Coded (CC)	240
Training (TF) (25% of CC)	60
Test (CB) (5% of CC+TF)	15
Backup Inventory (BAI) (10% of CC+TF+CB)	31
Attrition Reserve (AR) (10% of CC+TF+CB+BAI)	35
Total Aircraft Inventory (TAI)	381

SQUADRONS OF F-35s PER AEF	5
Combat Coded (CC)	1200
Training (TF) (20% of CC)	240
Test (CB) (5% of CC+TF)	72
Backup Inventory (BAI) (8% of CC+TF+CB)	121
Attrition Reserve (AR) (8% of CC+TF+CB+BAI)	130
Total Aircraft Inventory (TAI)	1763

Figure 7: Taking into consideration advanced technology, the traditional percentages for training, backup inventory, and attrition reserve results in this AEF force-sizing construct for the U.S. Air Force's F-35 inventory.

requirement for 381 F-22s was derived based on a nominal fighter squadron size of 24 combat-coded aircraft per squadron.

Key Factors for Sizing the Force

As the Air Force builds its future force—one properly sized to actually meet the needs of national security and defense strategies and afford leaders the policy options they will require—it is important to consider a few key variables. First and foremost, this new force must be a set of capabilities and overall capacity that speaks to present and future requirements, not those of the past. With dollars exceedingly finite and the operating environment pressing U.S. capabilities in ways not seen in decades, qualities like future combat cloud functionality, range, stealthy fifth generation designs, and improved readiness rates will prove critical. This future force is also not just about hardware—personnel like pilots and maintainers will prove vital for ensuring sustainable power projection capacity.

Using the AEF Model to Calculate the Objective Force Structure

Undersecretary of the Air Force Matt Donovan stated in February 2019 that airmen need to prepare themselves for a new era of superpower competition similar to the Cold War. Under the new National Defense Strategy he reiterated that the strategy "recognizes that the era of unchallenged American dominance is over." His point was that the resurgence of Russia and emergence of China as near-peer competitors pose new threats and that, "Our Chinese and Russian competitors spent the past quarter century learning how we fight and where our vulnerabilities lie…they've adapted with the single-minded purpose of exploiting what they've learned to further their strategic aims." Using the AEF model as described above, the Mitchell Institute calculates that the objective force structure that the Air Force needs to meet the force capacity outlined by Secretary Wilson is illustrated in the table below.

Type	Total Squadrons	Squadrons per AEF	PMAI	TAI Required
Fighters	70	7	1680	2700
Attack RPA	10	1	180	250
Bomber	15	1 low observable/0.5 conventional	180	300
Tanker	60	6	480	500
Tac Airlift	30	3	300	340
Strat Airlift	30	3	300	320
ISR	20	2	240	250
CSAR	10	1	120	150
Trainers				1500
Special Airlift				160
Special Ops				155
			Total 3480	**Total 6625**

NOTE 1: Squadron totals are provided for operational, aircraft-equipped units. Squadron totals are not provided for: aircraft equipped units that do not deploy with AEF rotations, such as training and test; and special ops squadrons.

NOTE 2: Squadron types not equipped with aircraft are not reflected, such as missile, cyber, space, etc.

NOTE 3: Aircraft unit equipage (UE) varies across the force. The following squadron UE are used for ease of illustration: Fighter is 24 UE; Tanker is 8 UE; RPA is 18 UE; Airlift is 10 UE (variation among C-130, C-17, C-5, AD, ARC); Bomber is 12 UE; ISR is 12 UE; and CSAR is 12 UE.

NOTE 4: PMAI=primary mission aircraft inventory (combat coded); TAI=total aircraft inventory

An airplane is of no use if trained personnel are not available to competently operate it, and ensuring a supply of enough spare parts is also vital to sustaining effective operations.

Additionally, even though Secretary Wilson's call for the "force we need" is premised upon growth, it is crucial to recognize that this increased size is aimed at meeting demand that already exists—not surplus capacity. That is a major reason why factors that do not directly relate to enhancing the ability to fulfill the most significant requirements of the *2018 National Defense Strategy*—either through the purchase of older equipment designs, like buying new-built F-15s or through a tiered approach to readiness—are counterproductive. All available resources must be dedicated to building the Air Force that real-world challenges warrant. A major conflict will see all available aircraft surge into combat. New air combat force structure must be focused on acquiring the most advanced and capable aircraft possible—aircraft that give America its asymmetric advantage over any adversary. The Air Force should not add to the challenge it already has in managing the risk that exists via legacy aircraft that will remain in the inventory for decades to come, such as the A-10, F-15, F-16, B-1B, and B-52. From a pilot's perspective, the Air Force could not generate enough replacements to backfill the losses that will likely occur by asking airmen to fly into harm's way in old aircraft designs. There is also, finally, a moral imperative—America owes its airmen the best available equipment to ensure they can successfully execute their missions and have the best possible odds of coming home safely.

The aerospace defense industrial base shrank dramatically after the Cold War. The nuanced skills and equipment required to build advanced combat aircraft are not variables that lend themselves to rapid reconstitution.

Nor is it appropriate or realistic to think the Air Force, or any of the other military services, can procure equipment and trained personnel in a rapid fashion should hostile circumstances rapidly unfold. The aerospace defense industrial base shrank dramatically after the Cold War. The nuanced skills and equipment required to build advanced combat aircraft are not variables that lend themselves to rapid reconstitution. Even in World War II, when the aircraft in question were orders of magnitude simpler in construction and operation, surge production took years to implement and the fortunes of the war vacillated precariously as commanders struggled to simply preserve enough force structure to stay alive and continue the fight. As the Battle of Britain example illustrates, when a commander hits the end of available resources, such limitations put the term "existential risk" in acute focus. Without a reserve, there are no more options. It is crucial that Americans understand future peer conflict will see these stakes become reality. This stands in contrast to the conflicts in Iraq, Afghanistan, and Syria where the consequences of failure are, in the end, not existential to the survival of the United States, and as a result seem abstract.

Adequate preparation for a potential peer conflict is vital. Today, aircraft and all their associated systems are far more complex than ever before. Production factors such as building microelectronics in secure, domestic foundries presents a major capacity challenge. So too is the difficulty of retaining adequately experienced personnel. It takes years of training and "on the job" learning to maintain and fly today's state of the art advanced aircraft. While LeMay faced problems getting his B-17 crews trained in the opening months of World War II, challenges facing today's air commanders are far more complex. It is no longer enough to teach just basic stick and rudder flying skills. Aircrews

must now be taught how to command, manage, and operate the tremendously complex technological enterprises that are modern combat aircraft.

While many have observed that Wilson's call for growth will demand additional resources, it is important to highlight that cost reduction is possible if leaders allocate resources in a "best value" manner. Air Force airpower affords options that are the most effective, efficient, and survivable means of power projection. The Air Force's decision to retire the A-10 stands as a cautionary tale. Given that sequestration-driven budget cuts were directed in a stove-piped approach with little appreciation for DOD-wide enterprise cost-benefit awareness, a highly capable asset was slated for retirement, while far less effective options were still slated for procurement. The DOD clearly faces resource challenges. However, room for necessary investment can be found to a degree within existing budgets by an honest review of roles, missions, and embracing a shift from a unit-cost acquisition metric to a cost-per-desired-effect measure of merit.

While many have observed that Wilson's call for growth will demand additional resources, it is important to highlight that cost reduction is possible if leaders allocate resources in a "best value" manner.

This latter point is especially important, for it involves looking at how combat goals are attained through an enterprise-wide assessment. Quite often such analysis will show that current courses of action do not reflect the most prudent way of achieving mission goals. In that case, given that the U.S. faces an air strike deficit, why are Air Force leaders advocating retiring the B-1B given that its cost-per-effect affords tremendous operational efficiency? Available evidence suggests that such decisions reflect further stove-piped thinking. Air Force Global Strike Command (AFGSC) leaders have been tasked with bringing the B-21 into the force at a specific budget number. To do this, they looked within their budgetary trade space and decided that the B-1B was the best offset. As publicly released sections of the current Air Force bomber vector explain, enterprise-wide reallocation of money, facilities, and other resources "are necessary to facilitate B-21 fielding and ensure the Air Force has a capable and effective future bomber force." The vector document also cites motivations regarding "force-neutral manning structure," and "harvest[ing] manpower billets from the retiring platforms."[50] However, such an assessment failed to look at what the retirement of the B-1B would mean from a broader DOD-wide vantage. Perhaps options like further Navy F/A-18 purchases needed to be part of the trade space analysis. This is especially true given the cost of operating aircraft carriers, and questions about carrier survivability when close in to enemy threats—the only approach that allows effective F/A-18 combat ranges. In addition, broader considerations about the demands multiple smaller aircraft place upon aerial refueling and logistics lines to achieve the same effect as one B-1B should have been also considered in this assessment.

Stove-piped thinking also empowers dubious concepts like the Army's newly proposed 1,000-mile "super gun."[51] While such technology might afford some combat value, is such an investment the best use of resources given that an aircraft or cruise missile can do the same job with greater accuracy, speed, and operational flexibility? Why are Army leaders looking to fill this operational void when the answer already exists? Beyond the technological development, acquisition, and personnel costs associated with fielding an artillery piece with a thousand-mile range, consider the employment challenges. Deploying this large piece of equipment,

sustaining it, and defending it from attack in an era where adversaries will easily locate it will prove immensely costly. If the concern is about strike capacity, then why is such a development option being considered at the very same time the B-1B is slated for retirement? The operational effectiveness, efficiency, and survivability of the B-1B is exponentially higher than this super cannon.

Taken in such a light, Wilson's call for growing elements of USAF force structure that offer the most combat utility for the lowest price should not be a difficult initiative to fund. This perspective is captured in the National Defense Strategy Commission's call for "new operating concepts that expand options and constrain those of China, Russia, and other actors."[52] To accomplish this requires an objective assessment regarding American military strengths.

Leaders like Winston Churchill and Curtis LeMay discovered what it was like to face an existential threat from a position of weakness. Granted the virtues of time, luck, and unique circumstances, they were ultimately able to prevail, often with service members sacrificing themselves in circumstances where adequate preparation could have provided a far better set of options had wartime planning begun earlier. Today, America is facing similarly dangerous conditions. Secretary Wilson is right: "We must prepare."

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