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AIR FORCE MAGAZINE

INVISIBLE AND EVERYWHERE

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AIR FORCE

December 2019. Vol. 102, No. 11

Photo: TSgt. Rachelle Coleman

SSgt. Antonio (last name withheld) packs an RA-1 free-fall parachute at Camp Lemonnier, Djibouti. See "30 Million Square Kilometers," p. 44.

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Photo: USAF

The new 16th Air Force's shield. See "16th Air Force Launches Info Ops for the Digital Age," p. 33.

STAFF

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By Tobias Naegele

Speed Kills

Air Force Chief of Staff Gen. David L. Goldfein often begins talks with a description of what a really bad day might look like for the United States—from the perspective of a service chief.

As he tells it, the first call comes from US Northern Command to let him know the US is engaged with a peer competitor. Then comes US Strategic Command; then US Space Command, and so on. Each combatant commander lays out needs and demands, which keep stacking up as more lines light up on Goldfein's phone. The point: Future wars cut straight across every domain—air, land, sea, space, and cyberspace. They'll spill over geographic areas of responsibility as well.

Goldfein has been talking up multi-domain operations and multi-domain command and control (MDC2) at every opportunity for the past four years, so much so that some people's eyes glaze over when he brings it up. But credit him with getting through. The new chairman of the Joint Chiefs of Staff, Army Gen. Mark A. Milley, may call it "Joint All-Domain Command and Control," but it's the same thing.

All-domain command and control cannot be reduced to high-function parallel play.

The difference between conventional jointness and Joint All-Domain C2 (JADC2)—or MDC2, if you prefer) is speed and integration. In practice, jointness has often amounted to parallel play. Everyone's in the same area of operations, and their activities are coordinated, but they are not fully integrated. For example, in Operation Iraqi Freedom, the Army stayed west of the Euphrates River, and the Marines stayed east of the Euphrates as they both marched toward Baghdad.

Goldfein tells a compelling story to illustrate how he's trying to change that construct. Visiting a defense supplier to see an air domain technology, he realized the supplier also had space capabilities. "So I'm assuming this connects to that, right?" No, the supplier exec came back. "That's a different part of the company."

The Chief's inevitable takeaway: "I'm walking away from that offering."

The Air Force can't afford to buy capabilities that don't connect. "If it doesn't connect in all domains, if it doesn't share information not only with our joint teammates but, equally important, with our allies and partners," he says, "... then it's no longer of interest to me as Chief."

Jerry-built gateways that kluge together a connection aren't going to be good enough. Gateways become bottlenecks. The chief wants the opposite: to open the floodgates. To move and process data in real time, enabling US and allied forces to keep adversaries on edge and at risk because they can't be sure where the next attack will come from—that's the objective. And that demands speed.

Speed is also needed in the acquisition system. To meet the objectives of the National Defense Strategy and to take on and deter aggressive, highly capable foes—China and Russia, of course, but also imitators and aspiring disruptors like Iran or North Korea—US forces will not be able to rely on an acquisition process that takes decades to produce results. Nor can its suppliers expect to have unlimited time to iron out the inevitable flaws in new weapon system designs.

For two decades, as America took on smaller, less capable foes, Air Force leaders cried out about the need to prepare for future conflicts with peer adversaries. Few listened. Instead, programs built for peer competitors were cut short, canceled, and delayed; planes and people were pushed to their limits. Now, the Air Force is too small and too old to meet all its obligations. Its modernization needs outstrip supply. And rejuvenation is still years away.

Yes, new fighters are coming off the assembly line—but not fast enough to replace aging aircraft that have already exceeded life expectancy; new tankers are arriving—but compromised by a faulty remote vision system that will keep them from becoming mission capable for four more years; a new bomber is under development—but first flight is still two years away.

It is certainly encouraging to see the Air Force double down on agile software development as a means to rapidly deliver iterative upgrades to the field and to step in and try to solve problems that contractors have found intractable, as with the F-35's Autonomic Logistics Information System. Likewise, USAF's embrace of a new "Digital Century Series" of fighter aircraft offers an intriguing solution to creating a more continuous development cycle for modern aircraft. Yet, these approaches must be applied to existing problems as well as new ones. It is not a matter of one side or the other moving faster, but rather we need ways to forge closer, more cooperative, and more effective collaboration between the airmen who use the equipment and the designers, developers, and engineers who create it.

Neither the military—nor its partners in industry—can afford to be satisfied accomplishing in months or years what could be done in days and weeks. Nor can they accept being slaves to process when improvements can be had faster through other means.

It's not for lack of money. When the next Air Force budget comes out, it will include some $9 billion over five years to develop the connective tissue that will enable Goldfein's vision for Joint All-Domain Command and Control. How that money is spent—and how fast new capabilities spill out from that investment—will be a key measure of its success. There isn't time to develop a silver bullet that may or may not arrive 20 years into the future.

All-domain command and control cannot be reduced to high-function parallel play. The combined threat of attack from every direction will be necessary in future conflicts to ensure adversaries, and not the US and its allies, are the ones rocked back on their heels. This is about delivering an offense so good that it makes our defense even better.

As a nation, we can't always tell who our next enemy will be or who will want to be our friends. Our military may participate in diplomacy, but it doesn't call the shots. What it does do is build the forces and develop the capabilities needed to deter and defeat adversaries. And it needs to do that more quickly and more efficiently.

America's adversaries are well-versed in our American way of war, and they intend to use that knowledge and new skills and capabilities to disrupt our every advantage. To stop them, US and allied systems must be so closely integrated, their actions so easily synchronized, that adversaries will be simply overwhelmed by the sheer volume of potential threats such a force can direct against them. The only thing rivals should be able to predict should be a decisive outcome—and one not in their favor. ✪

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2050
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LETTERS

You Say You Want a Revolution

The article, "The Counter-Revolution in Military Affairs," authored by perceptive John T. Correll in the July/August issue [p. 52] and [USAF Chief of Staff] Gen. David L. Goldfein's "Questions & Answers: Halt Force Readiness" in the September issue [p. 10] present strong evidence of the major structural changes either underway or essential to meet extraterritorial threats to the United States posed by technology. Although such technology-driven changes have been going on since the earliest days of warfare—the Roman chariot was one—some of these changes in recent times have caused strong rivalries between US military forces, as Gen. [William] "Billy" Mitchell discovered.

In the late 1950s, a monumental battle ensued over jurisdiction of the ICBM, pitting Army Maj. Gen. John Medaris and his German engineers with their German V-2 derived Redstone Missile against then-Air Force Brig. Gen. [Bernard] Schriever and the Air Force's industrial complex led by Convair and their Atlas missile and the brilliant former Hughes Aircraft's Dr. Simon Ramo. Ramo dominated the President's Scientific Advisory Committee that awarded the ICBM to the Air Force, and then led the contractor and provided technical direction of the Air Force program. The Department of Defense is once again faced with technological change that will force restructure of the armed forces.

Foremost for the Air Force is the fact that the need for piloted combat aircraft is rapidly declining, and it comes at a time when there is a severe pilot shortage. These two facts illustrate an immediate challenge that can be solved with the proverbial swipe of a pen. An order to eliminate most co-pilot positions would solve the immediate problem. Most modern aircraft have reliable automated systems that can control aircraft from takeoff to landing. The Air Force has had fully automated aircraft since 1949, capable of takeoff, flight to a distant destination, and landing without human intervention. Eliminating pilot positions is anathema to some Pentagon and industry interests. This is but one example of how technological change affects the armed forces.

ICBMs and IRBMs can be deployed and fired just as well by US Army forces as the Air Force, points originally made by Medaris and Wernher von Braun. Politics prevailed then, and politics may prevail now. I haven't mentioned the Navy or the Marines as the Navy's role is unique, but the Marines continue to expand their mission to conflict with both the Army and the Air Force, instead of their traditional role in support of Naval operations. Never underestimate the opiate of power.

The proverbial bottom line is DOD is due for a major shake-up and the resulting interservice battle will not be pretty, all due to a wide-ranging advance in the technology of war and the definition of war itself.

Lt. Col. C. W. Getz,
USAF (Ret.)
Fairfield, Calif.

Up-or-Out Dump?

Regarding your September issue "Editorial: Developing Better Airmen" [p. 2]: As a former Air Force public affairs officer (1964-68), I'm delighted that my career field is among the highly valued specialties that a revised promotion system will hopefully preserve and strengthen. Ending officer promotion zones is a good first step, but why not go beyond that by eliminating the up-or-out promotion policy that has destroyed careers and robbed the AF of many talented performers? Our military is the only organization I know of in the public or private sectors that fires people for simply not getting promoted. I recall a B-52 pilot griping that before joining the Air Force, he thought pass over was a Jewish holiday. Involuntary separation for not advancing at each grade level from captain to general makes no sense. Officers' tenure should be based entirely on their job performance, not on checking the right boxes to get ahead.

Dump up-or-out ASAP.

Richard Reif
Flushing, N.Y.

Security First, Second, Third

I enjoyed the article on software coders and the 10 centers of innovation ["The Air Force Software Revolution," September, p. 47]. What disturbed me as a security professional, is that security was mentioned 19 times throughout the magazine. However, only once was it mentioned in the article, and then as "cybersecurity." In my humble opinion, security should have been mentioned in each subsection and embedded in each of these young coders to make sure security is considered and worked on at the beginning of the software development life cycle; not somewhere down the road where the cost-benefit ratio (ROI) makes it almost impossible to fix. We would be no different than we are today in software development/maintenance.

I [also] read Timothy Cox's long, four-column letter regarding space ["Letters: Space Mindedness," October, p. 4]. What wasn't mentioned is that the Air Force has already had work in numerous agencies that were responsible for space, i.e., Air Force Space Command, US Space Command, JSPoC, etc. Right now, we have staff that have transferred over to so-called space, but have no clear direction. The one thing I see that a separate Space Force would do is have a separate budget in total just for space. However, doubling the bureaucracy, IMHO, will [not] help us defend ourselves in space any better. With such a dysfunctional president and Congress right now, I don't think we'll get our money's worth.

Roy S. Gertig,
USAF (Ret.)
Bellevue, Neb.

Unacceptable Dorm Norm

I am absolutely astonished when I read about the deplorable, unacceptable conditions in which airmen, soldiers, sailors, and Marines are living on our military

WRITE TO US

Do you have a comment about a current article in the magazine? Write to "Letters," *Air Force Magazine*, 1501 Lee Highway, Arlington, VA 22209-1198 or email us at letters@afa.org. Letters should be concise and timely. We cannot acknowledge receipt of letters. We reserve the right to condense letters. Letters without name and city/base and state are not acceptable. Photographs cannot be used or returned.

—The Editors

installations ["World: Mold, Moisture in USAF Dorms," October, p. 8]. The latest couple of articles talked about "town hall meetings" and housing occupants' "Bill of Rights." Whatever happened to the chain of command? I thought these responsibilities fall under the immediate purview of the base/garrison/camp commander. It doesn't matter that the housing maintenance is no longer an "in-house" responsibility. I understand that the housing maintenance has been contracted out. That does not relieve the commanders from the responsibilities of taking care of their people.

The airmen, soldiers, sailors, and Marines should be able to walk right into their first sergeant's office or even immediate commander's office and report unacceptable living conditions. Those reports should then be elevated up the line to the appropriate level where action is taken to fix the problem. I read that some of the military housing occupants are being threatened, or feel threatened, by contractors if they report problems. Other contractors have developed methods and systems where they hide the actual maintenance data from the military and report false data. Unless the military commanders actually go down and look at the housing firsthand and talk directly to the occupants, they will never know the real truth. It's high time we get commanders at all levels deeply involved in this unforgivable situation. That is when the fixes will be developed and applied.

Maj. Gen. Thomas R. Griffith,
USAF (Ret.)
Bozeman, Mont.

Jaw Officially Dropped

After reading recent articles on the forced purchase of F-15s by USAF and all the "reasoning" behind said purchase, I stand agape ["Keeping 4th-Gen Fighters in the Game," Oct., p. 34]. The real answer to this self-created problem is so obvious, yet has not been stated: Reconstitute the F-22 production line and build out the remaining three-fourths of the original planned purchase. The practice of having a low/high team of tactical/fighter aircraft on the ramp has been proven to work over and over, but seldom when said aircraft are not of the same generation. Worse, by the time USAF comes up with the "replacement" for the F-22 (2040?) and production is begun (2060?) the only viable recent production aircraft remaining will be F-35s.

We already fly F-22s. We already know how to maintain F-22s. We already know what parts of the F-22 need to be modified from original specifications. And we already know that now, and into the foreseeable future, the F-22 will be an even more superior fighter and tactical aircraft compared to foreign peer aircraft than the F-15 was in its era. It is the only fifth-generation fighter to have been used in combat.

There is a viable, available solution to a real problem confronting USAF's fighter ranks. It will not be solved by building more F-15s of any mark or modification. Fifth generation is and will be the minimum standard for combat aircraft going into the future. We only fly two aircraft in that class. We should not place our airmen and women in the position of having to compromise their safety—and ours—by providing them with lesser equipment. The answer is obvious, and cheaper both in dollars and time (the biggest expense) than a clean-sheet design that won't be built until far in the future.

Norman E. Gaines Jr.
Hartsdale, N.Y.

Scrap the Remote

It's been over nine months since the USAF took delivery of the the first KC-46 tanker ["McConnell KC-46 Crews Shaping the Future of Refueling," July/August, p. 21].

There were known Cat 1 issues with the platform upon delivery, first the RVS [remote vision system], and now cargo restraint devices.

The most pressing is the RVS, which is crucial to the tanker's primary mission. The Air Force was told numerous times that this would not work, yet they proceeded to have it placed on this platform. Memories are short in the Pentagon. Do we need a refueling boom through the cockpit of an aircraft to bring the point home?

You can already see the TCTO's [Time Compliance Technical Order's], caution, warnings, and notes being written in the Dash 1 on this substandard refueling system. For what reason do we need this system when we have a proven way to air refuel aircraft?

The AMC commander needs to have a critical-design review team establish a boom pod fix similar to the one on the KC-10, which is a proven system, ASAP. We still have time to fix this. Yes, it will cost money, but how many lives will it save? Better yet, it will have no restrictions.

The successful legacy of this platform rests solely on the AMC commander.

Scrap the RVS system, go to a proven system that USAF has been using for years, and move on.

Col. Clyde Romero,
USAF (Ret.)
Marietta, Ga.

Coding Questions

Commendations for tackling a seldom-considered topic, software in the Air Force ["The Air Force Software Revolution," September p. 47].

It is good to see the Air Force is approaching software with a new sense of spirited humor by initiating projects with names like "Kobayashi Maru" and "Kessel Run." Much is missing from the treatment of the software in the article, however. Undeclared are the main issues of software in the Air Force, namely (in order of highest significance first): late deliveries, cost overruns, missing or misperforming capabilities upon delivery, and difficulty in maintaining and/or upgrading the software when required in the future.

For the projects that are described in the article to be taken seriously, they must identify where and how they will address these issues. Missing from the discussion are some Air Force bases where software, either in acquisition or operation, is very intensive: Schriever, Peterson, Vandenberg, Kirtland, Los Angeles (only partially treated in the article), Wright-Pat, and Hanscom to name a few.

The software development practices cited are good, but nothing new. The practice of publishing software in incremental releases has been an industry standard for 40 years and is hardly revolutionary. Open-source architectures have been in use since 1984. Combining custom code with commercial products is 30 years old. Agile development is simply a disciplined approach of limiting the scope of a product, informed through clearly understanding the intended usage of the product. A caution about just running off and coding something in a hurry is that most such code is thrown away soon. Unspoken is the truth that most software is doomed through poor systems engineering (in particular, failing to specify good requirements), not software engineering.

The scope of effort is highly unspecified. Are these projects writing small sets of software, perhaps of a few dozen lines of code each, or are they developing major programs composed of millions of lines or more each? The former is implied by the content of the article.

The place of these projects in the software life cycle is unclear. Are these young

coders interacting with software designers at the beginning of major programs or modestly maintaining/enhancing software that has been long delivered? Are they harvesting existing data mines in new and innovative ways (it seems so) or creating new capabilities? In a realm of 10 billion lines of code currently operating in the Air Force, where do these projects fit? It appears to be in the maintenance phase and minor upgrade area. The targets of these new projects seem to be scattered. The return on investment is uncertain at this point.

That the Air Force should employ airmen to undertake software development is akin to enlisted personnel designing and building hypersonic aircraft instead of acquiring the aircraft from a defense contractor. This is indeed a brave new experiment, worth continuing.

A challenge is posed at the end of the article. Should the Air Force consolidate all these projects into a single model at this point? Should the model be Kessel Run or Rogue Blue, BESPIN or LevelUP? The experience of the DOD-mandated Ada programming language, a well-intentioned effort to solve all software issues in the 1980s by forcing all software to be written in an advanced language called Ada, should inform us today: a solitary approach doesn't always work, and the current projects should proceed independently without conforming to an as-yet-to-be-proven model.

The most significant import of the article is the revelation that the Air Force has created an "16K" software development officer career field and an "8K" enlisted career field, both with huge potential for positive impact on the Air Force. The courage to engage airmen in the software profession is phenomenal. An area to consider is that the 16K and 8K airmen should attend design reviews of major software programs, to provide critique and to gain intellectual insight for subsequent maintenance tasks.

Thanks for the good news brought by this important article.

Mark L. Lupfer
Colorado Springs, Colo.

Identified

Two photos which accompanied John T. Correll's fine article ["Against the MIGs in Vietnam," October, p. 53] caught my eye and encouraged comment. The first highlights Vietnam War aces, Capts. Charles DeBellevue and Richard Ritchie, and appropriately includes well-deserved, by-name recognition for two ground crew members that helped make their successes possible.

The other iconic Vietnam War photo pays tribute to fighter pilot legend, Robin Olds, and Operation Bolo, which he masterminded. In this photo, three other pilots are shown with Olds but they are identified only as "with airmen at Ubon, Thailand." This generalization unintentionally slights those three Air Force majors pictured.

Though the photo is famous, none of the many copies found on the Internet identified the "airmen" by name. In the end, I consulted a tried-and-true source, my mother-in-law, Beverly Moore, who provided the last piece to this puzzle.

Pictured in the photo are retired Air Force officers (l-r): Col. Bill McAdoo, Gen. Bill Kirk, Brig. Gen. Olds, and Maj. Gen. Joe Moore. Sadly, all those pictured are now deceased, and with the exception of Olds, all are now reunited at Barrancas National Cemetery in Pensacola, Fla.

On a related note, Correll states that the Vietnam War produced just five US aces (credited with five or more aerial victories, i.e. "kills"). Robin Olds could have been/might have been a Vietnam ace as well. Olds said that he intentionally avoided shooting down a fifth MiG, knowing that being an ace would have taken him out of the war prematurely and relegated him to public relations role back in the States. Others theorize that he had other MiG kills that he intentionally didn't take credit for and "was almost certainly an ace in Vietnam." Even my mother-in-law doesn't know the true answer to that mystery.

Col. Bill Malec,
USAF (Ret.)
O'Fallon, Ill.

Correction

■ *In the November 2019 issue, the AFROTC Cadet of the Year should have been listed as* ***Cadet Savannah M. Johnson,*** *AFROTC Det. 410, University of St. Thomas, Minn.* ***Cadet Sydney Cloutier*** *was AFJROTC Cadet of the Year.*

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VERBATIM

I De-Clare War

"You may want a war over, you may even declare it over, but the enemy gets a vote."

Jim Mattis, former Secretary of Defense, on President Trump's decision to withdraw American troops from Syria, "Meet the Press" [Oct. 13].

A Winner DOD Chooses

Photo: Steve Kotecki/USAF

"In a nutshell, we believe Microsoft and Nadella are popping the champagne tonight in Redmond while Bezos and Amazon are likely shocked they lost the World Series of cloud deals with JEDI."

Dan Ives, managing director of equity research at Wedbush Securities, after Microsoft scored a surprise victory over Amazon Web Services to win the Joint Enterprise Defense Infrastructure (JEDI) cloud computing contract in October [*Business Insider,* Oct. 25].

Illustration: Mike Tsukamoto/staff

"The fundamental problem for space systems is that they are designed assuming protection at their boundaries will be enough. Little internal protection exists if the boundary is breached. Similar schools of thought existed in the beginning days of traditional cybersecurity, where border firewalls were providing the only protection from intrusion. This approach proved to be faulty. ... Space system designs must overcome the risk of an adversary breaching the boundary and operating unhindered inside the system."

Aerospace Corp.'s Center for Space Policy and Strategy in a November 2019 report on **Defending Spacecraft in the Cyber Domain.**

Out of Africa

"For Russia, this return to Africa is like jumping on the last wagon of the train. There are still some elites across the continent that have ties to the Soviet era, but the next generation doesn't have the same links to Russia as before. So, we need to take the opportunity to return now while there are still people with connections."

Olga Kulkova, a senior research fellow at the Institute for African Studies of the Russian Academy of Sciences comments on President Vladamir Putin hosting African leaders at a two-day summit to increase Russian world influence [*Foreign Policy,* Oct. 29].

Photo: Kremlin

Photo: Mike Tsukamoto/staff

CONNECT THE DOTS

"If it doesn't connect in all domains, if it doesn't share information, ... if we haven't built artificial intelligence into the tactical edge so it's learning, and I can take humans out of the loop and put them on the loop, then it's no longer of interest to me as Chief."

Chief of Staff **Gen. David L. Goldfein** on what will spell success for future systems development at an Air Force Association event Nov. 6.

Islands For a Thousand, Alex

"Everyone is really scared about the possibility of China turning the island into a military base. That is what really scares people—because why else do they want to lease the whole island?"

Solomon Islands businessman **Michael Salini** on a secretive deal to lease the entire island of Tulagi for unspecified development [*The New York Times,* Oct. 16].

Objection

Photo: Republic of Turkey

"Some countries have missiles with nuclear warheads [but the West insists] we can't have them. This, I cannot accept."

Turkish leader **Recep Tayyip Erdogan** [*The New York Times,* Oct. 20].

By John A. Tirpak

Thinking Past the F-35

The Air Force seems to be sticking with its long-term strategy for the F-35, even as it prepares to put down big bets on the Digital Century Series of new aircraft in the Next-Generation Air Dominance program. The NGAD aircraft—intended to be rapidly designed, fielded, upgraded, and even retired to keep up with the technological threat—appear, for now, to be additive to USAF's plans for both the F-35 and F-15EX.

Service acquisition chief Will Roper says he thinks the Digital Century Series could yield an NGAD platform—which may or may not look like a fighter—in as little as five years. Service and Pentagon leaders are declining to discuss whether that puts the F-35 and NGAD in conflict.

Air Force leaders have said consistently in recent months that they're not backing away from building 1,763 F-35As, the original objective. At the planned rate of purchase, though, the last F-35A wouldn't be delivered to the Air Force until 2040. A lot can change between now and then.

"What we can't afford to do," said USAF's Undersecretary Matthew P. Donovan, is "get into multidecade programs." That's what the F-22 and F-35 became. The original prototype YF-22 first flew in 1990; the production version flew first in 1997. Initial operational capability was not declared until 2005. Likewise, even though Lockheed Martin has now delivered more than 400 F-35s, "it still hasn't met full-rate production and still hasn't finished [Initial Operational Test and Evaluation]," Donovan said. That makes it "about a 20-year development program," he noted.

Donovan declined to say whether success with the Digital Century Series would lead to curtailing production of the F-35—or of the F-15EX, which was inserted into the Air Force's fighter plans a year ago at the suggestion of the Pentagon's Cost Assessment and Program Analysis shop.

Pentagon acquisition and sustainment chief Ellen M. Lord acknowledged in October that Roper's approach is "very innovative and interesting," but added that the different programs are complementary, not competitive. "We look at the total capability here versus the adversary, and we find a place for the F-35, the F-15, and the new Century Series," she said. Asked specifically if a rethink of the Air Force's F-35 goal of 1,763 aircraft is coming, she said, simply, "no."

Still unclear is how many F-15EXs the Air Force wants. Donovan said no final buy objective has been set, though the service has talked about as many as 188 aircraft. A continuing resolution on the fiscal 2020 defense budget stuck the F-15EX in limbo, because CRs don't allow for new starts. Congress limited the F-15EX to two examples until USAF comes up with an acquisition plan, something it can't do while the CR is in force. Donovan said the service can't compute a unit cost for the aircraft without moving the program forward.

The Air Force requested $1 billion for NGAD in the fiscal 2020 budget; going into conference, the Senate was willing to approve that amount, but the House had cut it in half.

The Digital Century Series, if it works, "gives us some options" later on, Donovan said, but, for now, USAF is not cutting back on the F-35 buy.

Service leaders have said privately for years that they deliberately avoid talking about potential smaller F-35 buys because any reduction instantly increases the unit cost of the jet, as there would then be fewer aircraft across which to spread development costs. "We learned our lesson with the B-2 and F-22," said one. A spike in unit costs inevitably leads to a reduction in the production run, spurring still greater unit cost increases and putting the program into "a death spiral."

Photo: R. Nial Bradshaw/USAF

A pilot at Hill AFB, Utah, prepares to launch an F-35 during night operations in March 2019. Fly-away costs for new jets will soon be less than $80 million a copy.

The Air Force has not aggressively increased its per-year buy of the F-35, once forecast to be 110 aircraft a year by now, but still fewer than 60 in actual budgets. Service leaders have indicated they prefer to wait to buy the Block 4 version as the bulk of the fleet, whereas the Block 3F is the version now coming off the assembly line. The Block 4 jets will have improved electronic warfare, sensing, weapons and networking capability, and all indications are that they will be more maintainable and less costly to operate than earlier versions, many of which are being retrofitted to the current configuration.

UNDER $80 MILLION

The big F-35 news in October was the announcement of a firm contract between the Pentagon, its international partners, and Lockheed Martin for Lot 12-14 production of the fighter. Under the $34 billion deal, the unit cost of the F-35 will for the first time be less than $80 million a copy, starting in Lot 13. That's "one lot earlier than planned; a significant milestone for the department," Lord said at a Pentagon press conference. The contract actually beats the $80 million goal that Lockheed Martin and the Joint Program Office pledged to several years ago; by Lot 14, the unit price of the F-35A used by the Air Force will be $77.9 million in then-year figures and is expected to go lower still.

Photo: TSgt. Ryan Campbell/ANG

An F-35 on the ramp at the Vermont Air National Guard Base in South Burlington. Full-rate production of the Lightning II will not be achieved by the end of 2019 as originally planned.

The contract covered 478 aircraft (not including long-lead funding provided in earlier contracts), and includes 149 jets in Lot 12, 160 in Lot 13, and 169 in Lot 14. Maximum production of about 180 per year would be achieved in Lot 15 or 16.

"The most dramatic rate increases are now behind us," said Lt. Gen. Eric T. Fick, program executive officer for the F-35. "Lot 12, at 149 aircraft, represents only a 6 percent increase over Lot 11's quantity of 141, and the deltas for Lot 14 ands Lot 13 are similar." Lot 11 production "was a full 50 percent higher than Lot 10, which was itself 65 percent greater than Lot 9." Smaller volume increases should take some pressure off the supply chain, he said, which has struggled to keep up with demand at times, cramping aircraft availability. One problem was that vendors had to build unique parts for several blocks of aircraft, while chokepoints at the depot level also kept airplanes out of circulation.

The Lot 12-14 contract includes a so-called "block buy" for allied nations, locking in lower prices for raw materials and parts bought in greater bulk.

The US can't participate in the block buy yet, however, because US law prohibits multiyear contracts until weapon systems are in full-rate production. Lord announced earlier, in October, that full-rate production won't be achieved by the end of calendar 2019 as planned.

Still, "we exceeded the total aircraft quantity we delivered" in 2019 compared to 2018, "and we have a 96 percent on-time delivery rate, a tremendous improvement from where we were last year, with an average on-time delivery rate of 64 percent," Lord said.

She also quoted a "combat-coded operational unit mission capability performance" increase "from 55 percent in October 2018 to 73 percent in September 2019." That was an average of poorer-performing early jets and better-performing newer™ examples, and a narrowly missed a goal of 80 percent mission capable set by former Defense Secretary Jim Mattis last year.

GRADUATION DEFERRED

In order to get to full rate, the F-35 must first graduate from Initial Operational Test and Evaluation, a roughly yearlong assessment of the jet in various scenarios against a variety of threats and environments. Lord said IOT&E is going well, and the Pentagon is satisfied with the way the F-35 is performing.

"The Department has full confidence in the planes that are flying today," she said. "The Air Force and the Marine Corps have both deployed squadrons and are very, very happy with the capability." The IOT&E apparatus has "completed 90 percent of the testing," she reported, and "we are very confident in the configuration of the aircraft, and we are just working on the nuances of working against these advanced threats."

However, she has decided to wait to certify the F-35 fully compliant with requirements until it is integrated into a Pentagon virtual wargaming system called the Joint Simulation Environment. The JSE assesses how many of various weapon systems are needed to prevail in various conflict scenarios.

"The criteria in terms of getting out of IOT&E is to test against threats that we will see 10 years from now," she explained. "We can only do that in a synthetic environment."

Fick explained that "we're taking a digital representation of the aircraft ... integrating it into a synthetic representation of the threat space, to include ground threats, air threats, both blue and red weapons, environmental effects, all of those things ... and integrating them together so that the systems talk to one another digitally. And that's just a very, very large task to get done."

Although neither Lord nor Fick explained why the issue didn't erupt until late IOT&E, Fick noted that there were "some disagreements with Lockheed Martin on how to proceed." In the early days of the F-35, "there was no JSE. There was VSim, which was a Lockheed Martin proprietary environment." Some years back, he said, "we elected to pull that work out of that proprietary environment and put it into a US-government-owned facility in the JSE that will allow us to integrate other aircraft, perhaps other manufacturers, and do that system-of-systems work." The system allows for "more ... pieces; ... the fights get more complex, and then you find more things relative to the interactions of all those systems."

Because of the disagreement, "we struggled to get out of those gates," Fick said, but "the relationship with Lockheed ... is very much better now. We're working side by side with teams of embedded Lockheed coders and engineers ... with the NAVAIR (Naval Air Systems Command) folks at Pax River, doing that integration. And I think they're making decent progress."

Lord said she anticipated declaring IOT&E complete and the F-35 entering full-rate production perhaps 13 months late, which could mean as late as January 2021.

"This does not change what we're doing on the production line, what we're doing in terms of development or sustainment" Lord said of the JSE issue.

"While we are making progress, we are not where we need to be," she asserted. "We have industry's commitment on accelerating improvements in sustainment. Our focus is on improved F-35 fleet readiness and driving toward the service affordability goals."

The completion of IOT&E will be the next major milestone for the F-35; after that, the big benchmark will be deciding if the NGAD is good enough to forego further production of the Lightning II or the F-15EX. ✪

The Business-Case Approach

Matthew P. Donovan has been the Undersecretary of the Air Force since August 2013, and was Acting Secretary from June to October of this year. He retired from the Air Force as a colonel after a 31-year career, including five years of enlisted service, and later served as a senior civilian on the Air Staff and as Majority Policy Director for the Senate Armed Services Committee. He spoke with Air Force Magazine *Editorial Director John A. Tirpak in late October. The conversation has been edited for length.*

Q. You've said the Air Force will have to do things differently to align with the National Defense Strategy, that some missions will go away to make room for new ones. What should we expect in the 2021 budget?

A. Even before the NDS rolled out in early 2017, I've been leading an effort called the Zero-Based Review in the Air Force. The planning, programming, budgeting, and execution process that we have generally only looks at the changes from year to year, because, in a $700 billion-plus budget, we don't have time every year to go into every line in the budget. But that's where the bulk of the dollars are. We generally only change 10 percent, up or down.

This is a multiyear process. We're trying to break allegiances to ongoing programs, because every program that gets into the budget builds a constituency, both inside the Pentagon and on Capitol Hill. And in my experience, it's very easy to start a program, but very difficult to stop it.

When the NDS came out, we decided the Air Force had sort of been resting on its laurels. The Air Force is the technology force, and we've had a lot of efforts aimed at the high-end fight—take that as China and Russia. We have F-35, we had F-22, we have B-21. We felt 'we're already aligned' with the National Defense Strategy.

After the analysis we did to create "The Air Force We Need" blueprint, it turns out that to fight a peer competitor in the late 2020s, 2030, maybe we weren't as aligned as we needed to be.

We found there are some legacy programs that may be less useful in the high-end fight in the future. You've seen that before. We tried taking out the A-10, before the rise of ISIS, but we saw how useful the A-10 was over there, and we sort of saw the light and realized there is a use for a legacy-type program in that fight.

We looked at other things, too. The B-1 was built for the nuclear mission, but … in the Middle East, we were using the B-1 in a way it was never designed for, and we sort of broke them.

So we're taking a business-case approach, now: measuring what it costs to keep these legacy programs going versus the dollars required to shift to future capabilities.

We've gotten dollar boosts to stop the bleeding on readiness declines and help us shift more toward those future requirements. But Secretary [Mark T.] Esper has said—and I agree—that we've probably peaked out on our topline with the fiscal 2020 budget, and the best we can hope for is flat, over the next [Future Years Defense Plan]. So any shifts we make are going to have to be within the topline that we have.

That's challenging for us, especially when we look at the requirement to modernize the nuclear enterprise. It always seems to be just outside the FYDP, but there's a huge bill coming with that, for the [Defense] Department. You've got *Columbia*-class submarines, you've got GBSD [Ground-Based Strategic Deterrent] for us, B-21 bombers, all these things at one time.

Photo: Mike Tsukamoto/staff

Then-Acting Secretary of the Air Force Matthew Donovan speaking at the Air Force Association Air, Space & Cyber Conference in September.

Q. Are you ready to reap the harvest of this Zero-Based Review?

A. We are. In our fiscal 2021 budget examinations, we actually found $30 billion dollars for programs that need to be shifted more toward the future "Air Force We Need." That includes some manpower that wouldn't necessarily be divested, but repurposed. We plan to take advantage of things like artificial intelligence and machine learning. It's a pretty significant shift.

Q. "The Air Force We Need" specifies a larger end strength. How rapidly will that happen?

A. Several years ago, we cut a little bit too much in our end strength. That caused some holes in our manning. In our maintainers, we had a 4,000-person shortfall. We've since zeroed that out.

It takes about seven years to create a seven-year experienced maintainer. Although, as an aside, we're finding innovative ways to make a seven-year experienced maintainer in only four or five years, through advanced technologies such as augmented or virtual reality.

That's the way we're approaching end strength. Advances in artificial intelligence can give us a lot of help, for example in our ISR [Intelligence, Surveillance, and Reconnaissance] enterprise. For every MQ-9 we have airborne, it takes 140 individual people to support it, and most of those are in processing, exploitation and dissemination, PED. In that specialty, a lot of people stare at a screen for hours at a time looking at full-motion video to detect targets.

You may have heard of Project Maven, an artificial intelligence tool, to do full-motion video processing at very high speed and detect differences, as a human would do. If we're able to produce this capability at scale, we're talking thousands of people freed up. I've heard estimates of about 44,000 in the ISR/PED enterprise; if we could reduce that by 10 percent in a year, that's … 4,400 people that we can put onto higher priories.

Q. And the ramp to a larger Air Force?

A. We're continuously looking at it. The deep analysis we did for "The Air Force We Need" … gave us an analysis-based approach to back up our statement that the Air Force is too small to do what the nation asks us to do. People are our most expensive asset, but they are also our most important asset.

Q. There was some discussion at the AFA conference that maybe many airmen could have two or three specialties.

A. Right. In the maintenance career field, you have specialties in avionics, fuels, engines, etc. Our young folks are smart and they're raring to go, and we'll load them up using new training methods. Just as an example, if we could send 10 folks rather than 100, to take care of 12 airplanes, then why wouldn't you do that?

Q. Global Strike Command plans to retire the B-1 and B-2 to make room for the B-21, while retaining the B-52 with new engines. But the Pacific Theater demands more long-range platforms. Should the Air Force retain the older airplanes?

A. It really is budget-driven. Maybe not so much from a dollars perspective as it is from a people perspective. The people that we'll need to field the B-21 have to come from somewhere.

Think tanks such as AFA's Mitchell Institute have done studies on the B-21 that say 100 is not enough. They came out with, I think, 174 B-21s. And the Chief [Gen. David L. Goldfein] even said he agrees with that.

Q. "The Air Force We Need" calls for seven more bomber squadrons.

A. Exactly. "The Air Force We Need" described it in terms of squadrons, and ... there's about eight bombers in a squadron, and we'll need more than that. We've always said 100 B-21s is a minimum. You'll see us put some real numbers to the total [in the fiscal 2021 budget].

Q. In the last few months, a number of Majcom commanders have suggested it may be time for a new roles and missions debate. Secretary Esper has said he's comfortable opening that up. Is that underway?

A. We've had lots of reviews. The Commission on Roles and Missions reported out in the 2010 time frame, and they actually made some really good observations, but not really any conclusions, and they made no recommendations.

Q. They said everyone is doing all these new missions in space and cyber, anyway.

A. Exactly. The Chief has talked a lot about multi-domain operations and multi-domain command and control. Just about everybody in the [Defense] Department agrees that that's where we need to go. This is the idea of connecting every sensor to every shooter, to get decision-level information more quickly to stay inside the decision loop of any adversary, and present him with simultaneous dilemmas that just overwhelm his capability to respond in any one area. So, I think that's a good way to describe this de facto roles and missions review.

Q. Air base defense is an Army role. The Air Force is going to be moving forces around to a lot of austere bases, rapidly, but they need protection. Have you discussed this with your Army counterpart?

A. The agile basing concept does pose quite a problem of how you defend those bases. And moving a heavy Patriot battery to every one of those places has resource implications that the Army couldn't meet.

The Army is spending a lot of time and attention on SHORAD, in other words, Short-Range Air Defense capabilities that are indigenous to their BCTs [Brigade Combat Teams]. And there may be an opportunity for us to partner with them on that. There are also other things that we're looking at—directed energy—those type of defensive systems that put us on the right side of the cost curve.

If the enemy is going to throw a lot of ballistic missiles at you that cost thousands of dollars, it's not cost effective for us to come up with a system that costs in the millions of dollars to defend against them.

Q. How about in Space Force? Presumably, all the services will contribute to it. What will the Air Force be handing over to Space Force, or do less of in that domain, freeing airmen to do other things?

A. I think you'll see a significant portion of our current space forces that would move over. Now, we still have the responsibility—as will all the services—to be component providers to that force, so you'll see the Air Force retain some portion of space competencies. What that looks like will really be determined by Gen. [John] Raymond and the way he sets the requirements for those component force providers.

Q. USAF acquisition boss Will Roper says he's confident he can start producing the Digital Century Series in five years. How will that affect the F-35 and F-15EX acquisitions?

A. If you go back to the original Century Series, from the late '50s into the '60s, there was about a 15-year period where we built 11 prototype airplanes, and we actually fielded six. About every three to four years, we were rolling out a new airplane.

Since the Reagan years, there's been a lot of consolidation in the industrial base, but technology has also improved to the point where the digital design and digital engineering can be applied to all sorts of things. Dr. Roper's absolutely convinced—and I believe him—that we're able to do that with airplanes now.

Take the T-7, for example, originally the T-X. Boeing was the only competitor to come in with a clean sheet design, but they didn't have the data to provide to the Air Force that was required as part of the competition, whereas the other entrants had airplanes that had been flying for years. We weren't convinced they would be able to do that. But they built two prototypes and provided all the flight data to us and ended up winning the competition. It was a digitally designed airplane. So I think that's a good example of how we can move forward with this.

What we can't afford to do anymore is another 20-year development program, like we had for the F-22 and F-35. We can't afford to start a new, for example, sixth-generation fighter that's going to take 15 years to develop and field, and then another 10 years beyond that to … reach full operational capability. At the rate our adversaries are going, who knows how far behind we would be by doing that?

Much like the original Century Series, Roper's talking about fielding something quickly, but not committing to a very large buy. Enough so that you're operationally capable, and that might be 100 units. And then spiral to the next version.

Q. And how will this affect F-35 and F-15EX?

A. We haven't decided on the total buy of the F-15EX. Congress fenced the funds for us to two, until we deliver an acquisition strategy. So we're working on that very quickly.

But you can't design an acquisition strategy unless you know what the total buy is going to be, because you can't compute APUC [Average Procurement Unit Cost].

We have a requirement for 1,763 F-35s. I don't see any change in that right now. But, if [Roper] can design and build a next- generation air dominance platform—and it may not even look like a fighter—within five years, then that does give us some options, right?

That's not to say we won't have to make hard choices at a later moment in time. As I said, there are big bills coming forward with the nuclear enterprise, and the NDS clearly delineates the priority of the homeland defense first, and then the nuclear mission. Everything else, in my mind, falls below that. ✪

Tactical aircraft maintainers from the 801st Special Operations Aircraft Maintenance Squadron, Hurlburt Field, Fla., prepare to launch a CV-22 Osprey at Nellis AFB, Nev., in October. CV-22s are in high demand in Central Command and other operational theaters, but readiness remains a challenge. When CV-22s are deployed "and sustained by a responsive supply system, we generate a lot of flight hours," Lt. Gen. James Slife, commander of Air Force Special Operations Command, said in September. The problem is that some components wear out faster than expected, holding down mission capable rates at only about 60 percent.

Photo: A1C Bryan Guthrie

A future pilot (in virtual reality goggles) navigates a training sortie as Pilot Training Next instructor Capt. Jay Pothula (left), NASA aerospace engineer intern Derrick Ng (back), and NASA Extravehicular Activities Physiologist Alex Garbino watch. Now in its third iteration, Pilot Training Next is experimenting with virtual reality simulation in an effort to prepare pilot trainees more quickly and at lower cost. NASA and the Air Force are working together to collect physiological and cognitive data to better understand and maximize learning potential for individual students.

Photo: Sean Worrell/USAF

They may not be pretty, but they still do the job. B-52H Stratofortress bombers fly in formation during Bomber Task Force Europe in October over the Baltic Sea. The Air Force still has 75 B-52Hs in its inventory, at an average age of nearly 58, and plans call for keeping them flying for decades longer. A competition is now underway to re-engine the airplanes to dramatically increase fuel efficiency, ease maintenance, and extend the lives of this workhorse of the bomber fleet.

Photo: A1C Duncan Bevan

CSAF MEDIA LIST

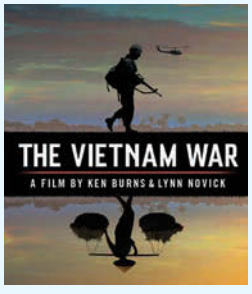
Gen. Ronald R. Fogleman created the CSAF Professional Reading Program in 1996 to develop a common frame of reference among Air Force officers, enlisted, and civilians. Each Air Force Chief of Staff since then has enhanced and continued the reading program.(For the reading list see *Air Force Magazine,* March 2019, p. 60.) Recommendations from CMSAF Kaleth O. Wright are also included.

Here are the Chief's recommendations for films, TED Talks, podcasts, and blogs. For the full reading list and an archive of past lists, go to *https://static.dma.mil/usaf/csafreadinglist/*

Films

Hidden Figures
20th Century Fox
Hidden Figures tells the true story of three African-American female mathematicians working for NASA during the beginning of the US space program. They were vital to many of the program's early successes, including one of history's greatest operations—the launching of the first manned orbit.

Tuskegee Airmen
HBO Studios
The story of the first squadron of black American pilots to be allowed to fight for their country. It is 1943, and the Germans are winning WWII. Four newly recruited pilots are united by a desire to serve their country—at a time when black flyers are not welcomed in the US Army Air Force.

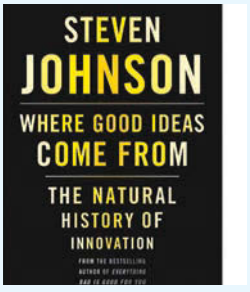


The Vietnam War
PBS
The Vietnam War is a 10-part, 18-hour film series directed by Ken Burns and Lynn Novick. Burns and Novick tell the epic story of the Vietnam War as it has never before been told on film. The Vietnam War features testimony from nearly 80 witnesses, including many Americans who fought in the war and others who opposed it, as well as Vietnamese combatants and civilians from both the winning and losing sides.

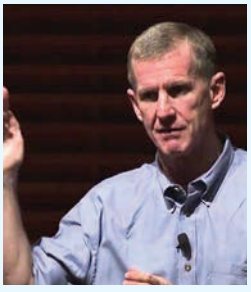
Frontline: Confronting ISIS
PBS Distribution
Two-year analysis of US-led efforts to defeat ISIS. Martin Smith travels with one of Iraq's Shia militia groups, as well as Kurdish Peshmerga fighters. He meets the father of a Jordanian pilot who was burned to death by ISIS and sits down for candid interviews with leaders including former US Secretaries of Defense Ashton Carter and Chuck Hagel, embattled Iraqi president Haider al-Abadi, and others.

TED Talks

The Puzzle of Motivation
Daniel Pink
Career analyst Pink examines the puzzle of motivation, starting with a fact that social scientists know but most managers don't: Traditional rewards aren't always as effective as we think. Listen for illuminating stories—and maybe, a way forward.



Where Good Ideas Come From
Steven Johnson
People often credit their ideas to individual "Eureka!" moments, history tells a different story. Johnson's fascinating tour takes us from the "liquid networks" of London's coffee houses to Charles Darwin's long, slow hunch to today's high-velocity web.



The Military Case for Sharing Knowledge
Stanley McChrystal
When Gen. Stanley McChrystal started fighting al Qaeda in 2003, information and secrets were the lifeblood of his operations. But as the unconventional battle waged on, he began to think keeping important information classified was misguided and counterproductive. McChrystal makes the case for actively sharing knowledge.

How to Make Stress Your Friend
Kelly McGonigal
Stress—it makes your heart pound, your breathing quicken, and your forehead sweat. But while stress has been made into a public health enemy, new research suggests that stress may only be bad for you if you believe that to be the case. Psychologist McGonigal urges us to see stress as a positive and introduces us to an unsung mechanism for stress reduction: reaching out to others.

Three ways to plan for the (very) long term
Ari Wallach
We increasingly make decisions based on short-term goals and gains—an approach that makes the future more uncertain and less safe. How can we learn to think about and plan for a better future in the long term—like, grandchildren-scale long term? Wallach shares three tactics for thinking beyond the immediate.

Podcasts

War on the Rocks

War on the Rocks is a platform for analysis, commentary, debate, and multimedia content on foreign policy and national security issues through a realist lens. The podcasts include interviews with soldiers, spies, officials, and scholars on a range of issues related to strategy, defense, and foreign affairs, and "Pacific Pundit," a series on the intersection of US and Asian geopolitics, foreign policy, and history.

Mandatory Fun

Mandatory Fun is a weekly podcast about the military and pop culture aiming to break cultural tropes and bridge the military-civilian divide through storytelling and entertainment in episodes such as "How Going to War Brings Out the Best and Worst in People," "Four Skills That Will Help You Survive in a Disaster or a Zombie Apocalyse," and "How Unconventional Tactics Won the Battle for Ramadi."

The Economist Radio

Podcasts that explore the latest tech trends, examine the booms and busts in business, and ask big names big questions. Episodes include explorations of the real consequences of German reunification, the Arab Spring, the Hong Kong protests, and analysis of Bolivia, Chile, and Sri Lanka's elections and impacts on the US and around the globe.

American Military History

Dedicated to telling the story of American history through the eyes of military men and women. Starting with the Revolutionary War, it covers engagements through the present day, as well as taking a few stops along the way to learn about the history of each of the branches of the American military—Air Force, Army, Navy, Marines.

War College

A weekly look at the weapons systems and tactics that both endanger the world and keep it safe, including episodes on US Special Operators training to fight Russian tanks (and memes), Syria, the Kurds, and civil war, the new nuclear arms race, and why people defend dictators on line.

Foreign Affairs Unedited

Since its founding in 1922, Foreign Affairs has been a leading forum for serious discussion of American foreign policy and global affairs. Recent broadcasts include "What the US Can Do About North Korea," "The Age of Global Transparency," and "Israel and It's Middle East Neighbors."

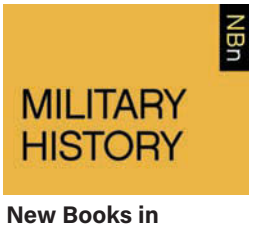
Message From the Chief

Staff photo by Mike Tsukamoto

"Our new ... list provides a range of professional development opportunities to refocus our thinking on the challenges that this new era brings. We must sharpen our understanding of nuclear weapons, deterrence, great power diplomacy, and future warfighting technologies. Airmen are the strength of the Air Force. I challenge each of you to take deliberate steps toward expanding your understanding of this new national security environment, the threats we will face, and the tools we will need to prevail. Your dedication and commitment to expand your understanding ensures we remain the best Air Force the world has ever seen. FIGHT'S ON!"

David L. Goldfein
General, USAF
Chief of Staff

Blogs

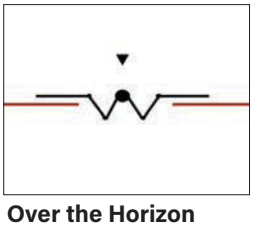


New Books in Military History

Interviews with scholars of military history about their new books including, among many others, "The Longer We Were There," "Footprints of War," "Transnational Nazism," "One Long Night," "Mexican Exodus," and "After Appomattox."

Leadership and Loyalty

Dov Baron is a headline leadership speaker and corporate cultural strategist. He speaks at global conferences on influence, business, and embracing purpose-driven, authentic leadership. The podcasts include "Why We Struggle and How to Stop," "Having the Courage to Create a Tribe," and "Leadership and Loyalty."



Over the Horizon

Rapid technological development and diffusion of power have created an environment that old paradigms have difficulty grasping, with an emphasis on multi-domain operations and strategy. It is a space to consider defining questions such as "What comes after the joint and interagency constructs?" and "What does an effective multi-domain operation look like?"

War is Boring

In daily articles on the US military from personnel issues to weapons systems and global and regional hotspots, War is Boring reports on drones to AKs and high technology to low politics, exploring how and why we fight above, on, and below an angry world.

The Strategy Bridge

A nonprofit organization focused on the development of people in strategy, national security, and military affairs. The blog offers podcasts, mentorship gatherings and other events, and scholarly articles about US and global military and defense affairs.

F-22's Agile Developers to Deliver First Link 16 Capability Next Year

Photo: 2nd Lt. Sam Eckholm

An F-22 performs a high-speed pass. USAF is using agile software development methods to speed up delivery of new capabilities to the nation's premier fighter to keep up with advances in China and Russia.

By Shaun Waterman

The F-22 Raptor is among the planet's most advanced combat aircraft, but to ensure it stays ahead of new Russian and Chinese fifth-generation fighters, the service has had to rip up the rulebook—and get Lockheed Martin to rip up its own, too.

Two years ago, faced with mounting delays in F-22 modernization efforts that threatened the fighter's dominance over its competitors, the Air Force decided to reform the way it rolls out updates to the Raptor. Instead of a conventional approach, in which requirements are documented in detail and the update is not delivered until every element is complete, USAF wanted to introduce new capabilities on a rolling basis using an approach known as "agile" development.

"Looking at our competitors ... they have very rapid development cycles," said Lt. Col. Christina Rusnock, materiel leader for the F-22 modernization program office at Wright-Patterson AFB, Ohio. "In order for us to maintain our competitive advantage, our air superiority, we knew that we needed to do business differently ... to move more quickly."

"Instead of fielding one big bang many years away, we can start to field them much earlier."
—Lt. Col. Christina Rusnock, materiel lead for the F-22 modernization program

The 2001 Agile Manifesto proposed a new methodology for software development, one that is now mainstream in the consumer world, where software updates are issued frequently and often without fanfare. Think of mobile phones and cloud-based apps, for example, which introduce new features and change interfaces without warning. Agile practitioners compare their methodology to a cultural revolution, leading organizations to embrace flatter, more flexible management structures and driving changes that extend far beyond coding and development.

Adopting such a methodology in highly structured government programs is more ambitious still, given the rigidity of government contracts and traditional defense acquisition processes. Yet the Air Force felt it was necessary. Rusnock said it would take 10 to 12 years to deliver new capabilities for the F-22 using conventional waterfall development—too long given the pace at which adversaries were updating.

Although the Air Force has used agile development before, the F-22 modernization is the first time it has been employed while developing both hardware and software, according to a DOD inspector general report last year, multiplying the challenges involved.

The Air Force told Lockheed Martin, "change or be changed," Michael Cawood, the company's vice president for F-16 and F-22 product development, recalled at a technology conference earlier this year.

Lockheed Martin's embrace of agile development—for the F-35 as well as the F-22—has made the defense giant one laboratory in which the newly dominant paradigm for commercial software development will be tested in the defense environment. It will help answer the question: Can it work in defense?

The iterative nature of agile development means requirements can be "sliced and diced" according to how critical they are and how easy to deliver, Rusnock said.

"It was clear that we could get some of those capabilities much earlier than if we were to wait until every single one was complete," Rusnock said. "Instead of fielding one big bang many years away, we can start to field them much earlier"—in two or three years instead of a decade or longer.

Agile development also means program managers can be responsive to changing threats and emerging capabilities and restructure the pipeline accordingly. "Some capabilities may never be delivered," she said, eclipsed by more urgent requirements until they become irrelevant.

In 2017, Rusnock said, the program office restructured four of its ongoing modernization efforts into "an agile capability delivery pipeline." The four lines of effort were:

■ **Tactical link:** Providing the F-22 with the capability to transmit data using NATO-standard Link 16 technology.

■ **Tactical mandates:** Providing enhanced "friend-or-foe" identification capabilities.

■ **Sensor enhancements:** Providing improvements to the F-22's advanced sensor technology and the software fusion engine that give the pilot a comprehensive overhead view.

■ **GPS with military code:** Providing new jamming- and interference-proof navigation capabilities.

Link 16 transmit capability could enable the stealthy F-22 to operate in concert with coalition air operations as a quarterback, enabling the plane to share its "God's eye view" of the battlespace with other aircraft, according to Orlando Sanchez Jr., Lockheed's vice president of F-22 programs. "The F-22 is the quarterback, … that's what it feels like, you have all this information and you can call plays," he said.

In February 2018, the F-22 program office used new acquisition authorities under section 804 of the Fiscal 2016 National Defense Authorization Act to issue a task order to Lockheed Martin—the Raptor Agile Capability Release, or RACR, contract.

In fiscal 2019, RACR was funded for $140 million out of the office's $563 million research and development budget—part of the $2.7 billion total direct cost of modernization and sustainment for the F-22 that year, according to Rusnock.

She said RACR was structured as a cost-plus-fixed-fee contract with an award fee, "an incentive based on the contractor's transformation … into an agile software development pipeline."

Lockheed Martin has embraced the need to revolutionize the way it develops software, said Sanchez. A retired Air Force colonel and F-22 pilot, Sanchez said the company's goal was to "deliver these new capabilities ahead of the threat and at the speed of relevance."

To do that, Sanchez said the company didn't just change delivery schedules. "We totally redesigned our seating arrangements and our floor spaces," he said. "We have folks sitting in small, agile teams with no walls or low walls. … Software engineers sitting with mechanical engineers … based on the product they're delivering."

Photo: SSgt. Kyle Johnson

Raptors on the line at Amberley RAFB, Australia, during bilateral exercise Talisman Sabre 19. Delivering incremental Link 16 capabilities will enable F-22s to work collectively with coalition partners.

Cross-functional teams can tackle and solve problems more quickly and that means they can deliver software updates "much faster today than we have in the past," he said.

RACR also enables program reviews to be divided into smaller, more frequent demonstrations with a wider range of participants. Holding these every six weeks helps developers quickly realize if they have to rework something. "They get much faster feedback that way," Sanchez said of the development team. "You save time and you allow for this check and adjust."

Still, RACR isn't exactly rolling out updates like Apple does on your iPhone. The first RACR release will take place next year, and Lockheed and the Air Force plan annual releases thereafter, Sanchez said.

With Link 16, the new approach means F-22 pilots will be able to get some capability while waiting for more, rather than all or nothing. Link 16 capabilities consist of hundreds of potential data messages accompanying location information, from, "Here I am," to "Here's a bad guy."

Users will get to decide which are the most important messages, then look to incorporate them in an early release—the first minimum viable product.

That first release, supporting only a handful of messages and including new hardware to start transmitting them, will be in RACR Release 1.0. Sanchez expects it will begin flight testing at the beginning of next year.

James Chow, a senior engineer and director of the Force Modernization and Employment Program at RAND Corp.'s Project Air Force and chairman of the Air Force Scientific Advisory Board, argued that, if successful, the effort could serve as a model for future programs.

"These are important upgrades and the sooner we can get them out the better," he said. "If it proves successful, it will be very helpful for future modernization efforts, not just the F-22." ✪

‘Global Lightning’ SATCOM Project Expanding to AC-130, KC-135

Photo: TSgt. Gregory Brook

An AC-130U Spooky gunship at Hurlburt Field, Fla. Air Force Research Laboratory plans to test Global Lightning data-sharing, a system based on commercial satellite systems, on AC-130s first, then on the KC-135 in spring 2020. The program aims to improve Internet connection and data-transfer rates for faster access to video, weather, and other data in flight.

By Rachel S. Cohen

An Air Force investigation into how the service could piggyback on the commercial industry’s broadband Internet satellites for cheaper, better communication is moving forward to include two key combat platforms.

The experimentation and prototyping effort, known as Defense Experimentation Using the Commercial Space Internet, or “Global Lightning,” is run by the Air Force Research Laboratory, which has partnered with companies such as SpaceX, Iridium, OneWeb, L3Harris, and others to put communications terminals on aircraft and see how well they share data with satellites and their associated ground terminals. USAF is also looking into the possibility of leasing commercial space Internet as a service, rather than buying large amounts of equipment itself.

“We’re not focused just on any one company,” Greg Spanjers, chief scientist at AFRL’s Strategic Development Planning and Experimentation office, told reporters. “Our intent is to characterize the performance and understand the pros and cons of all of the commercial systems when used on military platforms.”

So far, researchers have used a C-12 to vet data transfer rates with experimental SpaceX satellites. Soon, the program plans to test out data-sharing with the AC-130, followed by the KC-135 in spring or summer 2020, according to Global Lightning Program Manager Brian Beal. Those are large, popular platforms that comprise sizable fleets and are used in areas where commanders wish they had more ability to share information, according to AFRL.

“It’s the difference between getting low data-rate text messages and high-[definition], full-motion video.”
—Greg Spanjers, chief scientist at AFRL’s Strategic Development Planning and Experimentation office

Their work also explores the authorities and other steps the Air Force needs to take to transition the idea to operational use.

Program officials said the tests have proven out much higher Internet connection and data-transfer rates than Air Force aircraft can currently receive. That means faster access to video, weather, and other data in flight, though the service hasn’t tied the capability to a particular type of mission.

“It’s the difference between getting low data-rate text messages and high-[definition], full-motion video,” Spanjers said. “Your high-def TV at home is probably about 5 megabits per second data rate. That’s a data rate well above most of the Air Force platforms that we’re dealing with.”

The military is waiting for commercial industry to build its satellite communications constellations on orbit, such as SpaceX’s Starlink array, so it can tap into the capability on a large scale.

Going forward, the service will also run tests with Lockheed Martin’s open radio architecture that allows comms to switch between satellite constellations. The Air Force wants to be able to move between the systems of various companies with as few hardware or other changes as possible.

Another prong of the effort will work with Ball Aerospace and Army Futures Command on a phased-array radar mounted atop a moving ground vehicle to test communications with spacecrafts in three different orbits.

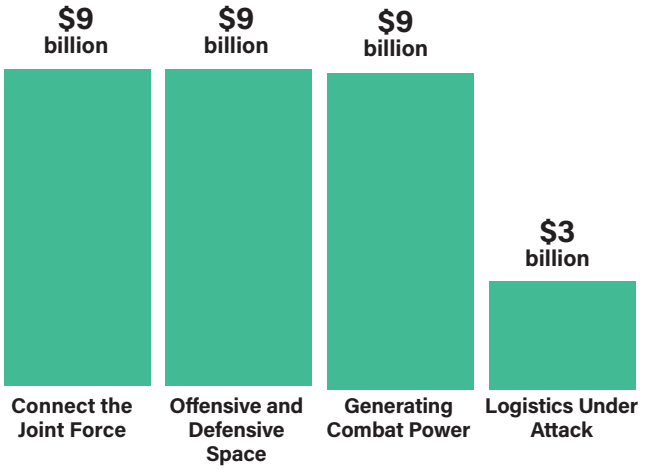
Several additional contracts are due out in the coming years for further testing, according to AFRL. ✪

Here's How USAF Aims to Spend $30 Billion in Legacy Savings

By Tobias Naegele

The Air Force plans to redirect $30 billion from the early retirement of legacy programs to fund new initiatives in connectivity, space, combat power projection, and logistics.

Chief of Staff Gen. David L. Goldfein spelled out his plans in further detail Nov. 6 at an Air Force Association event in Washington, D.C., defining the four investment "bins" and assigning amounts to each, over the future years defense plan (FYDP), beginning in 2021:



"If you want to achieve [Defense] Secretary [Mark] Esper's objective of gaining irreversible momentum for the National Defense Strategy, we have one good year to do it," Goldfein said, echoing common sentiments that increased defense budgets are highly unlikely after the coming budget cycle.

"The most important work is to set the digital foundation—it's a step you can't skip," he said. "If you want to get artificial intelligence, if you want to get hypersonics to work, if you want to go into defendable space, if you want to get directed energy where it needs to go, if you want to go into quantum [computing], you actually can't skip the steps of building the digital architecture and getting the common data cloud architecture to go forward."

Goldfein said the Air Staff "took a look at every legacy program we have and asked the question: Does this contribute significantly to the 2030 to 2038 time frame?" If the answer was no, then work began on trying to accelerate its retirement.

Connecting the force—"not just the Air Force, but the joint force," he emphasized—is the most critical step. War games bear this out. Citing a recent war game at the National Aerospace Intelligence Center at Wright-Patterson AFB, Ohio, he said, a future Air Force prevailed "in one of the most challenging scenarios we could put on the table."

That exercise—featuring "some of the best red teamers on the planet, who understood the threat and where the threat is going,"—projected a future contest in the 2030 to 2038 time frame. "For one of the first times we've seen in a while, we won," Goldfein said.

The key was joint force command and control, he explained. "The first thing you need to do to win is you've got to connect the joint force," he said. "We truly have to operate as a team: Connecting command and control, connecting sensors and shooters, taking humans from in the loop to on the loop, operating at machine speeds so you can close thousands of kill chains in hundreds of hours."

Repeatedly he emphasized the need to connect platforms across every domain. "While connecting an F-22 and an F-35 and an X-37 is interesting, let me tell you what's more important—connecting an F-35, a B-52, an Aegis cruiser, a Special Purpose MAGTF [Marine Air-Ground Task Force], a Brigade Combat Team, and new satellites," he said.

Systems that can't connect, or that operate in their own separate worlds, will not be considered in the future, he continued, describing a plant visit at which he viewed an aircraft offering. "I said, 'So you're also the same company that builds a space capability, so I assume this connects to that, right?' And what I got was, 'no, that's a separate part of the company,' " Goldfein recalled.

That's not an acceptable answer, he went on. "If you understand one thing from me, I'll make this loud and clear: I'm walking away from that offering because I can't afford to buy a capability that doesn't connect, doesn't share," he told a mostly industry audience. If it doesn't connect in all domains, if it doesn't share information, ... if we haven't built artificial intelligence into the tactical edge so it's learning, and I can take humans out of the loop and put them on the loop, then it's no longer of interest to me as Chief."

Goldfein said the Air Force is working with the other services to run connectivity experiments alongside large-scale exercises every four months. In the most recent experiment, as part of a Navy fleet exercise over the summer, the Air Force "took a space asset, connected it to an ISR asset, connected to a C2 asset, and connected it to a ship."

Using common data formats, a common information architecture, and pregenerated algorithms, the space asset identified an enemy vessel, then passed the target to an ISR asset, which used its own sensors to raise the confidence level of what was being seen. Assured the target was what the satellite spotted, the ISR asset passed the target and coordinates to a C2 platform, which selected the optimum weapon for attacking the target and handed that assignment to a ship.

"The first human in that kill chain was on the Aegis cruiser," Goldfein said.

GETTING TOUGH IN SPACE

Goldfein said it's hard to talk about space because of classification levels, but the $9 billion he intends to invest there is essential to ensure future victory and to deter aggressors from taking a chance against the United States and its allies.

"We have got to be the first mover in space," the Chief said. Acknowledging the challenges of asking for $9 billion for unnamed defensive and offensive space capabilities, he said he will press the edges of classification to make his case. "If you don't see the pluses, all you'll focus on is the minuses," he said, of lawmakers concerned about program cuts. "Much of the mitigation—the reason for taking legacy [systems] down—is that we're building up in classified.

Generating combat power is the third area of investment, with funding aimed to emphasize the "five P's" of combat airpower: "You've got to be able to penetrate," Goldfein said. "Once you penetrate, you've got to be able to persist. Once you persist, you've got to be able to protect those who are inside, in all domains, then you have to be able to proliferate, so one becomes many, and then you have to be able to punish by holding targets at risk. Because no country on the planet should be able to put a block of wood over themselves. The best they can do is to put a block of Swiss cheese overhead. Our job is to know where the holes are and get in. And I will tell you we know where the holes are, and we know how to get in."

The fourth and smallest investment area is logistics. Goldfein said future enemies will seek to deny logistics chains and battlespace access. "We have had the luxury for the past 18 years of moving in personnel and supplies at the time and place of our choosing in an uncontested way, and we do not think that is a good assumption for the future," he said.

That means the Air Force must be more expeditionary, more mobile, more flexible. "This is about preserving our ability to move," he said, promising an investment of some $3 billion over five years to support that capability. ✪

KC-46 Won't Finish Initial Testing Without Working RVS

Problems with the KC-46 Tanker's remote vision system will keep it in its initial operational test and evaluation phase longer than expected.

Photo: TSgt. John Winn

The first major test phase for the Air Force's next-generation tanker will likely last years, holding the KC-46 back from its initial operational capability milestone until after the aircraft's biggest problem—the remote vision system—is fixed.

As the aircraft enters initial operational test and evaluation, KC-46 builder Boeing is finalizing a solution to a problem that has kept the KC-46 from carrying passengers and cargo. The company aims to have the fix in place within weeks.

Air Mobility Command boss Gen. Maryanne Miller told *Air Force Magazine* that moving the KC-46 into IOT&E is a positive step, that the tanker will "not come out of IOT&E until RVS is fixed." Issues with the integral series of cameras and sensors that a boom operator uses to refuel aircraft have posed a complex problem for the Air Force and Boeing.

The service has outlined nine critical parameters the company must meet, and two have proven difficult. First is an issue with the display's acuity, or definition—currently akin to 20/50 vision. There's also a problem with depth perception, making it hard for an operator to know how far the boom is from the receiving aircraft. Meeting the parameters is seen as a pass/fail matter, and the Air Force recently said it remains "concerned about the slow progress" toward resolving those problems.

Miller said last month RVS shortfalls mean the KC-46 won't be able to deploy for three to four years. RVS may also force the tanker to remain in IOT&E for years.

The Air Force and Boeing are also still working to address the most recent "category one" deficiencies, an issue with the locks that hold cargo and seats in the plane's cargo bay. During pre-IOT&E flights, the locks signaled that they were not fully closed, Boeing said. Nothing came loose during the flights, but KC-46s are still not allowed to fly with cargo or passengers in the cargo bay.

Boeing said Oct. 28 that it successfully tested a new, retrofitted cargo lock that stops it from starting to disengage.

"The retrofit has already flown on the tanker during testing and meets all requirements," the company said. "Boeing and the Air Force are planning to install the new locks on all KC-46 aircraft in the coming weeks. The safety of the KC-46 aircraft and crew is our top priority."

AMC and Boeing are meeting again to discuss all the issues within weeks. Both the service and the company have laid out the milestones ahead, and Boeing set up labs to test system fixes, Miller said.

The IOT&E process is expected to raise more issues as testers vet the aircraft. Miller has met with the crews flying tanker test missions and working through the objectives. They must "not shortcut anything in this," she said.

"We'll add to the list of things to get after—that's what IOT&E is really all about," Miller said. "It really is wringing the airplane out."

—Brian W. Everstine ✪

Barrett Takes Over as USAF Secretary

Photo: Wayne Clark/USAF

Barbara Barrett takes the oath of office in a ceremonial swearing-in at the US Air Force Academy, administered by Deputy Secretary of Defense David Norquist and accompanied by her husband Craig Barrett on Nov. 2.

Newly arrived Air Force Secretary Barbara Barrett reaffirmed her commitment to the service, its core values, and its airmen Nov. 2, 2019, at a ceremonial swearing-in at the US Air Force Academy in Colorado Springs, Colo.

"The airmen who wear our nation's uniform are our greatest asset and treasure, and we have no greater charge than to develop and care for them and their families," Barrett said.

Air Force Chief of Staff Gen. David Goldfein said Barrett "may be the kindest and most thoughtful person I've ever met," noting that she walked alone to Arlington National Cemetery after her official oath of office ceremony on Oct. 18. She spent time in Section 60, where many of the troops killed in Iraq, Afghanistan, or Syria are buried, to "allow the gravity of her role" to sink in, Goldfein said.

In future conflicts, "we will be called first," Barrett said.

"Air Force C-17s may carry special forces to the far reaches of the globe, with KC-10s refueling them along the way," she said. "When these troops reach their destination, combat controllers will be embedded with them, providing technical expertise and directing the B-52s and F-35s overhead, protecting American forces on the ground. At the same time, Air Force [unmanned aerial vehicles] will be in the air, providing vital, real-time intelligence, and all of this will be enabled by space assets."

Deputy Secretary of Defense David L. Norquist swore in Barrett inside the academy's Polaris Hall. Barrett called the building "a monument to character and leadership," noting that the building's oculus points directly at the North Star, or true north.

"Pilots distinguish between magnetic north, which changes, and true north, which is constant, enduring, unchanging, solid," she said. "The United States Air Force is enduringly guided by its core values, its Polaris."

"As we share the light from the oculus in this room, I look to Polaris. I pledge to do my best, guided by the core values, as I do my part to organize, train, and equip our United States Air Force," Barrett said.—*Jennifer Hlad*

Does MC-130 Part Failure Signal Broader Issue?

The Air Force's C-130 program office is looking into what caused a torque tube and spring to recently fall off a special operations plane in Japan, a service spokesman said Oct. 25.

"It is not an issue we have seen before," Air Force Life Cycle Management Center spokesman Brian Brackens said in an email. "Therefore, we will be sending the part to the lab for failure analysis. The findings of this analysis will help us to determine whether this was an isolated incident or if it will impact the C-130 fleet."

Airmen discovered the torque tube and spring missing from the MC-130J during a post-flight inspection Oct. 18 at Kadena AB, Japan, officials told *Air Force Magazine*. The assembly weighs 1.2 pounds and is 4.4 feet long by 1.25 inches in diameter and is believed to have fallen off during take off or landing.

The aircraft—assigned to the 353rd Special Operations Group—had been doing touch-and-go training at Kadena and

Photo: A1C Greg Erwin

An MC-130 on the ramp at Kadena AB, Japan.

Ie Shima training range. Ie Shima is a US Marine Corps-controlled airfield on a small island just off the coast of Okinawa.

The assembly was found later Oct. 18 at Ie Shima; the 353rd SOG is still investigating what caused the incident.

When asked about the possible fleetwide impact the incident could have for all C-130s, an Air Mobility Command spokeswoman referred the question to AFLCMC. Earlier this year, Air Mobility Command launched inspections of all operational C-130s that were at risk for unusual wing joint cracks after one of the Lockheed Martin-built planes prompted a broader investigation into about one-fourth of USAF C-130s.

The Air Force also grounded 60 C-130Hs in February to address propeller problems. *—Rachel S. Cohen and Jennifer Hlad*

RAND Calls for More Focus on Nuclear Modernization

Photo: Michael Peterson

An unarmed Minuteman III launches during an operational test at Vandenberg AFB, Calif.

Air Force Global Strike Command needs to beef up its planning and advocacy for its future intercontinental ballistic missile and long-range bomber if it wants to successfully modernize its enterprise in an era of financial and technological challenges, the nonprofit research organization RAND Corp. said in a new report.

Over the next few decades, the Air Force plans to bring on the Ground-Based Strategic Deterrent, Long-Range Standoff Weapon, and B-21 bomber "after decades of near neglect" of older nuclear assets, RAND researchers wrote. Global Strike is also receiving new helicopters and moving forward with an overhaul of nuclear command, control, and communications systems.

"Nuclear-specific tasks related to testing and certification have not been performed at scale for many decades and will need to be relearned and revised for the current conditions," the report said. "The sheer scale of the programs is daunting. And this ambitious set of programs will be fielded by [AFGSC], a relatively young command with a relatively small staff that has limited experience in fielding new systems."

Others like the Air Force Scientific Advisory Board also have warned of cybersecurity, electromagnetic resilience, and other testing and certification challenges ahead. RAND suggests that nuclear certification reviews should be part of acquisition milestone decisions to ensure nothing gets overlooked.

Analysts recommend the Air Force create master plans for its land-based missiles and bombers that help define the steps needed to work through modernization from start to finish. The issues at hand are not new, RAND noted, but the nuclear workforce has become smaller and less experienced in the decades following the Cold War.

"These master plans would adopt a strategies-to-tasks framework to show a detailed decomposition of the means by which each of these missions will be sustained over time and how these systems contribute to national-level objectives," according to the report. "The Air Force should use this strategies-to-tasks framework for its nuclear roles to strengthen the coordination of advocacy across the Air Force."

RAND recommended that Global Strike, which turned 10 years old in August, should reach out to other major commands like Air Combat Command to learn from their experiences in buying and fielding new systems. The report also advises the command to establish a larger presence in the Washington, D.C., area to grow its influence over decisions that affect nuclear priorities.

At the same time as it prepares to bring on new systems, Global Strike is juggling sustainment of its current missiles, grappling with maintenance challenges for the worn-down B-1 and the B-52, which is expected to fly for 100 years, and eyeing retirement for the B-1 and B-2.

"The nuclear modernization effort is happening in a tight fiscal period with some opposition to various nuclear systems in favor of other national priorities," the organization said of the multibillion-dollar programs. "AFGSC will need to sustain legacy systems, field new systems, and manage the sometimes complicated transition between them. It is vital not only that strategic nuclear systems operate, but that the exact specified number be available or on alert at all times." *—Rachel S. Cohen*

X-37B Ends 718-Day Mission

Photo: USAF

USAF calls the X-37 Orbital Test Vehicle a "workhorse," and discussions about the need for a replacement are ongoing.

The X-37B Orbital Test Vehicle, a reusable and unmanned spacecraft, landed at NASA's Kennedy Space Center on Oct. 27. "Each successive mission advances our nation's space capabilities," Air Force Secretary Barbara Barrett said in an Oct. 27 press release.

Mission four lasted 718 days in space, though the spacecraft was designed to last only 270 days in orbit. A sixth mission will launch in 2020.

The X-37B performed experiments to lower the risk for potentially very expensive space technologies, helping the Air Force prepare for possible costly next steps or how it should operate in space in the future, Air Force Rapid Capabilities Office Director Randall Walden said Oct. 24.

While he would not provide details of those experiments, Air Force officials have said they relate to spacecraft materials, power generation techniques, and sensors.

In a press release after the landing, Walden said the space-

plane completed all its mission objectives, successfully hosted Air Force Research Laboratory experiments, and provided a ride for small satellites.

The X-37 also is informing whether the Air Force will need a new vehicle to replace it, Walden said.

"The data are still out" on whether USAF needs more X-37s to replace its two aircraft as they age, or whether the service is planning a follow-on program, he said.

The two vehicles in hand are "workhorses" that are faring well with their experimentation and prototyping missions, he said. He hinted that the X-37 is also helping answer the question of how the US could venture into reusable space assets, as it is exploring in the National Security Space Launch program for reusable rockets that can take military and civilian space assets to orbit.

In July, then-Air Force Secretary Heather Wilson revealed more details about the OTV, saying it "can do an orbit that looks like an egg and, when it's close to the Earth, it's close enough to the atmosphere to turn where it is." Military.com first reported on her remarks.

"Our adversaries don't know—and that happens on the far side of the Earth from our adversaries—where it's going to come up next. And we know that drives them nuts. And I'm really glad about that," Wilson said.—*Rachel S. Cohen, Jennifer Hlad, and John A. Tirpak*

JASSMs Level Compound in Syria

US aircraft fired a heavy onslaught of ordnance from the air, including multiple AGM-158B Joint Air-to-Surface Standoff Missiles, to destroy the Islamic State group leader's hideout in Syria following the raid that resulted in his death, the Pentagon said Oct. 28.

The airstrikes at the "tail end" of the raid on Abu Bakr al-Baghdadi's hideout just 4 miles away from Turkey leveled the structure, after US forces retrieved large amounts of intelligence and took two fighters into custody, Army Gen. Mark A. Milley, Chairman of the Joint Chiefs of Staff, said at an Oct. 28 press briefing.

In addition to JASSMs, US forces used guided bombs, Hellfire missiles, miniguns, and other small-arms fire on the compound. News agencies published photographs of the site taken after the raid that show piles of rubble, with no free-standing buildings left.

Milley did not specify which aircraft were used to conduct the strikes.

The incident marked the second time JASSMs have been used in Syria. In April 2018, B-1 bombers launched 19 of the missiles at the Syrian regime's chemical weapons production facilities as part of a large strike, which also included 57 Tomahawk missiles.

US special forces flew more than an hour to reach the location of the Oct. 26 raid, passing over areas controlled by Russian, Turkish, and Syrian forces. US forces used "deconfliction channels" to notify Russia about the overflight to avoid miscalculations, a step that is consistent with past operations, Milley said. Following the raid, Baghdadi's remains were disposed of in a manner consistent with international law, he said.

The Pentagon is going through the process of declassifying videos and photographs from the raid, and future briefings are likely to provide more detail on the operation, he said.

No US forces were seriously injured in the operation. A military dog that chased Baghdadi into a tunnel before he detonated his suicide vest was slightly injured and has returned to service,according to Milley. The Pentagon is not identifying the dog for security reasons.—*Brian W. Everstine*

Fewer Aviation Mishaps in 2019

Fiscal 2019 proved to be safer for the Air Force than the year before, with nine fewer of the most destructive mishaps compared to fiscal 2018, according to Air Force Safety Center data.

The service logged 14 Class A mishaps between Oct. 1, 2018, and Sept. 30, 2019, the AFSC reported. It recorded 23 Class A incidents from Oct. 1, 2017, and Sept. 30, 2018.

Class A mishaps occur when aircraft are destroyed or suffer more than $2 million in damage, or when the pilot or crew is killed or permanently, fully disabled. Incidents in which remotely piloted aircraft are destroyed don't count toward that tally unless one of the other two criteria are met, according to AFSC.

Of those 14 Class A events, the majority involved fighter jets: six F-22s, two F-15s, and two F-16s. Ten fighter platforms were involved in Class A mishaps in fiscal 2018.

A C-17, T-38, T-6, and V-22 were also involved in Class A mishaps in fiscal 2019. Pacific Air Forces saw the most severe incidents of any Air Force major command that year.

The AFSC noted one fatality, far below the 19 fatalities in the previous year, during which nine members of the Puerto Rico Air National Guard were killed in a May 2018 WC-130H crash.

The Air Force also saw 27 Class B accidents in fiscal 2019, down from 34 in the previous year. Class B mishaps are defined by aircraft damage costing between $500,000 to $2 million, personnel becoming permanently, partially disabled, or three or more people being hospitalized.

The improvements are at least partially attributable to new technologies and procedures in place. *Air Force Magazine* reported Nov. 7 that for the F-16, a new Automatic Ground Collision Avoidance System had saved eight aircraft and nine lives so far.

The National Commission on Military Aviation Safety, a group created by Congress in the Fiscal 2019 National Defense Authorization Act to investigate trends across aircraft mishaps that occurred between 2013 and 2018, recently briefed reporters on its progress.

While it's too early to draw any conclusions from what the commissioners have learned so far, Bryan Whitman, a spokesman for the group, told *Air Force Magazine* that its members had visited 16 Air Force installations, plus the US Air Force Academy as of Oct. 31. Another 13 USAF sites are still on its list.

"The commission is still in the data-collection phase, meeting with a wide range of personnel in the aviation community to hear firsthand the challenges they deal with every day," Whitman said in a Nov. 6 email. "Simultaneously, the staff is compiling all of the safety mishap [Class A-C] data from the services. Then we will take the reflections from the site visits and match it up with the mishap data to start identifying trends."

Commissioners are focusing on issues ranging from policy, to budget, to the pace of operations to training, sustainment, and more.

"One of the specific tasks the commission is appointed with is to make an assessment of the underlying causes contributing to the unexplained physiological events some military pilots have experienced in the past few years," the Air Force said in an Oct. 8 release.

NCMAS plans to release its findings in 2020, after which the Defense Department must tell Congress how it plans to implement the recommendations.

"The commissioners are confident that their recommendations will be well-informed, constructive, and actionable," Whitman said.—*Rachel S. Cohen*

Lost USAF Combat Controller

Air Force Special Operations Command has changed its search for a missing special tactics airman into a mission to recover his body.

SSgt. Cole Condiff, 29, was a special tactics combat controller with AFSOC's 24th Special Operations Wing, the wing said Nov. 9. He served in the 23rd Special Tactics Squadron.

Photo: SrA. Rachel Yates

SSgt. Cole Condiff

Military personnel have been searching for Condiff since he fell from a C-130 over the Gulf of Mexico during a Nov. 5 static line training jump. The Air Force and Navy are still conducting recovery efforts, and USAF is investigating the incident. The Coast Guard had suspended its search effort as of Nov. 8.

"Cole was a man with deep-rooted beliefs who dedicated himself to God, our freedoms, peace, and his family. He was a devoted family man within our squadron, focused on teaching his girls to be adventurous like he was," Lt. Col. Steven Cooper, 23rd STS commander, said in a Nov. 9 release.

Condiff, a Texas native, enlisted in 2012 and was assigned to Hurlburt Field, Fla., after completing the two-year combat control training program. He was a "static line jumpmaster, military free-fall jumper, combat scuba diver, air traffic controller, and a joint terminal attack controller" who deployed to Africa and Afghanistan and received two Air Force medals, according to the Air Force.

He is survived by his wife, two daughters, parents, sister, and two brothers.—*Rachel S. Cohen*

USAF Expands Plans for Light Attack Aircraft

The Air Force plans to buy a small number of AT-6 and A-29 aircraft, to be split between Air Combat Command and Air Force Special Operations Command, as its light attack experiment shifts into an acquisition program.

The service on Oct. 24 released its final request for proposals, which states it plans to purchase two to three light-attack aircraft each from Textron Aviation, which produces the AT-6, and the Sierra Nevada Corp.-Embraer team that offers the A-29. The Air Force expects to issue a contract for the A-29 by end of the year, and for the AT-6 in early 2020.

The AT-6 will go to Nellis AFB, Nev., where ACC will use it for testing and development of "operational tactics and standards for exportable, tactical networks that improve interoperability with international partners," the Air Force said in an Oct. 24 release.

Meanwhile, the A-29 will go to Hurlburt Field, Fla., where AFSOC will use it to create an instructor pilot program for those who advise foreign nations on air warfare. The program will help meet "increased partner nation requests for light attack assistance," according to the Air Force.

The light attack experiment began in August 2017, when USAF and Navy pilots flew a range of aircraft at Holloman AFB, N.M., to evaluate their ability to perform close air support and related missions in permissive areas. The Air Tractor, L3 Technology's AT-802 Longsword, and Textron's Scorpion also participated in the experiment, but were not selected to move forward in the process. Air Tractor later filed a protest related to the light-attack program with the Government Accountability Office, which was quickly dismissed.

"Our focus is on how a light attack aircraft can help our allies and partners as they confront violent extremism and conduct operations within their borders," Air Force Chief of Staff Gen. David Goldfein said in the release. "Continuing this experiment, using the authorities Congress has provided, gives us the opportunity to put a small number of aircraft through the paces and work with partner nations on ways in which smaller, affordable aircraft like these can support their air forces."

The turboprop planes will also be used to "examine a common architecture and intelligence-sharing network" that bridges them with sensors and other platforms, according to the release.

"If I hear one thing from my international air chiefs, it's, 'We need to figure out how to share information both ways," Goldfein said.—*Brian W. Everstine*

DOD Launching 5G Experiments

The Pentagon is rolling out an experimentation and prototyping campaign that will look at using 5G networks to provide augmented and virtual reality tools for mission planning and training, to manage warehouses and military logistics, and to learn more about sharing parts of the wireless spectrum with other users.

A draft request for proposals that uses new commercial technologies to further military network objectives was due out in November, with the final version expected this month—though that could be derailed if Congress does not pass a 2020 defense spending bill. Officials plan to publish new opportunities for industry about every three months if funds are available, and will hold an industry day before putting out the final RFP.

Lisa Porter, the deputy undersecretary of defense for research and engineering, said on a call with reporters the Defense Department wants to explore each of the use cases before turning to the matter of leasing 5G infrastructure at still-undisclosed bases.

Those installations will "provide streamlined access to site spectrum bands, mature fiber and wireless infrastructure, access to key facilities, support for new or improved infrastructure requirements, and the ability to conduct controlled experimentation with dynamic spectrum sharing," DOD said in a release.

The first round of opportunities includes: "establishing a dynamic spectrum-sharing testbed to demonstrate the capability to use 5G in congested environments with high-power, mid-band radars, integrating augmented reality and virtual reality into mission planning and training in both virtual and live environments on training ranges," and pursuing "smart warehouses to leverage 5G's ability to enhance logistics operations and maximize throughput," according to the release.

Officials are choosing projects that will also benefit commercial industry, which is leading the push toward 5G networks that are expected to be faster and more secure. The initiative comes as USAF is taking its own steps to spread 5G to bases one region at a time.—*Rachel S. Cohen*

USAF Arsenal Plane Options

Photo: SSgt. Trevor McBride

Whether the B-52 Stratofortress would make a good arsenal plane or whether something else is needed remains under discussion.

The Air Force is planning experiments and briefing senior leaders on progress toward its "arsenal plane" idea, looking at multiple aircraft options to fly with a large weapons load to back up strike assets.

An arsenal plane would be a multi-engine platform that could augment remotely piloted aircraft and fighter jets in combat and totes "network-enabled, semi-autonomous weapons," according to a 2016 Air Force video. The concept has been around for years under the Defense Department's Strategic Capabilities Office.

The idea "takes one of our oldest aircraft platform[s] and turns it into a flying launchpad for all sorts of different conventional payloads," then-Defense Secretary Ash Carter said in 2016. "In practice, the arsenal plane will function as a very large airborne magazine, [and] network to fifth-generation aircraft that act as forward sensor and targeting nodes."

Senior leaders are still discussing the prospect of fielding such a plane, service spokeswoman Capt. Cara Bousie said Nov. 3.

At AFA's 2019 Air, Space & Cyber Conference in September, Air Force Global Strike Command boss Gen. Timothy Ray told reporters the service was planning more experiments to flesh out the idea. More reports were due to senior leaders as well.

While people have speculated that the B-52 bomber would make an ideal arsenal plane, Ray indicated mobility platforms could be in the mix.

"You have to go look at those options, if you believe you'll have access to airlift assets to go do that in a time of crisis," he said. "I'm not mentally there, I don't see how that comes together."

He added that Air Force acquisition boss Will Roper—a former SCO director—would be briefed on the program at the end of September. Bousie said she couldn't provide any insight on those discussions.

"At the end of the day, there's a little bit of learning going on," Ray said. "It's an easy thing to draw, a tougher thing to do."

Could a mobility platform play the role of arsenal plane well? Todd Harrison, director of the Aerospace Security Project at the Center for Strategic and International Studies, believes it depends on what munitions the platform would carry.

"If it's used for air-to-air munitions, then externally mounted weapons would be ideal. But many mobility platforms were not designed to handle external payloads, so it could require extensive modifications," Harrison said in an email. "If the arsenal plane is intended to carry air-to-ground weapons, then they could deploy from the rear ramp of mobility platforms, which would not require extensive modifications."

He argues a B-52 is a better platform because it offers space for munitions inside and on its wings, and can carry many at a time.

"An arsenal plane does not necessarily need to be stealthy or fast, but it needs to have a large payload capacity," Harrison said.

Mark Gunzinger, director of future aerospace concepts and capabilities assessments at AFA's Mitchell Institute for Aerospace Studies, agrees that turning to mobility or a commercial-derivative aircraft wouldn't be practical when the Air Force could use B-52s or B-1s instead.

"C-17s will likely be in very high demand during the opening stages of a major conflict accomplishing their primary missions," Gunzinger said. "It wouldn't make sense to allocate them for strikes instead of using them to deploy forces into a theatre of operations. It would be even more difficult, and far more costly, to attempt to modify a commercial-derivative aircraft to carry a large number of weapons internally, depressurize for weapons releases, safely eject weapons, etc." *—Rachel S. Cohen*

"Open Up and Show Our Brokenness," AMC chief says

Photo: SMSgt. Vincent de Groot/ANG

Taking time out to talk to fellow airmen can be a vital tactic in the battle against suicide.

The Air Force is encouraging senior leaders to be forthcoming with their own personal stories to connect with airmen and ensure the discussion continues, following the recent stand-down implemented to focus on mental health amid a dramatic increase in suicides.

"[We], as leaders, need to open up and show our brokenness," said CMSgt. Terrence Greene, the command chief master sergeant for Air Mobility Command, in a recent interview. "We're not perfect, we're going through challenges in our lives."

Air Force Chief of Staff Gen. David Goldfein in late July ordered a one-day "resilience tactical pause" to address the issue of suicide across the Air Force, which he said was an "adversary that is killing more of our airmen than any enemy on the planet."

As wings across the service paused operations for a day to discuss suicide, Goldfein said some were more effective than others. In a recent interview with *Air Force Magazine,* he said the most effective discussions stemmed from commanders being proactive and opening up about their personal stories.

"There's a power of senior leaders actually telling their story," Goldfein said, adding it humanizes the commanders, and it dispels the myth that leaders "don't deal with this issue at all."

"I hear a lot of stories of commanders, command chiefs, senior NCOs, senior leaders who actually showed some vulnerability and shared things they are dealing with. It opened up dialogue."

Greene is using his story to try to connect with his airmen. At the 2019 Airlift/Tanker Conference in late October in Orlando, he said in a speech that airmen need to "lead from the neck up," and they should "inspire, and motivate, and encourage, and excite people. The only way to do that is to have a personal conversation, create an environment where people feel comfortable."

When Greene was young, his mother committed suicide, and he and his siblings faced abuse. When he joined the Air Force, he thought, "Holy crap, I found a family. I found this thing that I wanted." But, he said he focused so much on work, he neglected his own family.

Greene, like a lot of young airmen today, came "in with scars" that can lead to thoughts of suicide. While he's "really excited some airmen are strong enough to fight against it, there were times when my own brain would take me down that road."

The Air Force needs to work together to ensure all airmen can be strong and resilient in the face of these challenges. "We've got to get to know the person behind the uniform," Greene said.—*Brian W. Everstine*

Turkey Sanctions Lifted

Photo: SSgt. Joshua Hammock/USA Reserve

An MRAP is loaded onto a C-17 in Syria on Oct. 23.

The White House is lifting sanctions it imposed on Turkey after Turkey agreed to a "permanent" ceasefire in Syria but can now reach deeper into areas previously held by Syrian Kurdish fighters, President Donald Trump announced Oct. 23.

The limited sanctions, which Trump enacted in an Oct. 14 executive order, targeted Turkish steel and assets held by some of the country's leaders. Trump said Turkish President Recep Tayyip Erdogan informed him that Turkey was stopping its military incursion into northeast Syria, the day after Erdogan and Russian President Vladimir Putin reached a decision to jointly patrol the area along the Turkish-Syrian border—which, until recently, the US and Turkey did together.

"The sanctions will be lifted unless something happens that we're not happy with," Trump said. "This was an outcome created by us, the United States, and nobody else. No other nation; very simple. And we're willing to take blame, and we're also willing to take credit. This is something they've been trying to do for many, many decades."

US forces have largely left Syria, with a small number staying behind to secure oil fields and prevent them from being taken over by Islamic State group fighters. "We're going to be protecting it, and we'll be deciding what we're going to do with it in the future," Trump said of the oil.

Most US forces in Syria are moving to Iraq, where Iraqi leaders have said they are not authorized to stay. Defense Secretary Mark Esper met with Iraqi Prime Minister Adel Abd-al-Mahdi in Baghdad on Oct. 23, where he thanked Iraq for supporting the security of US personnel.

In an Oct. 22 interview with CNN, Esper said the forces that left Syria are being repositioned "temporarily" in Iraq as part of a "continuing phase" that will lead them home. Esper said the forces that will stay in Syria will be in the southern part of the country, likely the fortified Al-Tanf facility, "but that needs to be worked out in time."

Esper said that US airpower would stay active in the area if American forces are on the ground.

Turkey's invasion of Syria, targeting formerly US-backed Kurdish fighters, began after Trump on Oct. 6 announced he was ordering American forces to leave the area along the Syrian-Kurdish border. The Oct. 23 announcement came at the end of a temporary ceasefire that local reports said fighters largely disobeyed.

Trump said he spoke with Syrian Democratic Forces leader Mazloum Abdi, who "could not be more thankful" and said IS detainees are "under very, very strict lock and key."

That statement contradicts others from inside the administration. Esper, speaking with CNN, said there are reports of a "bit more than 100" IS fighters who have escaped captivity. James Jeffrey, the special representative for Syria engagement and the special envoy to the global coalition to defeat ISIS, told the Senate Foreign Relations Committee on Oct. 22 that some IS detainees have escaped, and that about 10,000 detainees are in "jeopardy if things go south in northeast Syria."—*Brian W. Everstine*

Reagan Library to Display F-117

The Ronald Reagan Presidential Library and Museum in Simi Valley, Calif., will display an F-117 Nighthawk stealth fighter starting in December.

The Ronald Reagan Presidential Foundation and Institute on Nov. 4 announced the F-117—Tail No. 803, nicknamed "Unexpected Guest"—will be unveiled Dec. 7 at the annual Reagan National Defense Forum. The jet is on loan from the National Museum of the US Air Force at Wright-Patterson AFB, Ohio, and will be on permanent display at the library.

"Unexpected Guest" entered service in May 1984 and flew 78 combat sorties, more than all other F-117s combined, according to the foundation. Nighthawks, the world's first operational stealth aircraft, became public in 1988.

"I'm glad the airplane can come out of the dark to take its rightful place in the light, somewhere it can be seen and appreciated by the people it helped to protect," retired Lt. Col. Scott Stimpert, a pilot who flew the aircraft when it was classified, said in a foundation release.

Lockheed Martin restored the airframe for display. The USAF museum in Ohio also has an F-117.

The Reagan Library and Museum complex was evacuated in October because of a raging brush fire in Simi Valley that came dangerously close to the building. It reopened to the public on Nov. 1.—*Brian W. Everstine*

Vigilant Ace Replacement

Photo: SrA. Jessica Smith

USAF F-15s once participated in large-scale exercises such as Vigilant Ace-18 above—not any more.

The US and South Korea will once again hold a reduced-size flying training event instead of the large-scale Vigilant Ace exercise, Korean officials told Yonhap news agency.

Pentagon spokesman Lt. Col. Dave Eastburn told the agency there will be an upcoming "Combined Flying Training Event."

The decision marks the second consecutive year that Vigilant Ace has been suspended. The exercise, which first launched in 2015, regularly included hundreds of aircraft from both the USAF and Republic of Korea Air Force, along with the US Navy and Marine Corps. It exercised the pre-positioned air tasking order that simulates the first few days of conflict on the Korean peninsula and included 24/7 flying operations. Last year's iteration was suspended following President Donald Trump's summit with Kim Jong Un.

US officials have insisted that the suspension of large-scale exercises, such as Vigilant Ace, Foal Eagle, and Ulchi Freedom Guardian, among others, have not affected readiness on the peninsula.

In March, US Forces-Korea Commander Army Gen. Robert Abrams told lawmakers the US changed the "size, scope, volume, and timing" of training, noting the US is "a trained and capable force." Pacific Air Forces boss Gen. C.Q. Brown said after Vigilant Ace was canceled there were no "immediate" concerns about the degradation of readiness, but canceled exercises could create "difficulties" down the road.—*Brian W. Everstine* ✪

USAF Scientist Moves to DOD

Former Air Force Chief Scientist Mark J. Lewis has been appointed Director of Defense Research and Engineering for Modernization, the Pentagon confirmed. Lewis will oversee the directors of 12 technologies the Defense Department deems its highest priorities, and their implementation roadmaps, ranging from hypersonics to biotech. In particular, he will focus on rationalizing the various hypersonics efforts of the military services and defense agencies. Lewis started Nov. 4, and will serve as deputy to Undersecretary of Defense for Research and Engineering Mike Griffin, who has made hypersonics his top priority. ✪

SMC Wins Top Award

The Air Force Space and Missile Systems Center's launch enterprise has won the Defense Department's highest award for acquisition, the 2019 David Packard Excellence in Acquisition Award, the service said Nov. 1. "SMC's launch enterprise team crafted an acquisition strategy of innovative public-private investments in launch vehicle development, resulting in the continuous delivery of acquisition performance with both affordability and speed," the center said in a release. The award is named for David Packard, a former deputy defense secretary from 1968-1971 and a co-founder of technology giant Hewlett-Packard. It was instituted in 1997 and went to another SMC team in 2018. ✪

USAF Pilots Fly F-35Bs at Sea

Photo: LCpl. Juan Anaya/USMC

USAF Capts. Spencer Weide, left, and Justin Newman with an F-35B aboard the USS *America*.

Two Air Force pilots on Sep. 27 flew F-35Bs from the amphibious assault ship USS *America* in the Eastern Pacific, marking the first time airmen flew the Marine Corps variant of the Joint Strike Fighter at sea. Capts. Spencer Weide and Justin Newman, both assigned to Marine Fighter Attack Squadron 122 at MCAS Yuma, Ariz., flew the aircraft as part of an integrated training exercise, according to a Nov. 1 Air Force release. "Integrated training like this is important because we operate off of a ship, and we get to learn the naval and Marine warfare functions," Newman said in the release. "This will allow us to return the knowledge back to the Air Force for better future integration." ✪

■ The War on Terrorism

Casualties:

As of Nov. 11, 82 Americans had died in Operation Freedom's Sentinel in Afghanistan, and 87 Americans had died in Operation Inherent Resolve in Iraq, Syria, and other locations.

The total includes 165 troops and four Defense Department civilians. Of these deaths, 79 were killed in action with the enemy, while 92 died in noncombat incidents.

There have been 494 troops wounded in action during OFS and 81 troops in OIR.

FACES OF THE FORCE

Photo: ROTC Det. 225

Second Lt. Kirsten Cullinan on Oct. 22 was recognized as 2019 Cadet of the Year by Air Force Chief of Staff Gen. David L. Goldfein at a ceremony at the Pentagon. Cullinan was selected from among more than 3,000 Air Force Academy, Reserve Officer Training Corps, and Officer Training School cadets. Cullinan said, "It was an honor" to receive the award, but she also said she felt any of her fellow cadets at the University of Notre Dame could have earned the prestigious award. Cullinan graduated in May with dual degrees in political science and Russian and is on Active Duty training to be an intelligence officer. "I wish I could tell you this will be the only time you'll be at the Pentagon," Goldfein said with a laugh. "But I'd be lying, because in the course of your career, I'd be surprised if you don't get tagged for a tour." The British Air Squadron established the award in 2000 and presented the Millennium Sword of Friendship to the Air Force, a symbol of the enduring British-American partnership. The name of each Cadet of the Year is engraved on the sword, it remains on permanent display in the Pentagon.

Photo: A1C :Leala Marquez

TSgt. Michael Jakubec became the sole service member at Luke AFB, Ariz.—and one of only two enlisted airmen in all of Air Education and Training Command—to get special permission to spend an unlimited amount of funds on the government's behalf. "Unlimited warrants are required for ... [many] projects exceeding $5 million," Jakubec said. He studied federal acquisition rules for 10 weeks and passed a warrant board evaluation to qualify for the warrant.

Photo: SrA. Tyrell Hill

1st Lt. Genevieve Miller and **A1C Michael Yoo** were selected to represent the US military in swimming at the 7th Conseil International du Sport Militaire Military World Games, held Oct. 15-30 in China. Miller is a deputy flight commander at JB Langley-Eustis, Va., and Yoo is an avionics backshop technician at Mountain Home AFB, Idaho. Both were competitive swimmers since childhood. "The most important thing ... is that I am representing something bigger than myself," Miller said.

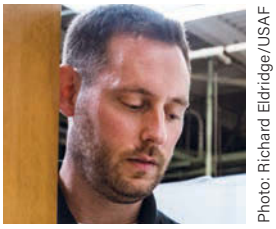


Photo: Richard Eldridge/USAF

An AFRL team led by 711th Human Performance Wing Research Psychologist **John McIntire** received a 2019 Defense Innovation Award for coming up with portable locks that can help secure or barricade most kinds of doors during active-shooter scenarios. The team has given some of the locks to Wright-Patterson AFB, Ohio, security personnel. "We hope this technology can provide a provably effective method of bystander or potential victim protection," McIntire said.

Photo: USAF

USAF posthumously awarded a Meritorious Service Medal to **SSgt. Adam Erickson**. The 412th Operations Support Squadron's former NCO-in-charge of Parachutist Program Operations was killed in a Sept. 10 training accident. The SERE (survival, evasion, resistance, and escape) specialist and test parachutist got his master parachutist rating about a month before his passing. He "very clearly enhanced every life that he touched," said MSgt. Brandon Fountain, program superintendent.

Photo: USAF

After a B-17G Flying Fortress crashed at Bradley International Airport in Connecticut on Oct. 2, an Air National Guardsman who was aboard the downed aircraft helped usher his fellow passengers to safety. **CMSgt. James M. Traficante**, command chief master sergeant for the 103rd Airlift Wing at Bradley ANGB, Conn., managed to release the plane's back hatch after the crash so that injured survivors could escape. He was reportedly able to do so because he had traveled with his DOD-issued fire-retardant gloves.

Photo: SrA. Alyssa Van Hock

After years of working as a translator for US and coalition forces in Iraq, **A1C Saeed Shnawa** fulfilled his dream of joining the US military. "I hold a tremendous amount of honor toward those troops in Iraq," he said. I used to wonder, 'Will I ever get the chance to do their job, in their uniform?' ... I wrote it off as an impossible dream." Shnawa, earned US citizenship and joined USAF in 2017, and now is an aircrew flight equipment technician with the 811th Operations Support Squadron at JB Andrews, Md.

Photo: SrA. Delaney Gonzales

USAF **MSgt. Galicia Castillo**, Air Combat Command A3 Operations Division command and control manager, shared her culture by performing traditional Mexican dances in honor of Hispanic Heritage Month at JB Langley-Eustis, Va. Castillo said she believes celebrating diversity is the reason the Air Force is a strong fighting force. "We all bring a different vision—a different way of thinking—to the fight," Castillo said.

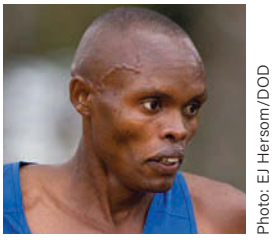


Photo: EJ Hersom/DOD

A1C Daniel Kirwa, a medical technician assigned to the 6th Healthcare Operations Squadron at MacDill AFB, Fla., is the fastest long-distance runner in the Air Force. Out of more than 12,000 participants, Kirwa placed first in the military category of the Air Force Marathon—and third overall—with a time of 2 hours, 33 minutes, and 3 seconds. "I was so excited when I finished the race because I represented the Air Force nicely, which was my main goal," Kirwa said.

Know of someone we should recognize? Send nominees to afmag@afa.org

16th Air Force Launches Information Ops for the Digital Age

Illustration: Mike Tsukamoto/staff

The new numbered Air Force will lead operations in the information domain.

By Rachel S. Cohen

Russia is targeting US elections. Hackers claiming allegiance to the Islamic State are going after US Central Command's social media. China is using computer espionage to steal and possibly alter sensitive data.

Against the ever-evolving backdrop of conflict in the digital era, the Air Force is stepping up efforts to explore and exploit cyberspace, the electromagnetic spectrum, and even the weather—further blurring the line between peacetime and wartime operations.

The new 16th Air Force launched in October to bring cyber, intelligence, and other information dominance operations together under one roof at JBSA-Lackland, Texas.

Sixteenth Air Force combines the assets of the former 24th and 25th Air Forces, which respectively oversaw cyber and ISR operations, along with electronic warfare, cryptology, psychological operations, the 557th Weather Wing, and the Air Force Technical Applications Center, which uses its own set of sensors to monitor nuclear treaty compliance.

"It will generate unmatched capabilities ... at a speed and scale like you've never seen before."
—Air Force Chief of Staff Gen. David Goldfein

Lt. Gen. Timothy D. Haugh, who won high praise at the ceremony for his multiple leadership positions in the cyber and intelligence worlds, is 16th Air Force's top officer. The Senate confirmed his promotion to lieutenant general Sept. 26, marking his second promotion since April.

By merging the two organizations, the Air Force aims to get a better understanding of what's happening in the digital realm so it can more easily attack, defend against, and smoke out bad actors in cyberspace as the Pentagon turns to data- and algorithm-driven "wars of cognition." Bringing them together opens up opportunities for collaboration between the RQ-4, U-2, RC-135, Distributed Common Ground System, cyber, and other enterprises that have been stymied in the past, say service officials.

"Starting today, 16th Air Force will be the thought leaders for operations in the information domain," Air

Photo: MSgt. Russ Scalf

An RC-135 Rivet Joint conducts a mission in the Middle East in May 2019. Sixteenth Air Force will aid collaboration between Rivet Joint, other airborne intelligence platforms such as the U-2 Dragon Lady and RQ-4 Global Hawk, and non-intel assets.

Force Chief of Staff Gen. David L. Goldfein said. "It will generate unmatched capabilities for air component commanders and joint task force commanders at a speed and scale like you've never seen before."

Haugh said his priorities include establishing clear insights into a commander's situation, tightly integrating with other groups across the Air Force, and competing with potential adversaries while preparing to escalate into overt warfare. Goldfein told reporters that although the service must be ready to fight when needed, 16th Air Force can also leverage its intel data and nontraditional options to de-escalate potential conflicts.

The new organization will assist US Cyber Command in securing US military and domestic networks; gathering intelligence, surveillance, and reconnaissance information; launching cyberspace offensives; and planning for how their combined capabilities could help US forces avoid enemy air defenses. It will also play a role in defending the integrity of the 2020 elections.

At the activation ceremony, CYBERCOM Deputy Commander Vice Adm. Ross A. Myers noted the Air Force's work to prepare US European Command for cyber warfare and its actions to stop interference in the 2018 midterm elections. That work set the military "on a path for the 2020 elections," he said.

Election security is "a mission that, I ... contend, will be enduring for the rest of time," Myers said. "It is not one that will end in 2020."

One way 16th Air Force could help deter conflict could be by publicly naming and shaming those who cause problems in cyberspace or interfere with the electromagnetic spectrum. Attribution in those domains is typically more challenging than land, air, and sea domains.

"The power of Air Force ISR to uncover adversary malign activity will create even more opportunities to expose their destructive behavior," Haugh said. "We will remove their plausible deniability on an international stage."

According to a 2018 Congressional Research Service report, cyberspace can help amplify information warfare, such as when social media spreads a particular narrative in a way that sows discord and confusion.

"Cyberspace operations can be used to achieve strategic information warfare goals; an offensive cyber attack, for example, may be used to create psychological effects in a target population," CRS specialist Catherine A. Theohary wrote. "A foreign country may use cyberattacks to influence decision-making and change behaviors. ... Cyber operations may be conducted for other purposes, such as to disable or deny access to an adversary's lines of communication, or to degrade components of critical infrastructure that may be used for nefarious purposes."

The 16th Air Force needs to come up with coherent operational strategies for peacetime and wartime, particularly focused on combating falsehoods spread by others that can confuse civilians and complicate military considerations, according to retired Lt. Gen. Dave Deptula, dean of AFA's Mitchell Institute for Aerospace Studies and former USAF deputy chief of staff for ISR.

"We need better integration of perception management and information operations coupled with lethal and nonlethal force application," he said. "Consider establishing regional 'Information Operations Centers,' as we have built air, land, and maritime operation centers, to monitor the information disseminated by every country/key organizations in every combatant command and act to counter ... information that is not correct."

Theohary notes concerns that such operations can spill over into misinformation and disinformation, and that some "worry that the military should not be involved in the production of propaganda."

The US is not alone in pursuing information warfare strategies, whether to precede armed conflict or to score wins without using physical force.

"Other countries and terrorist organizations have robust information warfare strategies and use a whole-of-government or whole-of-society approach to information operations," Theohary said. "For example, the Russian concept of IW describes preemptive operations to achieve political goals and to control the information space, deploying all elements of society to include patriotic hacker groups and private citizens."

In an Oct. 11 briefing with Goldfein, reporters, and other visitors, 16th Air Force wing commanders said their combined

capabilities can inform the service about what other countries' integrated air defense systems can do and offer ways to target them. Degrading IADS are a key consideration in future combat with Russia, China, and other sophisticated nations.

Commanders also said new cyber "munitions" will benefit from a closer relationship with ISR, and said an electronic warfare suite in development will allow the US to get closer to its targets. Col. Gavin P. Marks, commander of the 55th Wing, said his unit, which operates a range of niche ISR aircraft, stood up a team to pursue its own defensive cyber capability. Col. Brian D. Pukall, commander of the 557th Weather Wing, expects working in tandem with ISR forces will help the wing improve its ability to forecast weather conditions.

More than 33,000 airmen now work for 16th Air Force, spread across 10 organizations and its headquarters. Those include: the 9th Reconnaissance Wing at Beale AFB, Calif.; 319th RW at Grand Forks AFB, N.D.; 55th Wing and 557th Weather Wing at Offutt AFB, Neb.; 70th ISR Wing at Fort Meade, Md.; 67th and 688th Cyberspace Wings at JBSA-Lackland; 363rd and 480th ISRWs at JB Langley-Eustis, Va.; and AFTAC at Patrick AFB, Fla.

"The fundamental elements that will drive the 16th Air Force to success are resident in its component wings and subordinate organizations," Deptula said. "However, the key to their optimization will be a unifying vision, architecture, and enterprise-wide approach to actualize information as the dominant factor in warfare of the future."

He believes 16th Air Force should be a stepping stone toward something larger: a major command for information operations, on the scale of Air Force Global Strike Command or Air Mobility Command, "as soon as [the service] creates the robust information grid to underwrite the combat cloud warfighting paradigm."

RISKS VS. REWARDS

Whitney N. McNamara, a senior analyst at the Center for Strategic and Budgetary Assessments, told *Air Force Magazine* that while she's not opposed to grouping the various capabilities, doing so can make the service more likely to "gloss over" each component's shortcomings.

"Services are increasingly grouping their information capabilities, but that usually doesn't change the dynamic where the focus is on cyber to the detriment of other traditional components of information warfare, like [command, control, communications, computers, intelligence, surveillance, and reconnaissance] and electronic warfare," she said.

McNamara argues large gaps still exist in electromagnetic spectrum operations, partially because of how the career field handles personnel and training. The service acknowledges electronic warfare will be a key part of future combat and recently conducted a yearlong enterprise study on the subject.

"The time officers in the EW community spend in EW positions is a very small fraction of their overall career, attenuating the impact of the already little-existing EW training and professional education efforts there are," McNamara said. "There is no professional development path for electronic warfare officers either, so we lose that expertise as officers get promoted."

Another hurdle 16th Air Force faces is allocating its time and resources to address growing cyber and ISR needs around the world, including for CENTCOM's enduring wars in the Middle East, US Africa Command's burgeoning requirements, US European Command's attempt to rebuff Russian incursions into Eastern Europe, and US Indo-Pacific Command's work to monitor China's influence and advances in that region.

Inherent in the challenge of moving forward under the NAF will be establishing new authorities and classification norms that allow those enterprises and the broader intelligence community to work more closely together. Related efforts across the service are working to harness a wider variety of information, such as social media posts, in new ways and open it to more people within the service, in other parts of DOD, its allies, and the Intelligence Community.

"They have to actually change the intelligence classification paradigm of 'need to know' to 'need to share,' particularly in building a new construct of information warfare where allies will be absolutely critical in meeting our security objectives," said Deptula.

It will be the Defense Department's Joint Requirements Oversight Council, led by incoming Vice Chairman of the Joint Chiefs of Staff USAF Gen. John E. Hyten, to handle cyber and ISR integration and development across the services. But 16th Air Force must still "conceive, design, and establish just what those capabilities should be," with interoperability in mind, Deptula said.

McNamara believes the Air Force—and DOD—should invest more money in training-range improvements so that air, ground, and maritime forces can adequately prepare themselves for the threats other advanced militaries can wield. Many also argue that artificial intelligence, machine learning,

Photo: SrA. Tristan Viglianco

A Tu-2S Dragon Lady trainer is ready for airmen to attach "pogo" wheels at Beale AFB, Calif.

16th Air Force

AFTAC
Nuclear Detection & Treaty Monitoring

70th ISRW
Airborne, Cyber, & Space ISR
CMF
ISR for Cyber
ISR for Space

363rd ISRW
Targeting
All-Source
Specs Ops
Warfare Center

480th ISRW
DCGS
Multi-INT
Problem-Centric Analysis

67th CW
OCO
OCO
Capabilities Dev

JFHQ-C

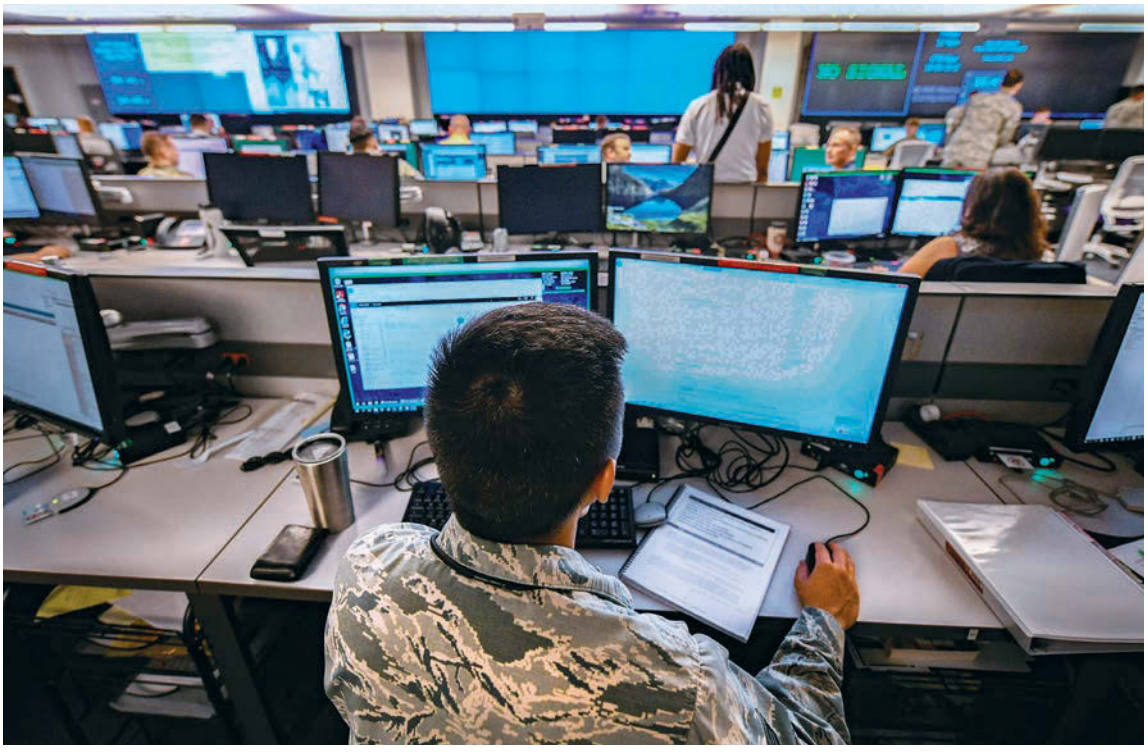
688th CW
DoDIN Ops
OCO
Engineering & Installation
Deployable Comms

9th RW
U-2
IMINT
SIGINT
Collection

55th WG
Airborne ISR
SIGINT
EW

319th RW
RQ-4
IMINT
SIGINT
GMTI
BACN

557th WW
Weather
Jt/IC/Square
PED (Wx)
Software Dev



Airmen with the 33rd Network Warfare Squadron conduct cyber operations at JBSA-Lackland, Texas. The unit uses the cyber weapon systems to protect, monitor, and secure Air Force and US Central Command's global networks.

Photo: TSgt. R.J. Biermann

new data-sharing systems, and other technologies are key to successful information ops.

The Air Force's information warfare architecture now mirrors that of the Navy, and the Army is starting to move in the same direction. While Goldfein said he won't speak for what the Army should do, he noted the Defense Department is starting to think about integrated information ops as a bigger part of the broader combat picture.

He sees 16th Air Force as one aspect of a larger push toward multi-domain operations, enabled by more comprehensive information and faster networks that allow new combinations of military systems to share data and launch offenses and defenses across air, land, sea, space, and cyberspace. Air Force investments aim to move the service closer to that vision and can benefit 16th Air Force's missions as well.

"Perhaps our adversaries are watching and listening today and taking note of where we're headed," Goldfein said. "I'm OK with that. … If we're successful, perhaps our enemies will pause and question whether they can achieve their political objectives with the use of their military power."

Goldfein told reporters that the Pentagon has moved away from the traditional notion of conflict in phases and toward the idea of competition, both militarily and economically.

"The important question we asked was, 'Where is [Russian President Vladimir] Putin right now in terms of his phase in cyber, and where are we?'" he said. "One could argue we're in shaping, and he's in active combat operations. The discussion of phases … actually is unhelpful."

But even as the Air Force wants to send a clear message to Russia that its new numbered Air Force is ready to compete in cyberspace, Goldfein said the US should look to collaborate with Moscow—where it can—on issues like space, science and technology, climate change, and the Arctic.

Military-to-military relationships can stay strong even when diplomatic ties are strained, and if the Pentagon paints Russia as the enemy all the time, he said, those opportunities may disappear—pushing countries closer toward more overt or armed conflict.

"As a Joint Chief, I do want to have a balanced approach," Goldfein said. "Let's be thoughtful about the world as it is and how it's going to be, and make sure that we continue to provide thoughtful options to the commander in chief. … It's not actually written anywhere that they have to take it, and I have to be OK with that." ✪

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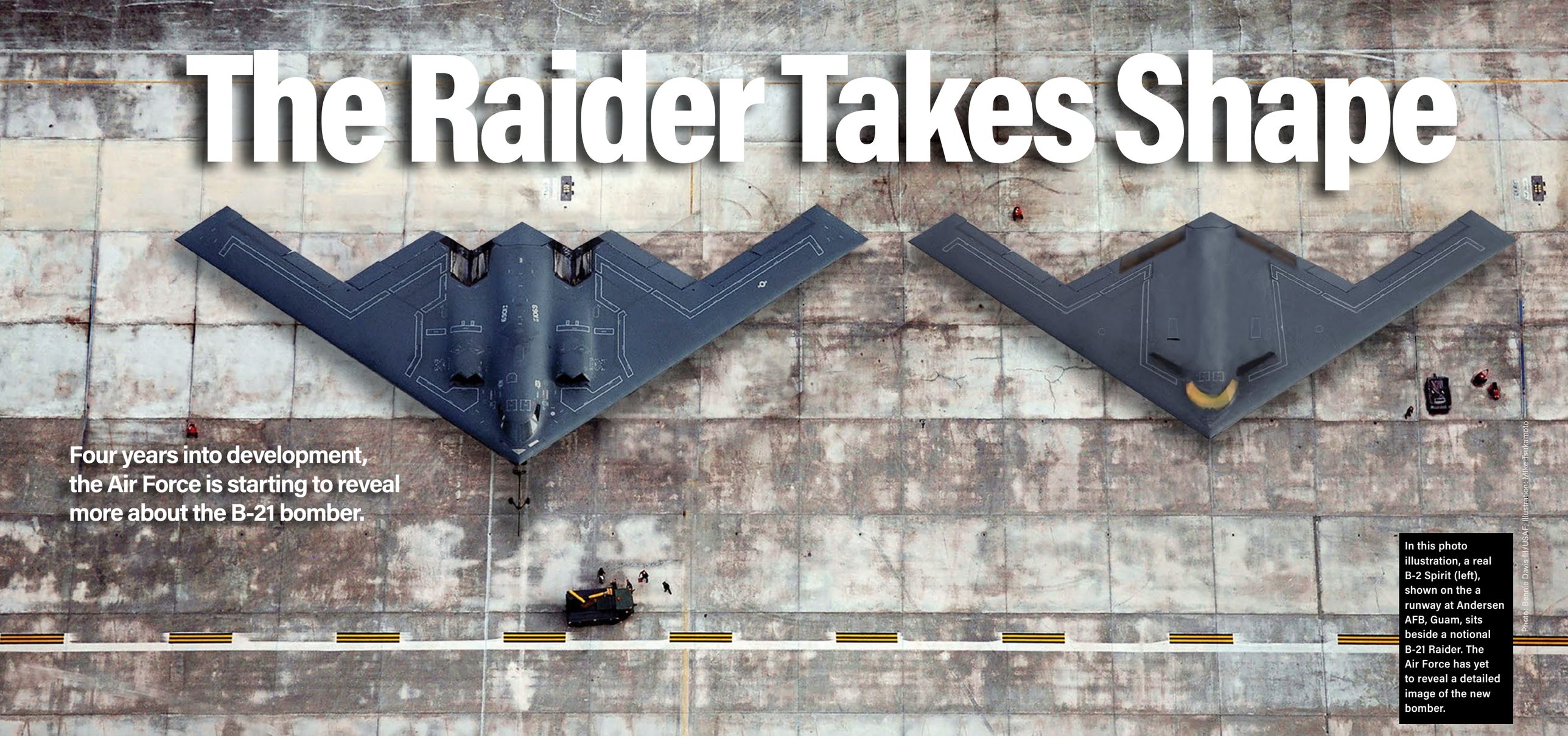
The Raider Takes Shape

Four years into development, the Air Force is starting to reveal more about the B-21 bomber.



In this photo illustration, a real B-2 Spirit (left), shown on the a runway at Andersen AFB, Guam, sits beside a notional B-21 Raider. The Air Force has yet to reveal a detailed image of the new bomber.

Photo: Bennie Davis III/USAF; Illustration: Mike Tsukamoto

By John A. Tirpak

The first B-21 Raider bomber is coming together at Northrop Grumman's Palmdale, Calif., facility and will likely be rolled out for public view in 20 months, making its first flight a few months later. The Air Force is also planning, in its next budget proposal, to increase the buy to 150 or more aircraft, up from 100. The B-21 picture, highly secret for the last four years, is starting to come into focus.

Top Air Force leaders are beginning to speak more openly about the B-21. Randall G. Walden, head of the Air Force Rapid Capabilities Office, which runs the bomber development effort, said in October, "We're ready to start actually building parts."

Construction has begun at Northrop Grumman's Palmdale plant. "We do have an airplane in there," Walden said. "That would be our test ship No. 1. We're working the production line, literally, today." Major structures, like the wings, are being brought into the assembly line.

When it comes to the B-21 Raider, USAF won't try to "sneak it out." There will be a public rollout of the new bomber.
—Randall G. Walden, head of the Air Force Capabilities Office

Timelines at this stage are still slippery. Gen. Stephen W. Wilson, Vice Chief of Staff of the Air Force, said he was counting down the days to the B-21's first flight, which he projected would come in December 2021.Walden is not so sure. Though that's still the target, "I would not bet on that date," he said, emphasizing how "complex" the B-21 is. Integration issues, ground testing, and even weather could affect first flight, he said.

The Air Force won't try to simply "sneak it out," Walden asserted, promising a public rollout at Palmdale, just as with the B-2 in 1988. But while it took nine months for the B-2 to go from rollout to inaugural sortie, Air Force officials anticipate a much shorter preflight evaluation period before that first flight from Palmdale to nearby Edwards AFB, Calif. After that, Walden said, USAF will "start to open up" about B-21 capabilities.

At a Palmdale event in August celebrating the 30th anniversary of the B-2, Northrop Grumman said it had grown from 24,000 to about 28,000 employees at its California locations. Aerospace Systems sector President Janis G. Pamiljans said, "We've been on a tremendous hiring spree" while simultaneously refurbishing and expanding the Palmdale facilities, which included relocating production operations for the RQ-4 Global Hawk and MQ-4 Triton.

Northrop's contract for engineering and manufacturing development (including the first five aircraft) represents a $23.5 billion investment. The production contract could be worth $55 billion for 100 airplanes, Walden said in 2016, not including additional, unidentified programs in the "family of systems" that will make the B-21 effective.

The Air Force's original plan for the B-21 contract called for "80 to 100" aircraft, but USAF leaders over the past two years have been touting "at least 100" airplanes. At AFA's Air, Space & Cyber Conference in September, USAF Chief of Staff Gen. David L. Goldfein said he's "100 percent in lockstep" with the views expressed in multiple third-party reports that 100 is too few. While he acknowledged the B-21's development cycle can't be sped up, he said he'd like to buy more than 100 of the jets, and buy them faster than currently planned.

Matthew P. Donovan, service undersecretary, in an October interview with *Air Force Magazine*, laid out the math behind the "Air Force We Need" analysis, which called for seven more bomber squadrons, growth required for long-range power projection in the Pacific Theater and elsewhere. "A bomber squadron's got about eight airplanes in it," Donovan noted, so

A B-1 Lancer aircrew steps to their aircraft at Eglin AFB, Fla. USAF plans to retire 62 B-1s as the B-21 Raider comes on line.

Photo: Samuel King Jr./USAF

the Air Force's analysis indicates a requirement for about 56 more bombers. "I think … you'll see us put some real numbers to the total numbers of bombers" in the 2020 budget request, Donovan said. But he also cited an analysis by the Air Force Association's Mitchell Institute for Aerospace Studies, which concluded the Air Force has a demand for at least 174 B-21s, noting Goldfein "agrees with that."

The Air Force has not announced any deviation from original cost targets and cost ceilings on the B-21. In base year 2010 dollars, the service said at contract award that it expected the jets to come in at $511 million apiece, with a not-to-exceed price of $550 million. In 2019 dollars, that would be $553 million and $651.7 million, respectively. Both numbers were calculated against a buy of 100 airplanes, though; a larger volume of production could drive unit costs lower.

Air Force leaders have said numerous times that the B-21 program is among the best-run programs in the Air Force, hitting its cost and schedule marks. Walden said the only thing that could dramatically raise the price of the airplane is a significant change in performance requirements.

USAF's Global Strike Command plans to retire the 62 B-1 and 20 B-2 bombers by around 2031. Producing 15 B-21s per year would enable the Air Force to have 100 of the new bombers on hand by that point. The Air Force has reactivated the 420th Flight Test Squadron at Edwards—the unit that tested the B-2—to put the B-21 through its paces.

Satellite images of Edwards reveal a number of new structures in the South Base area, including one building that is about 220 feet square—about the size needed to shelter a B-2-sized aircraft. The Air Force has also relocated B-1 and B-52 test activities away from South Base.

Walden told *Air Force Magazine* that the B-21 program had not made use of a subscale demonstrator to prove out the aircraft's aerodynamics, although he had previously described wind tunnel testing on the bomber. "You always look for opportunities to do things lower-risk," he said, but a subscale aircraft was not part of that effort, he said. He declined to offer further details.

Walden's comment was curious because a number of Air Force officials and members of Congress have made comments suggesting they were satisfied there was a "fly before buy" approach taken with the B-21. In selecting Northrop Grumman as the B-21 contractor, the Air Force cited the company's competence to do the project based on its "other programs." Those could include a high-altitude intelligence, surveillance, and reconnaissance aircraft said to be called the RQ-180, which may resemble the B-21's cranked-kite planform. Northrop's balance sheet indicates a hefty amount of classified work.

The B-21's shape, identical to the original planform of the B-2, suggests the aircraft is optimized for stealth at high altitude. The B-2's requirements were changed early in the program, to give that airplane more rigidity and ease of handling in low-level penetration flight. The B-2's shape was altered to the now-familiar "sawtooth" tail; a design revision that cost billions of dollars and years of time.

The sole artist's concept of the B-21 released by the Air Force shows the cranked-kite shape without modification, indicating USAF won't be taking the B-21 down to fly nap-of-the-earth.

B-21 development has not come without challenges. Rep. Rob Wittman (R-Va.), then head of the House Armed Services Seapower and Projection Forces Subcommittee, cited a dispute between "ducting contractors" and engine maker Pratt & Whitney in March 2018.

Pratt engineers sought to "change some of the cowling," Wittman suggested, which could affect low-observable characteristics.

The artist's concept shows the B-21 with very straight and narrow, angled air intakes on the upper fuselage. To maintain stealth, engine fan blades must be hidden inside the fuselage, and the ducting lined with radar-absorbent materials to reduce the radar cross section of the aircraft.

Wittman said the B-21 uses a "very, very different design as far as airflow," suggesting trade-offs between stealth and thrust were being debated. Meanwhile, other contractors were worried about the exhaust, he said. Without elaborating, Wittman also cited "snags" affecting the B-21's wings.

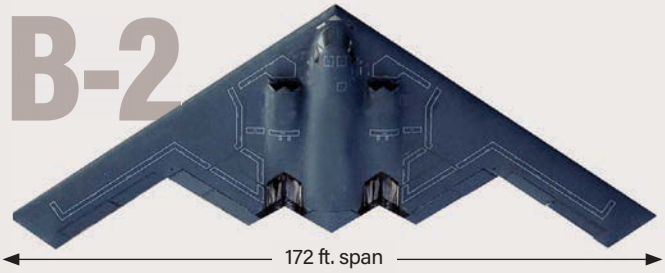
Months later, however, Walden said those issues had been resolved.

"Complex weapon systems, especially engine integrations" are challenging, he said. "You've got to get [engine] throat sizes done right, prior to anything being built." The Rapid Capabilities Office got "insight from actual lab testing," settled

Comparing Stealth Bombers

The new B-21 Raider bears a family resemblance to the B-2 Spirit, but the two bombers will differ substantially in size, and likely their number of engines and payload. Critically, the B-21 will also be far more advanced in terms of low-observable technology—at least two generations beyond its elder stablemate. Northrop Grumman is the prime contractor for both bombers.

B-2



172 ft. span

First Flight July 1989

Delivered 21

Planned buy 132

Accomodation

Two pilots, on ACES II zero/zero ejection seats

Engines 4 (per plane)

General Electric F118-GE-100 turbofans, each 17,300 lb thrust

Payload 60,000 lbs

Next-Generation Bomber (NGB)

Canceled in 2009

NGB was canceled out of concerns about cost and mission versatility. This artist's concept is based on a Lockheed Martin proposal from the period.

B-21*

Less than 150 ft.

First Flight December 2021 (est.)

Delivered 0

Planned buy 100+

Accomodation

Two pilots

* All data cited for the B-21 is pre-sumptive, based on public comments and/or published reports.

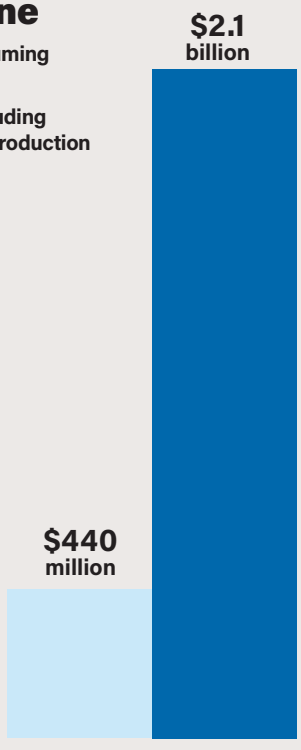
Engines *2-4 (per plane)

Pratt & Whitney

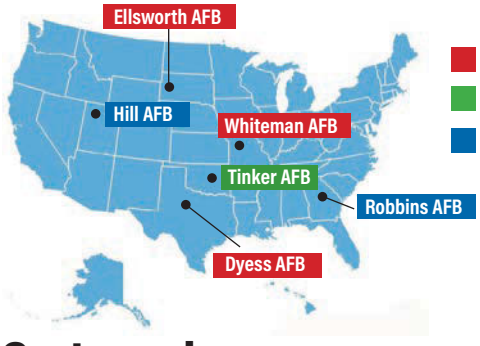
Payload >30,000 lbs

Cost per plane

- Original quote assuming a 132-bomber buy
- Final, full cost, including development and production

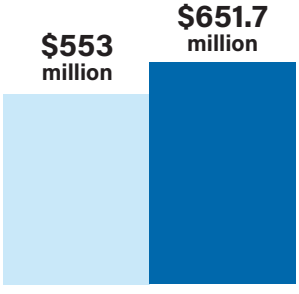


B-21 preferred bases



Cost per plane

- Quoted cost
- Not-to-exceed cost



2015 contract, adjusted to 2019 dollars.

Graphics: Dash Parham/staff;Illustration: Mike Tsukamoto/staff

Illustration: Mike Tsukamoto (photo courtesy USAF)

A photo illustration of what the B-21 may look like flying over the desert near Edwards AFB, Calif. From the outset, the B-21 has been labeled as an "optionally manned" aircraft, meaning it can fly with or without a crew.

on a solution, and component testing was moving ahead at an "appropriate speed."

Wittman also noted that the B-21 program had created a nonflying "iron bird" shape to test the fit of components. The use of mockups in this fashion is a common step in an aircraft's development.

Air Force officials, meanwhile, describe B-21 as an "extremely low-observable" design, as opposed to the "very low-observable" F-22 and F-35.

The Air Force has not said if the B-21 will be powered by two or four engines, but the consensus among aerospace analysts is that the jet likely uses Pratt's F135 engine, which also equips the F-35 fighter. Two F135s could generate 56,000 pounds of dry (non-afterburning) thrust, but would require a larger aperture to do so than the four General Electric F118 engines in the B-2, which combine to produce about 68,000 pounds of thrust.

The B-21 is believed to be somewhat smaller than the B-2, with a payload of around 30,000-pounds, just large enough to carry one GBU-57 Massive Ordnance Penetrator precision-guided conventional bomb, the largest in the Air Force inventory.

Only seven B-21 subcontractors have been named, and one of them—Orbital ATK—was acquired by Northrop Grumman in 2018. The other contractors are: BAE Systems in Nashua, N.H.; GKN Aerospace, St. Louis; Janicki Industries in Sedro-Woolley, Wash.; Rockwell Collins in Cedar Rapids, Iowa; and Spirit Aerosystems in Wichita, Kans. Rockwell Collins will become part of Raytheon Technologies under a "merger of equals" between parent company United Technologies and Raytheon as announced in June.

The B-21 predates the advanced digital engineering methods that Air Force acquisition chief Will Roper sees as the enabling technology behind a new "Digital Century Series" of fighters, which calls for aircraft to be developed very rapidly.

"We started with the manufacturing [technology] that we had at the time," Walden told *Air Force Magazine*. "I think that's what [Roper] is focused on… When can we get to that better manufacturing? But today, we're using the same techniques where and when it makes sense to bring it into production."

Walden anticipates "sharing" technology between B-21 and the Next-Generation Air Dominance (NGAD) program, an outcome made more likely since Roper chose former B-21 program manager Col. Dale R. White to head up NGAD.

The Air Force announced earlier this year that the "preferred location" for the first B-21 squadron will be Ellsworth AFB in Rapid City, S.D. Now a B-1B base, service officials said Ellsworth will likely "transition" from the B-1 to the B-21, rather than operate both bombers concurrently. Next up would be Whiteman AFB, Mo., the sole B-2 operating base, and Dyess AFB, Texas, which operates B-1s. Former Air Force Secretary Heather Wilson said earlier this year that "if you're a bomber base now, you'll be a bomber base in the future." Tinker AFB, Okla., will be the B-21's depot, aided by Robins AFB, Ga., and Hill AFB, Utah. The secondary depots will be responsible for rebuilding subassemblies and parts, and for component and parts testing.

The B-21 has from the outset been described as an "optionally manned" aircraft, meaning it could fly with or without a crew, but service leaders have not discussed this aspect of the program for over a year. The aircraft will be capable of flying nuclear missions and will be certified with both the B61 nuclear gravity bomb and the Long-Range Standoff (LRSO) missile now in development. That weapon will also be fitted to the B-52. A conventional version of the LRSO may also be in development.

Donovan told *Air Force Magazine* in October the Air Force may again try to get the Defense Department to fund the B-21, as well as the Ground-Based Strategic Deterrent program—which replaces the Minuteman ICBM—and the LRSO in a separate line outside the Air Force base budget. The Navy won similar status for the Columbia-class sea-launched ballistic missile submarine on the argument that the arrangement preserves the submarine industrial base; by contrast, the Air Force's two legs of the nuclear Triad have no such special status.

The Air Force may find high-priority programs squeezed out by the expense of modernizing its part of the Triad. Revamping the nuclear enterprise, along with all the other modernization challenges the Air Force faces—from fighters to tankers to space and cyber—is beyond the limits of expected budgets. "We … are not able to do that within the Air Force's … topline," Donovan said. ✪

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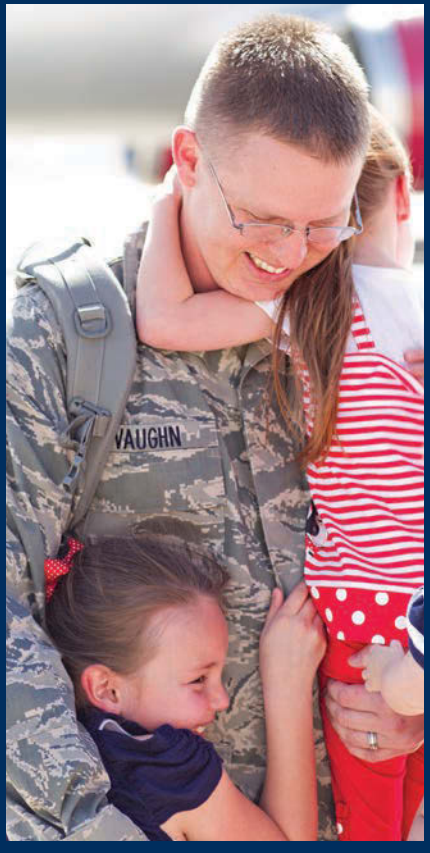

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Join the Fight!

30 Million Square Kilometers One USAF Rescue Team

Across the vast continent of Africa, US troops must rely on a patchwork of solutions for emergency rescue and evacuation.

By Brian W. Everstine

The US military has some 7,000 troops operating in and around the continent of Africa, most assigned to counterterrorism operations in and around Somalia, and the rest building partner relationships and supporting counterterrorist operations in locations such as Libya and Niger. Yet across the entire continent, there is just one Air Force combat search and rescue team solely responsible for US special operators.

USAF HH-60G Pave Hawks, HC-130s, and Guardian Angel personnel are on call for operations in Somalia and largely unable to respond to emergencies elsewhere on the continent, according to US Africa Command officials. The shortage has at times forced delays in ground missions because personnel recovery assets were unavailable.

In the central region of the continent, US forces rely on private contractors to assist with medical evacuations, and in the West, France—which operates its own large counter-terror operation in Mali—has been called on for assistance.

"Job one, for me, is to ensure we are synchronized with those types of activities that are occurring outside the wire, ... to make sure that if something happens, we're there."
—USAFE Commander Gen. Jeffrey Harrigian

"Job one, for me, is to ensure we are synchronized with those types of activities that are occurring outside the wire, that we need to be in the proper overwatch position to make sure that if something happens, we're there," USAFE Commander Gen. Jeffrey L. Harrigian said in a recent interview with *Air Force Magazine.*

AFTER TONGO TONGO

When four US Army troops were ambushed at Tongo Tongo, Niger, in October 2017, it took nearly six hours for French helicopters to come to their aid. By then, four soldiers were dead.

No American military medical evacuation forces were available to support those troops. AFRICOM's report on the incident states that the first evacuation aircraft, two French helicopters operating out of neighboring Mali, arrived 5 hours and 43 minutes after the initial contact and evacuated survivors. Shortly after, civilian helicopters from Berry Aviation in the Nigerien capital of Niamey, which were on

USAF special tactics airmen during the culminating event, Exercise Linda Rhino 2, of the African Partnership Flight Kenya 2019 at Larisoro Air Strip in August 2019.

Photo: MSgt. Renae Pittman

Photo: SSgt. Devin Boyer

USAF TSgt. Tyler Torr (center), gives instructions to a Niger Armed Forces soldier (left) through a Combined Defense Operations Center interpreter (right) during a training exercise at an air base in Agadez, Niger. The ambush of US and Nigerian military members in Tongo Tongo, Nigeria, more than two years ago remains a fresh memory.

contract and on alert, arrived to evacuate the deceased soldiers. This response was "consistent with the casualty evacuation plan that was in place for this particular operation," said then-Chairman of the Joint Chiefs of Staff USMC Gen. Joseph F. Dunford Jr. at a Pentagon briefing on the investigation.

The investigation highlighted risk-taking by the command, but did not recommend specific changes to the casualty-evacuation process. USAFE's Harrigian, who assumed his job more than a year-and-a-half after the incident and a year after the initial investigation came out, said the incident remains an issue across USAFE and AFRICOM.

"It remains on people's minds, that particular incident," he said. "It's one though that I think takes a constant revisit and reminder to make sure that we don't forget."

Harrigian has met with AFRICOM boss US Army Gen. Stephen J. Townsend to ensure air assets are adequately available when needed to support US operations in the region.

"There's been a refreshing look at when do we actually need to do those things, and what's the approval authority," Harrigian said. As a result of the Tongo Tongo report, leaders have focused on the need "to ensure that the right level of leadership had visibility and then the risk decision was appropriately viewed through the lens of: Do we need to do this now, and do we have the risk management sorted out over the top to be able to allow that operation to go?"

BUILDING PARTNER CAPACITY

To further improve recovery and response, USAF air advisers and AFRICOM personnel have focused in recent years on improving the personnel recovery capability of partner nations so they, too, could be called on if needed, as well as be better prepared when their own forces are in need.

Photo: MSgt. Renae Pittman

A Kenyan Air Force UH-1 Huey takes off after a simulated rescue during APF Kenya in August 2019.

This personnel recovery mission was the main focus of AFRICOM's African Partnership Flight in Kenya in August, when USAF instructors, led by the 818th Mobility Support Advisory Squadron and the Massachusetts Air National Guard, joined air force representatives of Kenya, Burundi, Tanzania, and Uganda at a Kenyan base for a week of training and instruction.

The USAF members, along with other US personnel from multiple commands, trained local forces to locate and rescue

injured and isolated personnel. The training culminated in the combined force "Exercise Linda Rhino 2" at Larisoro Air Strip in Kenya, where USAFE-AFAFRICA personnel joined members from other nations to practice a joint operation.

Ground forces and military ambulances loaded simulated casualties into fixed-wing and rotary aircraft, with strike helicopters flying security in a showcase to each nation's air force leadership.

"I hope the East African nations will be able to take the information they've learned here and not only make their own personnel recovery programs better, but build a program where we can count on one another and ensure all of our isolated personnel come back to their families and countries," said TSgt. Jared Todd, 818th MSAS survival, evasion, resistance, and escape (SERE) air advisor, in an AFRICOM news release.

The goal with exercises like this is to "leverage what they have to help us with personnel recovery," Harrigian said. "Because frankly they know the terrain better. The challenge becomes the distances you have to cover and how you have a lay down that leverages partners, whether they be the French in the Sahel, Lake Chad region, or as you move back into the more central portions. Those partners help us have a better level of understanding of what it would take to recover someone."

MISSION IN SOMALIA

While partner nations are being trained to help in other regions, USAF's personnel recovery specialists must stay focused on operations in Somalia. Though there is a small contract presence further south of the country, USAF pararescuemen and aircraft are on nearly constant alert; when USAF units are stretched too thin, missions are sometimes delayed, AFRICOM officials said.

More than 100 Reservists from the 920th Rescue Wing at Patrick AFB, Fla., deployed to support combat search and rescue missions in the Middle East and Africa in late September. Three HH-60G Pave Hawks and the combat rescue officers, pararescuemen, SERE specialists, and personnel recovery experts from the 308th Rescue Squadron joined Pave Hawk crews from the 301st Rescue Squadron, plus maintainers from the 920th Maintenance Squadron and 920th Aircraft Maintenance Squadron. They are supported by wing staff, operations support and logistics airmen, and communications specialists.

Airmen with the 563rd Rescue Group at Davis-Monthan AFB, Ariz., performed the mission through much of 2018. The group's 48th Rescue Squadron recently received multiple awards, including the Jolly Green Rescue Mission of the Year and the Air Rescue Association's 2019 Rescue Mission of the Year, for a particularly intense rescue operation in Somalia in which the team took heavy fire, saved the lives of US and local forces, and brought home a fallen US soldier.

The award citations offered a rare glimpse into the usually closely guarded clandestine US special operations mission in Somalia. In early June 2018, a team of five pararescuemen and one combat rescue officer forward deployed from Camp Lemonnier, Djibouti, to an operating base where they stood by to provide medical support to a US Army Special Forces team, according to a Davis-Monthan release.

A separate statement released shortly after the mission by AFRICOM said an 800-member combined US, Somali National Security Forces, and Kenyan Defense Force team was conducting a multiday mission to clear al-Shabaab from contested areas and liberate villages near the town of Jamaame. The combined mission "was specifically designed to increase the [Federal Government of Somalia]'s ability to provide vital government services to innocent civilians living under al-Shabaab's rule," according to AFRICOM.

Three days after deploying, the Special Forces team came under attack from multiple machine gun nests and a mortar

Photo: SSgt. Janiqua Robinson

US Air Force Chief of Staff Gen. David Goldfein poses with airmen from the 41st and 48th Rescue Squadrons at a banquet recognizing the units with the Rescue Mission of the Year award, the only non-Air Force rescue award recognized by USAF.

Maj. Anibal Aguirre, USAFE-AFAFRICA personnel recovery coordination cell director, provides feedback after an exercise at Laikipia AB, Kenya.

position. Receiving a casualty evacuation request, rescuers piled into their HH-60G Pave Hawk, arriving at the engagement site within 14 minutes. Taking heavy machine gun fire, the Pave Hawk responded with its own guns to provide suppressive fire. Communications were degraded, but the helicopter was able to land, and pararescuemen were able to locate the Special Forces medic and load critical patients first.

Once patients were loaded, the lead helicopter took off, but it could not immediately depart the area. "The lead had to stay over head to continue to provide suppressive fire for the trail," said Lt. Col. Blake George, commander of the 48th RQS from Davis-Monthan Air Force Base, in an Air Force release. "So they had to keep providing care while the HH-60G went into hard banks and fired the .50-caliber machine gun. They had to provide high-level trauma medical care while the aircraft was in the middle of a combat mission."

Pararescueman TSgt. Benjamin Cole was aboard that lead helicopter, and in the midst of battle, "secured a surgical airway and gained interosseous access to administer a blood transfusion" to the patient.

Back at the FOB, the team learned the combat troops had sustained more casualties, reloaded the aircraft, and returned to the site. Once again, the lead aircraft delivered suppressive fire and close air support for ground forces while a trail aircraft landed.

Photos: MSgt. Renae Pittman

Aguirre watches the last exercise during APF Kenya, where five partner nations exchanged best practices on personnel recovery tactics, techniques, and procedures.

"We were forward and very reactive so we got overhead very quickly," George said in the release. "Those lives were saved because we were prepared and able to get overhead very quickly." ✪

Paying for the Air Force We Need

Photo: SSgt. James Richardson

After two decades of cuts and high op tempo, the Air Force budget must be rebalanced to fund growth and modernization

F-22 Raptors fly in formation over the Joint Pacific Alaska Range. Shutting down F-22 production early was indicative of efforts to scale back long-term requirements in an attempt to free up near-term budget dollars.

By Mark A. Gunzinger and Carl Rehberg

In the years following the Cold War, and again following the 2007 troop surge to Iraq, the Air Force and its modernization accounts were dramatically cut. Now, after decades of hard use and too little investment, mission demands far outpace available capacity.

In September 2018, then-Secretary of the Air Force Heather Wilson made this precise point when she unveiled "The Air Force We Need," the initial results of a congressionally mandated study of the aircraft inventory needed to support the 2018 National Defense Strategy (NDS). That study concluded the Air Force needed to grow in order to align with DOD's strategic shift toward long-term great power competition. Two additional studies mandated by the 2018 National Defense Authorization Act supported its conclusions.

Three major budget trends combined to bring the Air Force to this point:

■ Compared to the Army and Navy, the Air Force absorbed the largest cuts to annual budgets in the 12 years between the end of the Cold War and the September 2001 terrorist attacks on the United States.

■ Obama administration defense reductions and the 2011 Budget Control Act (BCA) created another hole in the service's budget that it filled by further cutting its force structure, modernization programs, and end strength. While subsequent congressional agreements provided some relief from the 2011 BCA's budget caps, available funds were still far lower than what was required for maintaining a healthy force.

■ Finally, plus-ups to the Air Force's budget over the last few years, while significant, have not approached levels needed to compensate for the quarter-century-long, post-Cold War defense modernization holiday.

The Air Force lost nearly 65 percent of its combat air forces from 1960 to 2000, and another 22 percent since 2001.

NOT ALL BLUE

The Defense Department only allocates 23 percent of its budget to Air Force "Blue" programs (which excludes pass-through funding for programs, mostly in national intelligence, that the service does not control). However, the budget is not presented this way. Instead, the Air Force budget request includes more than $39 billion in pass-through funding—just over 19 percent of the requested total obligational authority (TOA) under the service's budget. This is as much as the total new aircraft procurement funding for the past four years. Put another way, $39 billion could pay for more than 400 new fifth-generation F-35As.

Common assumptions that the services share even

thirds of funding (the Marine Corps being part of the Department of the Navy) fuel a false impression that Air Force acquisition is in line with that of the Army and Navy departments. For instance, an August 2019 report by the Congressional Budget Office included a chart showing Air Force acquisition funding as far outstripping acquisition investment by the other services. Separating Blue- and non-Blue funding changes the picture dramatically, however, such that proposed Air Force investment represents only about 23 percent of total obligated authority versus 28.6 percent for the Navy and 26.7 percent for the Army.

In this article, unless otherwise noted, we will focus only on the Air Force's Blue budget.

AFTER THE COLD WAR

If fully appropriated, the president's $165.6 billion request for the Air Force in fiscal 2020 would be the service's 10th highest budget since fiscal 1962. Yet, while that would help fund long-overdue recapitalization and modernization, it is just a start at restoring funding lost in the aftermath of the Cold War, when many of the Air Force's premiere modernization programs were curtailed, delayed, or canceled.

During the 13-year period from 1989 to 2001, the Air Force absorbed the largest cuts among the services in four of the five budget categories.

Unequal Treatment

1989 to 2001 Changes in the Services' Total Obligational Authority by Percentage, using Constant Year 2020 (CY20) Dollars

Budget Category	Air Force (Blue Only)	Navy and Marines	Army
Military Personnel	-37.2%	-31.6%	-34.4%
Operations & Maintenance	-1.4%	-26.3%	-24.6%
Procurement	-52.0%	-32.0%	-35.9%
RDT&E	-39.7%	-17.7%	-8.0%
Total Change	**-31.6%**	**-28.2%**	**-29.2%**

The Air Force's TOA dropped by 31.6 percent from 1989 to 2001, significantly more than the 28.3 percent cut the Navy endured and the 29.2 percent hit to the Army budget. Yet, this only tells part of the story. The Navy and Army were able to absorb much of their cuts in operations and maintenance, dropping O&M investment by 26.3 percent and 24.6 percent, respectively. The Air Force had no such luxury. High op tempo to enforce two no-fly zones over Iraq, support NATO's air war against Serbia, and provide forces for other operations meant the Air Force could cut just 1.4 percent from O&M. That meant finding savings elsewhere, including cutting the size of its force. A 2018 Mitchell Institute report noted the service lost about half of its force structure after 1991. In the wake of the Vietnam War, USAF force posture declined to about 12,000 aircraft and ICBMs and remained roughly at that level until 1991, when the "Base Force" plan of Army Gen. Colin Powell, then Chairman of the Joint Chiefs of Staff, shrank the Air Force to only about 6,500 aircraft and ICBMs.

2008 TO 2015: THE SECOND HIT

Following the Sept. 11, 2001, terrorist attacks on the United States, military budgets rose significantly. The Air Force received additional base budget and supplemental funding for Overseas Contingency Operations (OCO) to pay for increased op tempo and to procure capabilities needed for operations in Afghanistan and, later, Iraq.

Most of the service's aircraft procurement investment in this period funded an increase in remotely piloted aircraft (RPA) to meet combatant commanders' demands for intelligence, surveillance, and reconnaissance and light-strike capacity, as well as to recapitalize portions of the tactical and strategic airlift force. Most of these aircraft were suited to permissive environments where air defenses were minimal, and they came partly at the expense of major weapon systems designed for high-end conflicts, such as the F-22 program.

In the context of 2018 National Defense Strategy, Todd Harrison of the Center for Strategic and Budgetary Assessments dubs this period "a hollow build-up" for the Air Force. While funds were largely concentrated on counterinsurgency warfare priorities, risk was accepted in mission areas that are now deemed essential in an era of renewed great power competition.

Airmen inspect GBU-31s on an F-15E at al Dhafra AB, United Arab Emirates in September 2019. The Air Force should invest less in research and more in new aircraft and next-generation munitions to succeed in contested battlespaces.

Photo: SSgt. Chris Thornbury

Beginning in fiscal 2009, the Air Force's overall procurement, research, development, test and engineering, and military personnel accounts all declined, while Air Force O&M funding increased to its highest level ever in fiscal 2020. This O&M trend was not unreasonable, given sustained high op tempo and the increased cost of maintaining and operating an aging force. By 2013, the Air Force's funding for new aircraft was at the lowest level ever as a percentage of its topline budget—4.3 percent—as a result of the 2011 Budget Control Act. At the same time, funding for O&M and personnel began to flatten, due to increased concerns over its near-term readiness.

Viewed from a defense-wide perspective, the fiscal 2008 to fiscal 2011 period saw the Air Force experience the lowest share of defense spending since the Eisenhower administration, dropping to 19.4 percent in fiscal 2008, 19.4 percent in fiscal 2010, and 19.3 percent in fiscal 2011. No other service has ever reached such a low percentage; the Army's low point was 22.6 percent in 1959; the Navy's was 24.6 percent in 2008.

Since then, the Air Force's Blue budget has rebounded, reaching 20.8 percent in 2014 and an estimated 23 percent in the president's 2020 request. Nevertheless, this is well below historical averages. From 1962 to 2020, the Blue budget averaged 25.8 percent of DOD's TOA.

"THE AIR FORCE WE NEED"

The *2018* National Defense Strategy outlines DOD's intent to create a future force that is more lethal, survivable, and capable of defeating great power aggression in contested environments. "We cannot expect success fighting tomorrow's conflicts with yesterday's weapons or equipment," it argues.

There have been numerous assessments on what the Air

(Continued on p. 53)

Why Near-Term Cuts Don't Always Yield Savings

For the past 20 years, the Air Force and DoD repeatedly sought to retire large quantities of aircraft and close production lines. While their reasons for doing so varied, the overarching driver almost always tracked back to the budget. Attempts to cancel the C-130J production line; retire the U-2, Global Hawk, and A-10; the shortsighted kills of F-22 and C-17 production; and the many retirements of fighters and bombers were all indicative of efforts to scale back significant portions of the service's aircraft inventory in an attempt to free up near-term budget.

Yet retiring aircraft doesn't retire real-world demand for them.

Blue vs. Non-Blue: Breaking Down the 2020 Air Force Budget Request

Budget Category	Air Force FY2020 TOA Request	Air Force Non-Blue "Pass-through" TOA	Air Force Blue Only TOA
Military Personnel	$40.325 billion	$5.11 billion	$35.215 billion
Operations & Maintenance (O&M)	$65.013 billion	$0.852 billion	$64.161 billion
Procurement	$50.087 billion	$22.386 billion	$27.701 billion
Research, Development, Test, and Evaluation (RDT&E)	$46.066 billion	$10.623 billion	$35.443 billion
Military Construction (MILCON), Family Housing, other	$3.265 billion	$0.213 billion	$3.052 billion
TOA	**$204.757 billion**	**$39.196 billion**	**$165.571 billion**

Unless a mission requirement is wholly eliminated, incremental force cuts yield predictable outcomes: Remaining aircraft are flown harder to fill the capacity shortfall and fleet readiness eventually declines. Herculean repairs and stopgap production efforts then drive costs higher than the costs that would result from better long-range fleet management and procurement decisions.

The Air Force's air superiority fleet provides one such example. When the F-22 production was prematurely canceled, the Air Force had to extend the service life of its F-15C/D fighters before it had done the requisite testing and engineering. At the same time, F-35 full-scale production—which could have helped replace some aging F-15s—was repeatedly delayed. With the release of the 2020 budget request, the Air Force announced that it had to procure new-build F-15s because existing aircraft were worn out. In other words, a key portion of the fighter force was broken due to compounding cuts to new aircraft procurement, major aging, and service-life issues involving legacy aircraft.

The nation needs more Air Force peer-fighting force capacity, which is why Secretary of the Air Force Heather Wilson announced in September 2018 that the Air Force needed to grow to 386 operational squadrons. However, a year later, acting Secretary of the Air Force Mathew Donovan announced: "We need to shift funding and allegiance from legacy programs we can no longer afford due to their incompatibility with future battlefields and into capabilities and systems that the nation requires for victory." Is the Air Force headed toward another round of budget-driven force divestitures?

The severe impact of such decisions can only be avoided if DOD increases aircraft production to achieve a concurrent one-for-one replacement.

The Air Force's Aging, Shrinking Fleet

Today's Air Force is now the smallest and oldest force the Air Force has ever operated. How the force evolved from 1950 to 2018:

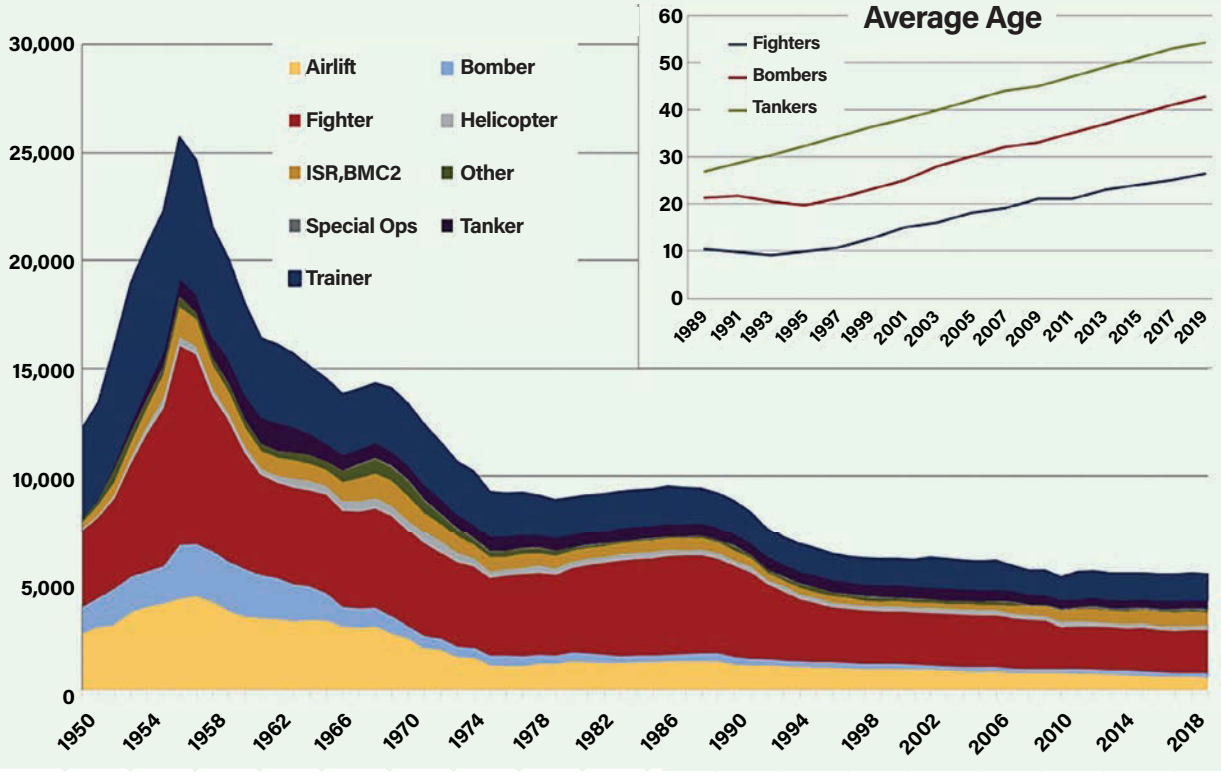

Chart: Dashton Parham/staff

Force could or should do to align with the 2018 NDS. In particular, reports submitted to Congress in early 2019 on three major studies made a number of recommendations for increasing the size and improving the capabilities of the Air Force's aircraft inventory. Reports authored by the Center for Strategic and Budgetary Assessments (CSBA) and the MITRE Corporation both recommended the Air Force should:

- Increase investment in long-range capabilities, including tankers.
- Increase the size of the nation's bomber force, procure more than 100 stealth B-21s, and do not cut current bombers (B-1s, B-2s, and B-52s) until significant numbers of B-21s are operational.
- Increase annual procurement of F-35A fifth-generation stealth fighters and do not cut F-35A investments in the near-term to pay for other programs.
- Consider adapting the T-7A, the Air Force's new pilot training aircraft, to support homeland defense, which could free up fifth-generation fighters for the missions for which they were designed.

Other reports, notably one released by the National Defense Strategy Commission and another by the Mitchell Institute for Aerospace Studies, made similar recommendations.

AIR FORCE PROCUREMENT FUNDING

Although analysis of the Air Force's budget should not be the only means used to assess progress toward its desired future force, it can help illustrate trends that could inform national defense policy and resource decision-makers. What matters at a macro level is that long-standing downward trends in capital investment accounts have only been mitigated, not reversed, and there are new trends that should be of concern. In particular, the Air Force's overall procurement budget—16.7 percent of the total 2020 request—is significantly less than the 24 percent of its total TOA it has averaged since 1962. The $10.8 billion requested for new Air Force aircraft in 2020 is also well below historic averages. In constant 2020 dollars, Air Force aircraft procurement averaged $14.4 billion per year from 1962 to 1989; it peaked at $23.6 billion annually during the peak years of DOD's last real defense buildup in the 1980s. That means the Air Force's planned 2020 aircraft procurement budget is about half of what was spent, on average, from 1981 to 1986.

Based on the aggregate average cost of new military aircraft, the Air Force may require an additional $10 billion or more per year for aircraft procurement alone, according to recent studies by MITRE, CSBA, and the Air Force. Not including trainers and small unmanned aerial vehicles, the Air Force is still only acquiring about 100 aircraft per year and less than 70 combat aircraft per year. By comparison, the Air Force procured an average of about 280 total aircraft per year and over 220 combat aircraft per year from fiscal 1982 through fiscal 1989. In fact, the Air Force should be buying more than double that number, possibly over 200 total new aircraft per year, in order to recapitalize about 4,000 aircraft (the Air Force's aircraft inventory minus its training aircraft and Operational Support Airlift/VIP Special Air Mission aircraft) over a 20-year period. That includes a sustained rate of at least 72 fighters per year.

Indeed, the Navy purchased more combat aircraft than the Air Force from 2008 to 2019. Common sense dictates the opposite should be true, given the Department of the Navy now has about 38.7 percent of DOD's total inventory of 3,560 fighter/attack and bomber aircraft, versus 61.3 percent for the Air Force.

AIR FORCE RDT&E FUNDING

Research, Development, Test, & Evaluation (RTD&E) funding trends are another indicator of the Air Force's modernization progress. From 1962 to 2020, the Air Force's Blue budget RDT&E funding averaged about $19.2 billion per year in constant 2020 dollars and was less volatile year-by-year compared to other Air Force budget areas. From fiscal 1962 until the end of the peak years of the Reagan defense buildup, the Air Force's annual RDT&E budget averaged about $17 billion and it has since averaged just under $20.2 billion per year. This equates to approximately 14.5 percent of the Air Force's budget over that period of time, with the lowest single-year percentage—12.3 percent—occurring in fiscal 1980 just before the Reagan build-up. This historical low was tested in fiscal 2015 when the Air Force's RDT&E dropped to 12.7 percent of its budget.

After the Cold War, RDT&E increased as a percentage of the Air Force's TOA due to the administration's decision to forego procuring a generation of major new weapon systems (with exceptions) and increase RDT&E spending to help keep the defense industrial base warm and prepared to ramp-up new programs when needed.

Since 2016, Air Force RDT&E spending has almost doubled to $35.2 billion—an all-time high as a percentage of its Blue budget. These recent RDT&E increases make sense given the need for new aircraft suitable for operations in increasingly contested environments, modernizing two of the three legs of the US nuclear triad, and developing hypersonic weapons, directed-energy systems, space systems, and autonomous technologies. Yet with Air Force procurement funding lagging, 2019 and 2020 are the only two fiscal years where any service has ever seen RDT&E funding exceed procurement. This welcome and necessary uptick in research investment must quickly translate to a significant increase in procurement of new aircraft and next-generation capabilities; new technologies will fail to deliver combat value unless they are purchased in operationally significant quantities.

A CONSTRAINING FACTOR: O&M

Operations and maintenance funds pay for aircraft flying hour programs, weapons systems support, wages for most Air Force civilians, contractor support, facilities sustainment, restoration, and modernization, and the service's base operating support portfolios. In general, when overall Air Force TOA declines, O&M requirements are more stable or decline at a lesser rate. This is evident following the peak years of the Reagan administration's defense buildup, during the budget downturn after the surge to Iraq, and after implementation of the 2011 BCA. Airplanes still need to fly to meet immediate mission demands.

One of the more significant trends in DOD's budget over the last 20 years has been the rise of O&M as a percentage of total spending. This is also true for the Air Force's budget, despite major force structure reductions absorbed since the end of the Cold War. From 1997 to 2011, the Air Force's O&M budget experienced real growth of 105 percent, well above growth in the Blue budget, which grew by about 60 percent. In 2011, O&M spending hit a record $69 billion, 45.4 percent of TOA. While its O&M growth rate has moderated somewhat in the last couple of years, the $64.2 billion requested for O&M in 2020 represents the Air Force's sixth highest O&M budget ever. Even now, O&M programs constitute almost 39 percent of the Air Force's Blue budget, well above the historical average of 28.7 percent from 1962 to 1989.

Since the Cold War, high op tempo, significant growth in

Photo: Boeing

Two T-7A Red Hawks, USAF's new advanced pilot training system, have a flexible design that can adapt as technologies and training needs change. Using the new jet as a homeland defense aircraft could free up fifth-generation fighters to perform the missions for which they were designed.

O&M requirements, prioritities placed on improving near-term readiness, and procuring aircraft to support counter-terror and counterinsurgency operations helped to reduce resources available for the Air Force to develop and acquire new capabilities suitable to future high-end operations. As aging aircraft will continue to require large O&M investments, this account cannot be seen as a source for funding new acquisition programs to develop "The Air Force We Need."

CONCLUSION

Historically, the United States has ramped up defense spending when challenged by significant threats, then throttled back as threats abated. To a notable extent, this pattern was broken for several generations during the Cold War. Nevertheless, many elements of the US military decreased in size after the Vietnam conflict as the capabilities of individual weapon systems improved. Except for a short period during the 1980s, the overall capacity (size) of US forces, including the Air Force, steadily decreased during that time, and the trend continued at an accelerated pace after the Cold War. The Air Force alone lost nearly 65 percent of its combat air forces from 1960 to 2000, and another 22 percent since 2001.

Today, the Air Force is too small, too old, and lacks the degree of survivability needed to support the 2018 National Defense Strategy. Without exaggeration, it now operates the smallest and oldest combat air force since it became a separate service in 1947. Procurement of new bomber and fighter aircraft was nearly halted for a 25-year period after the Cold War, with the exception of two small, silver-bullet fleets: 187 F-22 stealthy air superiority fighters and 21 B-2 stealth bombers. As a result, the Air Force had to extend the service lives of many of its combat aircraft, taking on additional risk.

The Air Force's procurement spending today is therefore insufficient to both modernize and grow its capacity by the 25 percent needed to achieve the "The Air Force We Need." Capabilities added since 2002 focused on niche counterinsurgency capabilities instead of capabilities for conflicts with peer adversaries, which require building a force to deter and, if necessary, prevail against great power aggression.

The post-Cold War defense modernization holiday that lasted for decades is a major reason why the Air Force has a significant strategy-resource gap. The Air Force's topline and modernization budgets dropped precipitously in the aftermath of the Cold War and again following the 2007-2008 troop surge to Iraq. After reaching a nadir in fiscal 2013, the Air Force's share of the defense budget slowly increased, aided in part by the Bipartisan Budget Act of 2015. From fiscal 2016-2020, the Air Force's topline budget increased by about 3.7 percent real growth per year. While this modest increase helped the Air Force address some of its most critical readiness problems, it has not placed it on a stable trajectory in support of the 2018 National Defense Strategy.

Building the Air Force our nation needs will require the administration and the US Congress to work together to increase the service's annual budget. Overall procurement should be increased, with new aircraft procurement among the highest priorities. Additionally, the long-standing trend of very high O&M growth should be reversed, and the more recent high levels of RDT&E must transition to fund procurement of new aircraft, capabilities, and next-generation munitions needed to survive and achieve effects in future contested battlespaces.

Absent a commitment to truly modernizing USAF, "The Air Force We Need" will remain out of reach—to the detriment of America's security. ✪

Mark Gunzinger *is the Director for Future Aerospace Concepts and Capabilities Assessments at the Mitchell Institute for Aerospace Studies.* **Carl Rehberg** *is a Non-Resident Senior Fellow at the Center for Strategic and Budgetary Assessments*

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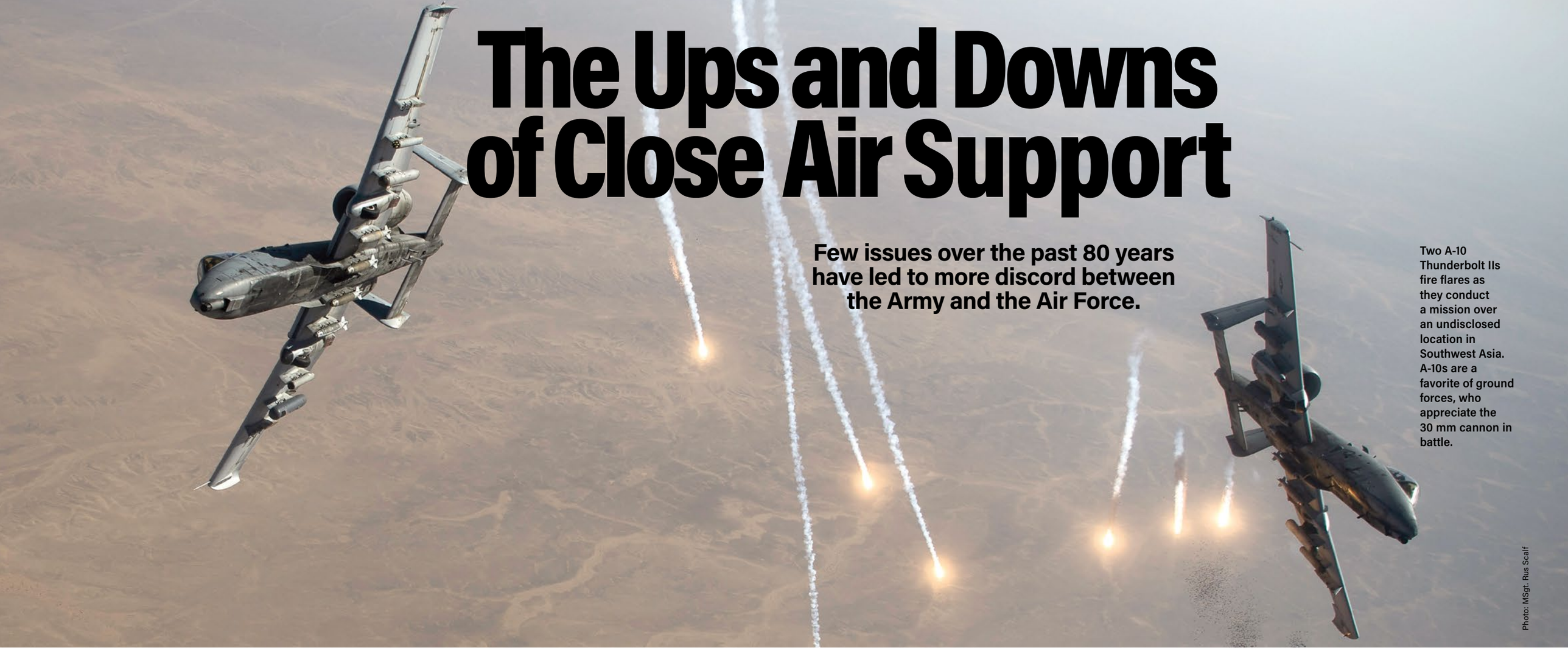
The Ups and Downs of Close Air Support

Few issues over the past 80 years have led to more discord between the Army and the Air Force.



Two A-10 Thunderbolt IIs fire flares as they conduct a mission over an undisclosed location in Southwest Asia. A-10s are a favorite of ground forces, who appreciate the 30 mm cannon in battle.

Photo: MSgt. Rus Scalf

By John T. Correll

According to Air Force legend, the best way for airpower to support Army battlefield troops was proven in Operation Torch in North Africa in 1943. The trouble is that the ground forces were not that impressed with the proof, and they did not subscribe to the legend. Eighty years later, the issue remains unsettled.

Operation Torch, commanded by US Lt. Gen. Dwight D. Eisenhower, began in November 1942 with a combined US and British invasion of Algeria. The goal was to link up with the British Eighth Army driving westward from Egypt and Libya and crush the German Afrika Korps in between them.

For US airmen, it was the first real combat experience against an enemy in proximity to friendly ground forces, a mission that would become known as "close air support," or CAS. US airpower was controlled by the ground commander, who parceled it out in increments for the benefit of local ground units.

That approach—plus the demand for a defensive "air umbrella" overhead—was inefficient and ineffective. It scattered the air effort for limited and temporary results. German airpower took a punishing toll on US air and ground forces.

"This is much more effective than any attempt to furnish an umbrella of fighter aviation over our own troops."
—Army Field Manual 100-20

The priority was soon switched from local air patrols to establishing air superiority and attacking German forces and resources that had not yet reached the front.

The change worked to the clear advantage of allied ground forces, both in the results of the land battle and in reducing the losses the Germans were able to inflict. Luftwaffe attack sorties dropped by 80 percent, then dwindled to almost nothing. German rear echelons were increasingly unable to sustain operations at the front.

In April, tactical airpower resumed direct support of ground forces, flying as many as 2,000 sorties a day. The campaign ended in May with the surrender of 275,000 Axis troops.

Operation Torch led to Army Field Manual 100-20, "Command and Employment of Air Power," published in July 1943. It proclaimed land power and airpower as "co-equal and interdependent" and provided for theater commanders to exercise command of air forces through their subordinate air force commanders.

FM 100-20 was approved by the Army Chief of Staff, but without consultation or concurrence from the Army ground forces. It was celebrated by the Air Force as a "declaration of independence for airpower," but the argument was just beginning.

THE COMING OF CAS

In 1914, the Army declared infantry to be "the principal and most important arm," with the cavalry and artillery corps in support. When the Air Service emerged, it was regarded as another corps to "aid the ground forces to gain decisive success." The strafing of trenches and enemy positions in World War I was a precursor of CAS.

A doctrinal split developed in the 1930s with the advent of the B-17 long-range bomber. In the Air Corps view, the most important mission was strategic bombardment. Establishment of air superiority came second.

"Attack aviation" was third. It made no distinction between interdiction—disrupting or destroying enemy capabilities before they could be brought to bear against friendly troops—and close air support.

FM 100-20 listed air superiority as the first priority for theater tactical aviation. "This is much more effective than any attempt to furnish an umbrella of fighter aviation over our own troops," it said. Second priority was to "prevent movement of hostile troops and supplies into the theater." A third priority was action "to gain objectives on the immediate front of the ground forces."

Between 1943 and 1945, there were enough airplanes to supply regular support for ground troops in contact with the enemy, so the doctrinal disagreement was not a serious problem.

The Key West agreement of 1948 assigned postwar roles and missions to the armed forces. A major function of the Air Force, which had been created in 1947, was "to furnish close combat and logistical air support to the Army."

CAS for Marine Corps ground units was left to Marine Corps aviation. "Marine Corps doctrine stressed that Marine airmen were soldiers first, flyers second, and that airplanes represented but one of a number of ancillary weapons the ground commander could use to support his infantry," said historian John Schlight. Marine airpower remained constantly available to the ground commander and had no responsibility for gaining control of the air, isolating the battlefield, or air interdiction.

Air Force Col. (later Gen.) William W. Momyer observed

A2C Michael Hall, left, and A1Cs Robert Greer and John Smith arm an A-1E Skyraider with 250-lb bombs at an airfield near Saigon, Vietnam.

Photo: USAF/AFA Library

that if Allied air forces had followed this doctrine in World War II, "the German Air Force would have been the victor" since it would have gone unopposed.

CULTURE WARS

The weight of evidence from conflicts since World War II confirms that the Air Force's most valuable support for the Army—both to the outcome of the ground battle and in limitation of casualties—is air superiority and air interdiction.

Theater commanders, who must choose priorities for their airpower, generally understand this, but the perspective of the ground forces tends to be less analytical and more visceral.

Big threats may be more important in the long run—they are distant and out of sight. Ground units seldom know about them. The enemy confronting them directly is a matter of life and death. Close air support is a large factor in confidence and morale.

To the Air Force, CAS is part of a broader air campaign that also includes interdiction and air supremacy. To the Army, CAS is a vertical extension of the ground battlefield, and airpower is a supporting arm.

"CAS is a function vital to the mission of ground forces for successful combat at minimal cost," the Association of the US Army said in 1993. "In the Army view, the Air Force is not greatly interested in the function and tends to neglect it in favor of strikes deeper into enemy territory."

Such perceptions have been encouraged by Air Force statements on occasion, notably during the nuclear "massive retaliation" era of the 1950s. USAF doctrine in 1954 held that it was no longer necessary to defeat an enemy's ground force.

The Army was also listening in the 1980s when program officials for the F-15 air superiority fighter, wrapped up in their zeal to hold down the airplane's weight, adopted the slogan, "not a pound for air-to-ground." The slogan was no indication of what the Air Force actually did. A multirole variant of the aircraft, the F-15E, went on to perform both air interdiction and CAS. It is still doing so—four decades later.

KOREA AND VIETNAM

The prevailing image of the air war in Korea is the clash of F-86 Sabres and MiG-15s in MiG Alley along the Yalu River. That, however, was the lesser part of the effort by Far East Air Forces.

The great majority of FEAF missions were in aid of the ground battle: 23 percent of them close air support and 55 percent interdiction. In the early months of the war, FEAF threw everything it had, including B-29 bombers, against the North Korean invaders.

At first, the propeller-driven F-51 Mustang, which could operate from rough airstrips and which had a long loiter time, was used extensively for CAS. F-84E Thunderjets arrived in December 1950 and took over the main close air support tasking for the rest of the war.

When USAF air commandos went to Vietnam in 1961 to train and assist the South Vietnamese, they flew vintage propeller-driven aircraft, the best of which was the A-1E Skyraider. The restriction on jet aircraft in Vietnam—seen as a possible violation of the Geneva Accords on Southeast Asia—was not lifted until the introduction of US ground troops in 1965.

The A-1Es, flying low and slow and able to loiter in the battle area, were popular with ground units, but improving enemy air defenses forced their withdrawal from South Vietnam in 1967. The main Air Force platforms for CAS were jets, the F-100 and F-4.

The Air Force flew air superiority and deep interdiction missions in North Vietnam and Laos, but the action in South Vietnam was in support of the ground war. Unlike previous conflicts, there were no fixed lines and few large engagements. Airstrikes were directed by forward air

controllers in light aircraft. FACs were used occasionally in World War II and Korea, but they were fundamental to strikes in Vietnam. Eventually, improving defenses required "fast FACs" in jet aircraft.

When possible, CAS missions were planned ahead of time for coordination of the strike and selection of the best weapons. About 30 percent of the allocated CAS missions, though, were held back as an "immediate" resource for response to unexpected needs. It took about half an hour to get bombs on an immediate target, but in tight situations, an aircraft already in the air could be diverted.

It wasn't exactly CAS, but the Army heartily appreciated the B-52 bomber formations that laid down saturation carpet bombing with high explosives in areas 1.2 miles long and about half-a-mile wide.

SPECIAL AIRPLANE

In 1961, the Army introduced helicopters into Vietnam for "direct aerial fire support," claiming that it was different from close air support, which was an Air Force mission. In 1966, the two services struck an agreement in which the Army would have all the combat helicopters and the Air Force would have all of the fixed-wing airplanes.

USAF, under pressure from Congress and the Department of Defense and fearing possible loss of the mission, announced in 1966 its intention to develop the "A-X," the Air Force's first—and so far only—specialized aircraft for close air support. Up to then, CAS had been an additional task for fighter and attack airplanes.

The A-X evolved into the A-10 "Warthog," which became operational in 1977. The A-10A was relatively slow, with a top speed of 439 mph. Its main claim to fame was the seven-barrel rotary GAU-8 30 mm cannon that protruded from its nose.

In the original design, the Gatling-style gun could pump out 2,100 rounds per minute, later raised to 3,900, but it typically fired short bursts with a distinctive sound described as "Brrrt." The A-10 airframe was essentially built around the gun.

A total of 713 A-10s were eventually built, and the ultimate model, the A-10C, could reach a top speed of 518 mph. The Army ground forces bonded with the A-10 and viewed with disfavor USAF's proposal in the 1980s to replace it with a faster, multi-role aircraft.

There was a flurry of interest by the military reform movement in a notional airplane called "the Mudfighter," slow and simple, heavily armored, and loitering above clusters of ground troops.

Meanwhile, the Air Force was moving in the opposite direction. Believing the A-10 could not survive in mid- to high-intensity conflicts in the 1990s, USAF evaluated 28 options for close air support and concluded that the "A-16," a variant of the F-16 fighter, was the best choice.

"The data does not say 'Mudfighter,'" said Gen. Larry D. Welch, Air Force Chief of Staff. "No matter how you slice it, the data says 'A-16.'"

The A-16 variant would have had stronger wings and a 30 mm cannon but it never went into production. Congress, in 1990, directed the Air Force to retain two wings of A-10s. Plans for the A-16 faded away.

AIRLAND BATTLE

The Army underwent an epiphany of sorts in 1982 with its "AirLand Battle" doctrine, which acknowledged that a war in Europe could not be won at the point of contact. CAS was still important, but defeat of Warsaw Pact forces required deep strikes and interdiction. The Army could not do it without the Air Force.

USAF's Tactical Air Command embraced AirLand Battle in 1983. NATO also signed up, adding a "Follow-On Forces Attack" strategy aimed at destroying or disrupting enemy forces in rear echelons.

It sounded like what Gen. Carl A. Spaatz and RAF Air Marshal Arthur Coningham said in 1943, except for one thing: With AirLand Battle, the Army was always in charge and airpower was always the supporting force.

Air Force doctrine recognized "battlefield air interdiction," a separate mission broken out from general interdiction, and referring to targets some distance from the front, but of special importance to ground operations.

To the Army, this was all part of an "extended battlefield." The corps commander was authorized to set the "Fire Support Coordination Line," within which the ground forces controlled all "fires," including airpower. In time, Army commanders claimed the right to draw the FSCL hundreds of kilometers ahead of the positions they actually occupied.

With the Gulf War impending in 1990, US Central Command's off-the-shelf Operations Plan 1002 was built around

US Army troops from 2nd Battalion, 16th Infantry, march through the Kasserine Pass in Tunisia on Feb. 26, 1943. German infantry, aided by Luftwaffe close air support, routed the inexperienced Americans.

Photo: US Army

Photo: 86th Fighter Weapons Squadron

An F-35 from the 34th Fighter Squadron drops a GBU-39 Paveway II during a Nov. 7, 2018, exercise. Future high-threat conflicts will thrust the F-35, and not the A-10, into the close air support roll.

AirLand Battle. The assumption was that the ground forces would take the lead in Operation Desert Storm, which was about to unfold.

IN THE GULF

To the surprise of all—especially the Army—the war plan chosen by the CENTCOM Commander, Gen. H. Norman Schwarzkopf, was not AirLand Battle. Instead, Desert Storm consisted of sequential phases, beginning with a 38-day air campaign. Ground forces did not play a major role until the final four-day phase, when the Iraqi forces were battered and reeling.

The early emphasis was on deep air operations against strategic "centers of gravity." Sixty-seven percent of the overall air effort targeted the Iraqi fielded forces, but close air support accounted for only six percent of the sorties. Both the A-10 and the F-16 performed well.

Battlefield air interdiction was not included in the Desert Storm concept of operations or the Air Tasking Order. It was dropped from Air Force doctrine in 1992. AirLand Battle was eliminated from Army Field Manual 100-5 in 1993.

In the regional conflicts of the 1990s, airpower figured prominently, but very little of it was close air support. The nature of the engagements seldom called for it. In Operation Allied Force in Kosovo, US ground forces were not even employed. It was all airpower. The demand for close air support did not surge again until operations in Afghanistan and Iraq after 2001.

A-10s remained in the force following the Gulf War, although some of them were placed in storage in an overall reduction of Air Force combat wings. In response to criticism in 1994, Air Force Chief of Staff Gen. Merrill A. McPeak offered to give the Army the close air support mission along with the A-10s if the Army thought it could do the job better. His offer was declined.

The Joint Strike Fighter program in the mid-1990s led to the stealthy F-35 Lightning II, envisioned as a successor to both the F-16 and the A-10. It was to replace the Marine Corps AV-8 Harrier as well. In 2007, the Air Force began installing new wings on the oldest A-10s to extend their service life.

The service partnership hit another bad bump in Operation Anaconda in Afghanistan in 2002, when the Army division commander complained about slow delivery of close air support. What he did not mention was that the Army had underestimated the opposition, did not request CAS in advance, and did not notify the Combined Air Operations Center of the operation until hours before it started. Even so, the air component managed to put a substantial number of precision attacks on target the first day.

CAS FOR FUTURE WARS

In recent years, the main dispute has been about what kind of airplane should be used for close air support. In 2013, Congress failed to meet its self-imposed deficit reduction goals. This triggered a massive budget sequester, with half of the money to be taken from the armed forces.

The Air Force, searching for big savings available by eliminating entire programs, proposed to retire the A-10s. The Warthog was getting old and was no longer capable of surviving in high-threat environments. Accusations arose immediately from the ground forces and Congress that this was another attempt by the Air Force to abandon CAS.

Exasperated, USAF chief Gen. Mark A. Welsh III—himself a former A-10 pilot—said that "CAS is a mission, not a platform," that the Air Force was flying 20,000 close air support sorties a year, and that about 80 percent of those flown in Afghanistan since 2001 were by aircraft other than the A-10. The F-16 alone had flown more CAS missions than the A-10.

No matter. The A-10 was a symbol of commitment to soldiers engaged in close combat, and Congress refused permission for its retirement. The Air Force announced that the A-10 would remain in the inventory until the 2030s and that an additional number of them would get wing replacements.

For the foreseeable future, CAS will be divided up between two domains. Against low-technology adversaries or when the opposition is minimal, the Air Force will use A-10s and perhaps modified light aircraft. Army AH-64 attack helicopters will most likely be restricted to this regime as well.

In high-threat conflicts, the preferred choice for CAS will be the F-35, with which the Marine Corps also proposes to replace its CAS AV-8 Harriers. A problem in this is that the Air Force has only about 200 F-35s altogether, far short of the 1,763 on which it had planned.

"Although in isolation CAS rarely achieves campaign-level objectives, at times it may be the more critical mission due to its contributions to a specific operation or battle," current Air Force doctrine says. "CAS should be used at decisive points in a battle and should normally be massed to apply concentrated firepower and saturate defenses."

That is stated cautiously, but it is not far from what Coningham and Spaatz said in 1943. ✪

John T. Correll *was editor in chief of* Air Force Magazine *for 18 years and is a frequent contributor. His most recent article,* "Disaster in the Philippines," *appeared in the November issue.*

New AFA Legacy Award

Photo: Mike Tsukamoto/staff

Then Air Force Association Chairman of the Board F. Whitten Peters presents the first W. Parker Greene Legacy Award to Dr. Lucy Greene.

By LaDonna Seely Orleans

Dr. Lucy Greene, wife of Air Force advocate W. Parker Greene, received the first-ever W. Parker Greene Legacy Award at the Air Force Association's 2019 Air, Space & Cyber Conference, held Sept. 16-18, in National Harbor, Md., just outside Washington, D.C.

A portion of the road leading from Valdosta, Ga., to Moody Air Force Base is named the W. Parker Greene Highway. The Moody headquarters building was christened the W. Parker Greene Base Support Center, and the coffee shop inside the W. Parker Greene Base Support Center is called Lucy's Corner.

When Parker Greene passed away in 2018, he and his wife, Lucy, had worked tirelessly to strengthen the bonds between the civilian and military community in Georgia for more than 48 years. As a result, AFA established the award to recognize an AFA Field leader who exemplifies Greene's personal qualities of public service leadership, airpower advocacy, and support of airmen and their families.

In the early 1990s, "Mr. Parker," as he was known, was credited for making Moody AFB "BRAC-proof" as the executive director of the Moody Support Committee, created to protect Moody from the Base Realignment and Closure Commission.

Soon thereafter, he was appointed to the Georgia Military Affairs Committee by Georgia's governor and earned the first-ever Chief of Staff of the Air Force Award for Exceptional Public Service.

He was twice awarded the Air Force Distinguished Public Service Award, the highest Air Force civilian honor.

"Parker Greene was an incredible man, who made us all want to be better men," said Air Force Chief of Staff Gen. David L. Goldfein. "Men like Parker Greene teach us all what a life of service, well-lived, really means."

The award will be presented annually during AFA's ASC Conference to a civilian who exemplifies:

- Direct and long-lasting support of the Air Force, airmen, their families and the local community;
- Proven leadership and involvement in both the military and civilian community;
- Continued participation in Air Force and community organizations and activities;
- Advocacy of Air Force and national security issues at the federal, state, and local levels;
- Significant contributions to the base mission and its airmen;
- Recurring interaction with Air Force and federal, state, and local government leaders;
- Public engagement on the importance of airmen's service and support for the Air Force;
- Demonstrated commitment to values of integrity first, service before self, and excellence in all they do.

New AFA STEM Scholarship

By Chequita Wood

Dr. Sydell Perlmutter Gold, a pioneer for women in math and science, earned her Ph.D. in Theoretical Mathematics from the University of California, Berkley, in 1973, when she was already the mother of three.

Now a new Air Force Association scholarship program will help other women to follow in her footsteps. Beginning in 2020, female graduating high school seniors who are dependents of currently serving Active Duty, Guard or Reserve, or retired Air Force members will be eligible for the Dr. Sydell Perlmutter Gold Memorial Scholarship, worth $5,000 per year for up to four years for young women pursuing careers in science, technology, engineering, or math.

Gold was a senior system analyst in the Evaluation and Planning Division of the Lawrence Livermore Laboratory from 1974 to 1980, then joined the National Security Council staff as a technical appointee, serving under Presidents Carter and Reagan. Returning to Lawrence Livermore, she was a laboratory representative contributing to the Department of Defense/Department of Energy Long-Range Planning Study for the nuclear weapons stockpile and, in 1982, was appointed deputy assistant Secretary of the Air Force for Strategic Systems and Arms Control.

In the 1990s, Gold was senior vice president and deputy manager of SAIC's Advanced Technology & Analysis sector, and in 2000 she was awarded the Women in Aerospace Outstanding Achievement Award for her contributions supporting women in aerospace. "Being recognized for helping women achieve professional goals by an organization dedicated to women's advancement is especially gratifying," she said after receiving the award.

Among her contributions, she collaborated with retired Adm. Bobby Inman to establish a Women's Business Forum at the company, which helped women in mid-level technical and management jobs meet with members of the company's board of directors.

Gold retired in 2006 and was appointed to the Joint Advisory Committee on Nuclear Weapon Surety, the US Strategic Command Strategic Advisory Group, the Defense Science Board, and the National Academy of Sciences task forces. She passed away in 2008.

Photos: Courtesy Ted Gold

Sydell Gold was an adventurer: She read, traveled, biked, ran marathons, backpacked, and snorkeled.

Born in New York City, Gold attended the Bronx High School of Science, one of the city's premier public high schools, then attended Barnard College. She earned a master's degree in mathematics from the University of New Mexico in 1962 and immediately began her career in applied mathematics at Sandia National Laboratories, where she worked until 1967.

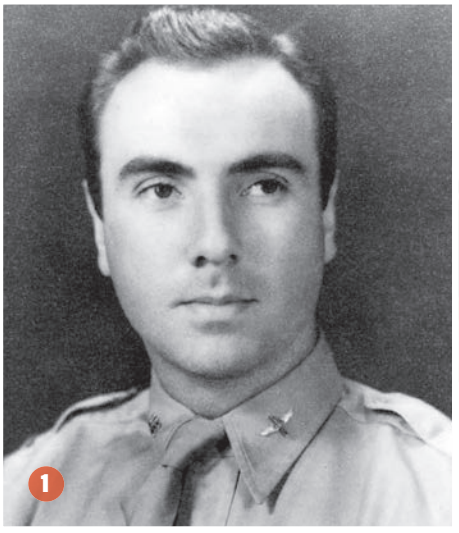
The scholarship award, set up in Gold's name by her husband, Ted S. Gold, and their children, follows another scholarship for Bronx Science grads. A past winner of that scholarship, now studying civil engineering at Columbia University, wrote, "What makes this scholarship so special is that you're not only receiving financial aid, you're winning a role model: Sydell's story is a very empowering one; she wasn't afraid to take risks and pursue her dreams in a field that was predominantly male."

To be eligible for the Dr. Sydell Perlmutter Gold Memorial Scholarship candidates must be:

- A graduating female high school senior who has excelled in mathematics;
- Accepted into an accredited four-year college or university;
- Pursuing a bachelor's degree in science, technology, engineering, or math;
- Be the dependent of a currently serving Active Duty, Guard or Reserve, or a retired Air Force member.

Preference will be given to applicants who are first-generation college students and have demonstrated financial need. To be eligible to renew the annual award, recipients must continue to study a STEM subject and submit an annual letter updating AFA on how the scholarship has influenced their lives and career aspirations.

Gold (third from the left) pictured with her Strategic Advisory Group colleagues. Early in her career she was usually the lone female.



1/ Harl Pease Jr. 2/ KC-46 tanker arrives Aug. 8, 2019. 3/ B-17 of 19th BG in Philippines.

Photos: USAF

PEASE

Maximum Effort

In 1957, Strategic Air Command bestowed a new name upon its largest New Hampshire bomber base. Portsmouth Air Force Base became Pease Air Force Base, in honor of Capt. Harl Pease Jr.

Thus did Pease, a local boy, enter the pantheon of SAC heroes.

Pease, born in 1917 in Plymouth, N.H., enlisted as an Air Corps cadet on Sept. 23, 1939, and received his wings in June 1940. Pease went straight to the Pacific. He regularly flew in mass-formation flights of B-17s, exploits for which he was awarded a Distinguished Flying Cross.

Pease's outfit, 19th Bomb Group, was based at Clark Field, Philippines, when Japan struck on Dec. 8, 1941, starting the War in the Pacific. What was left of the group redeployed to Australia.

Soon, the 19th BG marshaled 10 B-17s—Pease was one of the pilots—to strike enemy forces in Java, a heroic but futile effort to check Japan's advance. From Australia, Pease began flying combat and resupply missions to the Philippines some 2,500 miles away. For this, he was awarded a second DFC.

In May, Pease took part in the first Battle of the Coral Sea, flying grueling 16-hour missions to bomb targets on New Guinea.

Greater heroics lay ahead. US Marines were planning to storm Guadalcanal on Aug. 7, but feared Japanese air attack from Rabaul, New Britain. The 19th BG ordered a "maximum effort" bomber raid from Port Moresby on Aug. 7 to knock out Rabaul's air threat.

In a turn of bad luck, however, Pease's B-17 on Aug. 6 lost an engine, and was forced to return to Australia. It looked as if Pease would miss the big show, but he was determined to make it.

Pease located a beat-up B-17—#41-2439. Its engines were in disrepair and some armament was missing, but it was available. Somehow, Pease and a volunteer crew got it in flying shape and took off for Port Moresby. They arrived at 1 a.m. and slipped into position.

Showing great flying skill, Pease kept his aircraft in formation all the way to Rabaul, where it accurately unloaded its bombs and shot down several Japanese fighters on the way in.

On the way out, however, Pease's ramshackle B-17, which had taken major battle damage, couldn't keep up; the other B-17s pulled away and dove into clouds. Pease's B-17 never made it. Enemy fire ignited a fuel tank, and that was the last anyone saw of #41-2439.

Because Pease and his crew did not return, officers concluded the B-17 had been shot down with all hands lost. Only after the war did the Air Corps learn that Pease and another crew member had bailed out and were captured. On Oct. 8, 1942, they were executed.

For the bravery displayed on this final mission, Pease was awarded the Medal of Honor, presented to his father by President Franklin D. Roosevelt at the White House.

While Pease Air Force Base closed years ago, a smaller Pease Air National Guard Base operates on the site. It is home to the New Hampshire Air National Guard's 157th Air Refueling Wing, which was one of the first units to acquire USAF's new KC-46 tanker. A civilian airport occupies part of the old Active Duty base. ✪

HARL PEASE JR.

Born: Apr. 10, 1917, Plymouth, N.H.
Died: Oct. 8, 1942, Rabaul, New Britain
College: University of New Hampshire
Occupation: US military officer
Services: US Army Air Corps, US Army Air Forces
Main Era: World War II
Years of Service: 1939-42
Combat: Pacific Theater 1941-43
Final Grade: Captain
Honors: Medal of Honor (awarded posthumously), Distinguished Flying Cross (2), Prisoner of War Medal (awarded posthumously), Purple Heart (awarded posthumously)
Resting place: Body not recovered

PEASE AIR NATIONAL GUARD BASE

State: New Hampshire
Nearest City: Portsmouth
Status: Mixed use (Air National Guard, civilian)
Original Area: 6.4 sq mi / 4,100 acres
Site conveyed to USAF: 1951
Opened as Portsmouth AFB: June 30, 1956
Renamed Pease AFB: Sept. 7, 1957
Closed (by USAF): March 31, 1991
Pease ANGB opened: July 1991
ANGB area: .33 sq mi / 220 acres
Current owners: New Hampshire ANG, Pease Development Authority
Former owner: Strategic Air Command
Home of: 157th Air Refueling Wing (ANG), includes 64th Air Refueling Squadron (active USAF)

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