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MAGAZINE



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Photos: Samuel King Jr./USAF; Boeing

Two jets from different eras. See "F-15EX vs. F-35A," p. 30. Staff illustration by Dashton Parham.

Agile Fighter Development

Since its inception, the US Air Force has been at the vanguard of technological change. From the pre-Air Force Wright Brothers era through two World Wars, the space race, and the advent of stealth, the nation has benefited from the world's best cutting-edge technology, rapidly developed by industry and operationalized by airmen.

That technological edge is key to our National Security Strategy. The United States doesn't strive to be the world's largest military, but rather its most capable. Other nations may have more troops, planes, or missiles; the US counters with superior training and capability. These act as force multipliers, producing superior forces that comfort allies and deter potential foes.

Air superiority is critical to this strategic approach. Without it, our ships at sea, troops on land, cyber facilities, and a broad range of aircraft are not survivable. But as Air Force Chief of Staff Gen. David L. Goldfein reminds us, "Air superiority is not an American birthright." On the contrary, air superiority is attained and sustained only through continuous innovation and investment.

While 18 years of regional conflict and counterinsurgency distracted the United States, China narrowed the capability gap between its forces and ours.

Chinese defense spending will climb another 7.5 percent this year, on top of an 8.1 percent increase a year ago, and 7 percent annual increases in each of the two years before that. China's defense spending is growing faster than its economy and several times the rate of inflation, demonstrating its determination to catch up and, ultimately, overtake the United States.

According to the Defense Intelligence Agency, China's fifth generation J-20 and FC-31/J-31 fighter jets feature low-observable designs similar to those of American fifth generation fighters; modern AESA radars; long-range, multiband electro-optical targeting systems; and glass cockpits equipped with advanced avionics and sensor fusion. On the ground, China now has advanced Russian-built S-400 air defense systems and is investing in new strategic early warning, air strike, air and missile defense systems.

That is the threat the United States faces in a head-to-head engagement with China.

Now let's look at the other side of this equation. The decision to cancel the F-22 in 2009, after buying just 187 rather than 381 jets, set the stage for the US Air Force today: Its fleet of F-15Cs are aging out, and its options for replacing them are few. Having apparently ruled out overhauling those jets to extend their service lives, the choice on the table comes down to this: Buy new F-15EXs, which represent a modest upgrade over existing F-15Cs, or accelerate the purchase and fielding of the F-35A, which boasts transformative stealth, sensors, and situational awareness.

If ever there was an unfair fight, this is it. The F-35's radar cross section is 1/5,000th that of an F-15. Enemies can see an F-15 more than 200 miles out, but won't detect the F-35 until it's within 21 miles. It's like spotting a housefly coming at you at Mach 1.6.

This is what air superiority is all about: Creating an unfair fight, where we have the advantage. So why is this even a debate?

Surprisingly, it's not about the sticker price. Despite the gen-

erational difference between the two airframes, the marginal cost for each successive airplane will be almost identical by 2024-2025, when the F-15s would finally become operational. Nor is it really about operating costs. The cost per flying hour of an F-15 is lower today than it is for an F-35A, but F-35 costs are coming down and, under an agreement and plan between prime contractor Lockheed Martin and the F-35 program office, should fall below F-15 operating costs by 2024.

That's not to say, of course, that this debate isn't about money—it is. An order for 80 F-15EXs would be worth \$7.8 billion over five years, and perhaps double that over the life of a program that could total 144 jets.

That money has to come from somewhere, and the inevitable source will be F-35s. This is why the F-15EX finds itself in an unfair fight with a superior fighter.

Indeed, the real argument for buying the F-15EX isn't about fighter capability at all—it's about preserving the long-term industrial capacity to ensure that, when the time comes to build the next generation of fighter aircraft, the Defense Department doesn't find itself captive to a single supplier. That's the risk of shutting the door on Boeing fighter purchases for the next decade.


The solution is twofold: First, buy the F-35A. Commit to the more advanced platform, the one that imposes the greatest risk and cost on high-end adversaries. Second, reform the way the Air Force develops and buys new weapons.

Here, curiously, there is reason to turn back the clock. In the 1950s, the Air Force launched the "Century Series" of fighters, beginning with the F-100 and continuing through the F-117, the first stealth airplane. Not every Century Series design made it into production. But by continually developing new airframes, engines, sensors and concepts, the Air Force learned faster, gaining the upper hand on rivals.

That's how the United States bankrupted and defeated the Soviet Union. Air Force Assistant Secretary for Acquisition Will Roper cites the Century Series and its iterative development approach as a model. Advancing technology has strategic effects. It can deter rivals from risking conflict, and impose costs that force them to rethink long-term strategy.

Much of our future capability will be wrought from software, rather than hardware, but advances in materials, manufacturing, and systems integration can also benefit from this iterative approach. Indeed, F-15EX maker Boeing leveraged exactly those concepts to wring billions out of the T-X trainer program, enabling it to cut years of time and potentially billions of dollars from program costs.

Buying just one airframe every two or three decades cannot and will not support a dynamic, competitive industrial base. Nor will it deliver sustainable innovation.

Think of it: Without Apple and Samsung, we might all still be using BlackBerrys and paper maps. Put another way—without Russia and China—we'd be fine with fourth generation fighters. 

"Buying just one airframe every two or three decades cannot and will not support a dynamic, competitive industrial base."



The Real Value of Tyndall

Having been stationed at Tyndall four times and losing my on-base home and most of my belongings to Hurricane Michael, I appreciated y'all attempting to capture the challenges going forward and for quoting a great American, Retired Gen. [Herbert J.] "Hawk" Carlisle's sage wisdom ["Can Tyndall Recover?" December 2018, p. 20]. A couple of areas of clarification and additional thought:

Col. Brian Laidlaw did, and continues to do, an incredible job as 325th Fighter Wing commander. His decisive actions in the face of a Cat 2 storm that rapidly became a Cat 5 (in essence) literally saved lives and precious resources. Any questioning of his actions are basically done by folks outside the zip code. His actions may be "second-guessed," but only by those who are ill- and/or uninformed.

There is no such thing as the 53rd Air-to-Air Weapons Evaluation Group per p. 23 of your article. Air Force Public Affairs, *Air Force Magazine*, and a host of other folks have gotten this wrong. It is the 53rd Weapons Evaluation Group, and it does Combat Archer (air-to-air) and Combat Hammer (air-to-ground) evaluations of all major USAF weapons systems and reports their finding to the highest levels of USAF and DOD. I should know how amazing they are, ... I commanded that amazing group from July 2016 to July 2018.

The AOC, while able to deploy elsewhere and continue to operate, is placed at Tyndall for a lot of reasons. This AOC, in conjunction with all of

the other AOCs, is situated in a strategic location that provides diversity of mission and location versus other AOCs. As a current member of 1st Air Force, it is a national treasure that needs to be kept separate from other national treasures for good reason.

Lastly, the Panama City area needs Tyndall for more than just the money. The area's schools, places of business, shelters, churches, etc., rely on the business that Tyndall brings, but they also rely on the *people* that Tyndall brings to run the local economy. The nonmilitary spouses, high school-aged kids, volunteers, etc., are *all* part of the Panama City, Fla., community, and the high-quality folks that Tyndall bring "ups the game" of this now considerably challenged area.

I love Tyndall and the Panama City area for all the reasons y'all mentioned—and for those above.

Col. Lance "Blade" Wilkins
Panama City, Fla.

Tanker Tops BUFF Bargain

With respect to the article "The Best Bargain In Military History" from your December issue [p. 56], I feel I must disagree with the conclusion given by the authors. In actual fact, the KC-135 fleet of aircraft cost less than the original purchase of the B-52 fleet, USAF bought more aircraft for less money, and currently more KC-135s are still flying the line and doing the job every single day than the handful of B-52s that still fly. Does the KC-135 have the glamour or visceral impact of other aircraft in the USAF inventory? Admittedly, it does not, however, that wasn't what the title of the article implied, the title was suggesting which aircraft was the best deal ever for the USAF. We are all a team, and it takes everyone on the team to get the job

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—The Editors

done, but [Nobody Kicks A** Without Tanker Gas].

Maj. Randall A. Nordhagen,
USAF (Ret.)
Altus, Okla.

From the Boneyard

[Regarding "Re-Engining the B-52," January/February, p. 38]: I discharged from my first enlistment in USAF in 1966. I moved to Connecticut with my family and went to work for Pratt & Whitney Aircraft Co., in the flight-test department. Our main test aircraft was one B-17, used for testing Hamilton Standard propellers; and two B-45s which we used to test jet engines, from JT-12s to TF-30s. Around 1968, P&W had developed the JT-9D but had no in-flight analysis of its performance. Its marketability was based only on ground testing. Boeing, at the time, had a need for that engine to power its new 747 aircraft, but required in-flight testing prior to purchasing. So, P&WA obtained a B-52E Stratofortress (56-0636) from USAF at Davis-Monthan AFB, Ariz., commonly referred to as the "Boneyard." It marked the first time a B-52 was refurbished from storage.

After acceptance of the aircraft at Bradley Intl. Arpt., Windsor Locks, Conn., it was placed in a Cantilever hangar where it remained while extensive modifications were undertaken. Numbers 5 & 6 engines and their supporting nacelles were removed. We built another nacelle in their place designed to hold the JT-9D; installed wiring and tubing to support requirements for instrumentation; and generally continued the aircraft's overall restoration. We worked two shifts, 10-hr days, six days a week for about a year to get her airworthy again. Her maiden flight was very successful and provided a dependable JT-9D test bed for years. In 1979, a tornado ravaged the airport and collapsed her hangar around her. She survived, was repaired, and flew for a few more years. I'll never forget the memories that she provided and one day hope to see her again in the "Boneyard."

SMSgt. Wayne C. Beach,
USAF (Ret.),
Beverly Hills, Fla.

I am very interested in how the engine selection will be made. The article stressed the importance of fuel efficien-

cy and reliability over the TF-33. This is a very important part of the equation, but I would hope the decision-makers also put emphasis on thrust. I am also pleased, for a lot of reasons, that the eight-engine configuration will be maintained. I am in favor of at least a 15 percent increase in thrust. This can easily be managed with the thrust gate management procedures, and I believe there are engines in this range that can be fitted in the desired dimensional envelope. It should be noted that the KC-135 re-engine program gave the aircraft a 70 percent increase in thrust with the CFM-56. I am a former B-52H IP (instructor pilot) with a total time of 3,000 hours in the B-52D, F, G, and H. I know how much the added thrust given to the B-52H was a great advantage. I am also a degreed aerospace engineer and have experience with flight testing B-52 weapons.

I believe there are plans to add heavy external stores to the B-52H in the order of 20,000 pounds to each wing. If anything, increased thrust over the 17,000-lb T-33 is needed. I have in-flight refueled the B-52H to 525,000 pounds. The bomber becomes very thrust-sluggish at that weight. Additionally, consider loss of engines and/or thrust with heavy external stores. Yes, they can be jettisoned, but at what cost?

The re-engine program must take into account current and future plans for the B-52H and consider the added drag any weight and external configuration options may introduce. After all, the BUFF has 30 more years in service. That in itself is awesome. I would also suggest that the "lessons learned" from the KC-135 re-engine program be examined. I am sure Boeing has a lot to offer here. I will watch with great interest how this important program matures.

Lt. Col. Bill Barton,
USAF (Ret.)
Niceville, Fla.

A Rose is a Rose is NOT a Rose

I must comment on your excellent article on Air Force Special Ops recruitment ["Special Treatment for Special Warriors," December 2018, p. 42]. The Air Force doesn't and never has understood the marketing value of a name. People want to be a Navy Seal or an Army Ranger because it is chal-

lenging and because it is something they know they will be recognized for and proud of for the rest of their lives. Combat controllers and other Air Force special operators work side-by-side with seals and rangers, but who's ever heard of CCT?

The Navy has "Top Gun," the Air Force has "Weapons School."

Huh? Do you think Tom Cruise would have been in a movie called "Weapons School?"

Back when computers were brand-new, I spent several months writing a flight-planning software program for our newly forming F-117 squadron. I hadn't given much thought to naming the thing when my wife suggested I should call it something catchy, like "Hanner-Planner" (after my last name). The program worked well and was used for several years.

Nearly 30 years later, upon meeting a new acquaintance at a military function, he remarked, "Oh, are you that 'Hanner-Planner' guy?" I was astounded! There is so much in a name, and the Air Force just doesn't get it.

Lt. Col. Dale R. Hanner,
USAF (Ret.)
Loveland, Colo.

Doolittle Was a Zealot

Welcome to *Air Force Magazine* ["Letters: From the Editor in Chief," December 2018, p. 3]. As a 30-year-plus Life Member of the Air Force Association, I have long appreciated the different perspectives expressed in *Air Force Magazine*.

The difficulties faced by the Air Force you present in your December inaugural editorial ["The Air—and Space—Force We Need," p. 2] are unfortunately only too true. The Air Force is "overtasked and under-resourced," causing the Air Force to "fray at the edges." And, it is a DOD-wide issue, impacting not only the Air Force. However, I disagree with your conclusion that we do not need a separate Space Force, for the following reasons.

My grandfather was in the Aviation Section of the Signal Corps under General Pershing in WWI. My father was in the Army Air Corps flying combat missions in P-47s from Ie Shima in the South Pacific. Renaming the Aviation Section to the Army Air Corps, then renaming the Army Air Corps to the Army Air Forces, did not resolve the

problems of funding or tasking, because a consolidated airpower strategy was lacking. Only recognizing that the air was a separate domain from the Army-focused land domain finally led to airpower being more strategically implemented. As the Congressional Research Service pointed out in their Aug. 16, 2018, article "Toward the Creation of a US 'Space Force,'" there are long-standing concerns about the fragmentation and overlap in national security space acquisition management and oversight. It further stated that the slow pace of the Air Force in addressing space issues creates a growing threat to US national security in space. Only in forming the Space Force will this new, separate domain receive the focused funding and strategic tasking that only a space leader will provide. As Secretary of the Air Force Heather Wilson stated in her open letter of Sept. 14, 2018, we need to transition to a "consolidated space" effort. Yes, we need to invest more in the Air Force. That can best be done by Air Force leadership focusing on air—while Space Force leadership focuses on space.

There will be a Space Force. The recent Chinese and Russian military reorganizations have created their own Space Forces. If we do not evolve, as our adversaries have, we will hand over our current lead in space and jeopardize our national security.

The source of the funding and tasking issues, of course, is the lack of national will expressed by congressional failure to provide the necessary resources to fight our nation's battles. The inability of the members of Congress on both sides of the aisle, who represent their own parochial special interests rather than the greater good of the nation, is an unfortunate truth.

I do not believe submariners, nor cyber warriors, nor airpower advocates will "run amok" when the Space Force becomes a reality. I have great faith in our nation's professional military service members. And the zealots of your article are more likely the Arnolds, Mitchells, LeMays, and Doolittles of today.

Aligning existing capabilities will accelerate space capability development and unify the fractured efforts of DOD and other national organizations. We must maximize the limited existing resources and avoid duplicative functions, as stated in the Air Force Proposal for a Space Development Agency and Transi-

tion to a Department of the Space Force document of Sept. 14, 2018, and develop concepts, doctrine, tactics, techniques, and procedures, and organize, train, and equip space forces for global integrated command and control. Big words—if only we are up to the challenge.

Lt. Col. Mike Daetwyler,
USAFR (Ret.)
Colorado Springs, Colo.

Reader to Reader

Wow! Gee Golly Whiz, I didn't realize there were so many sour grapes in orbit! So she didn't like your "position on ... a separate Space Force" and then canceled her AFA membership and took all her space marbles home ["Letters: Blasting Off," March 2019, p. 4]?

I normally don't take the time to comment on a letter you publish (not since the last time anyway). But as a flight line maintainer for eight years and 43 years as a USAF contractor in missile and space systems acquisition technology and threat analysis, I felt I should comment after reading her letter. Perhaps I can offer an alternative reality to some of her points and questions.

First, I submit that "the USAF has got the Space mission" in a larger context than just "personnel management." Every day, 24/7, the military and national space systems must be monitored, updated for the mission (think how to spell GPS), and replaced when necessary. The USAF has clearly "got" this. It requires critical technology and systems development to meet the needs of launch and lifetime requirements. USAF personnel that do this, as performance shows, do an excellent job despite their "mismanagement." They've definitely "got" it!

My response to her questions follow:

1) Should a space officer lead an air wing?: Clearly, no! Despite all the technical knowledge it takes to understand the requirements for space systems, it does not include knowledge, but more importantly experience, of air systems and technology. For example, maneuvering in a gravitational field is obviously different than in an aerodynamic environment.

2) Can a space officer on a promotion board understand what a pilot did?: I would certainly think so. Even so-called "space cadets" are in the Air Force and can understand what fly and fight means.

3) Why do space officers have a two-year rotation after finishing their jobs?: Perhaps as more officers join the space

ranks, this will change. I did witness this, however: After educating young lieutenants into a particular space job, they rotate out of it—that is, they have the opportunity to broaden their experience and become more valuable to the Air Force overall. That's not all bad!

4) Why are the best and brightest sent to NASA and the NRO?: The critical nature of these missions in the former case is success for the big bucks and big publicity programs; in the second, it's big bucks and no publicity for national security. Why would we not want the best in those jobs?

5) Why are many Space officers deployed to OCONUS in non-space jobs?: Sorry, can't comment on this, but I suspect it has something to do with the needs of the Air Force.

6) Why can't space personnel be managed and promoted in their own career fields?: Seriously? If they're not, then they're being promoted in other career fields. That is not my observation in either military or national space programs. It doesn't even make sense.

7) How can the Air Force be trusted after Space and Missile Systems Center moved and then atrophied in Air Force Space Command?: Double seriously? The last time I checked, before retiring there, SMC was doing just fine, even though it's a tough job—putting big bucks into orbit for 10 years or more while maintaining close to top mission performance. Again, look at GPS, for example.

8) More space officers in the Army?: What about the Navy? Why is that a bad thing? I can remember when those services—happy with their INS (inertial navigation system)—didn't want to learn how to spell GPS! I bet they can now, thanks to the decades-long service of the space officers at SMC.

9) Why does the Air Force [only] promote two space officers to brigadier general at each board? Can't comment on that.

10) Why should any space entity fall under the Air Force's purview?: Because the Air Force has "got it" (see above). Also, any other option ("a separate space entity") would require a long learning curve (space is a complicated place) that would affect launch success and mission performance.

I hope I've clarified some of the issues Ms. Insprucker has raised. Sorry, but I guess the [Space] Force will not be with her.

Peter Hansen
Torrance, Calif.

Brave, By Any Definition

I really liked this article on the Son Tay raid ["Into Son Tay," October/November 2018, p. 72]. It gives me insight on how this raid took place. I found out about the raid—like most airmen—after it had happened. I was stationed at Udorn RTAFB, Thailand, when this raid took place. However, he left one thing out—in the intelligence report paragraph, the 11th Tactical Reconnaissance Squadron flew recce missions (RF-4C) on this target as well. It was not a solely SR-71 and Ryan 147S drone job. I am not sure about our sister squadron, the 14th TRS, which flew the RF-4C as well. I don't understand why tac-recce always seems to get swept under the rug for doing their dangerous job. Their Motto of, "Alone, Unarmed, and Unafraid," says it all. I am sure the unafraid part of the motto was a bit exaggerated, but they did their job. That is why—in my eyes—the RF-101C, RF-4C, and RB-57A aircrews were the bravest aircrews of the Vietnam War.

TSgt. Daniel Edwards,
USAF (Ret.)
Custer, S.D.

Yonder Loring

Your recent profile of fighter pilot Charles Loring Jr. ["Namesakes: Loring," December 2018, p. 64] triggered some warm—and also frigid—memories of the 15 months I spent at the base named in his honor.

I arrived at Loring Air Force Base in September 1964, after completing three months of OTS at Lackland, AFB, Texas. Northern Maine's brisk autumn breezes and tall pine trees seemed like paradise after Lackland's grueling summer heat and arid landscape. As a new second lieutenant, I was deputy public information officer for the 42nd Bomb Wing, part of SAC's Eighth Air Force. "You soldier in SAC," a Lackland sergeant told me before I left OTS. He was right.

SAC was a world unto itself, with regulations and pressures a world apart from the regular Air Force. It had "zero tolerance" for errors, whether they occurred in a MITO (minimum interval takeoff) of the wing's B-52s during an alert exercise, or a news release or article in *The Limelight*, our base newspaper (named after the nearest town, Limestone). Our biggest fear was an

ORI (operational readiness inspection), when an IG team hit Loring with no advance notice, checking out every base unit's adherence to SAC standards, including B-52 bombing precision. A pilot told me he'd rather have a war than an ORI. "You don't have to do a remake if you flunk a war," he said.

Your article noted Loring's "remote" location. But the Air Force could not designate it as a remote PCS assignment, because Maine's Sen. Margaret Chase Smith (the only female US senator at that time) declared that "no part of my state is remote." USAF couldn't place a time limit on a Loring assignment, which could last for a few years. I escaped by volunteering for Armed Forces Network, which sent me to the Azores.

Senator Smith was a powerful presence at Loring during my tenure there. She raised hell after learning that our base dining facilities served Idaho potatoes instead of those grown in northern Maine's Aroostook County, where Loring was located. The reason was simple: Idaho potatoes cost less under the Air Force's central food purchasing system. But that didn't satisfy [Senator Smith]. Maine spuds replaced Idaho potatoes on our menu.

Senator Smith's most dramatic impact came during her visit in January 1966, when local weather was freezing. Brig. Gen. Robert J. Dixon, 45th Air Division commander, and his staff prepared for the visit like they were planning an air strike on Russia. No detail was overlooked in their efforts to impress her. Dixon showed her huge piles of coal used to heat the base. "Senator Byrd of West Virginia will be impressed," she said.

Not content to stop while he was ahead, Dixon decided that his guest should eat lunch with a B-52 crew on alert status, ready to wage war at the sound of a klaxon. They ate in the cafeteria of an alert dorm that flight crews called "the mole hole." Smith asked a B-52 pilot how he like being stationed at Loring. "Well, senator, if God ever gave the world an enema, this is where he would shove up the tube," he replied.

"Now, captain, you exaggerate, it's really not that bad," said a shaken Smith. The captain, who was due to voluntarily separate from the Air Force in a month, said: "How would you know,

senator, you're down in Washington most of the time." Dixon turned white, and I did everything I possibly could to keep from laughing.

My time at Loring ended in March 1966 when I transferred to Lajes Air Base in the Azores, as Armed Forces Network detachment commander under USAF. I felt less isolated in the middle of the North Atlantic than I did in northern Maine, partially because Lajes was officially a "remote" PCS, with a 15-month time limit, although I really hated to leave. But I still have warm memories of Loring. The warmest—literally—is of the Air Force parka I was issued there, with my name sewn on it. It stayed with me at Lajes and Stewart AFB, N.Y., where I voluntarily separated in September 1968. But I was forced to turn it in when I left USAF, even though I offered to pay for it. "Sorry, this is Air Force property," I was told. I miss my parka and wish I still had it. But I'll never lose my fond memories of Loring or the other bases where I spent 52 months in the Air Force.

Richard Reif
Flushing, N.Y.

Head in the Clouds

As an "old school" (1983) retired USAF pilot, I found your recent article "The Future of Pilot Training" very interesting [January/February, p. 30]. The only "cloud-based training" I received was making (no kidding) instrument approaches in the frequent clouds and low ceilings around Columbus AFB, Miss.

While the article was informative and reflective of the many changes coming in flight training, I think that Lockheed Martin and Korean Aerospace Industries would be very surprised to learn that Boeing will be delivering their T-50A under the \$9.2B T-X contract that Boeing won last year.

Col. Jim Ratti,
USAF (Ret.)
Middletown, Ohio

Told You So

USAF was warned repeatedly by those of us who knew about the flaws of the Boeing FRANKEN TANKER, as we called it in the pages of *Aviation Week and Space Technology*, that this would happen ["World: Not Quite Perfect," January/February, p. 18].

We strongly opposed USAF buying

the Boeing model over the Airbus 330 variant.

The “Buy America” theme prevented USAF from buying the Airbus airframe, and we got what we got.

Had USAF bought the Airbus 330 tanker it would be fully operational Day One with no DD250 attached, and not two years late—ask the Australian Air Force how they like their tankers.

The only upside to this—if there is one—is that Boeing will eat the cost, but USAF will lose operational readiness while they try to work out the issues, which are many.

The United States needs to realize that we are a great country, and we did put a man on the moon, however, there are some countries that do things better than us, and we need to buy it from them and move on, especially when it comes to our nations defense.

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

John Tirpak indicated that the Air Force has accepted the first KC-46A despite persisting problems with the remote viewing system. “Under certain lighting conditions, and when the sun is at a particular angle, the boom operator’s view of refueling could be impaired,” he reported.

As a program manager for the KC-135 Boom Operator Part Task Trainer in the late 1970s, I met similar challenges with our electro-optical system as Aeronautical Systems Division engineers tried to fulfill a requirement that we simulate a refueling situation in which the sun shined in the boom operator’s eyes. Putting a bright light on the boom operator’s viewing window washed out the images of the refueling aircraft being projected onto the display.

After consultation with Strategic Air Command personnel assigned to the program, it was decided to address this challenge with an operating procedure, rather than a more sophisticated (beyond state-of-the-art at that time) engineering fix.

The operating procedure was modified to include a warning to the effect: “If the sun obscures the visibility of the boom operator during a refueling operation, change the refueling heading by 15 degrees.”

Perhaps this same approach could resolve at least this one particular problem cited with regard to the KC-46A.

Col. Robert J. Sallee,
USAF (Ret.)
Colorado Springs, Colo.

German Beer is Pricey

I really enjoyed the article about the SR-71 save [“Saving a Blackbird,” January/February, p. 43]. While reading the article I saw that Nordholz Air Base is in Denmark. If my memory is correct, and unless there are two Nordholz bases, this air base is located in Germany, on the North Sea coast next to Cuxhaven. I only bring this up because as a young staff sergeant, I was assigned as an F-4D crew chief with the 4th Tactical Fighter Squadron, 388th TFW. In 1977, we deployed to Nordholz for a month, as it was our Crested Cap/Checkered Flag base of assignment in order to fulfill our NATO commitment.

We were billeted in a caserne in downtown Cuxhaven, which also happened to be a German resort town. At that time an American dollar was worth about 1.78 German marks, so the off-duty enjoyment was kind of limited, as a beer cost a little over 3 marks ... just for reference, I enlisted in 1972, and 1977 was the first year I earned enough income to have Social Security withheld ... regardless, it was a wonderful TDY and left me with some great memories. Your article about the SR, and seeing the name Nordholz brought the memories flooding back.

CMSgt. Gary Martin,
USAF (Ret.)
Boiling Springs, Pa.

A wonderful article about the risks of Cold War reconnaissance in such dicey places as the Baltic. I’ve personally flown my share of missions in that area in RB-47H aircraft in the 60s. The MiGs were there all too frequently, one never knowing which way they were going to go, even though we were flying over international waters. We were also aware that there was a Swedish Air Force and were always happy to know when they were around, even though—on occasion—our aircraft saved themselves by escaping over Swedish territory.

Awarding the Swedish pilots the Air Medal made me proud. Long overdue, but it finally happened. As for the article, it would have helped understanding by readers not that familiar with that area to have had a depiction of the routes flown by both the SR and the Viggens. Nordholz, by the way, is an old German Zeppelin base dating from before the beginning of the Great War and has been used by our NATO fliers for years, including my son Charles

who flew his A-10 into that venerable base during a NATO exercise. We, in our RB-47s, like the SRs, recovered in England, if all went well.

Col. Wolfgang W. E. Samuel,
USAF (Ret.)
Fairfax Station, Va.

Loose Lips Could Sink Airships

I am, as usual, enjoying my *Air Force Magazine* (the January/February issue) and have taken more than a passing interest in the article, “Red Air Rising” written by Amy McCullough [p. 24]. Having spent most of my USAF career involved with airspace battle management, my interest was piqued at the thought of adversary air being outsourced. To be effective in a red force role, the contractor pilots must obviously be proficient with USAF air-to-air tactics as well as combined force and, finally, likely adversary tactics.

In-depth knowledge of the strengths and weaknesses of contending weapons systems and the technical performance parameters under a wide variety of environmental regimes is a must for these talented folks. Since some of this in-depth information likely stems from classified sources, it surprised me that no mention was made by the author or any other party quoted in the article about the implications or restrictions related to transfer of technology (TOT) or operations details of “possible intelligence value” when these same contractors are later hired by foreign governments to season their country’s air force pilots.

To my mind, the standard debriefing one receives when leaving US government service would likely be insufficient to prevent revealing in the heat of battle—albeit simulated—that information which should be protected. Code 22 USC 2778 addresses a wide variety of technical and operational information that our government can insist be protected. That said, I believe the subject, specialized red force behavioral knowledge, lies in an area that will fall between the cracks of such legislation with all our pertinent watchdogs believing that the matter lies outside their purview.

Capt. John Facey,
USAF (Ret.)
San Antonio

Powers Restored

First off, thank you for writing (and publishing) such a good and accurate

article about my dad, the U-2 incident, the fall out upon his return home, and the initial restoration of his reputation ["U-2 Down," January/February, p. 56].

However, the story does not stop with the 1998 CIA USAF declassification conference, which is actually the start of dad's reputation being fully restored and him being posthumously awarded the POW Medal, DFC, and CIA's Director's Medal for extreme fidelity and courage in the line of duty in May 2000, and the USAF Silver Star in June 2012.

My new book, *Spy Pilot*, released in January, fills in the gaps and outlines my 25 years of research into the U-2 incident.

Francis Gary Powers Jr.
Midlothian, Va.

I would like to make a slight correction to the article's statement that the CIA pilots went overseas in two groups. There were actually three groups designated Detachment A, B, and C. Det. A went to Wiesbaden AB, Germany, Det. B—which included Powers—went to Incirlik AB, Turkey,

and Det. C was deployed to Atsugi NAS in Tokyo, Japan. Det. C included my father, Albert J. Rand, who on June 8, 1957, piloted a U-2 overflight of the Kamchatka peninsula originating from Eielson AFB, Alaska. That made it a milestone as it was the first overflight for Det. C and the first overflight originating from US soil. Frank Powers and my father remained lifelong friends and are in fact interred next to each other in Arlington National Cemetery.

Lt. Col. David Rand,
USAF (Ret.)
Henderson, Nev.

As a HQ SAC ICBM Requirements staff officer from 1986-88, and later a Peacekeeper combat crew member, I read with interest John T. Correll's article on the MX/Peacekeeper program in the March issue ["Peacekeeper by Fits and Starts," p. 55]. Unfortunately, there were a couple of factual errors that bear correcting. First, when Rail Garrison was canceled, the missiles intended for that program were never installed in Minuteman silos. Second, when Peacekeeper was deactivated,

they were not replaced in the silos by Minuteman III missiles. Although two Minuteman squadrons at the 90th Missile Wing at F. E. Warren AFB, Wyo., were slated to be modified for Peacekeeper use, only one, the 400th Strategic Missile Squadron, was ever used. Following deactivation, the former Peacekeeper facilities were placed into caretaker status.

Lt. Col. Dennis Lyon,
USAF (Ret.)
Layton, Utah

Corrections:

In the April issue, Lt. Gen. (Ret.) Bruce "Orville" Wright's rank was incorrect. Also in April, Maj. Gilberto S. Perez's occupation should have read Commander, 505th Communications Squadron, Hurlburt Field, Fla., and Paul Hendricks III's military service was 1970-1990. All have been corrected in the online version of the magazine.

Armed and Tested

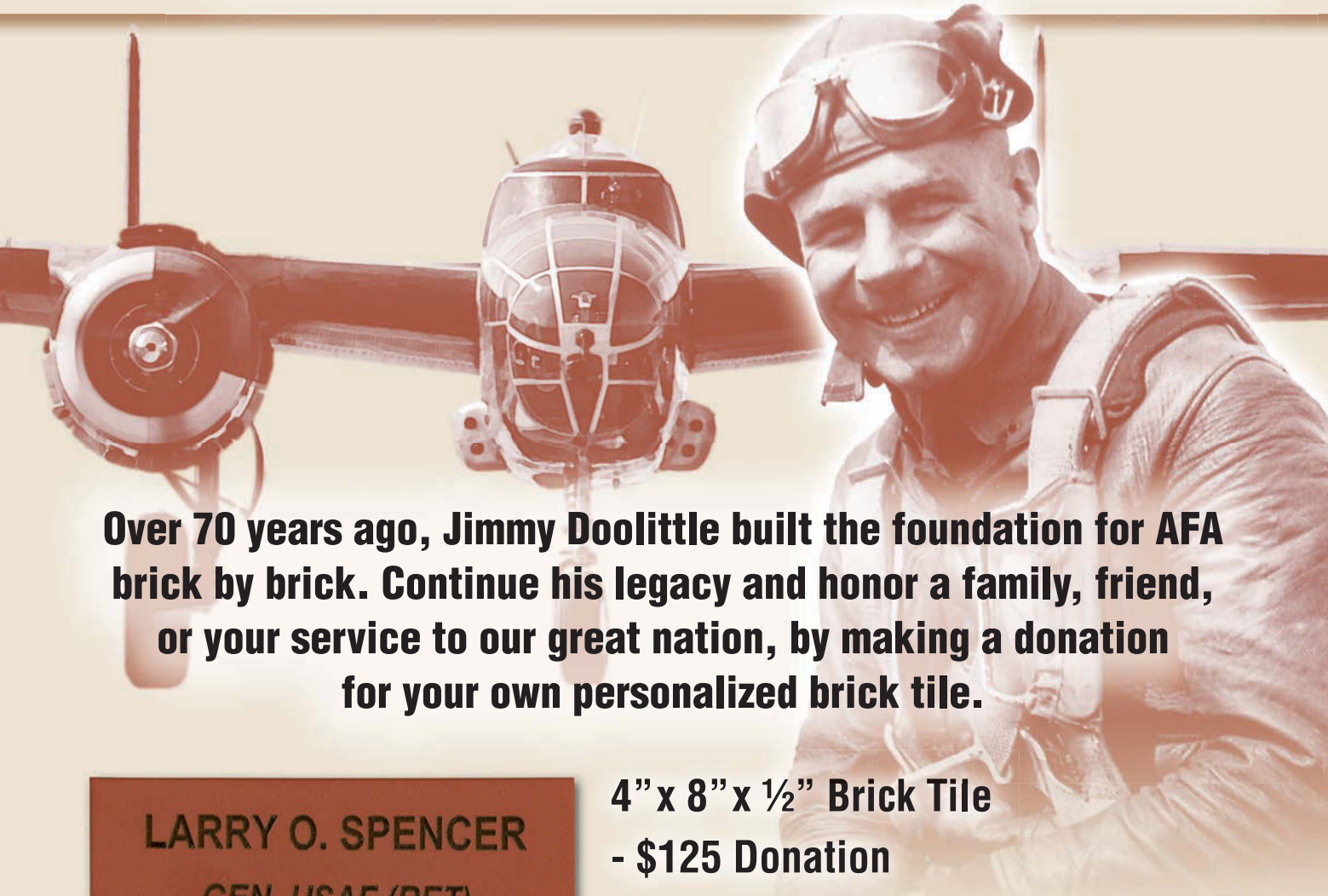
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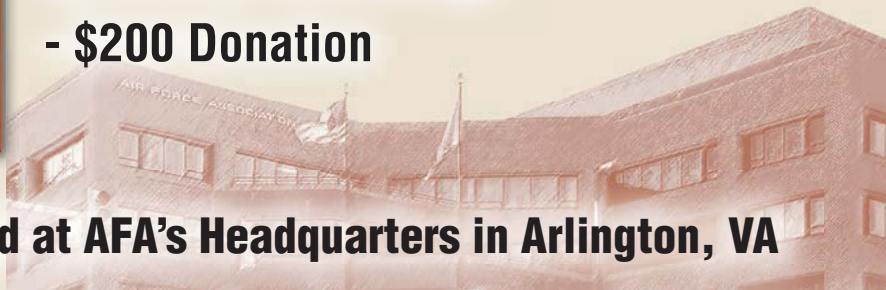
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A C-130J Super Hercules from the 36th Airlift Squadron at Yokota AB, Japan, passes Mount Fuji after airdropping a bundle at the Combined Arms Training Center, Camp Fuji, Japan. Yokota completed its transition to the new J models last year. Those planes can carry up to 2,000 more pounds and fly more than 700 miles farther than the H models they replaced.



Touch your elbows to your knees? Easy. Do it while hanging from a pull-up bar 50 times? That's something else entirely. Airmen at Kirtland AFB, N.M., didn't stop there. Competing in the Maltz Challenge—a timed, team competition—they set out to complete a 400-meter run, 50 pull-ups, a 100-yard fireman's carry, 50 dips, 100 push-ups, 100 sit-ups, those 50 elbows-to-knees, and then another 400-meter run. Call it airpower of another sort.

Two dozen F-22 Raptors from the 3rd Wing and 477th Fighter Group lead a C-17 Globemaster III and an E-3 Sentry to conduct the largest-ever elephant walk at JB Elmendorf-Richardson, Alaska, during a Polar Force exercise. The 24 Raptors, which lined up loaded with external fuel tanks for extended range, represent about 13 percent of the F-22 inventory.



Wolters on Europe

Gen. Tod D. Wolters, commander of US Air Forces in Europe-Air Forces Africa, sat down for an interview with Air Force Magazine Editor in Chief Tobias Naegele and Pentagon Editor Brian W. Everstine at the Air Force Association's Air Warfare Symposium in Orlando, Fla. Two weeks later, President Donald J. Trump nominated Wolters to be the next commander of US European Command. Wolters discussed his priorities for the region, how US forces need to exercise, and where the US needs to improve its posture.

Q: You've got a full list of exercises and deployments lined up this year. What are your priorities?

A: No. 1, we want to make sure that we continue to improve our posture from a readiness perspective. We want to make sure that we look at all of our activities and ensure that they're aligned with improving indications and warnings, improving command and control [and] feedback, and improving our mission command. Those are the items that make us a more ready force, so our lethality is better, our resiliency is better, our responsiveness is better. If we continue to make gains in all of those areas, we'll be in a position where we will get better.

What's a little bit different about the exercises that are coming up is the setting of most of our exercises—from an air component perspective, and from a joint perspective, and from a coalition perspective. Instead of all the exercises we've embraced in the past, focusing on about Day 150 to Day 180 of a confrontation where you're at Phase Three [of a] mass-on-mass confrontation, we're trying to take some of these exercises and change the setting to about Day 10, where you're actually starting a conflict and you're melding in all of those components in all the domains to achieve the appropriate effect and build early momentum in the campaign to breed success. When you have exercises that focus on the start of a confrontation, what you also test is your ability to bring logistics to bear quicker and faster. As you know, that's a challenge for all of us. I've yet to meet a commander that will look you in the eye and tell you that, "I'm really happy with how fast everything shows up." If it gets here in one hour, you look at somebody and say, "Tomorrow I want to get here in 55 minutes." And the next day you'll say, "I want it here in 30 minutes." So that's the focus, that's what we're thinking about from an air component perspective as we step into the summer of '19.

Q: You have said your posture is not perfect in Europe, but you'll be effective with what you have. How can you go about meeting those shortfalls?

A: Without getting into current ops, or specificities on systems that are coming into the theater, you always want to shoot faster, you always want to shoot more accurately, and you always want to shoot longer. So, you want to be able to put more targets at risk across the potential battle space, wherever that battle space may be. With the current posture, we're probably not as fast or as deep as any commander would prefer, and to be more effective you would like to be able, for example, to deliver fires



Photo: Mike Tsukamoto/staff

Gen. Tod Wolters, commander of USAFE, is President Donald Trump's nominee to head US European Command.

from all domains. Not just from the air, but from the maritime, from SOF, from space, from cyber, and certainly from land. As we look into the future about the potential of each one of those domains possessing the capability to deliver fires, we want to make sure that from an alignment perspective, and a deconfliction perspective, and a coordination perspective, the effect that we want to get in the battle space is exactly the one that we will get as a result of meshing all of those domains together ... on a potential target. If you do that ... you create tremendous challenges with a potential foe, because they have to defend, not just against what may come at [them] from the air, but also what may come at [them] from the land and from the maritime. In those areas, we want to make sure that we take a good look at what each one of the components are doing. What I'm doing in the air domain, what [US Army Europe Command Commander Lt. Gen. Christopher G. Cavoli] is doing in the ground domain, for example, and ensure that we have fine-tuned the effect that both of us can deliver for a given problem set and a potential battle space location, to make sure that we've got the right fire at the right time coming from the right domain. Those are areas ... none of us are satisfied with at this time. [US European Commander Gen. Curtis M. Scaparrotti] has worked very, very hard to improve our posture, to make sure that we can improve in that area. Over the course of the last two years, we've improved significantly in delivering multi-domain effects to include the fact that at his US EUCOM headquarters, he has a Joint Effects Group that actually focuses on that very challenge.

Q: So that's at the four-star level. How do you push that authority down? How do you achieve that kind of coordinated multi-domain effect further down the chain?

A: This goes back to the campaign design. You have the best indications and warnings possible, you have the best command

and control/feedback possible, and you have the best mission command possible. Mission command is a strategic term that applies to mission-type orders the tactical-level warrior at the tip of the spear is making about what effect that he or she wants to deliver to the battle space.

If your command and control/feedback mechanism is what it should be, once that decision is made, and once that tactical-level warrior has made the decision to deliver that effect in the battle space, there has to be enough sensitivity and fidelity in that command and control/feedback architecture to get that information back to the commander as quickly as you can get it, so the commander can determine the effect in the battle space and determine right versus wrong, and make corrections on the spot. ...

Militaries are great when you, as a commander, are able to gauge how far you can let a tactical-level warrior go and be in a position to where he or she can execute the clear guidance given by the commander. ... If the commander's guidance and intent is fuzzy, the tactical-level operator will be confused and concerned at the tip of the spear and you start to get into problem areas. Luckily, in our 21st century US Department of Defense military, I believe our commanders are doing as [well] as we ever have—certainly during the time that I've been in the United States Air Force—at giving crystal clear direction and guidance about commander's intent and what the objective is in the battle space. From that, we produce numerous documents that give the tactical-level warrior clear guidance on what he or she can and can't do. We're pleased to report that with the training that we have and the capability of our floor-level operators, they're making good decisions. They're executing the commander's direction and guidance and the commander's intent.

Q: And they feel confident that they can do that without being second-guessed?

A: They do. And it starts with this incredible word called trust, and how you train, and how you build trust, and how you build confidence. We're seeing that the 21st century commanders—in all of our services—*get it* when it comes to trust and *really get it* when it comes to empowerment. Part of that trust is, when you're training and when you're exercising, and a tactical-level warrior does something and you don't think it's right, you have an after action review section and there's candid feedback on what took place, so we can make the corrections—get it fixed so if you have to do it in real-world conflict, you'll be in a position to execute better.

Q: The Air Force recently stood up an MQ-9 detachment in Poland. The MQ-9s to date have mostly operated in a more permissive environment. What is the importance of having those assets in this region? What is the mission going to be?

A: Obviously, intelligence, surveillance, and reconnaissance as it builds upon better indications and warnings. So, with an MQ-9 asset in that region, as you can well imagine, given the distances that it flies and the locale that it happens to be in, we should be able to improve our understanding of the battle space in the vicinity of Poland, plus the Baltics. That's the whole purpose: Improve our indications and warnings so that, if tasked, we can respond quicker than we ever have in the past. The MQ-9 addition will do exactly that.

Q: When you talk to your allies in the region, what sort of help or assistance do they want from the U.S. Air Force?

A: Generally, things that we can do to contribute to indications and warnings, command and control, and feedback, as well as

the ability to neutralize a potential enemy. That's something that the nations ask from the United States; it's something that the nations ask from all of the other countries. I would tell you that, of the 29 nations that exist in NATO, they're always interested in anything that the US can contribute to improve indications and warnings and command and control and feedback. And they're certainly not opposed to anything that any other nation can contribute to improve their ability to neutralize a potential foe.

Q: There has been increased funding for the European Deterrence Initiative in recent years. What is the focus of the EDI in the near future?

A: There's infrastructure improvements for the sake of improving readiness. There are contributions in the European Deterrence Initiative for the sake of improving our ability to exercise and train. The pot of money that was doled out last year—we believe that this year it'll be about the same size—which is very good for all the services. So if you could imagine yourself in General Scaparrotti's shoes, he's got to make gains in infrastructure to improve posture so that we can close on the potential foe quicker. Obviously, we have to make gains with respect to the readiness of all the soldiers, sailors, airmen, and Marines. That typically occurs through a really robust training and exercise plan that focuses on the right area of a conflict and has the right balance with respect to the contributions from all the domains, and the EDI is providing just that. So we're very pleased.

Q: Can you talk about any specific ongoing projects?

A: I'll just give you one that's a great example: Amari in Estonia. With each passing day, we see improvements on the ramp, so there's better ability to store fire aircraft if they want to come pay a visit. There's better ability to receive a C-130 and offload pallets, and we're also seeing improvement in the ATC, the air-traffic control area. The tower is new, and with each passing day, the air traffic controllers are figuring out how to use the radios, figuring out where to surveil, who is coming in and out of the airspace. With each passing day, when you have an operator who visits Amari, Estonia, they walk away better trained because the environment that they're working in is more ready with its ability to receive goods, and with its ability to receive forces to promote indications and warnings, and command and control.

Q: What are your challenges, especially as you push East?

A: The biggest challenge is having the posture that you feel comfortable with, with respect to closing in on a potential foe. We want to get the posture to the point to where we're in [a] position ... where nobody will ever consider violating the sovereign skies, lands, or seas of the NATO nations that are in that region.

Q: You talk about improving posture. Estonia is a good example in improving the facilities on the ground so you can receive aircraft and control aircraft and see what's going on. Can you describe others?

A: For example, we just talked about an MQ-9 that's located in Poland that improves indications and warnings. That MQ-9 is going to be in a position to where the area that it will most likely start flying in is in the vicinity of the Baltics. That's an improvement in readiness right there, because we have better indications and warnings, [and] because we'll have more eyes on the battle space ... or potential battle space. ☐

By John A. Tirpak

Growing Skunk Works, Without Losing the Skunk Works Culture



Photo: David Henry

Jeff Babione, head of Lockheed Martin's Advanced Development Programs—the Skunk Works—speaks to company employees at a town hall meeting. Babione wants to grow the unit, but do so without hindering its light and lean culture.

The head of Lockheed Martin's Skunk Works wants to make his light and lean outfit bigger to better position it to tackle fast-turn, high-tech weapons development. The trick will be growing without slowing.

Skunk Works used to be larger and "perhaps, got too small" over the past two decades, said Jeff Babione, vice president and general manager of Advanced Development Programs (Skunk Works' official name). "My vision ... is to grow it significantly. I think there is an opportunity to grow without getting too big."

The government wants to accelerate weapons development, and Skunk Works wants to get involved in more projects.

"Skunk Works is really [an]...engine of new development. Once we get it to a certain stage, we want someone else" to develop and field the system, Babione said.

Growth comes with risks, Babione admits. Skunk Works' success is a product of its culture—where programs are small,

requirements simple, reporting chains short, and trust high. Babione has to find a way to increase the number of "Skunks" while preserving that culture. To do it, he's setting up a "Skunk Works Academy" to inculcate new hires with the Skunk Works approach. The goal: "Immerse' them in that culture."

The Pentagon has said it wants a "Skunk Works-like" approach to launching programs and propelling them toward revolutionary, usable products. "It's easy to say you will do it like Skunk Works," Babione said. "If it were that easy, everybody would do this."

Take hypersonics, for example. Lockheed has numerous hypersonics projects underway. To avoid blind alleys and reinventing the wheel, the company recently won permission to share insights across its divisions.

"We've been very fortunate that our customer has trusted us with all these hypersonics projects," he said. Aeronautics is working on Tactical Boost Glide (TBG) and the Hypersonic Air-breathing

Weapon Concept (HAWC); its Missiles and Fire Control division has the lead on the Hypersonic Conventional Strike Weapon (HCSW); the Space division is leading the Intermediate Range Conventional Prompt Strike (CPS) project; and Missiles and Fire Control, with support from Aeronautics, is working on the Air-launched Rapid Response Weapon (ARRW).

With so many secret projects going, there's a risk that work gets over-compartmentalized to the point where the company's left hand doesn't know what its right hand is doing. By allowing cross-pollination, however, Babione said the government is ensuring that technological red herrings are avoided and company units aren't duplicating effort unnecessarily.

"The expectation is, by giving us those programs, you're actually going to benefit greater than if they had been spread across other companies," he explained.

Lockheed has established a steering committee for hypersonics. The committee ensures "we share staff, we share lessons learned, we can move technology across where the security lines will allow us," and that projects can share hardware and vehicles. "We do everything we can to ensure that we learn as rapidly as possible," Babione said. "We're doing, I think, a pretty good job of sharing experiences near-real time."

Meanwhile, the Pentagon has hypersonic programs underway with other contractors.

"I fully expect, that as we succeed in certain areas, that you'll start to see some more alignment, both from a technology and funding standpoint," Babione said. Competition is healthy—"sometimes you run faster when you know somebody's chasing you," he said. "And we recognize that we have to perform."

Yet, he's confident Lockheed will lead the field. "We've assembled the best team in the world to bring this capability. If we can't do this, nobody can."

THE ACHILLES' HEEL?

One thing that could hold back progress, however, is the test infrastructure needed to let the research fully take off.

"If there's an area where I think we're challenged, from a resource standpoint, it's around hypersonic test facilities," Babione said. The nation's high-speed wind tunnels "have not been kept up," he added. "They're fragile." It's not uncommon to find facilities can't be used for lack of maintenance.

"Right now, we're on the ragged edge of having enough test capacity," Babione said. "We need, as a nation ... to invest in a much greater, more modern infrastructure to do this testing."

Such wind tunnels are too big and expensive to expect industry to build them, Babione said. They must be seen as "national assets."

ON TO 6TH GEN

Skunk Works drove the development of stealth aircraft and the X-35, the concept demonstrator that would eventually lead to the F-35 fighter.

Now Skunk Works is working on future improvements to that aircraft, even as it frames some of the debate about what next generation air dominance might look like.

In five or 10 years, "the threat's going to move," Babione said. By then the F-35 may require "a new optical targeting system," he added. "You need something to defeat an infrared threat. You need to hide your infrared signature."

One recent F-35 improvement out of the Skunk Works: the automated ground collision avoidance system (Auto-GCAS), which in early April won the National Aviation Association's Collier Trophy for the "greatest achievement in aeronautics or astronautics."

"We did that ... in a very Skunk Works fashion," he said, racing from development to testing "in six or eight months."

He declined to discuss further F-35 improvements except to say that, "we know there's a future gap, and so we're designing technologies that cover that future gap, to be sure that it's never a fair fight. We always want to win overwhelmingly."

What might a sixth generation air dominance system look like?

Babione said that while the current government preference is for "optionally manned" aeronautic systems, the weight of environmental and escape systems might be better used for fuel or payload.

"I think when people get more comfortable with 'optionally manned,' you'll see them get more comfortable with 'unmanned,'" he predicted. While there are still "good reasons" to put people in combat aircraft, he added, "in some of these cases, it's getting pretty dangerous."

Some of the revolutions will be in "pilot-vehicle interface. ... What envelope we fly in; the altitudes, the integrated sensors and avionics," Babione said. Another feature will be "integrated apertures ... getting away from just a radar" or electronic warfare and having broadband sensing "virtually across the spectrum ... and doing it in a way that it's very difficult to detect."

He said "our customer has leaned forward in ensuring we are working best technologies to solve their toughest problems."

STEALTH TANKERS AND NEW BUSINESS

What else is Skunk Works working on?

"We've spent the last 20 to 25 years operationalizing LO into our 5th generation platforms," Babione said, referring to low-observable, or stealth technology.

Now the threat is changing. Advanced air defense systems, are "pushing our tanker fleet farther and farther from the fight," he said. The result: "We have this discontinuity, where the aircraft can't make the trip from the tanker to the target."


LO technology could "get the fuel closer" with "some form of advanced tanking." What that looks like is the question. Is that "distributed tanking?" Babione asks. "Unmanned assets? How do you hide the fuel" or get it closer to the fight "so that now you have this ability for your combat aircraft to refuel before they go in, and go back out, and then go back in?"

He predicted a "dance around the edge of denied airspace," driving "an obvious need for some form of survivable—or more survivable—tanking."

Skunk Works is also focused on the Advanced Battle Management System (ABMS), the successor to the JSTARS program, Babione said.

"It's really about connecting existing platforms and then aggregating that information to make a decision," he said, suggesting that experience with autonomous systems may help solve this challenge.

Automation is critical because the volume of information keeps rising, and human ability to process incoming data is finite. Relying on human decision-making may prove to be a choke point in future battles, Babione said. The future of multi-domain operations will be "how do I get that data, turn it into information," and produce courses of action more quickly. Automation will enable swarms of unmanned aircraft to be able to coordinate attacks on enemies, he said, so that the aircraft are "acting as one, instead of independently."

"Now you really start to see an opportunity to have multi-domain command and control using manned/unmanned teaming, artificial intelligence, neural network connections—all those things that allow things to act together," Babione said. "We're not that far out from being able to connect all these things and start automating some of these decisions." 

Questions Remain as Lawmakers Mull Space Force Proposal



A SpaceX Falcon 9 rocket carries an Iridium satellite into orbit from Vandenberg AFB, Calif., in January.

Photo: Sr.A. Clayton Wear

By Rachel S. Cohen

Some lawmakers on Capitol Hill are confident an agreement on how to create a Space Force is within reach, although the path forward remains murky.

In the nearly two years since Alabama Republican Rep. Mike Rogers and Tennessee Democrat Rep. Jim Cooper rolled out a Space Corps proposal, the idea has picked up steam, thanks to continued congressional debate, President Donald J. Trump's support, and the Pentagon's formal Space Force proposal.

That plan calls for a separate Space Force within the Department of the Air Force. The new organization would encompass Army, Navy, and Air Force space groups, instead of limiting changes to Air Force Space Command as the initial Space Corps proposal asked.

"If we have legislation passed this year by the Congress, within 90 days we would stand up a space staff in the Pentagon with 200 people," Air Force Secretary Heather Wilson said.

But right now, it's unclear what legislation Capitol Hill may consider to organize, train, and equip space warfighters.

The Pentagon submitted draft bill text to lawmakers in February as part of its formal Space Force proposal, drawing mixed reviews.

Cooper, who chairs the House Armed Services strategic forces subcommittee, recently called the Defense Department's version "about as close to our original House proposal as you

can get." It is more modest than Trump's "over-the-top" idea for a new military department, he said. Trump has supported the idea of a Space Force within the Department of the Air Force, though he's also made it clear he'd eventually like to see the service become its own department.

"You can quibble about this element of the bureaucracy or that, but the key principles, I think, are there," Cooper said March 20 at the Center for Strategic and International Studies. "We've got to have an unrivaled space capability, and I think we're on track to make that happen."

He told reporters later that day there's a "greater chance for Senate acceptance than we've ever had before." The case for a Space Force is "overwhelmingly strong, he said, and "we're going to win."

But HASC Chairman Rep. Adam Smith (D-Wash.) later criticized the plan for creating too much bureaucracy and vowed to explore other legislative options.

"It seeks to create a top-heavy bureaucracy with two new four-star generals and a new undersecretary of the Air Force to oversee a force of approximately 16,000 people," Smith said in a press release. "It requests an almost unlimited seven-year personnel and funding transfer authority that seeks to waive a wide range of existing laws—all without a detailed plan or analysis of the potential end state or cost."

Politico reported that Rep. Rick Larsen (D-Wash.) expects the HASC will revive its first Space Corps proposal instead. A



Photo: Wayne Clark/USAF

Air Force Secretary Heather Wilson testifies during a House Armed Services Committee hearing in April. Wilson told Congress that USAF could set up a space staff in the Pentagon within 90 days of receiving legislative approval.

spokeswoman for Smith declined to comment on the possibility of bringing back old legislation and told *Air Force Magazine* it's premature to discuss details.

While Larsen suggested Trump's support for a Space Force has made it politically difficult for Democrats to move forward, Cooper argues his stake in the matter could help bring bullish senators on board.

Rep. Mike Turner (R-Ohio), ranking member on HASC's strategic forces subcommittee, believes lawmakers could find common ground somewhere in between.

"The original proposal had [too few] details and this one has so many constraints and additional resources concerns that somewhere in the middle is obviously where we're going to have to land," Turner said in an interview with *Air Force Magazine*, without identifying possible must-have or red-line issues.

Growing the Pentagon's already-behemoth bureaucracy is a sticking point on both sides of the aisle, in both chambers of Congress. But it may also be an area lawmakers could smooth out.

Senate Democratic Whip Dick Durbin (Ill.) invoked the late Arizona Republican Sen. John McCain when asking Air Force leaders whether a potentially "uncontrollable" bureaucracy is in America's best interest.

"[McCain] basically pushed back against the creation of brass and bureaucracy, saying, 'Let's put an end to the capabilities and readiness of the people who are serving our nation already,'" Durbin said at a March 13 Senate Appropriations defense subcommittee hearing. "I don't want to rain on this Space Force parade, but I do think we ought to have a cold day of reckoning here, in terms of whether this is something which we will come to regret."

Todd Harrison, a defense budget analyst at CSIS, said one area Congress could tweak is how much discretion the Space Force proposal allows the Defense Secretary to determine which DOD groups will transfer in and when in the next five years they will do so.

Another frequent concern is the long-term price tag. The Pentagon argues growing the Space Force over the next five years will cost \$2 billion, including \$72 million in fiscal 2020, and about \$500 million each year once the organization is fully established. That amounts to "dust" in the overall Pentagon

budget at a time when the US needs to dominate in space, protect those assets, and improve acquisition, Cooper argued.

While Cooper believes the government is "well within the ballpark of reasonable compromise" on the cost, Turner asserts the price "seems relatively high."

"Where are costs being created as a result of duplication and where are they giving us increased capabilities and functions?" Turner said. "I'm not eager to cut a \$2 billion check just to create a separate Corps to do what we're already doing."

At a Senate Armed Services strategic forces subcommittee hearing, Sen. Angus King (I-Maine) requested that Kenneth Rapuano, the assistant defense secretary for homeland defense and global security, submit a short memo justifying the change and outlining its "tangible benefits."

"Are you coming before us, saying, we can't manage this now and we need to spend half a billion dollars a year?" King asked. "Convince me that this makes some sense."

Lt. Gen. David D. Thompson, vice commander of Air Force Space Command, tried to reassure King the new force would help unify space capabilities spread across the department.

"I would also look at it as not just [as], 'are we trying to fix a problem?'" Thompson said. "It's a question of, is the nation prepared, and are we organized to accept and take on the challenge that comes with space as a warfighting domain?"

Others—including the Air Force Secretary—have questioned how to avoid duplicating efforts, particularly when looking at how the new Space Development Agency could cut into the Air Force and Defense Advanced Research Projects Agency's work.

Cooper believes those disputes simply amount to turf wars. "Let's get it going here," he said. "The person who most recently said the SDA is irrelevant or redundant will soon be leaving. I think that will clear a path for more positive thinking."

Turner dismissed the notion that Wilson's impending return to academia raises any red flags about where DOD's space reorganization is headed. Wilson resigned, effective May 31, to become the president of the University of Texas at El Paso after two years as the service's civilian leader.

"She's a very good friend of mine, and she said that she had a very important professional opportunity that she wanted to pursue, and I believe her," he said. ✪

Meet the Future Unmanned Force



Photo: AFRL

Air Force Research Laboratory's Skyborg drones will push artificial intelligence research.

By Rachel S. Cohen

Two new autonomous aircraft concepts that promise to redefine the Air Force's unmanned fleet are moving forward.

The first is Kratos Defense & Security Solutions' XQ-58A Valkyrie, an experimental "wingman" aircraft that would fly alongside manned combat jets. The second, still on the drawing board, is Skyborg, an autonomous drone prototyping program launched in October at the Air Force Research Laboratory. The goal: Create a low-cost, easily replaceable, combat-ready system by the end of 2023.

Will Roper, assistant secretary of the Air Force for acquisition, technology, and logistics revealed the program in March, saying the new aircraft must be able to take off and land autonomously, fly in bad weather, and avoid other aircraft, terrain, and obstacles. The "modular, fighter-like aircraft" serves as a springboard for more complex artificial intelligence work, according to a March 15 request for information.

"Skyborg is a vessel for AI technologies that could range from rather simple algorithms to fly the aircraft and control them in airspace, to the introduction of more complicated levels of AI to accomplish certain tasks or subtasks of the mission," Matt Duquette, an engineer in AFRL's aerospace systems branch, said in a press release last month.

An experimentation campaign for autonomous airborne systems is in the works for fiscal 2019 and 2020, the RFI said. The Air Force did not offer more details about the campaign by press time, nor did it answer whether Skyborg is related to another AFRL endeavor launched last year that sought to develop an autonomous fighter jet by the end of 2019.

A similar program, Kratos' XQ-58A Valkyrie, completed its first flight test March 5. The 30-foot-long, experimental "wingman" aircraft will fly five tests in six months to vet system functionality, aerodynamics, and launch and recovery systems, according to the Air Force.

Valkyrie is designed for long-range strike and intelligence, surveillance, and reconnaissance missions. It performed as expected during its 76 minutes airborne at the Army's Yuma Proving Ground.

"There are no specific restrictions for what it can or cannot pair with," a company spokeswoman told *Air Force Magazine*

last month. "The flight performance envelope matches the high subsonic and high G capability of fighter aircraft."

Kratos plans to sell the drone in bulk for about \$2 million per copy when bought in quantities of more than 100. Three aircraft will be complete this year. They declined to comment on future development spirals and production.

About two decades ago, the MQ-1 Predator changed modern warfare by allowing the military to hunt its targets from afar, prompting a slew of operational, legal, and cultural questions. Now the Air Force wants to push the envelope again.

New uninhabited aircraft ideas—whether low-cost, attritable wingmen, swarms, or stealthy designs that fly alone—are gaining traction in the era of great power competition. While Air Force drones have largely been used for air strikes and intelligence gathering in the past two decades of counterterrorism, new technologies are opening up possibilities for a more diverse, unmanned fleet that builds on missions flown today by the MQ-9 Reaper, RQ-4 Global Hawk, and classified UAVs.

"It looks like a very positive shift by the Air Force toward embracing the technology," Paul Scharre, director of the Center for a New American Security's technology and national security program, told *Air Force Magazine*. "The Air Force has been there on paper for a while, dating all the way back to the 2009 Air Force UAS flight plan. ... It hasn't necessarily really had the follow-through on this technology in the budget."

Scharre, a former staffer in the Office of the Secretary of Defense and Army Ranger, believes aircraft like the Valkyrie are the future of American airpower.

"We're basically looking for an Air Force that will have three versions of combat aircraft ... F-35, F-22, and B-21," he said. But "diversity is really helpful to complicate things for the adversary."

Cheaper, attritable aircraft can help as the service tries to limit its number of procurement programs and drive down production costs, he continued.

Retired Lt. Gen. David A. Deptula, head of AFA's Mitchell Institute for Aerospace Studies, argues Skyborg and Valkyrie wouldn't step on the toes of existing unmanned assets.

"They have the potential for dramatically changing the game in the conduct of air operations," he said. "They can bring ...

more force inventory at a fraction of the cost of inhabited aircraft, while facilitating the employment of dramatically increased weapons employment capability over a much shorter timeline than required with conventional aircraft.”

Nor does he expect this will mark an era when human pilots always get an unmanned sidekick.

“The spectrum of air operations spans from disaster assistance/humanitarian relief to global thermonuclear war—there are many missions across that spectrum of operations that will require manned aircraft without ‘uninhabited loyal wingman’ flying with them,” said Deptula, a former Air Force deputy chief of staff for ISR. “That said, there will be a large portion of combat air operations” that will need drones, he noted.

These platforms are meant to help, not replace, the human brain, Scharre added. They can be flown closer to enemy air defenses and sent out on longer missions than legacy manned platforms. Drones could also play a new role as decoy, electronic-warfare, and kinetic strike missions.

“We’re likely to move over time toward a world where you see the human-inhabited aircraft play a sort of quarterback role where they’re managing the fight, but out at the edge, you actually have a diverse mix of uninhabited aircraft of various shapes and sizes,” Scharre said. “Some of them will be low-cost, attritable ones. Some of them will be more capable stealth aircraft that are probably fairly expensive, and there’s probably a role for them as well to do things like long-endurance surveillance or time-critical strike.”

He expects unmanned aircraft missions will shift to encompass more than primarily surveillance. Modularity would allow them to carry a wide range of sensors and weapons for different combat environments and to be deployed in unique combinations with other platforms.

It’s too early to speculate on what the right mix of unmanned aircraft might be as these platforms mature.

“It will probably take a generation, but the balance of human-inhabited and uninhabited aircraft in the Air Force should shift over time,” Scharre said. He expects that ratio could reach 20 unmanned aircraft to every one manned aircraft. For instance, each F-35 could have dozens of autonomous partners to make it more capable in battle.

“I love leather jackets and fighter pilots, but that’s not the future,” said Rep. Jim Cooper (D-Tenn.), the House Armed Services strategic forces subcommittee chairman. “Unmanned aircraft, as we’ve seen with drones, are increasingly important in the world.”

Deptula argues the service already embraces manned and unmanned forces as equals and hopes the service simply picks the right system for a mission, regardless of pilot or domain.

Scharre said there’s more work to be done. Over time, uninhabited aircraft may become the default as operators grow to trust them, as command and control technology improves, and as bureaucratic and cultural hurdles fall.



The XQ-58A Valkyrie demonstrator completed its inaugural flight March 5 at Yuma Proving Ground, Ariz.

Photo: SrA. Joshua Hoskins

“I don’t know that they’re quite there yet,” he countered. “I think it’s where they need to get to over time. I think when you look at the bulk of the expenditures ... the Air Force is still oriented toward short-range, tactical fighter aircraft. They haven’t even really made the pivot toward longer-range, persistent surveillance and strike aircraft.” ❖

For USAF Bases, Hard Choices Follow Storms

By Rachel S. Cohen

Recovering Tyndall AFB, Fla., and Offutt AFB, Neb., will require \$1.2 billion in fiscal 2019 and \$3.7 billion across 2020 and 2021, and lawmakers were still searching for a solution at press time.

Without supplemental funding, Air Force Secretary Heather Wilson warned, USAF will have to move funds from projects at other bases.

Wilson has already pulled more than \$250 million from 61 projects at 33 installations in 18 states to pay for rebuilding efforts at hurricane- and tornado-ravaged Tyndall. Those suspended projects include runway and roof repairs, dormitory renovations, laboratory demolition, and heating, ventilation, and air-conditioning system updates, according to a list provided by the Air Force.

The base needs about \$1 billion by the end of September for operations and maintenance projects, as well as to plan its next steps. In the absence of additional funds, more cuts could come each month.

“The Air Force will make funding decisions based on the resources we receive,” service spokeswoman Ann Stefanek said April 1.

Without additional money, the Air Force predicted it would stop all new recovery work at Tyndall on May 1 and pause aircraft repairs across the service on May 15. Recovery at Offutt, “with the exception of immediate health and safety needs,” would be stymied as of July 1, and 18,000 flight training hours across the service would be cut starting Sept. 1.

Offutt was still partially underwater in early April after severe storms caused flooding. The Air Force said it immediately needs \$350 million in 2019 for facilities sustainment, restoration, and modernization.

Offutt’s needs are yet to be fully determined.

Although topline numbers differed between the House and Senate, the main spending package under consideration on Capitol Hill earlier this year included \$400 million for Air Force operations and maintenance. Another \$700 million for military construction could be used for recovery efforts until Sept. 30, 2023.

However, the service wouldn’t be able to tap into the funds until it sends House and Senate appropriators a “basing plan and future mission requirements for installations significantly damaged by Hurricane Michael.” A “detailed expenditure plan” for the money would be due within 60 days of the bill’s enactment.

“I don’t think most of the members of Congress recognize the damage that’s going to be done to the Air Force and our military readiness, much less the public,” Rep. Austin Scott (R-Ga.) said April 2. “This is ridiculous. Obviously, there is partisan politics going on over there, but the truth of the matter is, the President could have done more to help with this before now.”

A congressionally mandated climate change report published

in January acknowledged that the Pentagon needs to “better understand rates of coastal erosion, natural and built flood protection infrastructure, and inland and littoral flood planning and mitigation.” DOD says it must better understand the impact of sea level rise, storm surges, and floods, and how they can approach building differently to avoid weather-related damage.

Neither Tyndall nor Offutt were among the 79 facilities considered in the report, of which 10 were identified as most at risk for weather-related damage:

- Hill AFB, Utah
- Beale AFB, Calif.
- Vandenberg AFB, Calif.
- Greeley ANGS, Colo.
- Eglin AFB, Fla.
- Patrick AFB, Fla.
- JB Andrews, Md.
- Malmstrom AFB, Mont.
- Tinker AFB, Okla.
- Shaw AFB, S.C.
- JB San Antonio, Texas

USAF has created a task force to consider weather as an adversary. The group will look at weather forecasting and how to improve its models.

“The Air Force fights from its bases. They are our platforms for power projection. The Navy fights from its ships, the Army deploys forward and goes other places,” Wilson said. “When we plan our bases and look at things, the resilience of the bases, the duplication of power sources, the hardening of our assets” is critical.

The DOD report did not project what the Pentagon might have to pay to recover from and prepare for supercharged storms, expansive flooding, and other effects.

“The statute required each service within the department to assess the top 10 military installations that are most vulnerable to climate change over the next 20 years and detail specific mitigation measures—including their costs—that can be taken to ensure the operational viability and resiliency of the identified installations,” Reps. Adam Smith (D-Wash.), Jim Langevin (D-R.I.), and John Garamendi (D-Calif.) wrote to Acting Defense Secretary Patrick Shanahan in January.

The report also left out Marine Corps bases and threats to overseas installations.

“It is relevant to point out that ‘future’ in this analysis means only 20 years in the future,” the January report noted. “Projected changes will likely be more pronounced at the mid-century mark; vulnerability analyses to mid- and late-century would likely reveal an uptick in vulnerabilities” unless mitigation strategies are put in place. ☸

■ The War on Terrorism Casualties:

As of April 5, 66 Americans had died in Operation Freedom’s Sentinel in Afghanistan, and 76 Americans had died in Operation Inherent Resolve in Iraq, Syria, and other locations.

The total includes 137 troops and five Department of Defense civilians. Of these deaths, 66 were killed in action with the enemy while 76 died in noncombat incidents.

There have been 386 troops wounded in action during OFS and 77 troops in OIR.



Photo:ATC Alexi Myrick

MSgt. Arenda Jackson marshals a KC-46A onto the flight line at McConnell AFB, Kan. The first Pegasus was delivered to McConnell Jan 25, but USAF has halted delivery of the tankers twice due to problems with foreign object debris.

USAF Reviews Training After MAX 8 Crashes; KC-46 Uses Different Version of MCAS

By John A. Tirpak and Brian W. Everstine

The Air Force is reviewing its emergency training procedures and analyzing past autopilot-related mishaps following two crashes of new Boeing 737 MAX 8 aircraft, but it doesn’t believe its KC-46 tanker—which has a similar Maneuvering Characteristics Augmentation System (MCAS)—currently endangers military aircrews.

Chief of Staff Gen. David L. Goldfein has “directed Air Force leaders to ensure we have adequate training in our aircraft emergency procedures and simulator training,” Air Force spokeswoman Ann Stefanek said in an email. “As far as autopilot systems, most USAF aircraft have some version of autopilot, with varying levels of complexity. At this time, the [Air Force] has no indication of problems with Air Force aircraft similar to what has been reported with the MAX.”

The Air Force is awaiting the results of a Boeing review of the 737 MAX 8 MCAS system, and “if there are any findings that affect the KC-46, the Air Force will take appropriate measures to address the findings,” asserted an Air Force statement. “The 767 family has not been impacted” by the MCAS issue.

Boeing was criticized during the KC-X competition for cobbling together a “Frankentanker,” as its competitor Airbus charged, using physical elements and software from several different aircraft to develop what became the KC-46.

The 737 MAX 8 uses an MCAS to deal with weight and balance issues driven by the narrow ground clearance of its engines. It will automatically direct a nose-down attitude to prevent the aircraft from stalling if the angle of attack is too high. But, unlike the 737 MAX, the KC-46 uses a similar system because the weight and balance of the tanker shifts as it redistributes and offloads fuel. The KC-46 has a two-sensor MCAS system, which “compares the two readings,” the Air Force said.

Moreover, while the MAX 8 MCAS will reset and come back on automatically, the KC-46's system is "disengaged if the pilot makes a stick input," according to the Air Force. "The KC-46 has protections that ensure pilot manual inputs have override priority."

The service declined to comment on whether the KC-46 MCAS system was in any way shaped by the MAX 8 program.

To date, the Air Force has observed "no unexpected activations of the stall prevention system" on the KC-46 during testing, "or situations similar to what is known about the two MAX 8 crashes."

USAF's training review is not focused on specific problems, but represents due diligence as aircraft safety questions arise in the mishaps' aftermath, the service noted.

Two Boeing 737 MAX 8 crashes—a Lion Air flight in Indonesia last October and an Ethiopian Airlines crash near Addis Ababa earlier in March—led global airline authorities to ground the aircraft. ✪

■ Debris Causes 2nd KC-46 Acceptance Pause

The Air Force again stopped accepting next generation KC-46A tankers from Boeing in April after more debris was found hidden in closed compartments.

The Air Force initially stopped accepting the new tankers from Feb. 28 to March 11 after finding trash and tools in several aircraft. Officials enacted a 13-part corrective action plan to keep FOD off of the production line, but more debris was found after the action plan was implemented, causing the service to once again pause acceptance on March 23.

"The issues are unrelated to design or engineering specifications," Air Force spokeswoman Ann Stefanek told *Air Force Magazine* in early April. "Air Force leadership is meeting with Boeing to approve additional corrective action plans before aircraft acceptance can resume." She did not answer how many aircraft had debris.



Photo: USAF

Gen. John Hyten, now head of US Strategic Command, was selected to be the next Vice Chairman of the Joint Chiefs of Staff.

Senior Officer Movements

US Strategic Command chief Gen. John E. Hyten was nominated to become the next vice chairman of the Joint Chiefs of Staff, the second Air Force general in a row to hold the position. His nomination was submitted to the Senate April 8.

Hyten, a leading voice in the Pentagon's space enterprise



Photo: Craig Denton/USAF

Gen. John Raymond (right), with USAF Chief of Staff Gen. David Goldfein (left), in 2016 became the head of Air Force Space Command. He is now nominated to become head of US Space Command, a new combatant command.

overhaul and for nuclear weapons modernization, stepped into the top STRATCOM job in November 2016. He also brings to the Joint Chiefs a background in space operations and procurement, as the former commander and vice commander of Air Force Space Command, as well as a former space acquisition official at Air Force headquarters.

Last year, Hyten took over responsibility for building requirements for a new nuclear command, control, and communications portfolio and serves as the Defense Department's top official overseeing the NC3 enterprise.

Army Gen. Richard D. Clarke assumed command of US Special Operations Command during a March 29 ceremony in Florida, one day after Marine Corps Gen. Kenneth F. McKenzie Jr. took command of US Central Command.

Both Clarke and McKenzie received their fourth stars before assuming command. Clarke, who previously served as the director for strategic plans and policy for the Joint Staff, replaced Army Gen. Raymond A. Thomas III, who has led the command since 2016 and is retiring. McKenzie assumed command from Army Gen. Joseph L. Votel, who also is retiring. He previously served as director of the Joint Staff at the Pentagon.

In addition, President Donald J. Trump nominated several USAF officers for new positions, pending Senate confirmation.

Gen. John W. "Jay" Raymond was nominated to be the first commander of the new US Space Command. If confirmed, he will be dual-hatted, and continue to serve as commander of Air Force Space Command.

Elevating him to lead the new combatant command will give him a broader perspective and authorities as the Defense operations.

Lawmakers will consider Raymond's nomination as they also debate the whole scope of the Defense Department's space enterprise overhaul, which includes a Space Development Agency and a potential Space Force as a separate service under the Department of the Air Force.

Trump also has nominated Gen. Tod D. Wolters to be the next commander of US European Command and NATO Supreme Allied Commander, Europe. If confirmed, he would replace US Army Gen. Curtis M. Scaparrotti, who has led the command since replacing USAF Gen. Philip M. Breedlove in 2016. Wolters has commanded US Air Forces in Europe-Air Forces Africa since August 2016. Lt. Gen. Jeffrey L. Harrigian was nominated for a fourth star and tapped to replace Wolters at USAFE. Harrigian has served as the deputy commander of USAFE-AFAFRICA since September 2018. ✪

—Rachel S. Cohen

Andrew Marshall: 1921-2019

By John A. Tirpak

Andrew Marshall, the Pentagon's top strategist through eight presidential administrations, died March 25, at age 97.

Known to many as "Yoda," Marshall was, from 1973-2015, director of the Office of Net Assessment; an organization charged with long-term, deep thinking about US adversaries and the best ways to counter them.

Marshall proved prescient about a number of key strategic developments. He foresaw the Cold War bankrupting the former Soviet Union, causing its collapse, and he anticipated the rise of China as an economic and military powerhouse. He also warned against the possibility that India could become a strategic adversary in the same way as China, given its rapid industrialization and willingness to invest in education and strategic industries.

Born in Michigan, Marshall was medically disqualified from military service and worked in a Detroit aircraft factory during World War II. Afterward, he earned bachelor's and master's degrees in economics from the University of Chicago, but quit a doctoral program to work for the RAND Corp. in 1949. There he developed a theory of nations competing as corporations do, and emphasized asymmetric strategies for attacking opponents.

He joined the National Security Council in 1972 and, at the direction of then-Defense Secretary James R. Schlesinger, created the Office of Net Assessment in 1973 under the Nixon Administration. He was retained through the next seven presidential administrations because of his apolitical insight and mentorship of strategic thinkers in all the military services. His protégés include former Defense Secretaries Donald Rumsfeld and Dick Cheney. He is credited with coining the term "Revolution in Military Affairs," adopted by nations worldwide as shorthand for the era of networked operations, precision-guided weaponry, robotics, and information warfare.

While his emphasis on strategic competition caused Marshall to downplay or miss the threat posed by terrorism and cyber warfare, his thinking formed the basis of the George W. Bush Administration's restructure of the US military into a lighter and more agile force.

Robert O. Work, Deputy Defense Secretary in both the Obama and Trump Administrations, said in a podcast for *Defense and Aerospace Report* that although he never worked in Marshall's Office of Net Assessment, "I was really, really affected by his thinking" on strategic questions. Marshall influenced which programs Work paid special attention to as Navy undersecretary, and provided the impetus to Work's own "Third Offset" initiative, which aimed for yet another round of leap-ahead technologies that could guarantee US technological dominance in warfare.

Air Force Gen. Paul J. Selva, Vice Chairman of the Joint Chiefs of Staff and a former military fellow under Marshall, said in the same podcast that Marshall "was all about ... how to achieve strategic advantage without having to go through the messiness of tactical and operational activity; how to put your adversary in a position of strategic disadvantage"

to aid deterrence and prevent the adversary from gaining the upper hand.

"That was quintessential Andy Marshall," Selva said. "How do I get past the urgency of today? He taught me to ask that question."

Thomas P. Ehrhard, vice president for defense strategy at the Long Term Strategy Group—another military fellow under Marshall—said in the podcast that Marshall "took a multi-dimensional, multi-perspective approach" to analyzing potential adversaries, analyses that included cultural and anthropological studies in addition to simple evaluations of hardware and military capacity.

"This was ... in contrast to the systems analysis approach" favored during the Robert McNamara era, which preceded Marshall's tenure at the Pentagon, Ehrhard said. "It was more complex than that ... it was a better understanding of the whole, hence, 'net'" assessment. "You had to understand yourself, and your adversary, deeply." Marshall was a "pioneer of understanding bureaucratic behavior" in the US and Soviet Union, and "why they behaved the way they did."

Ehrhard also observed that Marshall's thinking was "ruthlessly empirical. He demanded a deep, deep level of research from his people." Selva echoed that thought, describing Marshall as "relentlessly skeptical."

Marshall was intolerant of surface-deep analysis, Ehrhard said. "Thinking about strategy can easily become a game of words. He wanted it to be a game of information, data, logic, and evidence." Also, it was never over for Marshall, Ehrhard noted, because the situation was always in motion, and strategies could be revised without warning. "That made a lot of people uncomfortable," he observed.

Marshall's infrequent reports were so closely held that their readership rarely exceeded a dozen individuals. Copies were not allowed. These reports identified "capability gaps," or vulnerabilities that a smart adversary could exploit to neutralize US strengths, and recommended actions to close those gaps. In meetings, Marshall himself spoke little and emphasized arriving at the right questions in order to produce meaningful answers. It was left to Pentagon leaders to implement or ignore Marshall's ideas.

His last major study, written in 2009 in concert with then-Gen. James Mattis, who later became Defense Secretary, pushed for renewal and expansion of US strategic capabilities, such as bombers, and greater realism in US wargames.

In 2012, Chinese Gen. Chen Zhou noted Marshall's ideas as highly influential in shaping the modernization of the People's Liberation Army. Marshall's ideas themselves were shaped by Chinese thought, particularly those that prize winning without fighting.

"He had the ability to take hard issues apart, always looking 5-10-15 years to the horizon," Selva said. Ehrhard called Marshall "an enigma. Painfully introverted. But that was because there was so much going on in his brain."

James Baker took over the Office of Net Assessment in 2015, when Marshall retired, at the age of 93.

That year, Washington defense analysts Andrew Krepinevich and Andrew Watts published a book about Marshall, "The Last Warrior: Andrew Marshall and the Shaping of Modern American Defense Strategy."


House Armed Services Committee ranking member Mac Thornberry (R-Texas) announced Marshall's death during a hearing. Few people "have had a bigger impact on focusing our defense efforts [and] our national security, Thornberry said. "He made such a difference." 



Photo: Scott Davis/Army

Andrew Marshall

Dick Cole: 1915-2019

By John A. Tirpak

Richard E. Cole, a key participant in the first US offensive action against Japan in WWII, and who was the last surviving member of the Doolittle Raid, died in Comfort, Texas, on April 9, at the age of 103.

Cole co-piloted the lead ship with Lt. Col. Jimmy Doolittle during the mission, which launched 16 B-25 Mitchell bombers with 80 men aboard from the deck of the USS Hornet on April 18, 1942 toward targets in Japan. Cole, then a 26-year old lieutenant who had joined the Army before the war, was hand-picked by Doolittle, who recruited only expert, mature aviators for the mission. Although the raid inflicted minimal damage on Japan, and all 16 aircraft were lost either to enemy action, captured, or crashed, it was both a huge boost to American morale and a shock to the Japanese military leadership, who felt the home islands were too far away from American forces to be at any risk.

Unable to find the planned landing field in China, Doolittle's crew bailed out of their B-25 when it ran out of fuel after 12 hours of flying. Aided by Chinese locals and western missionaries, Cole, Doolittle, and their crew evaded the Japanese and eventually made it back to the US. Of the 80 Raiders, 77 initially survived: eight were captured by Japan, and three of those were executed, while one died as a prisoner of war.

While most of the other raid survivors went to war in Europe, Cole served in Southeast Asia, flying cargo planes over the "Hump"—the Himalaya mountains—between India and China. He was later recruited to be part of the founding cadre of Air Commandos. His C-47 towed a glider for paratroops into Burma as part of an orchestrated drop of troops to launch the allied invasion of that country in 1944.

Cole attended the annual Doolittle Raider reunions, including the last, which took place in April 2013 with the last three members. He became a defacto spokesman for the group, which was awarded the Congressional Gold Medal by President Barack Obama in May 2014.

In later years, Cole became a kind of airpower ambassador, appearing at WWII commemorations, air shows and other aviation events, offering sharp-witted comments about the challenges of flying in WWII versus the technologies available to aviators of today.

Cole passed hours after receiving a visit from USAF Chief of Staff Gen. David Goldfein. Addressing the National Space Symposium on the day of Cole's death, Goldfein said, "There's another hole in our formation, and our last remaining Doolittle Raider has 'slipped the surly bonds of Earth' and is now reunited with his fellow raiders. And what a reunion they must be having." Goldfein said the Air Force is "so proud to carry the torch that he and his fellow raiders handed us. ... We're going to miss Col. Cole and we offer our eternal thanks and our condolences to his family. The legacy of the Doolittle raiders will live forever in the hearts of and minds of airmen long after we've all departed."

Air Force Secretary Heather Wilson, in a statement for the press, said "the Air Force mourns" with Cole's family. "We will

honor him and the courageous Doolittle Raiders as pioneers in aviation who continue to guide our bright future."

The Doolittle Raiders were depicted in three successful films: "30 Seconds Over Tokyo" (1944); "The Purple Heart" (1944); and "Pearl Harbor" (2001).

According to Tom Casey, president of the Doolittle Tokyo Raiders Association, there are plans for a memorial service at Randolph AFB, Texas; a burial at Arlington National Cemetery, and a ceremony at the National Museum of the US Air Force, which is the keeper of the Doolittle Raider cups. The 80 goblets are inscribed with the names of all the Raiders, and at the reunions, the goblets of those Raiders who died in the previous year were turned over. Cole's will be the last to be turned over. ✪

F-35As, KC-46s Top USAF Unfunded Priorities List

The Air Force wants to buy 12 additional F-35A strike fighters and three more KC-46 tankers as part of its \$2.8 billion fiscal 2020 unfunded priorities list, after requesting no aircraft in last year's version.

On top of the Air Force's \$165.6 billion blue budget request for 2020, USAF seeks funds for readiness, cyber-hardening of space assets, aircraft procurement, and advanced technology development.

Adding a dozen more F-35As in 2020 would bring the Air Force's total buy of Lockheed Martin Joint Strike Fighters that year to 60. Each new F-35A carries a \$90.8 million price tag, so the total cost of the 12 fighters would be \$1.1 billion—the same as the eight, fourth generation F-15EX jets the service wants to buy from Boeing starting next year.

Nearly \$2 billion in unfunded priorities fund another 12 F-35As in 2021 and pay for spare parts. The money can also level out the KC-46 buy at 15 aircraft, the same as the service is buying in 2019 and 2021, the list notes.

The second-largest amount in the list, \$579 million, would be used to boost sustainment for 10 unnamed weapons systems.

"If the Air Force does not receive supplemental and reprogramming support in FY19, we will have to take actions that drive unacceptable impacts to Air Force readiness," USAF warned. "This [line] item would recover the lost readiness by adding necessary weapon system sustainment funding to 10 weapon systems, and includes funding for B-1 repairs and fatigue testing to address critical structural issues, as well as unanticipated B-52 and KC-135 corrosion inspections and repairs associated with an aging aircraft fleet."

For defensible space assets, another \$149 million would speed up GPS M-Code receiver development to improve the accuracy of aircraft and weapons such as the Joint Direct Attack Munition, the extended-range variant of the Joint Air-to-Surface Strike Missile, and the Small Diameter Bomb I and II.

USAF also seeks \$61 million for agile development and prototyping on initiatives like directed-energy testing, navigation technology satellites, and "joint lethality in contested environments," as well as funding support for the Air Force Warfighting Integration Capability and senior leaders' projects.

A "high-speed, vertical lift demonstration," named Agility Prime, needs another \$25 million, the Air Force added.

Another \$18 million would advance hypersonics; nuclear command, control, and communications; and artificial intelligence, machine learning, and unmanned systems. ✪



Richard Cole

Photo: SSgt. David Salantri

FACES OF THE FORCE

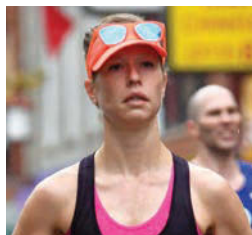


Photo: Courtesy

The Air Force 2019 Female Athlete of the Year is **Maj. Amy Natalini**, director of headquarters 8th Air Force's commander's action group at Barksdale AFB, La. Natalini is a marathon runner who, as team captain, led USAF's women's marathon team to a first place finish at the DOD Championships. Natalini also coaches elementary school runners and leads running clinics.



Photo: Courtesy

The Air Force 2019 Male Athlete of the Year is **2nd Lt. James Griffin Jax**, the most decorated baseball player in Air Force Academy history and an inductee into the USAF Baseball Hall of Fame. Jax, an acquisitions officer who is in the World Class Athlete Program, is in the Minnesota Twins minor-league system and was recently assigned to Class Double-A to play for the Pensacola Blue Wahoos.



Photo: Roland Bakil/USAF

Two 436th Maintenance Group airmen tied the knot aboard a C-17 Globemaster III at Dover AFB, Del., in January. Both bride and groom wore ABUs (airman battle uniforms) as **A1C Michelle Speer** and **A1C Joshua Brewer** took their vows before Speer's boss, 436th APS ramp operations supervisor **TSgt. Joseph Rice**. Both families and wingmen were in attendance.



Photo: USAF

Air National Guardsman **CMSgt. Greg Souders**, the 193rd Special Operations Logistics Readiness Squadron's superintendent, hits humanitarian home runs with Baseball Miracles, a nonprofit that hosts baseball clinics for kids in underserved communities. Souders led his first clinic last December in Yabucaco, Puerto Rico, which he called "the hardest hit area from Hurricane Maria." The group fixed batting cages, repainted facilities, and provided bats, balls and gloves.

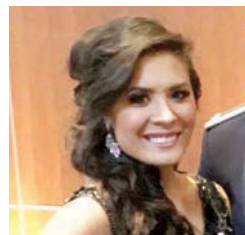


Photo: Courtesy

1st Lt. Rachael Preslar was crowned Mrs. Colorado March 30. A mission commander at Buckley AFB, Colo., she is the first USAF Active Duty service member to win the title and will be competing for Mrs. America in August. She is a 2015 graduate of the Air Force Academy and, in addition to her Air Force duties, Preslar is an outdoors and fitness enthusiast, and the daughter of a Miss Taiwan (1990).



Photo: MSgt. Jennifer Shirar/ANG

173rd Fighter Wing Commander **Col. Jeff "Sled" Smith** is reinventing commander's calls to better connect with his airmen. Playing off popular "TED" talks, Smith's "SLED Talks," are private discussions with 12 airmen or fewer to discuss the future of the F-15, possible future mission options, and timelines, he said. Airmen from multiple shops attend each talk, offering "diversity of thought, perspective, and experience," and more feedback than prior commander's calls generated.



Photo: Armando Perez/USAF

Air Force Academy Vice Superintendent **Col. Houston Cantwell**, with concept assistance from **Cadet 2nd Class Yann Wollman**, won a \$250,000 investment commitment to create a "What's Up" app that helps individuals or groups share calendar events with fellow airmen and USAF families. The prize comes with assistance from AFW-ERX and private sector tech accelerators to help develop a prototype of his app concept.



Photo: SrA. Sadie Colbert

US-Japan relations are generally strong, but language can be an issue. **A1C William Raley**, a weapons director technician with the 610th Air Control Flight, recently earned an award from the Japan-America Air Force Goodwill Association for breaking down those walls with voluntary English classes for Japanese airmen working in command and control.



Photo: USAF

AFRL's **Dr. Adam Pilchak** is this year's recipient of the Jaap Schijve Award. The international award is based on technical contributions to the advancement of the field of aeronautical fatigue. Selection criteria includes scientific quality of work, quality of publications in peer reviewed journals, relevance to fatigue and damage tolerance, and impact on aerospace engineering. Pilchak has emerged as USAF's leading expert in microstructural fatigue and damage tolerance of titanium alloys.



Photo: Kentucky ANG

K-9 Callie, a Dutch Shepherd with the Kentucky Air National Guard's 123rd Airlift Wing, is the Air Force's only search and rescue dog—and a social media star. According to her Instagram page, where more than 7,000 followers keep up with her, Callie's Air Force career began on Sept. 6, 2018, following training at the University of Pennsylvania's Penn Vet Working Dog Center. Follow her adventures on Instagram at @sar_pup.

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

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F-15EX vs. F-35A

Two jets from different eras, with different missions, strengths, and weaknesses, face off in a battle for today's funds.



An Advanced F-15 during system and flight control testing in Palmdale, Calif.

Photo: Boeing

By John A. Tirpak

The F-35 Lightning has been the Air Force's sole new fighter program since 2009, when the F-22 Raptor program was prematurely terminated. While behind schedule, the program has been a top Air Force priority for more than a decade and until recently, was expected to remain USAF's only fighter program until a future capability, still undefined, comes online.

Now the F-35 faces a new challenge from an old jet design, a variant of the F-15 Strike Eagle; an airplane from an earlier era, built for a different mission. Though the Air Force denies it, the two jets are competing for inevitably limited dollars within the service's fighter portfolio.

The Air Force's fiscal 2020 budget request includes \$1.1 billion to buy the first eight of a planned 144 F-15EX aircraft. The new airplanes are very similar to the export versions now being built for Qatar. The F-15EX is a two-seat fighter that can be flown by one or two aviators and is meant to replace F-15Cs and Ds that are reaching the end of their service lives.

Under the plan, the Air Force would receive two F-15EX airplanes in 2022, six more in 2023, and a total of 80 airplanes in the next five years. Separately, the 2020 budget request also includes \$949 million to upgrade existing F-15s.

Adding new F-15s was not an Air Force idea, but instead

came out of the Pentagon's Cost and Program Evaluation office, or CAPE, and was endorsed by former Defense Secretary James Mattis. While the Air Force's long-held position has been to invest only in fifth generation fighter technology, it has defended the plan to buy new F-15s as a way to maintain fighter capacity, given the aging of the F-15C fleet and the slow pace of F-35 acquisitions.

While the Air Force is adamant that buying F-15EXs will not reduce the requirement to build 1,763 F-35s, history and the Air Force's own budget request suggests otherwise. The 2020 budget submission shows the Air Force buying 24 fewer F-35s over the next five years compared to last year's plan.

The opening for the F-15EX results from the age and condition of today's F-15Cs. Designed as air superiority fighters and first fielded in the 1970s, the F-15Cs were planned to have retired by now. But the premature termination of the F-22 after acquiring 186 aircraft—less than half the planned production—compelled the Air Force to extend their service. Now, key structural components are reaching the end of their engineered service life—so much so that many F-15Cs must operate today under significant speed and G-loading restrictions.

The Air Force's arguments for the F-15EX turn on preserving capacity. The F-15Cs will age out of the inventory faster than new F-35s can come on line, reducing the available fighter fleet at a time when the Air Force argues it's already



An F-35 performs a weapons bay door pass during Demonstration Team training over Luke AFB, Ariz.

Photo: SrA. Alexander Cook

seven squadrons short of the 62 officials say they need to meet the National Defense Strategy.

The F-15EX, USAF argues, is essentially an in-production aircraft. It has upward of 70 percent parts commonality with the F-15C and E already in USAF service and can use almost all the same ground equipment, hangars, simulators and other support gear as the Eagles now in service. At a unit price roughly comparable to that of the F-35, F-15 squadrons could transition to the F-15EX in a matter of weeks, whereas converting pilots, maintainers, facilities and equipment to the F-35 takes many months, the Air Force says.

The F-15EX, though, is a fourth generation aircraft which lacks the stealth characteristics and sensor fusion of the F-35 and F-22 and therefore won't be able to survive against modern air defenses for very much longer. USAF has said that 2028 is probably the latest the jet could conceivably operate close to contested enemy airspace. However, CAPE and Air Force officials see viable continuing missions for the F-15EX in homeland and airbase defense, in maintaining no-fly zones where air defenses are limited or nonexistent, and in delivering standoff munitions.

While the Air Force has maintained since 2001 that it will not buy any "new old" fighters, and that it needs to transition as quickly as possible to an all-5th-gen force, proponents argue that buying F-15s and F-35s concurrently would fill gaps in the fighter fleet more rapidly. Moreover, USAF leaders, defending the new F-15 buy, have said that the F-35 still hasn't proven it can be maintained at the advertised cost (comparable to the F-16, at about \$20,000 per hour) and the service prefers to wait to make large bulk buys of the airplane after the Block 4 version starts rolling off the assembly line

in the mid-2020s. This approach, they say, will also avoid spending large amounts of money to update earlier versions of the F-35 to the Block 4 configuration.

This isn't the first time the Air Force has considered buying new F-15s, but the F-15EX isn't the same as upgraded models previously offered by the jets' maker, Boeing. The most recent offerings would have required extensive development work. In 2009, Boeing proposed the F-15 "Silent Eagle," which would have added stealth characteristics. That jet would have carried weapons internally in conformal stations and featured canted vertical fins and surface treatments to reduce its radar signature. Boeing offered another concept, the "Advanced" F-15, or F-15 2040C, last year. That jet would have had a substantially increased payload and advanced avionics.

Instead, the F-15EX requires almost no new development, would be able to execute a test program very quickly, and requires minimal additional development.

Air Force officials say one potential mission for the F-15EX would be carrying "outsize" munitions, such as hypersonic missiles, and as a possible standoff weapons magazine working in conjunction with the F-22.

The F-35 and F-15EX were designed in different eras for different missions. The F-15C was designed for air superiority in the pre-stealth era; the F-35 to be the battlefield "quarterback," gathering vast amounts of information from behind enemy lines while executing stealthy strikes and picking off enemy fighters. Yet, as Congress decides how to invest in future aircraft, comparisons are necessary as the two planes compete for resources. **Turn the page for a side-by-side comparison.**

How the F-35A and the F-15EX compare



Primary Functions

Stealthy, all-weather strike, close air support and air superiority; intelligence, surveillance, and reconnaissance; maritime strike; electronic warfare, and command and control.

Procurement Costs

\$89.2 million 2018 (actual) **\$80 Million** 2025 (projected)

Lot 11 price. Contracts stipulate maximum cost of \$80 million per plane by 2020.

Cost Per Flying Hour

\$35,000 2019 **\$24,000** 2025 (projected)

Prime Contractors

Lockheed Martin, Northrop Grumman

Production Capacity

188 to 221 annually for all versions of the F-35 (including B and C models)

Initial Operational Capability

2016

Inventory

150+ (USAF only)

Engine

1 Pratt & Whitney F135

Accommodation

One pilot

Performance

COMBAT RADIUS 670 Miles
Mach 1.6 **MAX G-LOADING 9Gs** **CEILING 50,000**

Fuel Capacity

- Internal: 18,250 pounds
- External: Two fuel tanks on wing hard points

Weapons

All US and NATO air-to-air weapons; most US and NATO air-to-ground weapons.

- Internal Capacity (Stealth Mode): 5,700 pounds
- External Capacity ("Beast" Mode): 22,000 pounds
- 25 mm cannon

Service Life

Design life 8,000 hours
 Tested to 24,000 + hours

Major Differences From Earlier Versions

Multiple software and processor refreshes, including to weapons capabilities and electronic warfare systems. Current in-production version is the Block 3F Baseline; Block 4 development, now underway, will include software and weapon updates on a twice-annual pace through 2024.

Allied Operators

Partner Nations

Foreign Sales

Congressional Support

Major constituencies for F-35 production: Texas, California, Georgia, Florida. Major bases and installations hosting or supporting the F-35A: Utah, Arizona, Florida, Nevada. Lockheed has placed F-35 subcontracts in all 50 states.

Sources: Data from Air Force Magazine's USAF Almanac, Aviation Week Analysis, Boeing, F-35 Joint Program Office, globalsecurity.org, Lockheed Martin, USAF

Primary Functions

Air superiority and strike in less- or uncontested airspace.

Procurement Costs

\$98.3 million 2019 (proposed) **\$80.3 Million** 2025 (projected)

Estimate for the first 80 aircraft under a \$7.865 billion, five-year proposal, including nonrecurring engineering costs. Average price projected to be \$89.7 million per aircraft for the duration of the buy.

Cost Per Flying Hour

\$27,000 2019 **<\$27,000** 2025 (projected)

Prime Contractor

Boeing

Production Capacity

24 to 36 annually

Initial Operational Capability

1975 F-15A **2016** F-15SA*
 *F-15SA (Saudi Arabia) is similar to the F-15EX configuration with fly-by-wire controls

Inventory

F-15C/D 235; F-15E 218

Engines

2 Pratt & Whitney F100-PW-229 or GE F110-GE-129 (USAF to decide)

Accommodation

Two aviators, but all systems can be operated by the pilot in the front seat. USAF plans to operate with pilot only.

Performance

COMBAT RADIUS 1,100 Miles
Mach 2.5 **MAX G-LOADING 9Gs** **CEILING 60,000**

Fuel Capacity

- Internal: 13,550 pounds
- With conformal fuel tanks: 23,350 pounds
- External: Three underwing and centerline hard points can accommodate fuel tanks

Weapons

All US air-to-air weapons; most US air-to-ground weapons; some "outsize" weapons, such as 5,000-pound GBU-28.

- Capacity: 29,500 pounds, all external, on nine stations
- 20 mm cannon

Service Life

Design life 8,000 hours
 Tested to 30,000 + hours

Major Differences From Earlier Versions

Major changes since the Air Force bought its last F-15Es in 2001 include a digital, fly-by-wire system; the Advanced Display Core Processor II (ADCPII); Suite 9 avionics which make the F-15C and E software compatible; new cockpit displays similar to those on the T-X trainer, and the Eagle Passive Active Warning Survivability System (EPAWSS).

Allied Operators

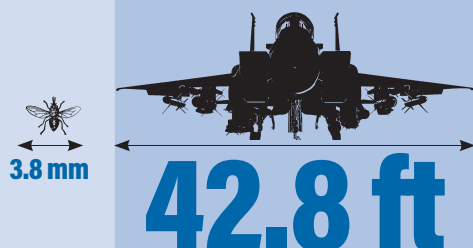
Partner Nations

Congressional Support

Major constituencies for F-15EX production: Illinois, Kansas, Missouri, Washington. Major institutions hosting F-15 activities: Georgia, North Carolina, and Oregon. Boeing's military and commercial entities do business in all 50 states.

Radar Cross Section

(Relative size of aircraft on radar)



3.8 mm

42.8 ft

Dimensions

Span 42.8 feet, length 63.8 feet, height 18.5 feet

Span 35 feet, length 51.4 feet, height 14.4 feet

51.4 ft

63.8 ft

Detection Range vs. S-400 Missile System

F-35A 21 miles

F-15EX 195 to 215 miles

Instant Contracts

USAF speeds up its game to leverage small business innovators.



By Amy McCullough

The military industrial base has been consolidating for decades and represents only part of American industrial might and ingenuity. For the Air Force to remain globally competitive in the future, experts say, it must discover new and better ways to tap the entire US industrial base, rather than just traditional suppliers.

Put another way, the Air Force cannot afford to be dependent on just a few big prime contractors to solve all of its technology and weapons requirements.

“We will not compete and win, not over the long term, if we have one hand [tied] behind our back in terms of who we can partner with,” said Will Roper, assistant secretary of the Air Force for acquisition, technology, and logistics.

“We will not compete and win ... if we have one hand [tied] behind our back.”

—Will Roper, Air Force acquisition chief

The days when defense requirements were driving technological change, spinning off capability that could be commercialized by others in aviation and space, have given way to a new era. Commercial demand and scale outstrip those of the Pentagon, and clunky acquisition processes can’t keep pace with the rapid advancement of commercial software and computing technologies.

That’s why the Defense Department created its Defense Innovation Unit and why the Air Force established AFWERX: to create an agile acquisition capability that could operate at the blazing speed of technology, rather than the glacial pace of conventional contracting. Being able to move fast is especially important to get the attention of startup businesses that can’t afford to stand by for months, or even years, waiting for a contract to come through.

“If you’re a startup and you’re 10 to 20 people,



USAF Assistant Secretary for Acquisition, Technology, and Logistics Will Roper (right) preps his team before Air Force Pitch Day in New York City in March. Some 51 firms won contracts totaling \$3.5 million at the event.

Photo: TSgt. Anthony Nelson Jr.

you can't wait three months for that contract," Roper said. "You have to be able to move in a week. We really want to be able to move in a day."

Today's tiny tech startup could be a household name 10 or 15 years from now. "Can we risk the next generation of companies not knowing us, ... not knowing the Air Force or your Department of Defense?" Roper asked. "That's a naïve position."

The Air Force's first-ever "Pitch Day," held March 6-7 in New York City, looked to open the door to small businesses, universities, and research centers and prove how easy it can be to work with the Air Force.

The service asked businesses to submit a small pitch deck of five pages or less detailing innovative ideas that could help solve the Air Force's most vexing problems in three areas:

- Command, control, communications, intelligence, and networks (C3I&N), such as cyber-resilient aerial networks, agile communications, modeling and simulation of the aerial

Innovation and Technology

There are three phases to SBIR (Small Business Innovation Research) and STTR (Small Business Technology Transfer). Phase I is typically for one year, Phase II is typically for nine months to two years, while Phase III's goal is to find external funding.

AIR FORCE SBIR/STTR STANDARD TOPICS



PHASE I

- 3 months, \$50-\$158k awards
- Encourage design thinking
- Validate relevance, military utility, and modification requirements of proposed commercial tech. Broad open topics, inviting innovation ideas to enhance capability in a mission area
- Goal: Optionality—connect to as many ideas as possible

PHASE II

- Between \$1.5-\$3M proto-type/demo projects
- Goal: Use SBIR to "bridge" the gap as we align funding for program integration or procurement

PHASE III

- Flexible contract vehicle (services, procurement, R&D, etc.)
- Allows multiple funding sources
- Protective benefits to small business IP
- Can choose to subcontract company to prime instead

Source: USAF Small Business Innovation Research

network, and machine learning in regard to data capture and analytics.

- Intelligence, surveillance, and reconnaissance and Special Operations Forces, involving challenges Air Force Special Operations battlefield airmen may face in the field, such as portable water desalination or portable weather sensors.

- Digital technology that can help secure cloud operations, trust in open-source software, and automate cyber security processes.

In all, 417 proposals were submitted to the Air Force. Program executive officers in each of the three focus areas got just two weeks to review them and narrow the field to 60 proposals from 59 small businesses, who would get to make their pitch live. The goal: Walk out the same day with a contract.

About half of the companies had never worked with the US government before, said David E. Shahady, program director of the Air Force's Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) program.

PUT THAT ON VISA

Each of the companies was allowed 15 minutes to make their pitch, which ranged from using artificial intelligence to help analysts pore through data more quickly, to medical devices that could help pararescue jumpers rapidly stabilize patients in the field.



Photo: J. M. Eddins Jr./USAF

The Air Force's Kessel Run Project is revolutionizing how USAF engineers use software. Here, Engineering Practice Lead 1st Lt. Justin Hohman (l) and Chief Product Officer Adam Furtado code together, an approach designed to improve contextual understanding across teams and accelerate software development.

When it was over, the Air Force had awarded 51 Phase 1 SBIR contracts worth \$3.5 million, paid for on the spot with the swipe of a government credit card. So intense and unusual was the card's activity, in fact, the credit card was temporarily locked down while the bank investigated potential fraudulent charges.

"We had a US Bank representative here, and I'm really appreciative we did," said Maj. Gen. Cameron G. Holt, deputy assistant secretary for contracting. "We had to shut down US Bank's fraud detection software completely. I don't know why it was bothered by some young lady spending \$50,000 a pop in Times Square."

In addition to the \$3.5 million spent on Pitch Day, another \$5.25 million is already committed for follow-on work. Of the 51 contracts awarded, 16 were related to C3I&N, 19 fell in the ISR/SOF category, and 16 were digital technology awards.

Prior to Pitch Day, the fastest the Air Force had ever paid a contractor was about three months, Roper said. On Pitch Day, however, the average was 15 minutes, and "the fastest we did was three minutes," Roper said.

Or as one startup executive marveled to Col. Dale White, program executive officer for ISR/SOF: It was "quicker to get an Air Force contract than it is to get a beer in New York City."

Fast payment wasn't just a gimmick. Roper saw it as an imperative, and using a credit card—which raised eyebrows in Washington—was the only way to get it done that fast. Speed matters because in the time it can take for a government contract to come through, a small company can literally wither and die.

Take Consul Systems, a small business that earned a

contract to better protect "critical device-centric networks in production weapon systems, clinical healthcare, and facility management." Doug Gourlay, the company's chief executive, said as soon as he returned to his hotel room after Pitch Day, he received a call from his banker. "He said, 'Do you need a loan?' I said, 'Well, they actually paid me today.' And, then he said, 'That usually takes at least 120 days. Don't you need a bridge loan?'" Gourlay said. "This was the fastest government thing I've ever seen."

LIFE SUPPORT

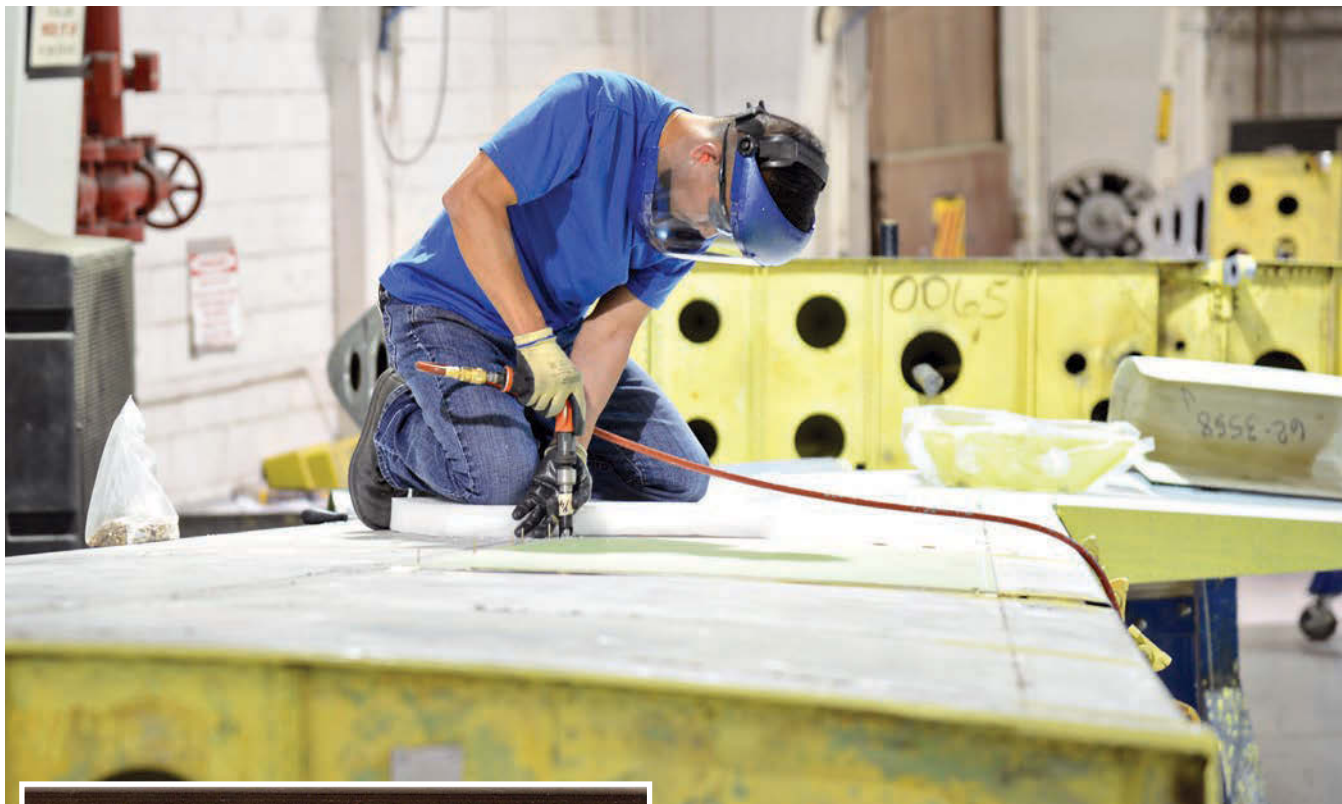
Securisyn Medical received funding for its SolidAIRity device—a fully integrated airway stabilization system that can provide much-needed stabilization to ventilated patients. Company co-founder Elyse Blazeovich said more than 33,000 people will die in 2019 when a tube that's been inserted into a patient's airway is pulled out prematurely or inadequately.

"In austere conditions of combat casualty care, if you don't have an airway, you don't have a patient," Blazeovich said in her pitch.

Special operators who heard the pitch explained the impact such a device could have. In the field, PJs caring for the wounded must monitor intubated patients until the tube is successfully removed. Because the SolidAIRity device is more reliable than a conventional tube, PJs could be freed to attend to other wounded troops instead.

"How do we not already have this capability?" White asked.

In fact, such face-to-face interactions provided critical "learning moments" for Roper, who found that some proposals that initially generated less interest quickly jumped to the top of the list after their presentations.



Photos: Kelly White/USAF; John McClure/USAF



Above, Danny Nguyen, a sheet metal mechanic at Tinker AFB, Okla., repairs a panel for a KC-135 vertical stabilizer. USAF's new Rapid Sustainment Office is exploring new technologies that can cut the costs of maintenance, such as the application of cold spray technology, an additive manufacturing process that enables maintainers to restore metal parts, such as these chafed titanium tubes (left), by adding metal back where it has been worn away. Depots at Tinker, (above) and Robins AFB, Ga., are already using the process.

"We've never had industry in the room for source selection," Roper told participants when it was all over. "We set that precedent today. It was real-time acquisition."

Now Roper wants to push the concept out into the field. "Pitch Days are now available for anyone to run," Roper said. "We're already working with PEOs who are ready to run Pitch Days in their backyards. We want it to be everywhere there is technology, and ideas, and passions. Maybe we will do a big Super Bowl of Pitch Days at some point. I could see that being an opportunity to give companies a big chance."

THE BIG IDEA PIPELINE

Pitch Day is an example of how the Air Force can get better at tapping the potential of nascent, innovative companies that can inject valuable new ideas into the service's pipeline. The Air Force still needs the big primes to manage its biggest programs, according to Roper, but it also needs access to the engines of innovation outside its traditional supplier base.

Major procurement "competitions are few and far between," he said. "Don't think this is about not needing our traditional companies. We need them, but we can't create a [business] environment that continues to collapse the number of companies that work with us."

Roper said one of the "fundamental flaws" of the current system is that it can take decades to build and field new fighters or bombers, leaving little room for innovation. Once

those programs are over, industry often has a difficult time holding on to its experienced personnel. He wants the Air Force to create a "big idea pipeline," through which both defense primes and dual-use commercial companies can flow, ensuring the service never runs out of new ideas.

The existing acquisition system tries to predict the future, then places its bets on one or two big threats and tries to solve those problems. Roper sees that as risky and naïve. Artificial intelligence, quantum computing, or other emerging technologies can mature faster than anticipated and suddenly "blow the lid off of this," he said.

To overcome that tendency, the Air Force must change its mindset and invest in a steady stream of prototypes. Some might make it to the field, while others might not. But by investing in them one after the other, the Air Force can learn from each increment, and the constant flow of work will help grow the industrial base.

"Think back to the original Air Force, back during the Century Series of fighters," Roper said, referring to airplanes beginning with the F-100 and developed in the 1950s and '60s. "Can you imagine how disruptive it would be if we could create a new airplane or a new satellite every three, four, [or even] every two years? I mean, what if modern digital engineering allowed a very heterogeneous fleet to be sustained at roughly the same cost as a homogenous fleet?"

More rapid development would—in theory—lead to



Photo: TSgt. Anthony Nelson Jr.

Devaki Raj, CEO and founder of CrowdAI, makes her pitch to the Air Force for deep learning for satellite video and imagery. Her company was awarded a same-day contract at the March Pitch Day event.

more rapid innovation and refinement, just as has been the case with other technologies, from automobiles to smart-phones. “We should really think about our future

not as a program but as a pipeline of development with the ability to go into small productions or not,” Roper said.

How will the Air Force pay for all these new prototypes? The answer is to cut the cost of sustainment. “There’s really only one place,” Roper said. Some 70 percent of all life cycle costs are in maintaining and sustaining equipment. Cut that by 10 percent, and you can significantly boost acquisition and development.

The Air Force recently stood up a Rapid Sustainment Office with the goal of pushing new commercial technologies into the depots to save money. If that works, Roper argues, the savings can be rerouted to build new prototypes.

For example, the new office has already introduced an additive repair process called cold spray at the Oklahoma City Air Logistics Complex at Tinker AFB, Okla., and at the Warner Robins ALC at Robins AFB, Ga. Cold spray allows maintainers to add metal back to worn metal parts, rather than scrapping them. Roper said the Air Force has already saved millions using this process.

Predictive maintenance is another potential area of savings. By using artificial intelligence to predict when an aircraft part may fail, maintainers can replace parts only when they are truly needed, rather than adhering to a prescribed maintenance schedule that replaces parts whether they’re worn out or not. In another innovation, a robotic, laser-based paint-removing system is now saving the Air Force \$1 million per plane.

“I see the potential for big savings in sustainment—enough that potentially we can afford that big idea pipeline,” Roper said. “If we only solve 5 to 10 percent savings, that’s a lot of high-tech prototyping. That’s a lot of big ideas coming through the pipeline,” Roper said. Adding, “We need light speed in all of our endeavors Air Force. We’re off to a great start but ... remember that, while we’re ready to go fight and win today, we are also competing to fight and win tomorrow.”

Pitch Day Winners

Of the 59 companies invited to participate in the Air Force’s first-ever “Pitch Day” in New York City, 51 walked away with contracts. They are:

Command, control, communication, intelligence, and networks

- Architecture Technology Corporation
- Axellio, Inc
- Barrier Group, LLC
- Basse & Co.
- BlackLynx
- CrowdAI
- DUJUD, LLC
- EMAG Technologies, Inc.
- Geosite, Inc.
- GeoSpark Analytics
- Gigavation Incorporated
- ICR, Inc.
- Onclave Networks, Inc.
- Pueo Business Solutions, LLC
- SecureLogic Corporation
- SitScape, Inc.

Intelligence, Surveillance, and Reconnaissance/Special Operations Forces

- Bambu Vault, LLC
- Battle Sight Technologies
- Camgian Microsystems Corporation
- Citadel Defense Company
- ClimaCell
- Combat Power Solutions
- Delta Development Team, LLC
- Elphel, Inc.
- Hadron Industries
- Higher Ground
- Intellisense Systems, Inc.
- Jio, Inc.
- nVision Technology, Inc.
- Plugnix, LLC
- Rapid Imaging Technologies, LLC
- Remote Health Solutions, LLC
- Securisyn Medical
- Slingshot Aerospace, Inc.
- Torrey Pines Logic, Inc.

Digital Technology

- Architecture Technology Corporation
- Arganteal, Corp
- ATC-NY, Inc.
- Beacon Interactive Systems
- Consul Systems
- Dark Wolf Solutions, LLC
- Emagine IT, Inc.
- Fastport, Inc.
- FiberQA, LLC
- Intentionet, Inc.
- Metis Technology Solutions, Inc.
- NAVSYS Corporation
- Power Fingerprinting, Inc.
- Praeses, LLC
- Segue Technologies, Inc.
- viaForensics, LLC

The Biggest Needs in the Mobility Fleet

Tankers top the list of a force stretched thin by constant—and growing—demand.



Photo: SSgt. Clayton Cupit

A KC-135 Stratotanker on the ramp Jan. 22, 2019, at Kandahar Air Field in Afghanistan. USAF is delaying retirement of the refueler because of the slow delivery rate of the KC-46.

By Brian W. Everstine

Future great power competition will step up demand for aerial refueling capacity and require air cargo crews to operate in contested airspace—potentially poisoned with chemical agents. As Air Mobility Command gears up for those demands, leaders are focused on fielding and developing new aircraft and making smarter use of the aircraft they have.

AMC's priorities over the coming years will be fielding the KC-46 Pegasus, developing requirements for the next tanker aircraft, dubbed the KC-Z, and developing better means of training and managing the force it has while building toward the force it needs. That includes more hands-on training to prepare for operations in hostile environments and employing new technologies to better understand demand for forces.

"The tanker connects to pretty much every mission set out there in the contested environment."

—AMC
Commander Gen.
Maryanne Miller

No sooner had AMC accepted delivery of its first brand-new KC-46 than new controversies erupted over tools and debris left behind in the new aircraft, prompting yet another pause in deliveries, while prime contractor Boeing promised new procedures to ensure there would be no more problems. Yet, even as the KC-46 works out its final kinks, and before it's deemed fully operationally capable, the next tanker is already taking shape on future drawing boards. That program will take precedence over developing new airlifters, said AMC Commander Gen. Maryanne Miller.

"The tanker's the one that's most in demand," Miller said. "The tanker connects to pretty much every mission set out there in the contested environment." Airlifters must wait, she added: "We are going to focus on that [tanker] before we focus on a C-X. Our priority right now is going to be the KC-Z."

Miller said it will take a year to nail down required

A KC-135 is partially disassembled in a hangar for an inspection at Fairchild Air Force Base in Washington in 2018. KC-135s are more than 50 years old, but most interior components are newer.



Photo: SrA. Ryan Lackey

capabilities for the KC-Z, based on the threats laid out in the National Defense Strategy and in USAF's Next Generation Air Dominance future fighter system.

"We'll have a tanker that supports" NGAD, she said, though it's still too early to say exactly what that means. For example, the future tanker could be autonomous, or it could include more than one aircraft.

AMC will then start an analysis of alternatives, a process expected to take three to five years.

The aim is to field a system in the mid-2030s, said Maj. Gen. Mark D. Camerer, the command's director of strategic plans, requirements, and programs.

"We're at the very, very beginning trying to describe what the requirements will be," Camerer said. The aircraft will be "a very large investment," developed from scratch, he added.

Some things are beginning to come clear, however. Miller said stealth is not likely to be a requirement for the KC-Z, because while the tanker may need to get closer to the fight than in the past, no one knows how to keep a tanker stealthy once it deploys its unwieldy refueling boom. AMC will consider all options, including a Navy concept for a "mother tanker" with smaller "children,"—a scenario in which the larger tanker lags back and refuels smaller aircraft, which then go forward to refuel other platforms. But Miller called that prospect unlikely.

The need for additional tankers is critical, Miller said. The planned number of KC-46s is not enough. "We will have 300 KC-135s in the inventory by the time we field the KC-46," she said, and those aircraft will have to be replaced. "We have got to get on this."

Even now, the Air Force is delaying the retirement of 28 KC-135s because of the slow delivery rate of the KC-46s.

US Transportation Command boss US Army Gen. Stephen R. Lyons told the Senate Armed Services Committee in March those extensions were needed so "we don't have this exorbitant dip in capability over time."

Miller said "heavily used" KC-135s are suffering from corrosion and other age-related and wear issues, all of which are "being mitigated," while they await replacement.



Photo: TSgt. Laura Beckley

A C-17A Globemaster III positions for a refueling by a KC-46 during training in March.

Blame it on age, she said. "It's one of the issues that comes up with a 60-year-old airframe." Otherwise, the aircraft are "in great shape."

Keeping the KC-135s fresh means sending them for depot-level maintenance every three years to get a "really good look at the airplane," Camerer said, stripping them down to check for corrosion and overhauling hard-worked engines. So while "the aircraft is 50 years old, the components inside the airplane" are far newer, he said.

In addition to ensuring structural integrity, both active and Air National Guard units are upgrading their KC-135s to keep them relevant. The Guard jets and a small number in the active fleet are receiving the Real-Time Information in the Cockpit system to improve their situational awareness. While the KC-46 comes with factory-installed systems, such as Link 16, to be better able to communicate, the older KC-135s require upgrades to be able to stay relevant in the long-term, Camerer said.

"We're still going to be flying KC-135s for a long time," he said.



Photo: AIC Alexi Myrick

A crowd welcomes a new KC-46A Pegasus during the aircraft's arrival ceremony at McConnell AFB, Kan., on Jan. 25. The new tanker type will serve alongside KC-135s, such as the one at left, for years to come.

ENHANCING TRAINING

AMC is changing how it is training its aircrews to focus on the threats that come with a fight against a stronger adversary, including in environments denied by cyberattacks or even chemical attacks.

For example, C-130 crews have changed how they train to better prepare to fly closer to a fight. Under a North Korea scenario, C-130s could face chemical weapons attacks, yet still need to fly close to the fight for resupply. Crews prepared for this in the past by doing one or two approaches in chemical suits, but now they will do so more frequently, Miller said.

Within the past year, C-130 crews have begun practicing more frequently in chemical suits, including wearing them throughout some local flights.

"They're going to be closest to the fight," Miller said. "They're going to be reachable by the threat, so we need to ensure that they are ready for that environment."

AMC is developing "different training regimes" for its different aircraft, because the threats C-130s face are different from those faced by C-17s and C-5s. The massive Mobility Guardian exercise, planned for September at Fairchild AFB, Wash., will include those elements. In the first Mobility Guardian, held in 2017, dozens of aircraft from more than 20 nations practiced the first days of a large conflict through joint forcible-entry exercises, airdrops, and setting up and sustaining austere airfields. This year, there will be greater focus on operating in a denied environment, Miller said.

"We're paying much more attention to: What do all crews need? And what specific, additive measures do some crews need because the threat is changing? We need to prepare them for that," Miller said. "We're trying to get much more targeted."

"Because we have a small force, the operational tempo is high every single day," she said. "So, when we get them home and say, 'Now, airmen, we need you train for this contested environment, and this other new thing that we need to do,' ... It's a balance every day."

The evolution in training gives AMC a chance to review current and past practices, and provide more targeted flying, which could help avoid training for highly unlikely scenarios.

"We're just now beginning the effort to do that," she said.


Yet as AMC prepares for high-end conflict, demands continue across the Middle East. In Afghanistan, C-130 aircrews have returned to almost surge-level airdrop operations, and tankers are forward deployed to keep up with unrelenting air strikes. Demand also continues unabated for tankers in both the Pacific and European Theaters.

"That's the balance, ... because our force is so small," Miller said. "We fulfill combatant command requirements, we fulfill training requirements, we fulfill service requirements. So, in the midst of all this, how do we carve out enough time so they can get the training? It's a discussion every day."

In early 2018, AMC began a unique effort to leverage technology to help address the problem. Using artificial-intelligence software to analyze deployment and operations tempo for tankers over the past several years, as well as maintenance and depot data, the command can now better predict when tankers will be most in demand. Those insights have helped commanders better align deployments with actual demand, reducing its number of deployed tankers from July to March, for example, by nine KC-135s with 17 crews and two KC-10s with six crews.

That's a major savings on both wear and tear on the aircraft and on the lives of those crews and their units back home.

"We have to meet the operational tempo out there because the war-fight demands it," Miller said. But that doesn't mean units need to deploy when they're not really needed. Wiser use of resources can make it easier—in the end—to do more with less.

"They're out there doing the mission every day," Miller said. "We've got them training for the high-end fight, depending on their weapons system. We've got them doing all different kinds of things to prepare for the next fight. We have to." 

Moving MDC2 from Research to Reality

Multi-domain command and control moves into the schoolhouse.

By Rachel S. Cohen

Barely two years after Air Force Chief of Staff Gen. David L. Goldfein laid out his vision for multi-domain command and control, the concept is beginning to take root.

This month, a select group of 34 mid-career officers will head to Hurlburt Field, Fla., for the Air Force's inaugural MDC2 training course, where they will prepare for a new career field known as 13O, or "13-Oscar." Meanwhile, about 1,400 miles away, a team at Hanscom AFB, Mass., is in the early stages of developing new tools and technologies for the job.

And for the first time, the Air Force's budget breaks out plans to dedicate \$150.8 million to MDC2 research and development in 2020.

Goldfein's once-abstract proposal—airmen should think outside their silos to wage smarter, faster war—is beginning to take shape.

MAKING A 13-OSCAR

The 13O course establishes clear steps for teaching airmen to understand multi-domain capabilities and is a primer on the joint planning process, according to Col. Francisco M. Gallei, the 505th Training Group commander at Hurlburt Field.

"We've always done multi-domain operations," Gallei told *Air Force Magazine* in a March 12 interview. "The problem is, we just haven't done it really, really well. A lot of multi-domain operations



"Enhancing old processes and capabilities is insufficient to meet the high-end fight!"

—Sheryl Thorpe, Multi-Domain Command and Control Capabilities Office

or capabilities have been brought to execution as an afterthought."

To combat that tendency, the course will approach MDC2 in three parts:

- How the air component works and how it integrates with higher authorities. Airmen will study joint planning and targeting and learn the role of intelligence and mobility assets, Gallei said.

- How the other service components work and what capabilities warfighters in each domain—air, land, sea, space, cyber—can bring to bear. Students will learn how to collaborate with other armed forces, interagency partners, and coalition members. The curriculum is being developed in consultation with the other services and coalition partners, who will teach the lessons concerning their branches and components.

- How to plan joint exercises and operations.

In the second phase, Gallei said, "We'll be doing what we call micro-joint planning exercises: They'll be presented a problem, and they'll have to go



The Combined Air Operations Center at Al Udeid AB, Qatar, provides command and control to airpower throughout Iraq, Syria, and 17 other nations. MDC2 means injecting a fuller understanding of other domains in the CAOC.

Photo: TSgt. Joshua Strang

through the planning process in order to come up with a multi-domain solution.”

Instead of building an air-centric plan, officers will learn to consider effects in any domain. Could a cyber effect make more sense? Would a naval capability be useful? How might a space asset help? What are the risks and benefits of a kinetic effect versus an electronic attack?

MDC2 operators do not have to memorize all the capabilities a domain can offer, but instead must know how to reach back to subject-matter experts who can provide the right options.

Those skills are essential for the third phase of the course, when students take on bigger joint planning exercises.

“They’ll be given, for example, a scenario and then the students will have to plan just as if they were on the air component staff or a joint staff, going through the whole joint planning process,” Gallei said.

Students will likely visit the Combined Air Operations Center at Nellis AFB, Nev., and be evaluated on their performance on an operations floor.

After completing the training, graduates will be assigned

to AOCs around the world, initially regional AOCs in the US and overseas and, later, functional AOCs at USAF major commands.

“The plan, of course, is that as we get more students through the pipeline, that’ll expand naturally to the ... joint headquarters and those kinds of things,” Gallei said.

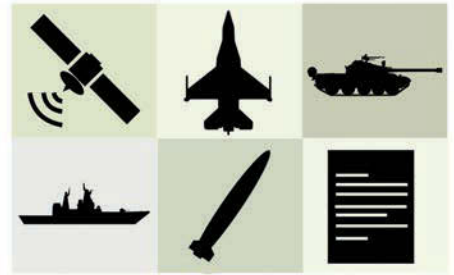
A few classes will need to cycle through before instructors start getting feedback from the field—for instance, whether exercise scenarios should be tweaked or if students don’t grasp current technologies, he added. He noted the Air Force doesn’t need to adopt any particular new tools before it can teach MDC2.

The first 20-week course will start May 28 with 34 officers—about half of those who applied—according to Air Force spokesman Maj. Bryan Lewis. The course will run twice a year and aims to graduate about 70 13Os each year. Mid-career officers with about a decade of experience in any specialty are eligible to apply.

Graduates of Air University’s 10-month multi-domain operational strategist program can also become 13Os, Gallei said. Maxwell AFB, Ala., officials did not comment for this story.

Leveraging Blockchain for Multi-Domain Warfare

Blockchain is a digital technology that generates a highly trusted immutable record of changes to a database. Best known for its use in digital currencies, such as Bitcoin, where blockchain's distributed ledger system exists in an open system, the technology can also be used in closed systems to ensure data integrity. Air Force officials are investigating its use in managing simultaneous space, cyber, and air targeting across different classification levels.



1 An event is encoded into a block of digital data and given a unique identity.



2 Each block of data is connected to the one before and after it, creating a chain that cannot be removed or altered. This blockchain information can be viewed by any authorized user.

3 As more blocks are created, they are chained together, which prevents any blocks from being removed, altered, or inserted between two existing blocks of encrypted information.

Source: IBM: Blockchain For Dummies

Some argue that waiting until so late in an officer's career to teach multi-domain concepts is a mistake. Air Force Secretary Heather Wilson said in 2018 that the service should start MDC2 training earlier.

But Gallei and Air Force Operations Director Brig. Gen. B. Chance Saltzman, who ran the service's yearlong study of MDC2 in 2017, argue 13-Oscars need substantial tactical experience in air operations, satellites, and cyber operations before they can be effective MDC2 planners. Once they achieve that designation, they'll remain in that capacity, rather than do it for one tour and rotate back to their specialty. As a result, operational experience is critical to inform their general understanding.

"The new career field is opening up opportunities for officers to serve at the operational level for an extended period of time," Lt. Col. Andrew Smith, 19th Airlift Wing staff director, said in a January news release. "These officers will gain valuable experience while increasing continuity and effectiveness of operations."

The key to their success lies in the Air Force's ability to ensure becoming a 13-O is not a dead end. "If there are no opportunities for a 13-Oscar," Gallei said, "eventually you will get folks who are not interested."

Planners have to "stay current on capabilities," he said. "Part of the course is to teach them the capabilities and where to ask for capabilities, who to go to. ... I really don't see a lot of things changing in the way people interact at the AOC."

Existing C2 training courses are already feeling the ripple effects of the service's MDC2 pivot. Air C2 operators see information about other domains in their initial qualification training, Gallei said, and space and cyber operators are learning more about AOCs.

"I think there will be some goodness, some bleed-over in capability and training between the 13-Oscars who are really focusing on the multi-domain piece and the joint planning piece to the [initial qualified training] students coming in brand-new," he said.

While Gallei said the ultimate size of the career field depends on the service's capacity, Saltzman has said he expects to reach around 500 13O billets.

According to slides Saltzman presented at a MITRE Corp. conference last summer, certain billets at AOCs would be

converted to MDC2 jobs. He anticipated the Air Force will eventually have 250 majors, 125 lieutenant colonels, and 25 colonels working on MDC2.

Those who will succeed in the field are lifelong learners, students of history and current affairs who are eager to expand their horizons, Gallei said.

BUILDING THE TOOL KIT

To succeed, the Air Force also needs the digital tools to make decisions quickly. In February, a new Multi-Domain Command and Control Capabilities Office laid out its vision and priorities to more than 100 companies and partners at its first Industry Day in Lexington, Mass. The goal is to develop a new process and information architecture that will enable warfighters to be more effective in the heat of battle.

"Enhancing old processes and capabilities is insufficient to meet the 'high-end' fight," said Sheryl Thorp, the office's program manager, and Russ Jimeno, its chief engineer, in written responses sent March 8. "This office has been tasked with standing up an enduring experimentation campaign to consistently experiment and identify innovative ways to meet 2030-and-beyond future warfare."

They're working with Eileen Vidrine, the Air Force's new chief data officer, to sketch out an architecture that can share data across systems in different domains.

One of the office's first initiatives will explore using blockchain—the same tamper-proof database technology behind Bitcoin and other digital currencies—to "experiment with performing simultaneous space, cyber, and air targeting across classification levels," according to Industry D ay slides.

The Air Force also wants to demonstrate it can autonomously collect, process, and share command and control data from an airborne platform.

"Shadow Net," a data-processing network set up between several military sites in the US, aims to eventually include that airborne node.

The Shadow Net "will create a specific data location where multiple sensors can input information," the service said in a Feb. 25 release. "Airmen and combatant commanders can read and process that information in order to make fully informed battlefield decisions."

Thorp and Jimeno said they would issue requests for proposals for the blockchain and mobile C2 node initiatives "in the



Photo: A1C Krystal Ardrey

Airmen at the Joint Space Operations Center monitor computer systems to detect, track, and identify artificial objects in Earth orbit at Vandenberg AFB, Calif. New 13-Oscar officers must learn what effects can be achieved in air, space, cyber, sea, and ground operations.

near-term.” AFWERX has its own data-fusion effort underway to support the MDC2 Capabilities Office.

Following an agile software development model, each experiment will last a year or less, broken down into six-month sprints, to reduce the risk of locking in old technology, considering it changes so quickly, the officials said. Other efforts will focus on identity management, artificial intelligence, machine learning, automation, and data sharing among various classification levels.

Identity management is critical to this challenge, Saltzman told *Inside Defense* in December 2018.

“We have to do a better job of expressing in policy terms the risk framework for sharing information,” he said. “Even among ourselves, need-to-know is really indiscriminate. If you’re a US person in the military but don’t have a need to know, I cut you off the same as if you’re a coalition partner that I’ve determined doesn’t have a need to know.”

The Air Force must approach C2 assets more holistically, rather than thinking about them as independent programs and hoping they align, Saltzman said. The new office is reaching out to those who run current C2 systems to figure out how to work existing technology into the experimentation campaign.

“In our experimentation, if technology or services can support the operational communities, our goal is to ... leverage that capability soonest,” Thorp and Jimeno said.

Industry was “very responsive” to what they heard at the February gathering, the officials added.

Traditional defense firms worry that the focus on innovation, emerging technology, and startups will blind the Air Force to the capabilities of its traditional supplier base. Lockheed Martin, for example, has tried to woo the Air Force with significant investment in MDC2 tools and a war game series now

on its fifth iteration. Company officials told reporters at AFA’s Air Warfare Symposium in March that Lockheed will align resources across all of its business areas to push the MDC2 envelope even further.

Thorp and Jimeno acknowledged that traditional suppliers are part of the discussion. “We have been talking with many companies to include Lockheed, discussing their activities and tracking their innovative ideas,” they wrote. “There are many areas to collaborate.”

‘ONE BITE AT A TIME’

The multi-domain theme is spreading across the service in other ways. For example, Air Education and Training Command will soon tie multi-domain warfare into its Pilot Training Next initiative.

Vice Chief of Staff Gen. Stephen W. Wilson is also challenging airmen this year to “harness the human-machine teaming technology found in the myriad of apps on portable devices and deliver a similar situational awareness capability for the joint force.” Meanwhile, solicitations for new MDC2 research efforts regularly appear online.

What’s next? Gallei thinks sister-service participation in the 13O career field could spur the Army and Navy to send students to the Air Force’s course, or encourage them to develop their own multi-domain warfare courses. The MDC2 Capabilities Office is involving the other services early in its experiments to better address joint data-sharing issues.

“Whether you’re talking training and education, adapting advanced technologies, or creating new operational concepts, it’s a big animal,” Saltzman said last September. The Air Force can’t swallow it all in one move. “We intend to eat it—one bite at a time.”



Building the Air Force We Need: Keys to Shaping Tomorrow's Air Force

By Lt. Gen. David A. Deptula, USAF (Ret.) and Douglas A. Birkey



Lt. Gen. David A. Deptula, USAF (Ret.) is the dean of the Mitchell Institute for Aerospace Studies.

Douglas A. Birkey is the executive director of the Mitchell Institute. This article is adapted from the Mitchell Policy Paper *The Force We Need: Key Factors for Shaping the Air Force for the Future*, which can be downloaded in its entirety at: www.mitchellaerospacepower.org.

Secretary of the Air Force Heather Wilson issued a warning at AFA's Air, Space & Cyber Conference last September: "We must see the world as it is. That is why the National Defense Strategy explicitly recognizes that we have returned to an era of great power competition. We must prepare."

World events back up this assertion in no uncertain terms. With China aggressively expanding its territorial zone of control in the Pacific Ocean in excess of international norms, and Russia pursuing overt acts of hostility in places like Ukraine and Syria, the global threat environment is growing to levels unseen since the Cold War. North Korea's possession of nuclear weapons and Iran's continued assertiveness in the Middle East are also generating strategic-level threats from regional actors. Finally, persistent instability in places like the Middle East, Africa, and beyond continues to demand military attention. Said another way, "The security and well-being of the United States are at greater risk than at any time in decades." This grim assessment is the opening line of the recent report by the bipartisan Commission on the National Defense Strategy for the United States. Cutting to the essence of the specific challenge facing the Air



A KC-135 refuels fighters during a training mission over the Baltic Sea. Air-refueling orbits are an essential component of the American way of war.

Photo: TSgt. Roitdan Carlison

Force, Secretary Wilson stated the issue succinctly: “The Air Force is too small for what the nation expects of us.”

An undersized US Air Force means fewer national security options and the assumption of increased risk at the strategic, operational, and tactical levels of conflict. The basic reality is that Air Force airpower provides a unique asymmetric advantage for the United States through its ability to strike targets anywhere on the globe, anytime; secure and maintain theater-wide air superiority; gather vital intelligence, surveillance, and reconnaissance (ISR) on a global scale; facilitate command and control of forces; and execute global mobility in a matter of hours. These attributes are vital to empowering successful, decisive strategies against highly capable adversaries.

While the US possesses other military air assets in the Army, Navy, and Marine Corps, these aviation arms are designed to support the core functions of their respective military services. Individually, they lack the scale, scope, and capabilities necessary to facilitate independent, theater-wide, full-spectrum operations. For example, naval carrier air wings are first and foremost focused on defending surface battle groups. Their small size also limits their ability to project large-scale, sustained airpower. Marine

Corps aircraft are tied to Marine Air-Ground Task Forces (MAGTFs) and are generally not available for theater taskings. The same holds true for organic Army aviation assets with their function directly assigned to their Army organizational units.

The Air Force is uniquely organized to project range, mass, lethality, and survivable power in a theater-wide fashion, free from organic surface mission obligations. Combatant commands (COCOMs) understand this value, and it is a key reason why they place a high priority on Air Force aircraft and personnel. As one Air Force leader recently detailed: “In the last five years, [Air Force Global Strike Command] has gone from supporting one enduring COCOM requirement to an average of 12 annually, a 1,100 percent increase.” Given the Air Force’s small bomber fleet of 157 aircraft, a record low number by historic standards, meeting this demand presents challenges. This is not a one-off situation—nearly every Air Force mission set is in high operational demand with fewer aircraft available than ever before in Air Force history to meet the spectrum of the nation’s national security requirements.

FORCE-SIZING THE AIR FORCE

Recognizing the need to align available resources with demand, the Air Force leadership articulated the requirement to grow operational Air Force squadrons from 312 to 386 by the 2025 to 2030 time frame. However, 386 operational squadrons outline an organizational construct—not a force-structure plan. The missing pieces needed to make sense of the 386 figure include what actual platforms, quantity, and capabilities make up those squadrons. This detail is necessary to make the 386 squadron mark connect, hold credibility, and endure rigorous resource discussions.

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

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

SrA. Cody Mehren signals a B-2 during a refueling stop at Andersen AFB, Guam. A robust Guam presence is vital to American strategy in the Pacific Ocean in the face of a rising China threat.



Photo: TSgt. Jake Barreiro

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

Each AEF is a “mini Air Force” and has sufficient numbers and types of aircraft and personnel to conduct core missions when called upon by combatant commanders. Ten were necessary to meet the needs of the national defense strategy at the time. An AEF is a group of associated units that provides a cross section of aerospace capabilities. The AEF does not deploy en masse; rather it is a resource pool from which to draw the right mix of forces to accomplish a combatant-command requirement. These task-organized forces were presented to theater commanders in the form of Aerospace Expeditionary Wings (AEWs), and their subsidiary groups, and squadrons. Elements from two AEFs were either deployed on a rotational basis or on call, with the remaining eight in sequence recovering from deployment, conducting proficiency training, or preparing to deploy. The AEF represented a well-defined package of Air Force aerospace power.

While the AEF concept remains sound, budget pressures and corresponding force-structure divestitures over the past decade strained the model, particularly when Air Force leadership tried to accommodate Army rotation policies in the midst of both Operation Enduring Freedom and

Operation Iraqi Freedom as they dragged on into the late 2000s. The Air Force became so small that balanced force rotations were no longer possible, and the AEF concept was shifted to meet ground-force demands. This shift would become one of the principal drivers behind the current pilot crisis and result in reduced readiness to respond to major regional conflicts. People and equipment burned out at a rapid rate—the exact circumstances a sustainable rotation-based model was designed to prevent.

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

Furthermore—and most important—using the AEF as a force-sizing methodology provides the Air Force a logical, relevant, and easily understandable means for the American people and Congress to comprehend the tie between the demands of the national security and defense strategy and the quantity and types of aircraft needed to execute them. Specifically, there are two tenets of American national security strategy over the last quarter century that have endured through presidential administrations of both political parties. First, the US will maintain sufficient forces and capabilities to engage around the world to encourage, shape, and maintain regional peace and stability; and second, in the event the US does need to fight, it will do so in an expeditionary fashion away from American territory in

Combat-Coded Aircraft Requirements

Type	Operational Squadrons ¹	Squadrons/AEF	PMAI ²	Total Aircraft Inventory
Fighters	70	7	1,680	2,700
Attack RPA	10	1	180	250
Bomber	15	1 low observable/0.5 conventional	180	300
Tanker	60	6	480	500
Tac Airlift	30	3	300	340
Strat Airlift	30	3	300	320
ISR	20	2	240	250
CSAR	10	1	120	150
Trainers				1,500
Special Airlift				160
Special Ops				155
			Total 3,480	Total 6,625

1: Does not include training, test, or special operations.

2: PMAI=primary mission aircraft inventory (combat-coded).

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

a manner that puts our adversary's value structures at risk, while maintaining the ability to win more than one major regional conflict at a time.

In order to be able to fulfill both of these tenets, the Air Force needs enough robust, capable, and ready forces to establish a rotational base sufficient to sustain peacetime engagement operations. To do that, the Air Force can use its AEF structure to maintain sufficient numbers of rotational forces. With respect to the second major requirement of both national security and defense strategies—the ability to win more than one major regional conflict at a time—historically, this has required five AEFs worth of capability per major regional conflict (or 10 AEFs). This requirement was articulated explicitly in the early 1990s during DODs “Bottom-Up Review” (BUR) and remains today, although language in subsequent defense reviews cleverly reformulated the construct to match the reality of periodic defense budget cuts. Arbitrary budget constraints—not threats or strategy—have driven the most significant changes to the Pentagon's force-planning policies since the 1993 BUR. The return to great power competition and growth of major regional threats, such as Iran and North Korea, have revitalized this important force-sizing concept.

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

At the same time, because of the enormous cost-effectiveness of legacy bombers for a range of missions and their highly relevant capabilities, the US also needs a minimum of six nonpenetrating long-range strike aircraft per AEF for operations in a standoff role, or for when permissive airspace is created. This reflects mission demand seen in

regions such as Iraq, Syria, and Afghanistan over the past 17 years. It is also important to highlight that, despite the age of these aircraft, their attributes would also see them engaging in a “nonpenetrating” fashion against more advanced adversaries. Including training, attrition reserve, and backup aircraft inventory, that requirement equates to a total legacy bomber force of 90 (60 combat-coded; 15 for training; 15 for attrition reserve and BAI). This would allow for five operational bomber squadrons. When viewed together, the Air Force needs a total bomber force of 270 bombers of all types, or 15 total operational bomber squadrons. Today, the Air Force possesses eight-and-a-half bomber squadrons. The situation is similar for fighter aircraft. The AEF construct was actually used in one instance as a rationale for a particular aircraft—the F-22 Raptor. This construct established a revised requirement of 381 F-22s during the 2001 Quadrennial Defense Review (QDR), based on a nominal squadron size of 24 combat-coded aircraft per squadron.

Using the AEF model as described above, the Mitchell Institute calculates that the objective force structure that the Air Force needs to meet the force capacity required by the US National Defense Strategy is illustrated in the table (above).

The bottom line is that we have a choice: We can either fund our military to meet the demands of the National Defense Strategy, or we can lower the expectations of the defense strategy to some arbitrary budget amount. Congress cannot go on living the fallacy that the defense budget is sufficient to execute the demands of our defense strategy.

ADAPTING THE AMERICAN WAY OF WAR

Potential adversaries have studied the traditional American way of war—concepts of power projection that have generally remained static since the end of the Cold War. These include rapid deployment and sustainment of large air, ground, and naval forces to forward bases and littoral seas; staging, maneuver, and support of large numbers of ground forces; efficient generation of combat-aircraft sorties 24/7 from land and sea bases; secure ISR and air-refueling tanker orbits; and US possession of strategic initiative.

The US way of war is dependent on highly efficient supply chains and force-generation processes. Can US forces generate combat effects if these processes are heavily attacked? Adversaries will be capable of denying these elements in the

The sun rises on an EC-130 Compass Call aircraft at an undisclosed location in Southwest Asia.



Photo: SSgt. Jeremy Mosier

future. They have worked to both emulate US strengths and probe US weaknesses.

Russia and China are developing fifth generation stealth fighters for their air forces today to disrupt these US war-fighting elements. Chinese military leaders speak openly about using advanced anti-ship missiles to sink American aircraft carriers.

There will be no extended “spin up cycle” for future wars. Modern conflicts now emerge quickly, move fast, and are unpredictable, and victory often hinges on decisive, prudent power-projection capabilities. Advanced combat aircraft required to succeed in modern warfare are not built overnight. The same holds true for the airmen who fly and maintain them. Training, building experience, and honing concepts of operation takes years. Decisions made today regarding the size and composition of US military force structure will fundamentally govern the scale and scope of national security options available to leaders for decades to come.

RECOMMENDATIONS

The Mitchell Institute believes there are five keys to solving the force-sizing dilemma:

Close the Requirements Gap. The Air Force must continue to highlight the gap between available force-structure capacity and real-world security requirements. The Air Force must develop and implement a force-sizing construct to ensure service leaders, defense officials, congressional staff, and other stakeholders can get insight into the nature of these capacity gaps. The AEF model provides a logical, relevant, and easily understandable means for the American people and Congress to comprehend the tie between the demands of the US National Security Strategy and the quantity and types of aircraft needed to execute it.

Build a Force for the New Defense Strategy. For the last three decades, the success or failure of US military campaigns did not fundamentally threaten America’s existential security interests. This dynamic is rapidly changing in an era defined by multiple peer-nation security challenges. The Department of Defense must address “high-demand, low-density” mission areas that tie directly to core aspects of the 2018 National Defense Strategy, which stresses the importance of great power competition.

Address Future Needs, Not Just Present Demands. The growth requirements articulated by Air Force leadership are focused on meeting existing demands on the force, not surplus capacity. The Air Force must prioritize capabilities and capacity that address future requirements. Finite funding and growing operational demand weight on US military forces require qualities such as “combat cloud” functionality, improved readiness rates, range, stealth, and fifth generation design characteristics. Growth is also not just about aircraft force structure, but also pilot production, maintenance capacity, and effective logistics. All of these factors will prove critical to yielding credible, sustainable combat power in the future.

Shift Cost Models. The Department of Defense clearly faces resource challenges. However, room for necessary investment can largely be found within existing budgets by conducting an honest review of roles and missions, and shifting from a “unit cost” metric to a “cost per desired effect” measure of capability merit—the actual enterprise mission expense associated with securing desired aims—versus the traditional upfront unit acquisition expense as a decision metric. For example, a stealth aircraft is far more cost-effective than the alternative of a strike package of over a dozen nonstealthy legacy aircraft to net the same objective at far greater risk. The qualities of future war will be different as well. The operating paradigm must shift to focus on the US military’s ability to gather, process, and disseminate information to ensure that the most effective mix of assets will be at the right time and place to best net a desired effect, while minimizing undue vulnerability.

Reform and Replace Operating Constructs. Finally, legacy operating constructs must be challenged, from combatant commands to the military services. Past approaches through a given domain, or done with certain assets, do not preclude the pursuit of more effective, efficient, survivable, and responsive mission alternatives. A paradigm shift is required as an imperative for success in the information age—a concept to achieve an intelligence, surveillance, reconnaissance; strike (ISR); cyber; maneuver; and sustainment complex often referred to as a “combat cloud.” This is the way of the future, generating the capability to create a global sensing grid, and then actualizing the ability to make decisions and engage at the combat edge, outpacing any adversary’s decision cycle. ☛

POTUS Flies

The VC-25B will be next in the line of presidential aircraft from FDR to Donald Trump.

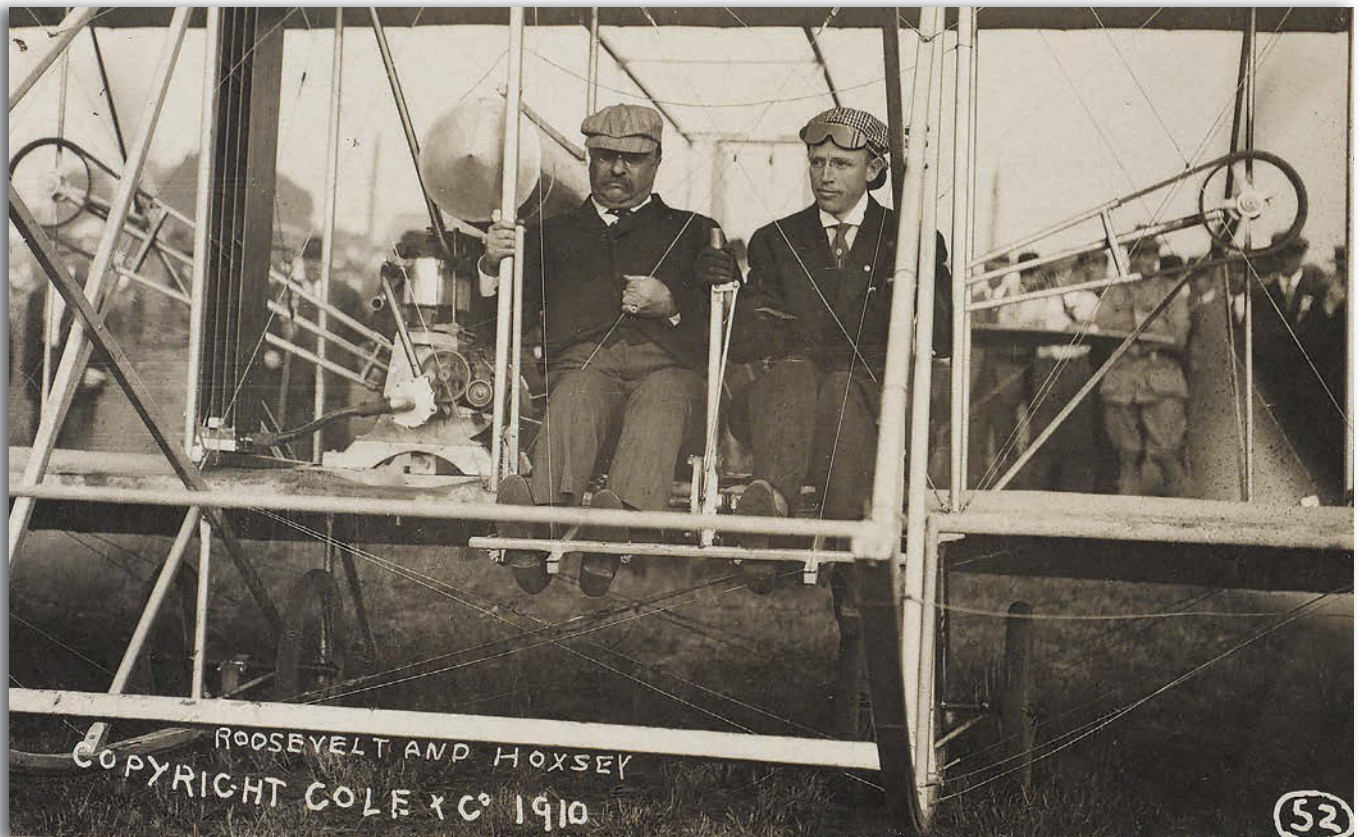


Photo: Cole & Co. via Library of Congress

In 1910, former president Theodore Roosevelt (l) grasps a strut on a Wright Type B biplane at Kinloch Field in St. Louis. The pilot, Archibald Hoxsey, who worked for the Wright brothers, died a few months later in a crash attempting to set an altitude record.

By John T. Correll

In January 1943, US President Franklin D. Roosevelt and British Prime Minister Winston Churchill met in secret in Casablanca to plan the next phase of strategy for World War II. In preceding months, German submarines had sunk hundreds of Allied vessels, so crossing the Atlantic by ship to the conference in North Africa was considered too dangerous for the president.

FDR boarded a Pan American flying boat, the *Dixie Clipper*, in Miami and flew by stages to Trinidad and Brazil, then across the ocean to British-controlled Gambia on the coast of Africa. From there, a C-54 transport took him on to the meeting in Morocco. The trip was not disclosed to the public until he was safely back home.

It was the first time an incumbent president had traveled by air on official business, but—depending on how the historic milestone is interpreted—Roo-

“By George, it was fine! I only wish I could have stayed up an hour!”

—Teddy Roosevelt

sevelt was not the first president to fly. That honor is usually accorded to FDR’s distant cousin, Theodore “Teddy” Roosevelt.

At a county fair in St. Louis in 1910, Teddy Roosevelt—whose tenure as president had ended 18 months previously—took a four-minute flight in a Wright Type B biplane. A contemporary photo shows him sitting beside the pilot, holding on to a strut. “By George, it was fine!” he said. “I only wish I could have stayed up an hour.”

FDR’s *Dixie Clipper* was the first in a long line of airplanes assigned to transport POTUS (as the president of the United States is referred to in Beltway shorthand). Although the Army and Navy kept airplanes ready for Roosevelt, most notably a modified C-54, the *Sacred Cow*, he flew only twice more, to the Allied conferences at Tehran in 1943 and Yalta in 1945.

President Harry S. Truman inherited *Sacred Cow*, which was later replaced by a DC-6, *Independence*,



President Franklin Roosevelt (second from left) celebrates his 61st birthday on *Dixie Clipper*, returning from the Casablanca Conference.

Photo: National Archives

named after his hometown. President Dwight D. Eisenhower's airplanes were two C-121 Constellations, *Columbine II* and *Columbine III*. (The original *Columbine* was his military C-121 when he was Supreme Allied Commander Europe.)

For the past 60 years, presidents have flown on variants of four-engine Boeing airliners. The call sign for any USAF aircraft when POTUS is aboard is "Air Force One," but the principal one currently in service is a VC-25, the military version of the Boeing 747 jumbo jet.

For shorter trips, including the hop from the White House to Joint Base Andrews in the Maryland suburbs where Air Force One awaits, the president usually takes a Marine Corps helicopter designated as "Marine One."

The "Special Air Mission" fleet at Andrews, operated by the 89th Airlift Wing, consists of about 15 aircraft. They include the primary VC-25 and a backup, as well as business-jet variants used by the president and assorted senior government officials. The aircraft are identified by the initials SAM plus the tail number.

The VC-25s—SAM 28000 and SAM 29000—have been flying since the early 1990s and are due for replacement. The next Air Force One, the VC-25B, is on contract and scheduled for delivery in 2024. It will be a variant of Boeing's 747-8.

EARLY BIRDS

Other world leaders had traveled by air in their official

capacities well before Roosevelt did. In Germany, Adolf Hitler flew to the massive Nazi Party rallies on a Junkers Ju 52. His arrival in Nuremberg in 1934 was featured in the famous propaganda film *Triumph of the Will*. In 1938, British Prime Minister Neville Chamberlain went to Munich on a Lockheed Electra for his notorious "appeasement" meeting with Hitler.

The first US airplane configured for presidential use was a transport version of the B-24D bomber named *Guess Where II*. FDR never flew on it, but First Lady Eleanor Roosevelt did. For his trip to Tehran in 1943, Roosevelt took the battleship *Iowa* to Cairo and flew from there to Iran on a TWA C-54.

Sacred Cow, delivered in June 1944, had an elevator to lift Roosevelt in and out of the aircraft in his wheelchair. FDR flew on it only once. In February 1945, the heavy cruiser *Quincy* took him to Malta, where he met up with *Sacred Cow* for the flight to Yalta for the conference with Stalin and Churchill.

For the final Big Three meeting in Potsdam in July 1945, Truman made his transatlantic crossing on the cruiser *Augusta* and flew on from Antwerp to Berlin on *Sacred Cow*. Churchill also flew. Stalin came by train. After a rough flight with severe turbulence in a Lend-Lease American C-47 in 1943, Stalin refused to fly again for the duration of the war.

In 1945, Truman dispatched *Sacred Cow* to bring his mother, Martha Truman, 92, from Missouri to Washington for Mother's Day. Upon landing, she was going down the elevator that had been installed for FDR when it stuck. It

Air Force One throughout the years



Sacred Cow is now at the National Museum of the US Air Force.



Independence, Truman's Air Force One, was a DC-6 named after his hometown.



SAM 26000 flew presidents from Kennedy to George H. W. Bush.



The current Air Force One is a modified Boeing 747, but a new aircraft is in the works.

Photos: National Museum of the US Air Force (1,2); National Archives; SSgt. Kenny Holston

President Ronald Reagan (l) in the cockpit of Air Force One, call sign SAM 27000, in 1982. The aircraft is now on display at the Reagan Library in Simi Valley, Calif.



Photo: White House

had to be pulled up to get her out. Turning to the pilot, she announced that, “I am going to tell Harry that this plane is no good, and I could walk just as easily as I could ride.”

On July 26, 1947, Truman signed the National Security Act onboard *Sacred Cow*. This act established the Air Force as an independent service, making *Sacred Cow* “the birthplace of the Air Force.”

The next presidential aircraft, *The Independence*, entered service in 1947. In 1950, it carried Truman to Wake Island in the Pacific to confer with Gen. Douglas MacArthur, commander of US and UN Forces in the Far East, about the progress of the Korean War.

Eisenhower’s first official aircraft was the VC-121A *Columbine II*, similar to the military transport he had used in Europe. A VC-121E Super Constellation, *Columbine III*, was added in 1954. These were the first airplanes to be called “Air Force One.”

Over Richmond, Va., in May 1954, *Columbine’s* pilot checked in with the air route traffic control center as Air Force 8610. This induced a query from an Eastern Air Lines pilot whose call sign included the same numbers. Contrary to an often-told story, the two airplanes did not cross paths, but it was decided that the president’s plane should have a call sign like no other.

THE BIG BOEINGS

The first jet, a Boeing 707 named *Queenie*, joined the Special Air Mission fleet in 1959. It was not designed specifically for presidential travel and most of its service was in backup roles. The classic Air Force One—a highly modified 707-320B airliner, military designation VC-137, tail number 26000—was delivered in October 1962.

The distinctive appearance was developed by First Lady Jacqueline Kennedy and industrial designer Raymond Loewy. The aircraft was painted in vibrant blue and white with the words, “United States of America” running in tall letters along the fuselage and an American flag on the tail. That set the look for Air Force One that continues today.

SAM 26000 was the airplane that took President John F. Kennedy to Dallas in November 1963 and brought his body back to Washington after he was assassinated. Lyndon B. Johnson took the presidential oath aboard the aircraft.

A second VC-37, SAM 27000, was added in 1974. In honor of the upcoming bicentennial, President Richard M. Nixon had “*Spirit of ‘76*” lettered on the noses of both aircraft. To his chagrin, the new names never caught on and were eventually removed.

Nixon resigned from office Aug. 8, 1974, effective at noon the next day. At that time, he was airborne in Air Force One, bound for San Clemente, Calif. When Gerald R. Ford took the presidential oath just after noon, the pilot notified the air traffic control center at Kansas City that the call sign had changed to “SAM 27000.” The passenger was no longer president.

When the Air Force in 1985 put out a request for proposals to replace the VC-37s, one of the bids was for a wide-body Douglas DC-10. However, it had only three engines, one under each wing, one atop the fuselage. That was sufficient for the requirement, but tradition was strong for a four-engine airplane, and a variant of the Boeing 747 jumbo jet was chosen. Two of these, designated VC-25s, were delivered in 1990 and 1991 and are still the primary Air Force One aircraft.

The biggest collection of retired presidential aircraft is at the National Museum of the US Air Force in Dayton, Ohio. *Sacred Cow* is there, as are *The Independence*, *Columbine III*, and the most famous Air Force One of them all, SAM 26000, which flew presidents from Kennedy to George H. W. Bush. SAM 27000 is at the Ronald Reagan Presidential Library and Museum in Simi Valley, Calif. The Museum of Flight in Seattle has *Queenie*, the first of the presidential jets.

FLYING WITH POTUS

There is plenty of elbow room on Air Force One. A regular Boeing 747 in high-density configuration seats 660 passengers. The standard complement of Air Force One is fewer than 100, counting the crew.



Photo: Pete Souza/White House

President Barack Obama (I) meets on Air Force One with Secretary of State John Kerry, National Security Adviser Susan Rice, Phil Gordon, coordinator for the Middle East, North Africa, and the Gulf region, and Ben Rhodes, deputy national security adviser for strategic communication, during a trip to Riyadh, Saudi Arabia, in 2014.

The aircraft has three decks, the lowest one for cargo and equipment, with the flight deck and communications center up top. Passengers are on the main deck. In earlier presidential aircraft, the president's stateroom was in the rear, away from the engine noise. Nixon had the cabin moved forward, in front of the engines, where noise was not an issue.

The press section, accommodating a pool of about a dozen reporters and photographers, is in the back. In between are the staff offices, a conference room, dining room, and a medical suite that can function as an operating room. There is always a doctor onboard.

On VC-25, the pilots sit up high. The flight deck is 29 feet above the ground, 100 feet forward of the main landing gear, and 12 feet in front of the nose gear.

For security reasons, all the food—enough to last for two weeks—is obtained in Washington. Passengers are expected to eat what they are served, but the stewards make sure the choices reflect what the main passenger likes.

Reagan enjoyed meatloaf and macaroni and cheese except when First Lady Nancy Reagan was along on the trip, in which case, he had a bowl of vegetable soup with a salad or fruit. Ford's favorite was cottage cheese and A-1 Steak Sauce. George H. W. Bush banned broccoli from the airplane altogether.

Even jaded travelers cherish the souvenirs from their flight. These once proliferated, and included Air Force One playing cards, mugs, glasses, and other trinkets. The takeaways have been reduced in recent years but the special M&Ms are still available, the boxes embossed with the presidential seal and the autograph of the current president.

The aircraft was featured in "Air Force One," a political thriller movie in 1997 starring Harrison Ford as President James Marshall. Presidents Bill Clinton and Donald Trump have given the film good reviews but pointed out that the escape pod through which Harrison Ford eludes his adversaries is fictional.

Presidents have differed appreciably in their demeanor aboard Air Force One. Ford is generally remembered as the

most congenial and considerate. By contrast, Johnson was imperious and often ill-tempered. "He installed a special seat, which his aides called 'the throne,' that he could raise at the push of a button so he could ascend to a higher, more regal elevation than anyone else," said press pool veteran Kenneth Walsh of *US News & World Report*. Bill Clinton was informal and gregarious. He would wander back to the conference room, wearing a T-shirt and jeans, for a game of Hearts.

Normally, news coverage of Air Force One is positive for a president's image—but there are exceptions. In 1993, Clinton called Beverly Hills hair stylist Christophe to come give him a high-priced trim aboard Air Force One at Los Angeles International Airport. Departure was delayed by almost an hour.

Unfortunately, the delay was not anticipated and the airplane sat on the ramp, engines idling. Since other air traffic stops before and after a presidential arrival and departure, two of the airport's four runways were shut down for the duration. Clinton took a pounding in public relations for the abuse of privilege.

THE REST OF THE FLEET

The big VC-25s need at least 7,000 feet of runway. When the destination is a shorter airfield, one of the other aircraft in the SAM fleet at Andrews takes over as Air Force One. A frequent choice is the VC-32, the military model of a Boeing 757 twin-engine midsize airliner, which most frequently operates as "Air Force Two," transporting the vice president.

Presidents have made use of smaller airplanes all along. Eisenhower favored a propeller-driven LG-26 Aero Commander which flew as Air Force One when shuttling him to his farm in Gettysburg, Pa., where there was a grass runway. Similarly, an Air Force C-140 business-style jet could land at Johnson's LBJ Ranch in Texas.

Helicopters have served since 1957 for short hops between the south lawn of the White House and Andrews or to the presidential retreat at Camp David, near Thurmont, Md., about 60 miles from Washington.

President Donald Trump and First Lady Melania Trump debark from Air Force One at Lawson Army Airfield, Ga., March 8 en route to Lee County, Ala., where tornadoes and storms killed 23 people.



Photo: Patrick Albright/USA

Initially, both Army and the Marine Corps helicopters transported the president on such trips, but the mission was assigned to the Marines alone in 1976. Marine One is accompanied by several identical helicopters that shift position in the formation, making it difficult to determine which one is carrying the president.

The current Marine One helicopters include the Sikorsky VH-3D Sea King and the smaller VH-60N White Hawk. After a string of program problems and delays, Sikorsky is on contract for the next Marine One, the VH-92A, with deliveries to begin in 2020.

Three presidents have been pilots themselves. The first was Eisenhower, who learned to fly on a Stearman PT-13 biplane trainer in the Philippines in 1936 and logged 350 hours of flying time between 1936 and 1939. George H. W. Bush was a naval aviator in World War II.

However, the only president who ever flew as a presidential pilot was George W. Bush, who in his younger days had been an F-102 pilot in the Texas Air National Guard. In May 2003, Bush was aboard "Navy One," an S-3B Viking taking him to the carrier *Abraham Lincoln* off the coast of California. He was in the co-pilot's seat and took a turn at flying the airplane en route. The regular pilot resumed control for the tailhook landing.

In an unusual instance of presidential flight, a United DC-10 became "Executive One" in December 1973 when the Nixon family flew as commercial passengers from Washington to Los Angeles. An oil crisis was in progress at the time, and Nixon wanted to set an example of conserving fuel by not making the trip on Air Force One.

NEXT IN LINE

In 2015, the Air Force announced its intention to purchase, sole source, the Boeing 747-8I as the next Air Force One. That aircraft, the third generation of the wide-body 747, had

a lengthened fuselage, redesigned wings, new engines, and improved efficiency. USAF said it was the only available choice meeting the established requirements.

In December 2016, President-elect Donald J. Trump threw a monkey wrench in the works, declaring that the airplane was too expensive, and that he would cancel it. His tweet came 22 minutes after press reports that a Boeing official had been critical of Trump's trade policy.

That led in 2018 to a revised deal with Boeing at a substantially reduced price, made possible in part by filling the order with two 747-8Is originally produced for a defunct Russian airline. The airplanes had never been flown, going straight from the assembly line to storage in the Mojave Desert. They will be refitted to Air Force One specifications and designated VC-25Bs, with delivery in 2024.

"Air Force One is going to be incredible," Trump said in July 2018. "It's going to be top of the line. And it's going to be red, white, and blue, which I think is appropriate."

Trump's decision for a new color scheme raised some eyebrows, but it would essentially return to the markings in use before Jacqueline Kennedy's redesign. The previous presidential aircraft, *Queenie*, had been finished in red, white, and a natural metal that had a bluish cast, depending on the light.

Whatever the outcome, it is unlikely to be as flamboyant as Truman's VC-118 *The Independence*, which had a stylized eagle motif. The design was not blatant. It takes a moment to see the beak and tail feathers, but they are there. The eagle's beak, formed by the nose of the aircraft, was originally yellow, but pigment in the paint interfered with the nose-mounted radar, and it had to be redone in white. ★

John T. Correll was editor in chief of Air Force Magazine for 18 years and is a frequent contributor. His most recent article, "Bring 'Em Back Alive," appeared in the April issue.



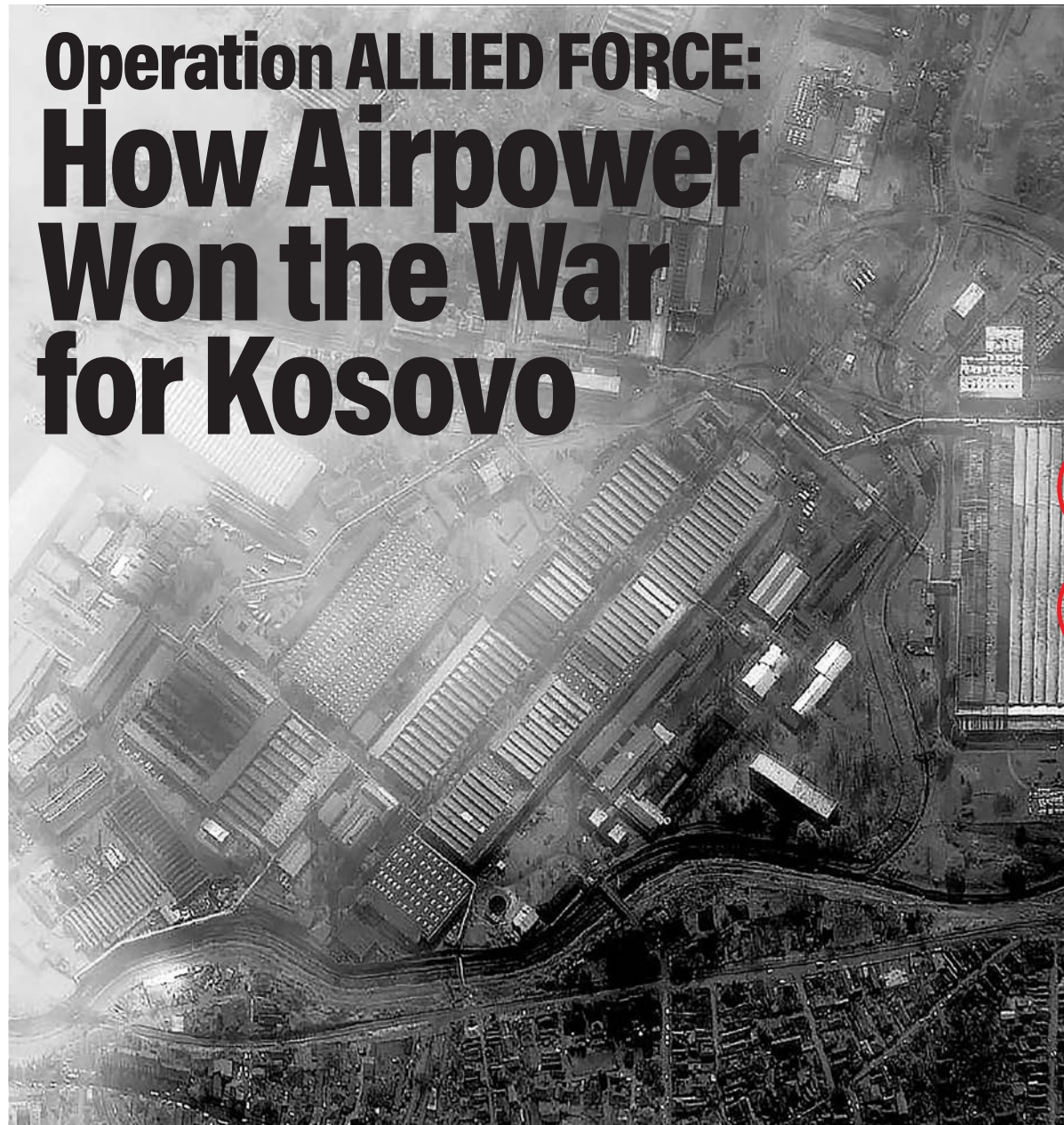
Photo: NATO

Slobodan Milosevic's Federal Republic of Yugoslavia regime targeted ethnic Albanians in Kosovo.



Photo: Helene Stikkel/DOD

US Secretary of State Madeleine Albright presented Milosevic's regime with an ultimatum: If the Serbs refused NATO's demands to stop ethnic cleansing and grant Kosovo more autonomy, the US and NATO would respond militarily.



Operation ALLIED FORCE: How Airpower Won the War for Kosovo

By William A. Sayers

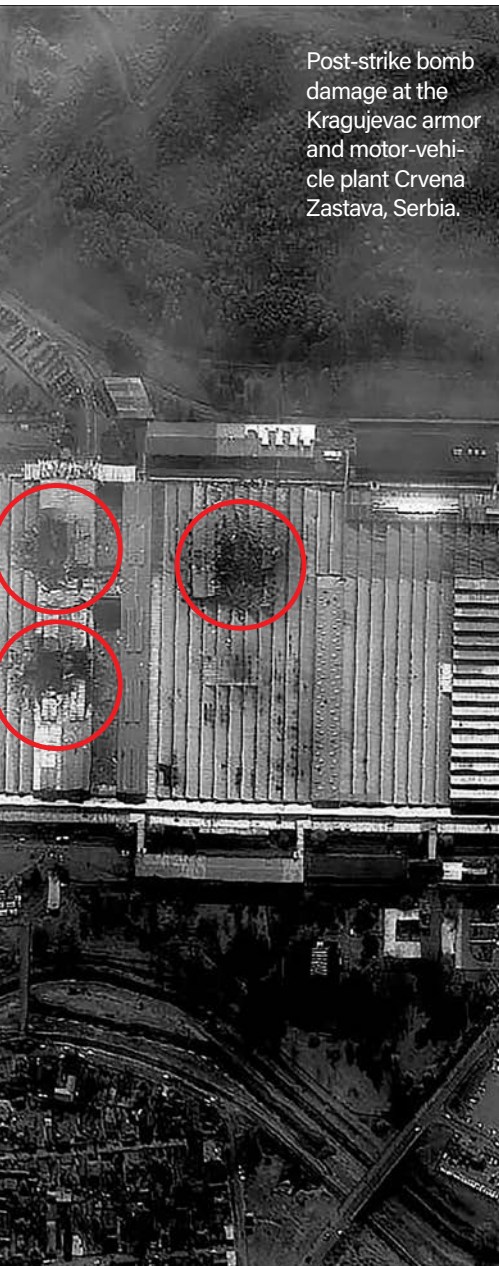
Operation Allied Force (OAF) was a NATO air campaign intended to halt a violent effort against the Kosovo Albanian population in the Federal Republic of Yugoslavia by the regime of Slobodan Milosevic. NATO was initially neutral during the rise of tensions between Milosevic's Serb-dominated government in Belgrade and the independence-minded Kosovo Liberation Army (KLA) based in neighboring Albania. However, a string of KLA provocations and subsequent Serbian reprisals culminated in the Jan. 15, 1999, deaths of 45 ethnic Albanians by Serbian paramilitary forces in Racak, Kosovo. While the exact circumstances of the incident remain unclear, it served as a turning point for the US Secretary of State and other key members of the Clinton administration, who now believed that the use of force would likely be necessary to restrain Milosevic.

At meetings held at Rambouillet, France, in February and March 1999, US Secretary of State Madeleine Albright presented Milosevic's regime with an ultimatum: If the Serbs refused NATO's demands to stop ethnic cleansing and grant Kosovo's

Albanians more autonomy, the US and NATO would respond militarily. The Rambouillet accords contained elements that were unacceptable to Milosevic. The accords granted Kosovo virtual autonomy within the Federal Republic, while its citizens would still participate in Yugoslav political institutions (including parliament, the courts, etc.); they called for a referendum in Kosovo on the question of independence (given the ethnic makeup of the population, a certainty to pass); and they gave NATO free run through all of Yugoslavia, with the duty and power to investigate and deliver suspected war criminals to the International Criminal Tribunal for the Former Yugoslavia at The Hague. As Milosevic, himself, was suspected of war crimes, acceptance would have been tantamount to a surrender of not only Kosovo, but his own person. Consequently, Milosevic refused to sign the Rambouillet Accords, thus triggering NATO's Operation Allied Force.

PLANNING WAR ... OR FORCEFUL DIPLOMACY?

Clinton administration officials believed that NATO bombing would only last a few days before Milosevic would



Post-strike bomb damage at the Kragujevac armor and motor-vehicle plant Crvena Zastava, Serbia.



Photo: DOD

Washington officials told Lt. Gen. Michael Short, "Mike you're only going to bomb for two or three nights; that's all the alliance can stand, that's all Washington can stand."



Photo: SrA. Mitch Fuqua via National Archives

Gen. Wesley Clark believed it would take at least three months to assemble 175,000 men in Albania to launch a ground invasion. This would have given Milosevic plenty of time to drive wedges deep into the alliance.

Photo: DOD

capitulate to their demands. According to USAF Lt. Gen. Michael C. Short, 16th Air Force commander and air chief of Allied Force, Washington officials told him, "Mike you're only going to bomb for two or three nights; that's all the alliance can stand, that's all Washington can stand."

Operation Allied Force was planned as a gradually escalating, three-phase air campaign. Phase 1 would target the Serbian Integrated Air Defense System (IADS) and associated SAMs and interceptors. If Phase 1 failed to intimidate Milosevic, Phase 2 would attack the Yugoslav Army (also known by its Serbian initials, "VJ") forces deployed in Kosovo and their support structure. In a postwar interview on PBS's *Frontline*, former National Security Council staffer Ivo Daalder said the administration was convinced that bombing would be sufficient to "take care of the Serb armor, their artillery, and the Serb paramilitary forces, to prevent them from doing the kind of widescale slaughter and atrocities that they would engage in." Unfortunately, this view was out of sync with what USAF commanders believed they would be able to do in a campaign prosecuted strictly by airpower.

The third phase, if it was needed, involved widening the target set geographically to include command, control, and communications (C3) and infrastructure targets in Belgrade and throughout Serbia. At the end of each phase, a political decision would have to be made in Brussels to authorize moving on to the next phase.

ATTACK AND CONFUSION

Phase I opened on the night of March 24, 1999.

While Operation Allied Force's stated goal was to stop atrocities on Kosovo Albanians by Serb paramilitaries, the massive Serbian "ethnic-cleansing" program to flush Albanians out of Kosovo was, in fact, triggered by NATO's bombing campaign. While Serbian forces actually began their ethnic-cleansing campaign shortly before the NATO attack began, Milosevic gave the order to begin his operation only after NATO indicated that its attack was both inevitable and imminent. Either Milosevic saw Allied Force as an excuse to execute a previously existing plan to denude Kosovo of its Albanian population—in essence, he had nothing to lose by doing so—or he used it as a ploy to trip up NATO's campaign. Either way, the shock from the unprecedented scale of atrocities in Kosovo (eventually, some 700,000 ethnic Albanians were driven from the province) swiftly led to a shift in NATO targeting from Phase 1 to Phase 2, in an attempt to stop Serbian paramilitaries from carrying out their outrages.

This was a role NATO air forces were singularly ill-equipped to perform. As Chairman of the US Joint Chiefs of Staff Army Gen. Henry H. Shelton would say later, "The one thing we knew we could not do up front, was that we could not stop the atrocities or the ethnic cleansing through the application of our military power." At this point, it was clear that the plans of the Clinton administration and NATO leadership had been based on false assumptions.

NATO air forces could not actually attack the Serbian paramilitaries in the act of committing atrocities on the ground—atrocity is generally committed in intimate contact with the victims, and pilots flying at altitude cannot distinguish individuals from one another—so they turned their attention to the Kosovo-based Yugoslav 3rd Army, thought to be protecting the paramilitaries from KLA attack. Although NATO aircrew and intelligence officers thought they were doing substantial damage to the 3rd Army, it is now known that the difficulties of targeting and the widespread and clever use of decoys by the Serbs greatly mitigated the damage. To this point, Milosevic and his country were not only weathering the bombing with visible ease, but the lack of success and media images from Serbia and Kosovo were threatening to split NATO from within. According to Ivo Daalder in the postwar BBC production, *Moral Combat: NATO at War*, "There was a sense that in fact [Albright] had led the administration down this path and had failed. Madeleine's War, as it came to be called, all of a sudden didn't look so good."

As an airman thoroughly trained and indoctrinated in the use of strategic attack, Short believed from the beginning that he should be allowed to go after a broad range of targets. On April 1, after a contentious, closed-door session at NATO headquarters, Short was authorized to widen the air war's targeting priorities, but still not to the extent he wished: Aircrew could go after infrastructure and other targets south of 44-degrees north latitude—a line well south of Belgrade—but north of that line, targets were limited to C3 and government headquarters.

The expanded campaign failed to have the desired effect.

The Serbian paramilitaries continued to drive out Albanians from Kosovo, and Milosevic showed no sign of acquiescence. Short believed political control over NATO was tying his hands with “lowest common denominator targeting,” where a single member country could object to a given target and keep it safe from NATO attack. Of one particular target, he was told by officers from a NATO ally, “Don’t even ask!”

TURNING POINT

By NATO’s 50th Anniversary summit in Washington, D.C., on April 23, the offensive was foundering. Between setting off the worst case of ethnic cleansing in modern history and the widely broadcast incidents of collateral damage, a full month of bombing had failed to do anything except weaken NATO’s moral case. Former Secretary of State Henry A. Kissinger said at the time that failure would “threaten the very essence of NATO,” while Daalder in his *Frontline* interview added, that if we lost the war, “NATO is ended, and the credibility of American foreign policy is at an end.”

Ironically, it was recognition of the threat to the existence of the alliance that ultimately emboldened NATO to make one more push to win the campaign. According to RAND senior political scientist Benjamin S. Lambeth’s *NATO’s Air War for Kosovo: A Strategic and Operational Assessment*, the consensus from the Washington Conference was increased NATO willingness to attack major infrastructure targets. NATO’s Master Target File had started OAF with 169 entries; now it had grown to 976. “The new goal became punishing Belgrade’s political and military elites, weakening Milosevic’s domestic power base, and demonstrating by force of example that he and his fellow perpetrators of the abuses in Kosovo would find no sanctuary.”

CRONY ATTACK

The gloves hadn’t come off entirely, but now a new strategy was implemented in the Allied Force planning cell. The Joint Warfighting Analysis Center in Dahlgren, Va., analyzed the Serbian levels of power and focused on recommending targets that would bring the war home to Milosevic and his benefactors on a personal level. According to USAF Maj. Julian H. Tolbert’s 2006 School of Advanced Air and Space Power Studies thesis, NATO was now engaged in a campaign of “Crony Attack.”

The idea, Tolbert wrote, was to coerce the regime’s key patrons into pressuring a change in policy. The trick, of course, was to find out who Milosevic’s cronies were and what pressure points they would be susceptible to. According to Major Tolbert, “Crony attack strategy relies primarily on intelligence. ... A network of cronies must be carefully mapped out, and it must be based on the nature of the relationship with the leader to help determine how best to influence the regime.”

According to a 2001 MSNBC article by William Arkin and Robert Windrem, on the night of May 15, USAF B-2 bombers attacked a steel plant at Smederevo and the copper smelter at Bor in a classic crony attack. Both of these facilities were used by Milosevic’s benefactors to personally and illegally enrich themselves at the expense of the state. In a bold move, NATO information warfare specialists took the unusual step to contact the targeted cronies before the strikes, just to drive the message home that NATO could destroy their sources of wealth at will—and there was absolutely nothing they could do to stop it. While there were still more maneuvering and strikes to come, NATO had found its silver bullet. According to Daalder and the Brookings Institution’s

Michael O’Hanlon in their postwar book, *Winning Ugly: NATO’s War to Save Kosovo*, the timing was perfect: “That escalation in the strategic air campaign came on top of earlier attacks against bridges, petroleum refineries, and other key infrastructure, which in turn came on top of years of sanctions against Yugoslavia. ... Probably fearing that time would only work against him strategically from that point on, Milosevic relented.”

THEORIES, ARGUMENTS, AND REVISIONISM

Almost as soon as the dust from the last NATO bomb had settled, alternative theories were put forward to explain Milosevic’s capitulation. Most of these (Russia’s decision to turn its back on Milosevic, easing of Rambouillet’s demands, etc.) are easily seen as being complementary to the bombing and not a substitute. But others (KLA attacks forced the Yugoslav Army to concentrate, making tactical bombing effective) are demonstrably false. One theory, however, has had sufficient weight put behind it that it has become almost conventional wisdom: Milosevic caved because he was afraid of an invasion by NATO land forces. Gen. Wesley K. Clark, NATO’s Supreme Allied Commander, espoused this theory himself in his 2001 autobiography, *Waging Modern War: Bosnia, Kosovo, and the Future of Combat*.

However, there are a number of reasons why this is highly unlikely:

- First, Clark believed it would take at least three months to assemble 175,000 men in Albania to launch a ground invasion. This would have given Milosevic plenty of time to drive wedges deep into the alliance.

- Second, the logistical problems were nightmarish. The only country willing to serve as the launch point for the invasion was Albania. Macedonia had pointedly ruled out an invasion from their soil, and Hungary did not want to give Belgrade any excuse to persecute ethnic Hungarians in the Serbian province of Vojvodina. Also, the sole road suitable as a main supply route through Hungary would have to be improved before it could support armored vehicles. Further, even the later insertion of UN-sanctioned Kosovo Force (KFOR) peacekeepers under truce conditions proved problematic. The senior British Army commander in KFOR reported that an opposed entry would have been “unworkable.” He reported back to London, “It is the view of this headquarters that had the situation on 12 June been anything less than benign, there would have been command, control, and communication difficulties which could not have been resolved by KFOR headquarters.”

- Third, given the prevailing political climate, there is little chance NATO could have mounted a ground invasion. Several NATO member states were adamantly against it, and Germany’s Chancellor, Gerhard Schroeder, promised to veto any invasion plans. France, Italy, and Greece also stood opposed to invasion and undoubtedly others would have followed their lead, had it come to a decision. The Pentagon was also against it. None of this would have escaped Milosevic’s attention.

However, the most important argument against the idea that the threat of invasion was the ultimate defeat mechanism is history itself. The heritage of the Yugoslav Army stems from their fierce guerilla war waged against the WWII Nazi occupation. VJ doctrine was to fight a delaying action against an invader to allow partisan forces to organize and arm themselves, eventually driving the invaders out. It cannot be overstressed how deeply this culture runs through the VJ—it is their identity.

Air Force bases during Operation Allied Force

B-2 bombers from Whiteman AFB, Mo., flew 30 hour, nonstop missions to targets in Kosovo.



Source: "The Kosovo Campaign: Aerospace Power Made It Work," an Air Force Association Special Report, September 1999.

Since neither the VJ, nor partisan warfare, could successfully resist an effective air campaign, their only hope of victory was to divide NATO politically or force NATO into ground combat where Yugoslav forces would have stood a chance. A NATO invasion would likely have done both. Sandy Berger, President Bill Clinton's national security adviser, believed that debate over a ground war could have split NATO and handed Milosevic his only shot at victory. According to Berger, "An equally good school of thought says that Milosevic would have loved to get us into a ground war." Russian President Boris Yeltsin claimed in his memoirs that Milosevic actually encouraged Russian Special Representative to Yugoslavia Viktor Chernomyrdin to conduct the negotiations in such a way that the ground operations would start faster.

In a postwar interview, Nebojsa Pavkovic, commander of the 3rd Yugoslav Army said that, "[NATO] would have lost any advantage [in a pure air campaign] the minute they committed their troops. ... We knew the land, and we were well prepared in the event of the ground war. ... We were not afraid of the ground war."

Said RAF Air Vice Marshal Tony Mason: "[Milosevic] wanted a ground-force strategy. ... Milosevic really wanted us to get into ravines and into gorges. He really wanted to relieve the Serbian situation in the 1940s again."

Therefore, far from being intimidated by the threat of NATO ground troops, Milosevic and the VJ would likely have welcomed the chance to draw enemy blood on their home ground.

Coercion worked in Kosovo because NATO airpower could hold at risk things that the Milosevic government needed to remain in power. Contrary to popular belief, Milosevic was not a dictator, but rather the leader of a political coalition in a rough-and-tumble neighborhood. He and his party were actually at risk if the voters of the Federal Republic of Yugoslavia became radically discontented. With effective economic sanctions in place, Serbia was diplomatically isolated and particularly vulnerable to strategic airpower and coercion. The price of noncompli-

ance with NATO's demands—somewhat softened since Rambouillet—was more than they could afford to pay.

CONCLUSIONS

The fact that airpower won NATO's first war is indisputable. However, this victory was far from inevitable. Just showing up with a lot of airplanes isn't enough, and in this case, risked shipwrecking an alliance that was the foundation of US and European defense policy for 50 years. Airpower must be wielded in an intelligent and appropriate manner to be effective, and its proper usage is not always intuitive. In Allied Force, much time and political capital were expended to no positive effect when the template for Operation Desert Storm was unthinkingly overlaid on Kosovo by government and military leaders unschooled in air operations. Further, the factors that made airpower so effective in OAF—diplomatic and economic isolation—may not be present in another conflict, so air planners cannot merely overlay the Allied Force template over every future problem.

Airpower is one tool in the nation's foreign policy toolbox. It will be the preferred tool for some situations, and will be inappropriate for others. Airpower should take the lead role in conflicts like Allied Force, while in others, such as the counterinsurgency campaigns in Afghanistan and Iraq, it can only be a supporting arm. However, airpower's inherent flexibility and the fact that it can be employed without the intractable commitment required by ground forces can make it particularly attractive to politicians, even in situations in which it might not be the most appropriate tool. Therefore, Air Force officers must not only be masters of their trade in traditional usage, they must have the mental flexibility and creativity to handle complex problems not traditionally found in their wheelhouse. ✪

William A. Sayers has master's degrees in military studies and strategic studies from Marine Corps University. He spent 28 years as a military analyst at the Defense Intelligence Agency, the National Counterterrorism Center, and the CIA.



Welcome Home, Old Friend

How these Seattle vets rallied to save a B-52 and create a Vietnam Veterans Memorial Park.

By Jon R. Anderson

When former Air Force pilot James Farmer first laid eyes on the rusting hulk of the broken-down B-52 bomber in an out-of-the-way corner of Paine Field, just north of Seattle, it was like looking upon a forgotten veteran, lying on his deathbed.

“It was heartbreaking,” Farmer said. “It was like seeing a dear old friend that was just totally deteriorating. Like a friend you hadn’t seen in 30 years and you barely recognize them because they’re in such bad shape. The paint was peeling, it was an ugly color, pieces were falling off. It was nasty.”

The B-52 had been sitting on Paine Field, a former military airport, since 1991, when it was decommissioned from the Air Force. Eventually donated to Seattle’s Museum of Flight, 40 miles away at Boeing Field, just south of Seattle, it was too big and expensive to move.

So it sat. For nearly 30 years.

Now it’s set to become the centerpiece of a new Vietnam Veterans Memorial Park, which will open in Seattle on May 25 over Memorial Day weekend.

“What we wanted to create was a place where all Vietnam veterans would feel honored and welcomed home,” Farmer said. The B-52 could be part of it. And so began what became known as “Operation Welcome Home.”



Photo: Jon Anderson

After Vietnam veteran and former Air Force pilot James Farmer discovered a decaying B-52 Stratofortress 40 miles from Seattle, he and others set out to restore the airplane and build a Vietnam War Memorial.



Illustration: Courtesy of Project Welcome Home

A rendering of a new Vietnam Veterans Memorial Park, set to open in Seattle on May 25, featuring the restored *Midnight Express* B-52G Stratofortress. The memorial is at Seattle's Museum of Flight.

For Farmer, the B-52 really was an old friend. Both took part in Operation Linebacker II, a bombing campaign credited with forcing North Vietnam to the peace table in early 1973 and ultimately returning hundreds of US prisoners of war from captivity.

Joe Crecca was one of those POWs. His F-4 Phantom was hit by a surface-to-air missile over North Vietnam, his jet literally blowing apart around him as he ejected.

"If I had taken just the split second to drop my helmet visor, like I was supposed to, I wouldn't be here right now," Crecca said. Captured as soon as he hit the ground, Crecca was taken to the infamous Hanoi Hilton, where he was beaten, tortured, and later placed in solitary confinement, where he risked tapping out a coded message to a fellow prisoner in an adjacent cell.

He smiled as he decoded the tap-tap-tap of the response in his head: "Don't give up. Keep up the fight." Months later, Crecca met the US Navy prisoner who encouraged him to endure: then-Lt. Cmdr. John McCain.

For the next six years, Crecca repeated that mantra—Don't give up. Keep up the fight.

And now for the past six years, he's found himself saying those words again, as he, Farmer, and a core grassroots group of veterans and volunteers have struggled to find an appropriate home for the B-52 and also a welcoming place for fellow Vietnam veterans.

They raised \$3 million to restore, dismantle, move, and reassemble the B-52, bring it to its new location adjacent to the Museum of Flight, and build the park itself.



Photo: Jon Anderson

Former POW and Air Force F-4 Phantom pilot Joe Crecca survived the Hanoi Hilton and saved the old B-52 by relying on the same mantra: Don't give up. Keep up the fight.

"It was a massive effort," said Tom Cathcart, the museum's Director of Aircraft Collections.

First, the aircraft needed the scrub down of its life, removing decades of Seattle grime and rust. The cowlings for the planes eight underwings had to be fully overhauled. Fresh paint came next, and only then was the entire aircraft—the size of a Boeing 747 jumbo jet—disassembled for its journey. The 171-foot main body was disconnected from the 135-foot-wide wing section, which was then cut in half. The 30-foot-tall tail was removed, and its vertical fin disconnected as well.

"That's a lot of bolts—some the size of Coke bottles—that really don't like being unbolted after that many years," said Cathcart.

Finally, under the cover of darkness—to minimize traffic disruptions—the pieces were loaded onto a convoy of extra-long flatbed trailers for the slow, three-hour trek to the other side of Seattle.

"It was an amazing sight to see," Farmer said, beaming as he showed off the reassembled, fully restored aircraft at its new home. "It's like it drank from the Fountain of Youth."

The balance of the funds raised by Operation Welcome Home are now paying for the final touches to the park that is being built around the aircraft. The park will also feature flags from each branch of the Armed Forces and an 8-foot, bronze statue of an airman in flight gear carrying a folded US flag.

"The airman symbolizes the veterans who were able to return home alive," Farmer said. "The flag represents those who made the ultimate sacrifice."

If you plan to visit: Seattle's new Vietnam Veterans Memorial Park, featuring a restored B-52G Stratofortress, memorial statue, and a tribute wall with personalized plaques from people honoring the veterans in their lives, opens May 25 with an opening ceremony, including aircraft flyovers, a color guard presentation, and a special pinning ceremony honoring Vietnam veterans in attendance. Throughout the May 25-27 Memorial Day weekend, veterans will be admitted free, along with one adult and any children under 17. RSVPs are requested but not required. ✪

Jon R. Anderson spent more than 25 years as a military affairs reporter with *Military Times and Stars and Stripes*. He is now an independent writer based in the Pacific Northwest.

The D-Day Pilot and Flight Nurse; CAP and UAS



Left: Capt. Vito Pedone (pilot) and his wife, 1st Lt. Geraldine Pedone (flight nurse), were both participants in D-Day's Operation Overlord. Above: Lt. Col. Stephen Pedone, their son, served 25 years in USAF.

Photos courtesy of Pedone family

As the United States geared up for Operation Overlord and the D-Day invasion of Normandy in the months leading up to June 1944, more than 2.8 million American troops gathered on British soil in anticipation of the Allied assault on Nazi Germany and occupied Europe.

Among them was a married couple, Capt. Vito Pedone, a C-47 pilot, and 1st Lt. Geraldine (Jerry) Curis-Pedone, a flight nurse, who met and married in the midst of the military buildup. When D-Day arrived, Vito co-piloted the lead Ninth Air Force Pathfinder Troop Carrier C-47 and air-dropped the first stick of 101st Airborne Pathfinder Paratroopers into Drop Zone A. Four days later, Jerry's Medical Air Evacuation

missions began. Flying in on unarmed C-47s and landing on dirt fields near the combat zone, the planes picked up the wounded, and flight nurses provided in-flight medical care as they ferried the wounded back to England.

Now, 75 years later, their son, Lt. Col. (Ret.) Stephen Pedone, is returning to the scenes of their historic youth. Pedone, a member of the Air Force Association's **Miami-Homestead (Fla.) Chapter**, will travel with his wife, Ximena, to D-Day commemorations in the UK and France. To learn more about the D-Day pilot and the flight nurse, visit the D-Day Squadron website at ddaysquadron.org/the-d-day-pilot-and-flight-nurse.

Roanoke Chapter (Va.) CAP Funds UAS Familiarization/Pilot Program



Photo courtesy of Roanoke Chapter

In February, CAP students fly a HALO Board drone in UAS class at Danville Community College in Virginia. The class will help students earn their remote pilot certifications.

The **Roanoke Chapter** (Va.) worked with their local Civil Air Patrol Squadrons in the Danville area to procure an Unmanned Aircraft System (UAS) for their cadets. An AFA Chapter Aerospace Education Grant, along with a Virginia State AFA Aerospace Education Grant, allowed the CAP Danville Squadron to acquire a HALO Board UAS.

This UAS fulfills the need of providing the CAP Danville Squadron cadets interesting, as well as hands-on, aerospace education learning experiences that teach flight principles, real-world maintenance, and the realities of adherence to FAA and CAP regulations and policies. The aircraft is flown under the instruction of Capt. David Hutcheson, the CAP Danville Squadron's public affairs officer. He completed his Professional UAS Pilot Course at Danville Community College where the program was first launched. The cadets really enjoyed flying the UAS as a part of the Civil Air Patrol's requirement for monthly aerospace education.

After the Storm: How AFA's Tyndall Chapter Helped Airmen Recover



Photo: Courtesy of Gavin MacAloon

AFA Vice Chairman for Field Operations, Gavin MacAloon, lost his on-base home at Tyndall AFB, Fla., to Hurricane Michael.

By Jennifer-Leigh Ophriory

When Hurricane Michael ravaged Tyndall AFB, Fla., last October, the local chapter of the Air Force Association swept into action. Edward W. Hood, the chapter president, became the boots on the ground, helping the nonprofit Air Warrior Courage Foundation distribute about \$107,000 to 215 needy USAF households.

Working with Gavin MacAloon, a chapter member and AFA's Vice Chairman for Field Operations, Hood also helped the foundation provide aid to hurricane evacuees who sought refuge at the Air Force Enlisted Village, an organization primarily focused on aiding the widows of retired Air Force enlisted airmen.


MacAloon, a civilian Air Force employee, was living at Tyndall when Hurricane Michael hit and lost his home. But as soon as displaced residents were allowed to return to base to retrieve possessions, MacAloon met with Wing Commander, Col. Brian Laidlaw, and a chaplain, as well as affected airmen. When the Air Force Enlisted Village deployed an aid truck with supplies for displaced Tyndall residents, he led them to displaced families who had fled the base.

"It's not a powerhouse chapter," MacAloon said. "But that didn't matter here, and it's a perfect example of how an AFA chapter—just by using your name, getting your connections—can make a difference in people's lives."

What did Hood and MacAloon learn? The answers aren't

so different from any other kind of preparedness. But they are lessons every chapter can apply to ensure they're ready to step up when disaster strikes.

- 1. Keep membership rosters up to date and have a communications plan in place.** Hood said that when he deployed a mass email to his chapter's membership, he only heard back from 2 percent of recipients. Many people on his membership roster were no longer active members and had long since moved away.
- 2. Have a plan for collecting donations—before disaster strikes.** Hood opened a PayPal account before the storm when he had "a gut feeling" the chapter might need one. It was a saving grace for the chapter and community, allowing AFA National to rally support and direct donors to those in need. That helped the chapter amass \$10,000 in donations.
- 3. Be ready with thank-yous and tax receipts.** "Have a system, platform, or software that streamlines your tax receipts," Hood said, in order to generate thank-you notes and receipts with the click of a button. When homes are lost and you're working around the clock, paperwork should be the least of your worries.

Hood and MacAloon said chapters should also assemble their own experiences and advice and share those after-action reports to different types of emergencies with fellow AFA leaders around the country. You never know when—or where—the next disaster will strike. 



1/Frank Tyndall.
2/ Airmen clean up debris after Hurricane Michael devastated Tyndall AFB, Fla., in October 2018. 3/ Tyndall Field in circa 1940s.



TYNDALL

War Hero, Test Pilot

In 1941, US Army Air Forces was well into building a new base in Florida but did not have a name for it. Rep. Bob Sikes did.

The Florida Democrat proposed naming it after Frank Tyndall.

Tyndall was a Florida native, heroic World War I airman, and key test pilot of the interwar years. Army leaders quickly approved, and Tyndall has become one of the service's most famous names.

Francis Benjamin McCausland Tyndall—he was always known as Frank—was born Sept. 28, 1894, in Sewall's Point, a small town some 100 miles from Miami. His English-born father emigrated at 24 and served in the cavalry before marrying and settling in Florida.

Frank, upon college graduation in 1916, joined the National Guard and went to patrol the Mexico border. In 1917, after the US entered the Great War, Frank joined the Army to become a combat pilot.

He was commissioned in the US Army Air Service in 1918 and soon was in the thick of air combat on the Western Front.

Tall and handsome, with piercing gray eyes, Tyndall was only a lieutenant when he was given command of the 22nd Aero Squadron for the St. Mihiel Offensive.

On Sept. 4, 1918, he shot down a Fokker pursuit aircraft in German airspace. Tyndall led a highly successful Sept. 28 fighter sweep.

On Oct. 29, 1918, he chased a German Fokker far into enemy airspace, downed it, and returned to base, earning the Silver Star.

Ultimately, Tyndall was credited with downing four



enemy aircraft, and evidence existed for another two kills. After the war, Tyndall became a test pilot.

In a Nov. 11, 1922, test flight in Seattle, his MB-3A lost an entire wing. Tyndall bailed out and made a safe landing, only the second military airman to do so.

In 1927, Tyndall successfully flew the highly experimental Keystone X-1B Super Cyclops, a five-ton bomber designed for a five-man crew, six machine guns, and 2,700 pounds of ordnance.

Tyndall and five other Army pilots in 1929 completed training as instructors and crisscrossed the US, training new pilots.

Tyndall's last posting was to 2nd Bomb Group, Langley Field, Va. On the night of July 15, 1930, he boarded his Curtiss P-1F Hawk and took off for Texas. The Hawk, in a dense fog, crashed in North Carolina. Tyndall died instantly. He was buried at Arlington National Cemetery in Virginia.

Located next to the nation's largest military aviation training range, Tyndall has served for decades as a premier pilot training base. Since 2004, it has been the top training site for F-22 Raptors. In October 2018, the base was ravaged by Hurricane Michael, a Category 4 storm that destroyed the base's housing and damaged 90 percent of its infrastructure. Estimates to restore the base approach \$5 billion. While training has resumed there, almost all the base's inhabitants have been moved elsewhere. Plans call for basing an F-35 wing there in the early to mid-2020s.



Photos: San Diego Air & Space Museum; SSgt. Matthew Lotz; USAF

FRANCIS BENJAMIN MCCAUSLAND TYNDALL

Born: Sept. 28, 1894, Sewall's Point, Fla.
Died: July 15, 1930 (KIF), Mooresville, N.C.
College: Valparaiso University, Ind.
Occupation: Architect, US military officer
Services: Florida National Guard; US Army (Signal Corps, Air Service, Air Corps)
Main Era: World War I
Years of Service: 1916-30
Combat: Western Front, Europe 1918
Final Grade: First Lieutenant
Honors: Silver Star, Commander 22nd Aero Squadron
Buried: Arlington National Cemetery

TYNDALL AIR FORCE BASE

State: Florida
Nearest City: Panama City
Area: 45.3 sq mi / 29,000 acres
Status: Open, operational
Opened as Tyndall Field: Dec. 7, 1941
Renamed Tyndall Air Force Base: Jan. 13, 1948
Current owner: Air Combat Command
Former owners: Training Command, Tactical Air Command, Air Training Command, Air Defense Command, Tactical Air Command, Air Combat Command, Air Education and Training Command

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