AFA WARFARE SYMPOSIUM WRAP-UP

AIR FORCE MAGAZINE

BETTER BUFF

USAF Launches Its B-52 Refit | 38

A B-52H flies over the Alps on a Bomber Task Force mission March 7.

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AIR FORCE

April 2022. Vol. 105, No. 4

Breaking a tie vote: Air Force Chief Information Officer Lauren Knausenberger, center, holds up a sign declaring Project Arcwater the winner at the Spark Tank competition, March 4.

DEPARTMENTS

FEATURES

ON THE COVER

Airman 1st Class Zachary Wright

A B-52H Stratofortress flies over the Alps March 7.

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By Tobias Naegele

Something to Fight For

America's deterrence strategy can be summed up in the phrase "speak softly and carry a big stick." By presenting a robust, technologically advanced military designed not for conquest, but as a check against those who might conquer and subdue others, America provides a bulwark against aggression and adventurism all around the world.

President Teddy Roosevelt built his "big stick diplomacy" on four tenets, all of which still apply today: Possess great military power; be willing to employ that power to full effect when necessary; never bluff—threaten force only when prepared to use it; and finally, be a good citizen of the world by respecting all nations—even adversaries in defeat or retreat.

We find ourselves today on the other side of the deterrence challenge, intimidated by Russian President Vladimir Putin's threats of possible nuclear war. Putin's willingness to break norms others take for granted are destabilizing. Targeting civilians in Ukraine, using chemical weapons in Syria, even his willingness in January to blow up a satellite in orbit, are proof he does not think like Westerners, nor will he act according to the rules-based order embraced by most of the world.

Putting his nuclear forces on alert turns a conventional regional war into a global strategic chess match. Every NATO member is on notice, since any wrong move could potentially trigger world-altering consequences. Those stakes slow NATO's progress in offering and delivering aid and buy Putin time.

"Strong doesn't mean big. Strong is brave and ready to fight for the life of its citizens."

The Ukrainian people's whole-of-nation defense, rallied by the inspiring leadership of Ukrainian President Volodymyr Zelensky, is something too few of us can comprehend: A free people fighting with whatever they have, defying a larger army through sheer will. They understand what they're fighting for; the average Ukrainian was 10 years old when their country declared its independence and the Soviet Union was no more. They earned their freedom and cherish it.

Contrast that with our comfort-seeking countrymen here in the United States. A recent Quinnipiac University Poll posed this provocative question to 1,324 American adults in March: "If you were in the same position as Ukrainians are now, do you think that you would stay and fight or leave the country?"

Among 18 to 35-year-olds—those most needed in a military conflict—48 percent said they would "leave the country." Only 45 percent said they would stay and fight. (Given the poll's margin of error—+/- 2.6 percent—that's effectively an even split.) Their parents are a heartier crowd: 66 percent of Americans ages 50 to 64 said they would stay and fight, just 28 percent said they would leave. Is it that they have more to fight for, or that they better understand what would be at stake?

Most respondents who identified as Hispanic (61 percent) believe America is worth fighting for, more than whites (57 percent) or Blacks (38 percent). One imagines America's newest immigrants know precisely what it took to gain freedom in the United States, and value that more highly than our native-born citizens. Life-long Americans, long used to relying on an all-volunteer military, have forgotten that national defense is everyone's responsibility.

This is dangerous. It's not enough to grant our military early boarding privileges on airlines, 10 percent discounts at big-box stores, and thank-yous for their service every Veterans Day. We need more Americans to participate in and contribute to our national defense, either through a modern-day national service program or mid-career opportunities that give working professionals a chance to contribute their talent and ability to the military that secures their nation. Selling such a program won't be easy, but you can bet the payoffs would be huge.

Back to Ukraine. One thing Americans *do* understand is that our country can to do more to help. The majority of Quinnipiac Poll respondents called the sanctions imposed by the Biden administration "not tough enough." Four of every five support a united NATO military response should any NATO member be attacked. Three of five believe Putin is truly willing to use nuclear weapons. And yet, most seem surprisingly undeterred by that threat.

Zelensky, clad in his trademark green T-shirt, addressed a joint session of Congress via video March 16, speaking both in his native tongue and in English. "Right now, the destiny of our country is being decided," he said. "The destiny of our people, whether Ukrainians will be free, whether they will be able to preserve their democracy. Russia has attacked not just us, not just our land, our cities. It went on a brutal offensive against our values. Basic human values. Against our freedom. ... Against our desire for happiness. Against our national dreams. Just like the same dreams you have, you Americans."

Evoking Martin Luther King Jr., Zelensky said, he too has a dream, or perhaps more accurately, "I can say I have a need. ... I need to protect our sky."

Trying to impose a no-fly zone while war rages, however, is engagement, not peacekeeping. Neither the U.S. nor NATO are prepared to enter the war under those circumstances. NATO is willing to help, not to fight. That comes in the form of $1 billion in U.S. military aid and new NATO resolve to further reinforce its eastern flank.

Yet the White House dithers over Poland's offer to provide Ukraine MiG fighters, alternately suggesting they would not make much difference and saying that providing them could be seen as escalation. Be serious: 40-year-old combat aircraft are no more an escalation than planeloads of Javelin and Stinger missiles. Both are needed. Both can help Ukraine defend itself. Neither will win the war alone.

Likewise, the U.S. should offer to backfill NATO partners willing and able to provide Ukraine Russian-made S-300 air defense systems. By deploying additional Patriot missile batteries in Eastern Europe, the U.S. can strengthen NATO defenses while simultaneously signaling Putin about the West's resolve. This is what should be expected of the United States as leader of the free world, the winner of World War II, and the one victor in history that helped its worst former enemies recover to become among its closest allies.

"Being the leader of the world means to be the leader of peace," Zelensky reminded Congress and the American people. "Peace in your country doesn't depend anymore only on you and your people. It depends on those next to you and those who are strong. Strong doesn't mean big. Strong is brave and ready to fight for the life of its citizens and citizens of the world."

Americans can learn something from his message.

LETTERS

Air Sick

As a former 30-year naval aviator in helicopters, jets and turboprops (and gliders, as a test pilot at Pax River), I have covered the entire spectrum of military aviation.

The focus of the study of cancer restricted to only fighter pilots is perhaps myopic ["Air Sick," January/February, p. 46]—but data mining, in light of recent confluence of scientific, political, and *legal* (i.e., class action suits) "interpretations," is perilous, but still necessary.

The scientific method offers lots of ways to actually narrow the search—I would recommend reporting on other aspects that might lead you to actually assist this study, such as demographic and genetic marking, however sensitive it might be.

Military aviators were NOT a diverse group, but reacted differently based on their current psychological state. A flight surgeon author stated that physical and mental traits of aviators were extremely uniform down to the majority profiled by birth order (majority are firstborn) as per his report on "Sex and the Naval Aviator."

If you help broaden the scope of aviator analysis, beyond typical radioactive or toxin exposure, one might find the real correlation, which may be surprisingly genetic ... or not.

Capt. Vinny Lamolinara, USN (Ret.)
Patuxent River, Md.

Your January/February 2022 article caused me to consider the cause of my prostrate cancer. I served in the late 1960s, TAC, flight line refueling F-100 aircraft. I was certainly exposed to jet fuel and jet fumes. In those years we did not wear face masks. So I will follow-up with the VA as you suggest. One correction is noted. The aircraft on page 46 are not F-4s, they are F-100Ds.

David K. Ribbe
Pres. AFA Chapter 251
Westborough, Mass.

Editor's Note: *Thank you. The aircraft have been updated in the online version.*

Thank you for the excellent summary of where DOD stands with respect to tracking down chronic military related illnesses in both Active duty and retired personnel. Seems like things are still in the "study" stage and will be for quite some time, though. Having straddled an APG-63 for 2,306 flight hours, I don't need another study to know why I got prostate cancer 15 to 20 years before I expected to. Thankfully an early diagnosis and aggressive treatment stopped the cancer before spreading in my case. Concrete action by DOD cannot come soon enough.

James D. "Tony" Mahoney
Las Vegas

Back to Basics

I am an "old" Air Force, Vietnam/Cold War-era veteran, and I consider myself a stakeholder in the Air Force and the United States of America. After reading my January/February Air Force Magazine, specifically the editorial, "Russia, China, and Air Power Politics," and several articles "USAF Aircraft Availability On Long Downward Trend;" "Unapproved Religious Exemptions Could Force Out Up to 10,000;" and "Pentagon Releases New Rules to Control 'Extremist' Activity," I became increasingly upset.

WRITE TO US

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

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How can the Air Force (and other military services) afford to undertake a "great (mandated, woke ideological) transformation" and departure from its heritage, traditions, and martial values when we are confronted by peer-to-peer, superpower competition and potential armed conflict with Russia and Communist China? What is the point of focusing on notional, "feel good" stuff like diversity, inclusion, and equality, and hyper-vigilance to root out military extremists, when the No. 1 priority should be preparation for a war that promises to be radically different from the "sandboxes" of Iraq and Afghanistan?

As far as I recall, during the 45-year Cold War, our armed forces were on their A-game as the defense of the United States, and preservation of our way of life was paramount because of the ever-present threat of a nuclear exchange with the Soviet Union. "Fly, Fight, Win" was the mission and focus of the Air Force. This became more clear when I was assigned to SAC; the legacy of Gen. Curtis E. LeMay lived on in terms of standards, discipline, uniformity, and cohesion. There was no forgetting that "Peace is Our Profession" and that it was a byproduct of "Peace Through Strength."

I visited www.af.mil and saw where the Air Force unveiled a new mission statement in April 2021. The addition of "air power, anytime, anywhere" to the original "Fly, Fight, and win" statement will likely not deter Russian or Communist Chinese aggression if they don't believe that a balance of power really exists.

Author Aidan McCullen, paraphrasing the ancient Chinese proverb, cautioned us that in order to "Bleed less in war, use peacetime wisely and build capability before you need it." Therefore, the time for the Air Force to square up for the coming fight is now.

MSgt. Mark A. Bernhardt,
USAF (Ret.)
Orlando, Fla.

Balls and Strikes

Glad to see that our magazine's Letters column has recently taken a more interactive approach. In the February 2022 edition not only did readers provide feedback to other letter writers but even the editors jumped in. The latter provided a dictionary definition for a routinely used but often misrepresented word (insurrection) that has dominated the media landscape for the last year. For the editor to excuse any "political motivation" to its use ignores the extremely divisive political times we exist in.

It's certainly not as simple as "You say tomato, I say tomahto," but as the title of David Richardson's letter indicates, words have meanings (plural). The spirit and intent of word selection is critical to the narrative. Politicians and journalists know that and craft their presentations accordingly.

To call the Jan. 6 Capitol storming an insurrection when none of the hundreds detained have been so charged is a bit of a head-scratcher. That, recently, sedition charges have been filed against some adds still another abstract term to the descriptor pile for everyone's use and abuse.

As the editors so aptly stated, "Those who write these early drafts of history are like umpires, who "call 'em as they see 'em." The problem with that, unlike in professional baseball where videotape allows for instantaneous reality checks by replay, in our current climate Americans are at the mercy of word selection from politicians and media. We can only hope that those will be factual and unbiased and not tainted by the presenters. Case in point, the firestorm caused by just one newspaper journalist's attempt to (re)write American history with The 1619 Project.

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

Your use of the baseball umpire metaphor in the editors' reply to David M. Richardson's letter in the January/February Air Force Magazine ["Words Have Meanings," p. 3] is very revealing, because umpires do not always get it right. I know, I'm one. Regrettably, sometimes umpire bias is difficult to overcome, and we can forget that home plate is only 17 inches wide instead of 29 inches. Many an umpire wanted the next pitch to be just close enough to legitimize a called third strike without being sufficiently close to compel the batter to swing. And 6 inches off the plate was plenty close to "ring him up."

Technically, you are correct. But use of the term "insurrection" in relation to the events of Jan. 6, 2021, is not a reflection of impartial and objective media reporting. In today's highly charged political environment it comes across as shilling for the sole political party using, it's contrary to the definition you provide. I hope Air Force Magazine remains committed to unbiased, objective reporting.

Thank you and may God bless the United States of America.

Maj. Patrick J. Hoy,
USAF (Ret.)
Billings, Mont.

UN Blather

"Something We Can Agree On," [Verbatim, p. 8, January/February] quotes a joint statement signed Jan. 3 by the five permanent members of the U.N. Security Council: Britain, China, France, Russia, and the United States: "We believe strongly that the further spread of such weapons must be prevented. We affirm that a nuclear war cannot be won and must never be fought."

I believe the Security Council wasted an opportunity to stop any further expansion of nuclear weapons by posting such a useless political statement. What it should have said is that, "While we do not advocate any expansion of nuclear weapons, the use of such weapons as a threat or to fight a war will be met by all holders or any current holder of such weapons with a retaliation as a punishment for its use."

Lt. Col. Russel A. Noguchi,
USAF (Ret.)
Pearl City, Hawaii

Future World

Amanda Miller's report on Artificial Intelligence (AI) ["Turning Up the Heat on AI," January/February, p. 39] is a good report on the state of AI in DOD, but for some meaningful detail about a few of those "600-plus AI projects" mentioned by Secretary [Lloyd J.]Austin, the reader should check out the article found in a most unlikely source: "Flying Aces," The New Yorker, Jan. 24, p. 18.

In that piece, author Sue Halpern provides eye-watering examples of real-life (funded) projects that could affect USAF operations in the not-too-distant future. For example, did you know that DARPA engineers are working on—and have had considerable success with—an unprecedented design for "a plane that can ... engage in aerial combat ... without a human pilot operating it." This is part of DARPA's Air Combat Evolution (ACE) program.

Decades ago, while stationed at the Pentagon, I attended several presentations by so-called "futurists." Afterward, I shook my head in quiet disbelief as I rushed off to the next crisis-of-the-day. These days, the science and technology predicted by those "futurists" have come true and will dramatically affect all military operations. Wonder what present-day "futurists" are currently dreaming up?

Col. Evan Parrott,
USAF (Ret.)
Ashburn, Va

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INNOVATING FOR FREEDOM

Money Well Spent

"All but five years of the United States Air Force's life as a service, there's always been a B-52. ... And guess what, there will be a B-52 until 2050."

—Gen. Anthony J. Cotton at the AFA Warfare Symposium (AWS) in Orlando, Fla., March 3.

Technology for $200, Alex

Mike Tsukamoto/staff

"I am hopeful that we are actually going to [digitize] WAPS testing. Like, it is 2022, if we can't get out of taking a No. 2 pencil into promotion tests, something is wrong."

—CMSAF JoAnne S. Bass, March 3 at AWS.

That's Not a Good Boy

"I feel like a chew toy between different combatant commanders where they're pulling and asking for more Air Force capability to go to different places. Because the Air Force is the one service that can get there faster than anybody else, except for the space portion."

—USAF CSAF Gen. Charles Q. Brown Jr., at AWS March 3.

Office of the President of Ukraine

Never Satisfied

"Everyone thinks that we are far away from America or Canada. No, we are in this zone of freedom. And when the limits of rights and freedoms are being violated and stepped on, then you have to protect us. Because we will come first. You will come second. Because the more this beast will eat, he wants more, more, and more.

—Ukrainian President Volodymyr Zelensky, interview with ABC news, March 7.

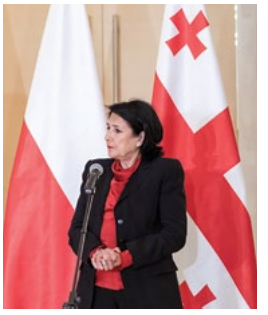
House Armed Services Committee

Upgrades Needed

"The strategic security environment is now a three-party nuclear near-peer reality. Our existing nuclear forces are the minimum required to achieve our national strategy. We must modernize and recapitalize the nation's nuclear triad, nuclear command and control, nuclear complex, and supporting infrastructure to meet presidential objectives."

—Adm. Charles A. Richard, STRATCOM commander, HASC strategic forces subcommittee, March 1.

Hard Labor



Office of the President of Georgia

"Putin has already failed, because he has given birth to a monster: European power and European defense."

—Salome Zourabichvili, President of Georgia, quoted in the New York Times, March 2.

On Second Thought ...

"Mr. Putin says that he doesn't want a strong NATO on his western flank. He's getting exactly that. ... I can honestly say that I have never seen the alliance more relevant and more united and more resolute than I see it today."

—Secretary of Defense Lloyd J. Austin III, press conference after NATO Defense Ministerial, Feb. 17.

Peaceful Growth

"We will advance the peaceful growth of relations across the Taiwan Strait and the reunification of China. We firmly oppose any separatist activities seeking 'Taiwan independence' and firmly oppose foreign interference."

—Chinese Premier Li Keqiang, address to Parliament, Reuters, March 5.

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Two Chiefs, One Fight

The keynote addresses from the Air Force and Space Force chiefs are highlights of AFA's major conferences, and the 2022 AFA Warfare Symposium was no exception. But this year's event featured a unique twist: Air Force Chief Gen. Charles Q. Brown Jr. and Chief of Space Operations Gen. John W. "Jay" Raymond shared the stage in a conversation moderated by one of their forerunners, Gen. John P. Jumper, who was the 17th Air Force Chief from 2001-2005. This transcript has been edited for length and clarity. Find the full video and a complete transcript at www.AirForceMag.com/AWS22.

As Chief of Staff of the Air Force, Gen. Charles Brown Jr. called USAF the "elder sibling" to USSF, while Chief of Space Operations Gen. John "Jay" Raymond laughed at being called the "little brother."

Mike Tsukamoto/staff

Gen. Jumper: This is the 75th anniversary of the Air Force. Some of us of a certain age were there when the Air Force were born—I was 2 at the time. And then I celebrated my 75th personal anniversary when the Space Force was born. So I've watched it all. C.Q., talk a little bit about the 75th anniversary of the Air Force.

Brown: It's a big deal, as you might imagine, and it's not just the Air Force, but the department, and what we're able to do together. It's exciting, I would say, as the 'older sibling,' to work with someone I've known for a number of years ... "one team, one fight," but also two separate services. ... Over time, you know, our culture will be embedded in theirs. But there are some things we're going to learn from the Space Force, as well.

Jumper: Well, 'little brother?'

Raymond: "First of all, I've been an Airman for 35 and a half years, and I've been a Guardian for two, and I celebrate the Air Force's birthday, as well. We're one team, as the Secretary said. .... But I think we are better ... having two independent services.

Jumper: How do we think about this global environment and what we're doing to sort of stay ahead?"

Raymond: It's a global, dynamic—probably the most dynamic and complex security environment in three generations. ... Three years ago, I would have told you we were tracking about 22,000 objects. Today, we're tracking close to 50,000 objects in space. Three years ago, I would have told you we were tracking 1,500 satellites. Today, we're tracking almost 5,000 satellites. In fact, about two hours ago, we just launched another 47 out of Cape Canaveral, supporting a SpaceX launch. In fact, that one company, SpaceX, in the last two years, has launched more satellites than we were tracking [just three years ago]. And then if you look at those capabilities, and you look at what China and Russia have done—I'll focus on China—and have integrated those capabilities into a warfighting architecture, [such] that if deterrence were to fail, we are now going to be up against an adversary that has the same advantages that we've enjoyed. ... Couple that with the spectrum of threats that we're seeing from low-end, reversible jamming to high-end kinetic destruction, and it's a different domain. ... It requires a different approach.

Jumper: In Kosovo, I recall everybody celebrating these chat nets that we had among our platforms, and they were celebrating doing things at the speed of typing. And I said, 'No, no, we've got to do this to the speed of light.' And here we are now. We have this opportunity. What are the most urgent priorities for each of you right now?

Brown: One of the things that the Secretary kind of highlighted was bureaucracy—the ability for us to make decisions faster. My goals are really laid out in the Action Orders. And, you know, just this last month, I actually updated the Action Orders because "Accelerate Change ... or Lose" is really the enduring part of what I'm focused on. And the reason why I did the modifications is because ... facts and assumptions always change. And so it's really, you know, how do we take care of our Airmen? Things like a static closeout date on our OPRs [officer performance reports]. It's the as-

pect of how we work resilience for our Airmen and our families. It's working through the bureaucracy; it's introducing the staff to the staff. What I mean by that is how do we collaborate better? It's how we deepen our understanding of the PRC. ... In an Action Order on design implementation, it is doing exactly what we did last year, being on the same page with our senior leaders and communicating off of one page. And that's an aspect that not only will happen as that [fiscal] '23 budget comes out, but as we start to build '24. ... Because we're on a path to transition to the future. ... Those are my goals, you know, those are short term, but they're also long term, as well.

Raymond emphasized the positives of having a small service and the ability to do things differently, and commended Brown's vision for "Accelerate Change ... or Lose.

Mike Tsukamoto/staff

Raymond: I applaud C.Q.'s 'Accelerate Change ... or Lose' vision. We see that the same way. It's a little different for us, though. ... We've been given an opportunity to start with a clean sheet of paper. And so we're trying to build it differently from the ground up. There are probably a couple thousand people in this room. If you added another one of these rooms, that's the entire Space Force. We're really small. I'm not worried as much about bureaucracy in that we have a really small bureaucracy in the Space Force. My challenge, our challenge, is do we have enough mass to be able to operate in the broader Department of Defense bureaucracy and to be effective?

For us, the first year was largely about inventing the service. And the second year was all about integrating it into the broader department. We've got all the major pieces in place. Now, it's really continuing to deliver and capitalizing on what we've built. The big focus area for us this year, and for the next decade, is shifting our space architecture to a new, more resilient architecture by the design of the force. The capabilities that we have in space are exquisite. They're small in numbers, and they're not easily defendable. Our joint and coalition [obligations are to deliver] the space capabilities that we provide. Those can't be [viewed] as a given anymore. And so we're going to continue to provide those capabilities, and do so in a way that's more resilient, so we can assure that and they can't take be taken for granted.

Jumper: We created the Space Force out of the Air Force ... beginning with our Air Force missions and Air Force Airmen but also the other services and addressing space capabilities in the other agencies, as well. How has that transition gone, as far as separating the missions and how we've addressed the people issues?

Raymond: Today, we've got just shy of 7,000 Active-duty Guardians. We'll grow by the end of this year to about 8,400. .... It's interesting: About a third of those will have never served an Active-duty day in the Air Force. ... One of my former bosses used to talk about the art and science of professional development, and that when you have a service that's really, really large, the science kind of takes over, the machine takes over, because it has to. When you have a service our size, you can do things differently. And so we've built a strategy that allows us to have a little bit more art ... because we can. And we want to take advantage of that luxury to really, really make a difference in our Guardians' and their families' lives.

Brown: The one thing that Jay and I talked about, as he came into this position, was the balance of how much do we, you know, hug each other close and how much do we let them, you know, kind of spread out and grow. ... They're actually able to go do some things at a smaller scale. It's a forcing function for us as an Air Force, because there are some things we can learn. You know, if you've got a toddler, if he's running around at 2 years old, you've got to chase them. ... We are so intertwined, we are so dependent on each other, not just from a base operating/support construct, but operationally. We cannot do what we do as a joint force without the Air Force and the Space Force. Not to disparage the other services, but the relationship we have makes a lot of things happen around the world for our allies and partners.

Jumper: I think that's an advantage of being in the Department of the Air Force. It gives you this natural closeness. How about the other services, Jay? How's that gone trying to integrate with the missions and the people of the other services?

Raymond: That's been one of the benefits of having an independent service. I can now go directly to those other services. We've gotten done a lot of analytical work with the Navy. We just signed an MOU with the Army on tactical-level ISR. I think it's one of the things that Congress highlighted when they were debating whether to pass the law on an independent service. There were a few things that they highlighted: ... One was the ability to integrate. There were 60-something people in the Department of Defense that could say 'No,' and nobody could say 'Yes.' So today, the [Joint Requirements Oversight Council] ... has designated the Space Force as the lead integrator for joint space requirements. That's a huge deal. ... The Secretary of Defense will delegate to the

Space Force the force design work, so no longer do you have 60 different people trying to come up with things. Our goal is to drive that unity of effort across the department and then get everybody rowing in the same direction, and then tee that up for the Secretary of the Air Force and DOD's governance structure to make the decision. And then we can move out at speed and reduce duplication, reduce costs.

Jumper: I think probably every service chief for the past couple of decades has had to deal with a continuing resolution [CR] or sequestration or government shutdown or some other bump in the road in the budgetary process. And it is really an impediment to progress. What are the risks of not having an approved budget?

Brown: I just want the whole audience to repeat after me: 'CRs are bad.' They're frustrating. We had to testify before the House Appropriations Committee in January to look at the potential for a yearlong CR. And we talked about buying power and the like, and that's why I asked my staff to actually pull something together for me. And the fact is, over the past decade, we've only passed one budget on time. If you add up all the time we've been in CRs, it's been over three years. So basically 30 percent of the last [decade]. … If we were in a race with somebody, we just spotted him three years! We can't keep doing this. …

It impacts our ability to fight, impacts our ability to do foundational-type things, to do our foundational pieces, to take care of our Airmen, families, infrastructure, how we work with the combatant commands, the Guard and Reserve. It drives up risk in execution, because we'll build a good plan, but then we can't execute it because of the CR. And then it impacts our industrial base and our ability to commit to moving things forward. … We've got to quit doing this to ourselves.

Raymond: CRs are bad and a yearlong CR is unprecedented. … We've gotten good at bad behavior. We've gotten good at pushing contracts to the end of the year. We've gotten good at doing things that we had to do because we didn't have the resources to do it or a law that allowed us to do it. … A yearlong CR for the Space Force is a $2 billion hit to the top line. … It impacts our modernization. It impacts our pivot to a resilient architecture. It impacts our readiness. It impacts our being able to develop training capabilities and testing capabilities, and it impacts our Guardians and their families because we rely very heavily on the Air Force for those types of programs. … And it impacts our ability to continue to establish the service. We've identified missions that are going to transfer from the Army and the Navy into the Space Force. … All the people have volunteered. I've been on the road here recently visiting them and overseas and in CONUS. They're eager to come. But we can't bring them in until the law is passed. … A yearlong CR would be absolutely devastating to us. [March 10, Congress passed the omnibus spending bill to fund the federal government for the rest of fiscal 2022, sending it to President Joe Biden for his signature.]

Jumper: How would you describe the current state of the industrial base?

Raymond: I think in the space domain, we've learned a lot about the industrial base, especially under the pandemic. It forced us to understand it better. …[A recent report on the space industry] talked about how it is tactically strong but strategically fragile. … There are opportunities to expand this industrial base to get more … innovative players into it, which is what we want to do. And we think there are opportunities here … for a national-level vision on an industrial base. …

Brown: I think we've gotten … so efficient in certain areas, whether it's the industrial base in the commercial sector … [or] our depots, that we … may not be effective in the future. If we had to surge, we'd be challenged. I get worried about the age of our fleet, and you look at diminishing manufacturing sources, where the company that actually built this particular [system] doesn't exist anymore. You have to start from scratch. … We haven't put as much into R&D or the aspect of STEM education. … I've had a chance to meet with a number of smaller companies—with venture capitalists—and they're patriotic, and they want to work with us, but we can't make it so hard. … You know, the 'valley of death?' … There's a lot of innovation on one side of the valley, a lot of interest on the other side, [and] we just can't get the two of those to meet. … It's the aspect of being able to use the operational imperatives—put operators with the technical experts with acquisition professionals with industry. … It's all about collaboration to buoy these things forward.

Jumper: There are many initiatives underway that make our force more agile, more survivable. Would you talk about how the Air and Space Force are thinking about these fundamental shifts in the way we go to war?

Brown: We've gone to the same places for the past 20, well, actually 30 years, for the Air Force in the Middle East. And we've gotten used to going someplace where everything's all set and ready to go. You don't have to set anything up; it's already there. In the future, we're going to go places we haven't gone to before, particularly if you think about the Indo-Pacific. … This is where the operational imperatives come in. … The other thing that I think about as we move forward from a wartime perspective is … agile combat employment. There's a capability, but it's also the mindset of our multicapable Airmen: The ability to not only go into a base that you haven't gone to before, set things up, tear it down, and move around, but it's the ability to stretch our Airmen and allow them to use all their skills and talent. … When we changed our doctrine to mission command and talked about centralized command, distributed control, decentralized execution: It's the aspect of being able to work small teams and trusting our Airmen to be able to do things. … The conflict in the future is going to be much different than what we've been doing in the Middle East. We've got to really change ourselves.

Raymond: As you become more agile and more dispersed, you also have to be able to bring data from space down and get that into the hands of the folks that need that information. And so the work that we're doing to develop tactical-level ISR requirements for the department and then figure out how best with our Intelligence Community and partners to satisfy those requirements and then task and distribute data to the joint force is going to be critical.

Jumper: This idea of being truly expeditionary is fascinating for some of us old guys, who at the front end of creating the Air Expeditionary Force, got trapped into this static situation. But what we also learned in that period was that part

of our core competencies need to include security outside the fence—engineering, maintenance, and sortie generation. So how do you look at this development of these competencies?

Brown: When we talk about multi-capable Airmen, it's one part of the doctrine. It's the mindset to allow them to trust themselves that they can do these things. … I want a mindset of Airmen that actually think differently and challenge the status quo of how we might operate. … I just need to be able to understand what it is they're trying to get done so that I can support them. … And then, technology is much different. You know, … I didn't have an email address when I came into the Air Force. I think that my first email address was when I was a captain, which tells you things have changed. So we've got to change too. … We need to redefine 'expeditionary'—what we did during the AEF construct to where we're going to go today."

Jumper: We never really achieved the agility we were striving for because the conditions were different. We've got to get there now.

Brown: Exactly.

Jumper: Talk about this current generation of Guardians and Airmen and what we have in the force today.

Raymond: They're incredible. I mean, they're way smarter than I am. And my college roommate's here somewhere, and he'll vouch for that. They're collaborative; they're connected. They want to serve. They are bold. They've got ideas. And it requires a different leadership style. It requires less AFIs and 'Here's how we're going to do business,' and [being] more open to choices. … Chief Towberman, our chief master sergeant of the Space Force, has really been working this hard. We've developed a human capital plan with what we call the 'Guardian Ideal' that gets after this. …

Brown: I think about this generation as they come in and the aspect of how connected they are, how much they want their leadership to know them and care. … And we got to make sure we get out of their way to allow them to contribute. … You think about the tools we provide them. We want to make sure that they don't have to step back into the '80s when they come to work each day.

Jumper: How do you look at the risks and the challenges for sustaining Air Force readiness at the level that we need it to be confident in our missions?

Brown: It's a challenge, because the United States Air Force is very popular. And I joke about this, but I feel like a chew toy between combatant commanders, where they're pulling and asking for more and more Air Force capability to go to different places. Because the United States Air Force is the one service that can get there faster than anybody else except for the Space Force—17,500 miles an hour, we can't go quite that fast—but we can get there and do things in hours and days that may take others weeks and months to do. So we make it look too easy.

… The other part for the Air Force is we've got to be a little more bold. We've got to speak up for ourselves and show what the impact is. And that's something I don't know that we've done very well. … We've got to do a better job of talking about what happens to our readiness if we continue to use our capabilities at the rate we do and we don't modernize. You've got to look at it from a broader perspective. And I think if you look at current events today, with Russia and Ukraine, and our pacing challenge, we've got to be able to walk and chew gum at the same time. And we've got to really think about how we preserve some of that readiness [and] at the same time assure deterrence.

Staff Sgt. Elora McCutcheon

Moderator Gen. John Jumper (Ret.) joined Brown and Raymond in condemning seemingly endless continuing resolutions instead of passing funding bills in a timely fashion.

Raymond: I had the opportunity to be a combatant commander and a service chief at the same time. And what you see different between a combatant commander and a service chief is a combatant commander has a very near-term focus, one to three years, and service chiefs look to the future. And so I had the opportunity to disagree with myself in my two hats. And the cool thing is, I won. I really can't tell you which hat I won in, but I always won. General Brown has highlighted that in a way that I think has helped inform the joint force and will help us build the readiness that we need for future issues we have to face.

Jumper: I think we're watching sort of a recasting of how we view alliances in the current situation in Europe. Can each of you just say a word about our alliances and the importance of our alliance partners going into the future?

Brown: We've got to think differently about how we do our formula, tell ourselves how we do co-development of capabilities, how we share information. Those are the things that are going to break down some of the barriers. The things that we have to do with our allies, we've got to make some things more actionable. You can look at today's current events of how NATO has really come together for a crisis. But we can't wait for a crisis. We've got to be doing these things on a day-to-day basis.

Raymond: [With space], typically the partnerships over history have been in the civil space side with NASA. We haven't had the international partnerships on the national security space side to the level that we need. We need them in a big way [now,] with the domain becoming a warfighting domain. … What used to be largely one-way data-sharing partnerships are now two-way partnerships. We operate together; we train together; we wargame together; we operate capabilities together. And if we get this force design right, where we build this new design for our space capabilities, we think there's greater opportunity for allied partnerships and those capabilities, as well. So it's extremely, extremely important, and we're very grateful to our partners for being there with us. ✪

By John A. Tirpak

Fast-Tracking the Wedgetail

The Air Force usually takes a long time to procure new equipment, even when the need for something new is clear and urgent. But it seems the service may drop its typical agonizingly deliberative process and move quickly to buy a replacement for—or at least complement to—its fleet of aged E-3 AWACS air battle control jets. That new platform will almost certainly be the Boeing E-7 Wedgetail.

"I want them in the inventory … two years ago," Gen. Mark D. Kelly, head of Air Combat Command, said bluntly during an AFA Mitchell Institute for Aerospace Studies discussion last October. The E-3 is "unsustainable without a Herculean effort" on the part of ACC's maintenance teams, and he warned that "there's only so many miracles" maintainers can work "before physics come into play on a 45-year-old airframe."

Chief of Staff Gen. Charles Q. Brown Jr., speaking at AFA's Air, Space & Cyber Conference (ASC21) last September, said the Wedgetail offers "an opportunity to be able to get" modernized air battle management capability "faster than if we were to start a new one from scratch," and he's been impressed with its capability, having flown aboard an Australian model twice while he was Pacific Air Forces commander.

Staff Sgt. John Linzmeier

A Royal Australian Air Force E-7A forms up with an F-22 near Hawaii in April 2021. The Wedgetail could be USAF's solution to declining AWACS readiness.

Gen. Kenneth S. Wilsbach, the current head of PACAF, said Wedgetail is "a proven capability," that he also finds desirable. In February 2021, Wilsbach told reporters at AFA's Aerospace Warfare Symposium that "we need something relatively quick because of the reliability of the E-3." He called the AWACS "challenged" by its age.

Air battle management is a critical mission. The AWACS scans the battlespace, detecting and identifying aerial threats out to 250 miles or more, vectoring friendly fighters to intercept them. To illustrate its range, an AWACS flying over New York City could manage the aerial battle as far away as Boston, Mass., and Washington, D.C., at the same time.

But the AWACS's age is working against it. Air Force Secretary Frank Kendall, in a "Coffee Talk" aired online in January, said he's deeply concerned that "some fleets, like our battle management fleet, AWACS … are not anywhere where they need to be" in terms of their readiness.

READINESS RATES FOR THE AGED

Statistics provided to Air Force Magazine show that the 40-year-old E-3G fleet managed only a 60.65 percent mission capable rate in fiscal 2021. The E-3B variant managed only 55.78 percent, meaning that most of the fleet is unavailable for duty nearly half the time.

Speaking with reporters at AFA's conference last September, Kelly said, "There's a reason why exactly zero airlines around the globe fly the 707," on which the AWACS is based, noting that parts and equipment to repair the type have become practically extinct.

Kelly's October comments about getting a new AWACS in a hurry came just a few days after the Air Force published a solicitation seeking studies and analyses from Boeing to ascertain "the current E-7A baseline configuration and determine what additional work will be necessary" to make it compatible with Air Force standards. The Air Force didn't state an intention to buy the jet, but senior leader comments indicate they're leaning in that direction. Kendall, at ASC21, said the Wedgetail "could be useful" in bringing USAF up to date in AWACS capability.

The Air Force has resorted to new acquisition authorities given by Congress to rapidly acquire some new systems. Boeing's F-15EX is one example that did not go through USAF's and the Joint Staff's elaborate requirements process.

In its October solicitation, the Air Force said "the Aircraft Rapid Prototyping Requirements Document [RPRD] has specifically called out the E-7A and it has been determined that this is a sole-source requirement."

The E-7 was developed by Boeing for the export market. It's hosted on a 737-700 airframe, and rather than a rotating radome—the iconic, flying-saucer-like feature of the E-3—the Wedgetail uses a large blade-like structure on its back, housing an active electronically scanned array radar.

"It's … a smart sensor that directs beams, directs waveforms," Lt. Gen. Steven M. Shepro (Ret.), Boeing's vice president for business development for bombers, fighters, mobility, and surveillance said of the Wedgetail's distinctive feature.

"The blade is transmitting, side to side," he explained, "and then the 'Top Hat'"—a horizontal lip overhanging the blade—"is able to complete the 360-degree coverage."

Privately, senior USAF leaders said there isn't a viable alternative to the Wedgetail. While the Northrop Grumman E-2D is in service with the Navy, which is satisfied with it, the turboprop-powered Hawkeye lacks the speed and altitude the Air Force requires. A Swedish platform called the Erieye similarly lacks the power, speed, and altitude the Air Force wants.

Kelly lamented that Australia, South Korea, and Turkey have

a modern Wedgetail, yet USAF doesn't field "a cutting-edge, air-moving-target indicator capability."

Shepro said the Boeing study work is "ongoing." It's looking at "the configuration, feasibility, and risk reduction," but he declined to say how long the work will take. The Air Force is "developing its requirement," he said.

Besides being a fresher and more reliable platform, newer technology makes the E-7 more desirable, Shepro said. The E-3's rotating radome "comes around every seven to nine seconds," he said, but the E-7's blade antenna is "instant sweep. This is especially important for long-range weapons and defense." He added, "You have to have that speed of scan in order to confront modern threats."

Based on the 737, the E-7 enjoys the benefits of that aircraft's commercial ubiquity.

"It burns a third of the fuel of a 707, it has 40 percent of the sustainment costs, and it only has 50 percent of the manpower requirement," Shepro said. "The availability rate with the partners is about 96 percent." Somewhere in the world, a 737 is taking off "every five seconds," he said, indicating how pervasive the 737's support enterprise is.

The last E-3 was built in 1992. The type also equips NATO, France and Saudi Arabia, and Japan flies a version hosted on a 767 airframe. The British Royal Air Force retired its last E-3s late in 2021, in anticipation of the Wedgetail's arrival.

The Air Force has made halting efforts at updating its air and ground moving target indicator capabilities. In the early 2000s, it planned to buy the E-10 Multi-Sensor Command and Control (MC2A) aircraft from Northrop Grumman. Hosted aboard a Boeing 767-400, the E-10 was to first replace the E-8 Joint STARS ground moving target indicator aircraft, with a new radar that would give it enhanced capability for spotting cruise missiles. A second "spiral" upgrade would have added capabilities to make it a successor to AWACS; it was even expected that it would use a blade-like radar similar to that on the Wedgetail. A third spiral—or possibly a variant airframe—would have given the aircraft signals-intelligence capabilities like those of the RC-135 Rivet Joint fleet.

The E-10 was scaled back in 2006, however, to become simply a demonstrator and disappeared from the budget completely in 2007. The only element that survived was the Multi-Platform Radar Technology Insertion Program (MP-RTIP) radar. The Air Force decided to keep the JSTARS and AWACS going with technology refreshes and postpone replacing them with new airframes.

TEMPTING TARGETS

The Air Force admitted, though, that its high dependency on JSTARS and AWACS made them tempting targets. USAF began to shift its sights to the Advanced Battle Management System. The ABMS is expected to be a cloud-like network of space-based and aerial sensors federated among USAF's entire fleet, thus denying an enemy a single node it could shoot down to blind USAF forces.

Kendall has said, however, that he thinks ABMS has been overpromised and needs to advance more deliberately, requiring the interim step of new flying platforms.

In a Center for a New American Security interview in January, Kendall said there is no "grand solution" to the ABMS requirement, and there will have to be intermediate steps including "airborne components" toward an "over-arching solution." A space-based system is the ultimate goal, but it's not ready yet, he noted.

The space-based system won't be "affordable or easily achievable on a timescale that's realistic to meet our needs," Kendall asserted.

However, Kendall did not specify the Wedgetail as the only path. Unmanned assets will likely play a role, because "high-level nodes" could still be "vulnerable to attack." He also wants elements of ABMS to function in contested airspace, in which platforms like the AWACS could not survive.

The E-7's more advanced sensor technology versus the E-3 means its detection range is "multiples" better, Shepro said, allowing the aircraft to either see deeper into contested areas, or stand off farther from them.

"It can even do maritime moving target" detection and tracking, he noted. It can also do electronic warfare support measures (ESM), "and then there's a lot of classified capabilities I can't discuss."

An Australian E-7 participated in a January Red Flag exercise at Nellis Air Force Base, Nev., and "the feedback was very positive," Shepro reported. The E-7's "ability to connect" with all the participants was a key demonstration; "second was the ability to do command and control at long range," he said. The ability to "orchestrate … all that … stood out."

The biggest advantage, though, is that the E-7 is "available. … It's in production," Shepro said. "We could get it on the ramp" for the Air Force "in under five years." If the Air Force bought the E-7, there would likely be further international appeal as "other AWACS users would be interested in recapitalizing."

There is a time factor, though. Boeing is looking at closing out the 737 Next Generation, on which the E-7 is based, in 2025. The company has extended production lines to accommodate the Air Force before, however, especially when it extended the 767-200 production line to give USAF more time to choose it as the basis of the KC-46 tanker.

NATO, Shepro said, "is looking at its allied future surveillance and command system." The plan is for a "system of systems, but there's a very good chance E-7 could be involved." NATO operates 14 AWACS.

The Wedgetail could also be a "gateway" that could allow fifth-generation F-22 and F-35 fighters, which do not have compatible communication systems, to talk with each other, Shepro suggested. It's not a capability of the E-7 now, but "it will be able to do that gateway capability in the future. That's a configuration we'll be discussing with the Air Force."

Australia and Boeing have worked to make the E-7 capable of knitting together Australia's F-35s, F/A-18s, P-8 patrol airplanes, and "eventually, their ATS Air Teaming System," which is an unmanned escort for combat aircraft.

The E-7 is not yet an "open architecture" platform, but Shepro said Boeing is "invested" in open mission systems, "as you've seen with the F-15EX and T-7," and could create an open architecture for the jet.

Air Combat Command is "focused on … the long-range kill chain," and the E-7 would help it get there, Shepro asserted. ACC's goals are to: "'sense, connect, engage' and 'agile and comprehensive battle management,'" he added. "And that's what we're really invested in. … The E-7 really hits the mark on ACC's desire to have that first-shot, first-kill capability."

The Congressional Research Service, in a January bulletin describing new initiatives being pursued by the Air Force, said USAF "may see an opportunity to save money by capitalizing on … existing production" of the E-7, "although that may overlook the effort required to tailor [its] systems to U.S. requirements, and the fact that no budget line exists for AWACS replacement." There is no "identified source of funding" for the E-7, the CRS said. ✪

Staff Sgt. Donoven Wright checks the fins on an AIM-120 during a weapons load competition at Eglin Air Force Base, Fla. Teams competed to see which was fastest to load an AIM-120, AIM-9, plus chaff and flares onto an F-22 Raptor. The Air Force recently deployed F-22s to the United Arab Emirates to support its self-defense against Houthi rebels in Yemen.

Samuel King Jr./USAF

An F-15 Strike Eagle from the 336th Fighter Squadron and two Polish MiG-29s, one with a portrait of Poland's top World War II ace on its tail, as seen from a B-52H Stratofortress during a February bomber task force mission. Weeks later, Poland offered 28 MiG-29s to Ukraine, a deal quickly became bogged down in political crossfire. The Soviet-era MiGs are approaching their fourth decade and while effective in air-to-air operations, present fat targets for integrated air defense systems.

Airman 1st Class Zachary Wright

F-16 Fighting Falcons break away from behind a KC-135 Stratotanker after refueling over the Red Sea during a regional exercise designed to test information distribution in the face of a simulated threat posed by unmanned aircraft. Low-cost unmanned systems pose a variety of threats and hazards to airborne ops, and countering those threats is increasingly important as more nations and even terror groups field unmanned platforms.

Staff Sgt. Joseph Pick

Mike Tsukamoto/staff

Future manned combat aircraft are on their current trajectory not affordable, Air Force Secretary Frank Kendall said at the AFA Warfare Symposium in March. Unmanned autonomous aircraft hold the key to making future tactical aviation affordable.

Betting on Unmanned Bomber, Fighter 'Families'

SECAF Frank Kendall believes the future is unmanned—mostly.

By John A. Tirpak

The answer to the Air Force's need for new tactical and strategic aircraft largely will be unmanned—embodied in a family of new aircraft in various states of development—Air Force Secretary Frank Kendall said at the AFA Warfare Symposium in March.

"On its current trajectory, the tactical Air Force is not affordable," Kendall asserted. The F-35, F-15EX, and the coming Next Generation Air Dominance (NGAD) aircraft "are all too costly to fill out our needed force structure." As older airplanes retire, there won't be enough aircraft to meaningfully deter China or Russia unless USAF sets off in a new direction, he said, emphasizing that while Russia may pose the most "immediate" threat, China remains the pacing threat against which the United States must benchmark its military capability. Unlike Russia, China has the economic means to challenge the U.S. in every military domain.

"Russia reminds us that 'great power conflicts' could happen, and could do so at any time."
—Secretary of the Air Force Frank Kendall

"A clear-eyed, objective perspective" on the relative dangers of China and Russia "is impossible in the moment," Kendall said, speaking just one week after Russian forces invaded Ukraine. "The threat of a major land war in Europe was something that, until a few days ago, most of us believed was extremely remote. So much for that."

But what Russia reminded the world is that "great power conflicts could happen and could do so at any time." The role of the Department of the Air Force is clear, he said: "to provide Air and Space Forces that will deter aggression and, if necessary, defeat it."

Kendall said his top three priorities remain unchanged: "China, China, China," and the Air Force

must swiftly overhaul itself to meet that challenge.

"We have an aging and costly-to-maintain capital structure with average aircraft ages of approximately 30 years and operational availability rates that are too low," he said. "We're still limited in our ability to shift resources away from the legacy platforms we need to retire to free up funds for modernization."

USAF isn't "flying and training enough," Kendall said, "sacrificing" its historical advantage in aircrew experience and is burdened with 20 percent excess basing capacity and "a significant number of programs that are not fully funded beyond the budget year."

Yet the Air Force must be able to deal with "a possible invasion of Taiwan and a land assault on a NATO member, … not some time in the future. Now."

Kendall promised a fiscal 2023 budget request, anticipated for release in April, that will be "aligned" with the new National Defense Strategy and National Security Strategies.

Repeating his seven imperatives for the Air and Space Forces, he said "there is a great deal of work to be done in finalizing the best long-term modernization program for each."

Kendall said, "We start more programs than we can afford, and don't prioritize the most promising ones early."

New unmanned aircraft programs can address many of the Air Force's problems, he noted, but like all of his imperatives, "if we don't get them right, we will have unacceptable operational risk."

The Next Generation Air Dominance family of systems will include a crewed platform, Kendall said, teamed with "much less-expensive, autonomous, uncrewed combat aircraft." Employing a distributed, tailorable mix of sensors, weapons, and other mission equipment, these systems will be designed to operate "as a team or a formation" in a system-of-systems approach to air-to-air combat. NGAD, he said, "must be more than just the next crewed fighter jet."

Kendall envisions "one to five uncrewed combat aircraft controlled by a single, modern crewed aircraft," which could be the NGAD or the F-35.

"The idea is for the crewed aircraft to be essentially calling plays and employing uncrewed combat aircraft as wingmen in tactically optimized ways," Kendall said. These would be "attritable" aircraft, inexpensive enough that they could be lost without grave disadvantage. That opens up "a world of fascinating tactical opportunities."

The exact mix of manned to unmanned aircraft, and the tactics they could employ, are all being analyzed and defined, Kendall said. The Skyborg autonomous flight control system and the "loyal wingman" Australian Advanced Teaming System concept have generated "enough confidence" that he's convinced that such systems are achievable.

Brig. Gen. Dale R. White, program executive officer for fighters and advanced aircraft, said the new programs will be built around the artifical intelligence developed for Skyborg.

"We're ready for a program … ready to move out" in fiscal 2023, he told reporters at the symposium. While there's still "more science and technology to do," the core capability is there, he said.

Maj. Gen. Heather L. Pringle, head of the Air Force Research Laboratory, promised a program "focused … on what the Secretary wants to do." White said a close relationship with ACC on unmanned programs will ensure that operators are involved in designing the systems.

Now, Kendall said, manned-unmanned teaming must cross the so-called "valley of death" where interesting prototype efforts and concepts die before becoming programs of record that produce meaningful capabilities.

Kendall said the Air Force's "4+1" fighter roadmap, laid out last summer, remains valid, and is necessary to organize force structure and new investments.

The 4+1 plan includes:

- The F-22 transitioning to the NGAD;
- The F-35;
- The F-15E and F-15EX;
- The F-16; and
- The A-10 as the "plus-one," phasing out completely circa 2030.

Kendall's Operational Imperatives

- Defining a resilient and effective space order of battle
- Achieving an operationally optimized Advanced Battle Management System
- Defining the Next Generation Air Dominance system of systems
- Achieving air and ground moving target identification at scale
- Defining optimized, resilient basing
- Defining the B-21 long-range-strike family of systems
- Readying the Department of the Air Force to transition to a wartime posture against a peer competitor.

BOMBER TECHNOLOGY

"Defining the B-21 bomber's long-range strike family of systems" is among Kendall's seven imperatives, but an unmanned bomber is "more speculative" than unmanned wingmen in the fighter community. As with NGAD, he wants the unmanned aircraft to be a lower-cost strategic capability that complements the manned B-21 bomber now nearing first flight. Kendall said he's aiming for a system half the cost of the B-21, or less. He wants the same from an unmanned NGAD system.

The B-21 has a ceiling cost of $550 million, in base year 2010 dollars, or $713.6 million today. The new unmanned bomber would have to cost less than $356 million apiece, while matching or besting the B-21's speed and range. That suggests the airframe will have large wings, according to Randall Walden, Rapid Capabilities Office (RCO) director, whose office is overseeing the B-21.

The new aircraft must have "a reasonable payload when it gets" to its destination, Kendall said. It has yet to be defined whether the new airplane must be nuclear-capable.

Like the uncrewed fighter, the unmanned bomber will have "mission-tailorable capability" and will be able to employ a variety of sensors, payloads, and weapons, according to Kendall.

"They can also be attritable or even sacrificed if doing so conferred a major operational advantage," he said.

Kendall declined to comment in detail on B-21 progress, saying only that the program is doing "reasonably well" and adding, "we may end up buying more than we've currently planned" because the Air Force will need "perhaps more long-range capability … at some point in the future."

The original requirement was 80 to 100 B-21s, but the Air Force has since changed that to a "minimum" of 100, with Air Force Global Strike Command leaders suggesting that 120 or more should be the minimum buy. While Kendall declined to say how many new uncrewed strategic platforms

Northrop Grumman/courtesy graphic

The B-21 Raider, the first new Air Force bomber design since the 1980s, is scheduled for its first flight within the year.

are needed, he noted those aircraft would be "additive" to the B-21 fleet, not a substitute for manned Raiders.

Walden said the new strategic aircraft would likely fly ahead of the B-21, serving as its ultra-stealthy eyes and ears, and possibly neutralizing air defense threats ahead of the manned airplane. But the cost has to be tightly controlled to realize the operational benefits, he said.

"We would take more risk with an unmanned system that is not as expensive as the manned system," he said. Could Kendall's new unmanned bomber spell the end for crewed bombers? Walden said every USAF bomber so far has had a human crew, with the advantage that mission aircraft can be recalled even after they are dispatched to combat. It was always planned that there could be an unmanned version of the B-21, Walden said. That's still the case, but an unmanned B-21 would not meet Kendall's requirement that it be "half the cost" of the standard model.

"Once you start to put cost on there, just like we did with the B-21, that really tells what the design's going to be," he said.

But the unmanned bomber is real, Walden said. "We've got the top-level requirement from the Secretary of the Air Force."

The B-21 program, which got underway in 2015, is now on the verge of rollout and first flight. If the unmanned bomber follows the same timeline, it could be available by the end of the decade. Once the program is officially launched, Walden said, the RCO is "pretty good at doing that piece in a relatively fast way."

He said the program will likely start with a risk-reduction phase, with potentially competitive designs going through preliminary and Critical Design Review. After that, a judgment would be made whether industry could actually produce an operationally useful platform, after which source-selection criteria could be defined.

"We know how to do this," he added. "We've done this before."

Walden revealed that the first of six B-21s now under construction has wings and landing gear installed and "really looks like a bomber." It has been moved to a different hangar at Northrop Grumman's Palmdale, Calif., plant, where calibration testing will begin soon.

The results of those tests will lead to a last-chance evaluation, "making sure the structure is designed and built to what we actually meant it to do," Walden said. Then comes the final preflight tests. "We have to apply power to it, start the engines, go through hydraulics, everything you normally do in a ground test to make sure it's operating correctly." After that, low- and high-speed taxi tests will follow before the first flight.

Kendall said there will be seed money for the unmanned systems in the fiscal 2023 request, but serious money will follow in fiscal 2024. The aim: "to get meaningful operational capability into the hands of operators as quickly as possible," Kendall said. "And that entails risk—and commitment." ✪

USAF's Big Goals Meet Tech Challenges

By Greg Hadley

The Space Force wants to build the nation's first "digital service." The Air Force wants to embrace cutting-edge technologies like artificial intelligence (AI), integrated networks, and digital engineering.

Yet to achieve these lofty goals, the services, along with the rest of the Pentagon, need to make some fundamental changes, says the former Google CEO—changes that would put them more in line with Silicon Valley than Washington, D.C.

Eric Schmidt served as CEO and executive chairman of Google and its parent company Alphabet from 2001 to 2017, overseeing a company with tens of thousands of employees and tens of billions of dollars in revenue.

"The next battles will be fought based on software supremacy." —Eric Schmidt, former CEO, Alphabet

He also worked as the first-ever chairman of the Defense Innovation Board and the chair of the National Security Commission on Artificial Intelligence. His own personal net worth, Bloomberg estimates, is around $25 billion.

In a March 3 keynote address at the AFA Warfare Symposium (AWS) in Orlando, Fla., Schimdt promised transformative impacts from AI and other software. But he also offered a blunt assessment of where the Defense Department stands today on those fronts—and what it needs to do better.

"In the tradition of the military, I will be direct and I hope that's OK," Schmidt told an audience of Airmen, Guardians, and industry leaders. "If I look at the totality of what you're doing, you're doing a very good job of making things that you currently have better, over and

Mike Tsukamoto/staff, Air Force Magazine

"The problem is you don't have enough bandwidth," Schmidt said. "You've got to get the networks upgraded. ... you don't have enough software people," who though "often obnoxious ... can change the world."

over and over again.

"But I'm an innovator. And I would criticize, if I could say right up front, that the current structure, which is an interlock between the White House, Congress, the Secretary of Defense's [office], the various military contractors, the various services and so forth, is a bureaucracy in and of its own. And it's doing a good job at what it has been asked to do, but it hasn't been asked to do some new things."

From there, Schmidt had plenty of suggestions of new things to try.

FIRST, FIX THE NETWORKS

Perhaps the most basic, fundamental problem Schmidt addressed is one that plenty of Airmen and Guardians likely already knew.

"The real problem you have is that you don't have enough bandwidth ... no one ever tells you this," Schmidt said. "Your networks, excuse the term, suck. You've got to get the networks upgraded. And you just have to, because all of these things depend on that kind of connectivity, right?"

Those comments were met with warm applause from his audience full of service members—the issue of poor network connectivity and IT systems is a constant source of frustration among Airmen and Guardians.

That audience reacted similarly when Chief Master Sergeant of the Air Force JoAnne S. Bass brought the topic up during her own AWS panel discussion and acknowledged she is also frustrated "beyond belief" by how slow, cumbersome, and sometimes outright unusable the IT systems can be.

"Our Airmen always say, 'I wonder if our leaders know, I wonder if our leaders understand the challenges we have.' And I'm like, 'Yes, we do, and we share those challenges, right?'" Bass said. "As many times as you have to add in your PIN, I have to do that too. I mean, I send stuff home to my phone or my whatever so that I can actually watch whatever I need to watch, because I can't do it on my work [computer]."

Without better networks, most of Schmidt's suggestions become far less feasible.

STAFF UP

There are more than 600 projects currently underway in the DOD devoted to artificial intelligence, and countless others focused on software and IT modernization.

But as things stand, the numbers simply aren't adding up, Schmidt said, whether it's in staffing levels or funding. Schmidt's comments echo the final report from the National Security Commission on Artificial Intelligence, which called for an increase in funding from $1.5 billion a year to $8 billion.

"Every time you try to do something in software, one of these strange scavenging groups within the administration takes your money away. It's insane," Schmidt stated. "The core issue here in the military is you don't have enough software people. And by software people, I mean people who think the way I do. You come out of a different background, and you just don't have enough of these people."

The software people the DOD needs, Schmidt acknowledged, aren't like those many typically associate with the military—"they're often very obnoxious, ... they're difficult, they're sort of full of things"—but they're necessary because "they can change the world," he suggested.

This issue is particularly glaring when it comes to AI, Schmidt said. And not only does the military lack the necessary personnel, the defense industrial base does too—touring the symposium's exhibition hall, Schmidt said he only saw "like two AI companies ... and by the way, they're the little ones in the corner."

Again, Schmidt's comments echo the commission report, where he and his vice chair wrote that they "worry that only a few big companies and powerful states will have the resources to make the biggest AI breakthroughs."

There have been some examples of breakthroughs, Schmidt said, pointing to Project Maven, an Air Force AI project that

awarded a contract to Google but ignited controversy among its employees in 2018. Nearly four years later, Schmidt said Maven has had "very successful classified use in the right ways."

"That's an example of something where you pick it and you fund it, and you weigh it and you build it, and you build the constituencies and then you have it," Schmidt insisted.

But Maven was just one project, and "to be very blunt, you don't have enough people, you don't have the right contractors, and you don't have the right strategy to fill in this," Schmidt said of the Pentagon's work in AI. "We need 20, 30, 40 such groups, more, more, more. And as that transformation happens, the people who work for you, the incredibly courageous people, will have so much more powerful tools."

CORNERS OF INNOVATION

Yet despite all this, perhaps the biggest issue facing the Air Force's software and AI efforts isn't really about software.

"We love to talk about strategy, and we need more money over here—and by the way, we do—and we need more partnerships over here—and yes, we do—and we need more of this over here, and every state has to have its money and all of that's fine," Schmidt said. "But what we don't have and we need a lot more of is the kind of talent to drive this world."

It's one thing to say the Pentagon needs to hire more personnel to work on AI and software. In order to retain and grow that talent, Schmidt said, the military needs to empower innovators instead of holding them back, granting them a certain level of autonomy to make decisions and take risks.

Air Force Chief of Staff Gen. Charles Q. Brown Jr. has made empowering Airmen one of the key themes and goals of his tenure. Yet given the massive bureaucracy Schmidt described at the top of his speech— the White House, Congress, the Pentagon, the services, and the defense industrial base—sweeping, comprehensive changes are unlikely.

"When you have such a large bureaucratic problem with so many different stakeholders, you're not fundamentally going to fix it as an architecture," Schmidt pointed out. "You're going to have to adjust it, you're going to have to make corners, and one of the principles of decentralized leadership is to allow corners of innovation."

The Air Force and the Secretary of Defense should determine the highest priority areas, Schmidt said, and allow innovators to experiment and pursue cutting-edge technologies.

In that regard, the service could look to its past for a model.

"The Air Force should properly be proud of the Skunk Works model," he said. And the Skunk Works model in the '60s was interesting because it was run by a set of colonels, right? And I don't exactly understand how politically they managed to get the freedom … but somehow they managed to do it on a cycle that was a yearly cycle rather than a 10-year cycle."

Empowering tech innovators will also have the benefit of helping the military attract and retain talent.

"If I can just be incredibly blunt, you've got to figure out that the people that do stuff that I do are like doctors, in the sense that they're specialists, and they want to be doctors, right?" Schmidt said. "The military doesn't take these, again, beautifully trained medical people, you don't just transfer them out to other activities. You have a career path. And they'll stay … because they believe in your mission. They believe in you. They believe in your culture. It's not about compensation. Everyone's obsessed about compensation, which is always an issue. People want to serve."

Schmidt's warning comes just a few months after Nicolas M. Chaillan, the first-ever chief software officer of the Air Force, abruptly announced his resignation in a candid LinkedIn post expressing frustrations about the Pentagon's bureaucracy and lack of appreciation for "prioritizing IT basic issues."

Mike Tsukamoto/staff, Air Force Magazine

Eric Schmidt, former Alphabet CEO, speaks with AFA's President Gen. Bruce "Orville" Wright at the Warfare Symposium.

There is an inherent tension between the Pentagon bureaucracy and the innovation Schmidt envisions. He recounted an incident while visiting Al Udeid Air Base in Qatar and watching a USAF general authorize a strike against a target after consulting with his lawyer.

"What I learned from that was, you're going to have to have top-down control when kinetic force is used. But you're also going to have to find a way to give autonomy to the person to do it," he said. "And that is at the root of your cultural problem. You want the centralization for protection of the institution, for good reasons. But I also want the autonomy for our men and women to do what they need to do and do it quickly and well."

WHY IT'S NEEDED

Schimdt's intense enthusiasm for software development in DOD is born out of his belief that "the next battles will be fought based on software supremacy. And they really will be. And you understand this, you've heard it, but you don't have it yet."

In particular, "AI is a force multiplier like you've never seen before," he said. "It sees patterns that no human can see. And all interesting future military decisions will have as part of that an AI assistant."

Schmidt is hardly alone in predicting AI will have a seismic impact on warfare. It has the capacity to transform missile defense, precision weapons targeting, precision analysis, and autonomous systems.

But advocates say they've also encountered resistance and inertia within the Pentagon, preventing the U.S. military from fully embracing AI's possibilities and forcing service members to "spend all day looking at screens doing something that a computer should do," Schmidt said.

As the Air Force and Space Force look to transform themselves into hotbeds of innovation, there is one current internal example they can look to for inspiration, Schmidt added—the B-21 Raider program. Praising the Rapid Capabilities Office, Schmidt said the Air Force developed the new stealth bomber in a "new and innovative" way.

"Think about the B-21 example, but apply it to things other than bombers," Schmidt urged. "Like, let's try to do the same thing for software." ✪

Zhang Feng/China Ministry of Defense

Soldiers assigned to a brigade with the People's Liberation Army Rocket Force raise a ballistic missile on its transporter launcher into launch position during a night training exercise at an undisclosed location March 10, 2021.

Modernizing the Triad

The U.S. can't afford to postpone modernization in a tri-polar nuclear world.

By Amy Hudson

The U.S. nuclear triad is falling technologically behind its rivals, and in an age where the United States faces not one, but two peer strategic threats, there is no longer margin for error, leaders say. Modernization is not an option, but a necessity.

"We have to keep what we currently have safe, secure, and reliable as we transition to more safe, more secure, and more effective systems that can meet future threats," said Lt. Gen. James C. Dawkins Jr., USAF deputy chief of staff for strategic deterrence and nuclear integration, during the AFA Warfare Symposium in early March. "The sense of urgency has never been more important. If you'd asked me a year ago, I would have said the same thing, but Ukraine has brought that into sharper focus."

As Russia launched an unprovoked war in Ukraine in late February, Russian President Vladimir Putin announced to the world he had put his strategic forces on high combat alert, raising tensions to a height not seen since the Cold War. Russia has completed more than 80 percent of its nuclear modernization programs. It's also aggressively pursuing "novel nuclear weapons concepts" not covered by treaties, and to which the United States doesn't "have an answer to, other than a strong deterrent," Dawkins said.

"The fundamentals of deterrence have not changed. It's about adversaries' perception of our will and capability."
—Lt. Gen. Jim Kowalski, USAF (Ret.)

China, with a couple hundred weapons just a few years ago, also is investing heavily in its own nuclear triad. U.S. Strategic Command boss Adm. Charles "Chas" A. Richard told the Senate Armed Services Committee in early March that China is in the midst of a "strategic breakout," and is on pace to have more than 1,000 nuclear weapons by the end of the decade. China is not a signatory to any strategic arms limitations treaties. none of which are covered by a treaty.

With China's rapid growth and Russia's recent aggression along NATO's eastern flank, modernizing all three legs of the U.S. nuclear triad is the "absolute minimum" that must be done to deter adversaries, Richard told senators.

And though China and Russia are the biggest threats, they aren't the only ones ringing alarms. North Korea launched seven ballistic missiles in the month of January alone, and the White House announced on March 10 it was putting its Asia-based missile defense units in a state of "enhanced readiness" after North Korea began testing what is believed to be a new ICBM intended to reach American cities.

"We made these revelations public, we announced some of the additional ISR and enhanced readiness

we are taking because we believe it's important to call out the behavior that we've been seeing, particularly in the last few weeks," Pentagon spokesman John F. Kirby said on March 11. "We believe it's important for the entire international community to speak with one voice about the concerns that we know they have over the DPRK's continued ballistic missile program. … Clearly, these continued tests are a provocation. They are a violation of U.N. Security Council resolutions and they give us, as well as so many other nations, added concern about the kinds of capabilities that the North is trying to develop."

LOOMING BOW WAVE

The U.S. Air Force is responsible for two of the three legs of the triad.

The National Nuclear Security Administration completed the first production unit of the B61-12 Life Extension Program in December 2021, five years after the program kicked off. The airdropped battlefield/tactical nuclear weapon is the B-2 bomber's primary strategic weapon, but it can also be equipped on forward-deployed F-16s and F-15Es to protect NATO allies. It will one day also be integrated on the F-35A.

The B61 Mod 12 updates a weapons system first delivered in 1966, consolidating modifications -3, -4, -7, and -10 into a single configuration to be used through 2040. Mod-11, the most recently fielded update, was introduced in the late 1990s.

The new B-21 Raider bomber will replace the nuclear-capable B-2 and conventional B-1 bombers starting in the mid-2020s, while the 1950s-era B-52 will get new engines as well as updated radars and avionics to keep it flying into the 2050s—nearly a century after it first entered the fleet.

"For all but five years of the United States Air Force's life as a service, there's always been a B-52," said Gen. Anthony J. Cotton, commander of Air Force Global Strike Command, during the AFA conference. "And, guess what? There will be B-52s until 2050, so the modernization efforts that are going into the B-52 is incredibly important for strategic deterrence."

The B-21, however, will make up the "preponderance of the bomber force moving forward," he noted. Six of the new bombers are under construction at Northrop Grumman's Palmdale, Calif., facility, and the first B-21 expected to fly has moved to a new hangar for loads calibration tests—one of the final steps before first flight.

Both the B-52 and B-21 will be equipped with the Long-range Standoff missile (LRSO), which is slated to replace the nuclear AGM-86B Air-Launched Cruise Missile beginning in 2030. First flight of the LRSO is expected sometime this year. The missile will have a range in excess of 1,500 miles.

The Air Force requested $609 million for the LRSO in its 2022 budget request, but cost estimates for the overall program range from $10 billion to $20 billion.

The Minuteman III ICBM—the ground-based leg of the triad—was designed with 1960s to 1970s technology and intended to serve just 10 years. Yet, it recently celebrated its 50th birthday. The Air Force is working to transition to the Ground Based Strategic Deterrent (GBSD) "at the end of this decade," but the program is continually attacked on Capitol Hill as members of Congress, overwhelmed with the impending cost of the modernization bow wave, look to push off upgrades one more time, or worse, scrap the program all the together in favor of a dyad deterrent.

"What I find interesting in the conversation about GBSD: We're five years into the program of record on GBSD," Cotton said. "So, let's stop talking about it like we're trying to figure out if we're going to turn it into a program of record. It IS a program of record. It is the system that we need to replace the Minuteman weapon system. And the team, many are in the audience, are doing an incredible job doing just that."

Dawkins said Congress generally seems to recognize the threats and has agreed to fund modernization for all three legs of the triad. However, he said there's still confusion about what GBSD actually is, and that's on the Air Force to make that messaging clear.

"We've got broad bipartisan support on the Hill … for the nuclear modernization programs, both through the Air Force and Navy," he said. "But it's going to take that constant communication because more than once I've heard with regard to GBSD and Minuteman III, 'You mean it's more than just a simple missile swap?' Yes, it's more than just a simple missile swap. It's all the launch facilities and all the [command and control], and all the alert facilities … that's being modernized. All that goes into GBSD, and it's important to keep folks tracking on the context surrounding the modernization we're about to do."

Speaking at the McAleese FY2023 Defense Programs Conference on March 9, Air Force Secretary Frank Kendall echoed Dawkin's comments, saying the unfolding situation in Ukraine, as well as China's threatening moves toward Taiwan and its campaign to build up its strategic nuclear forces, have "pretty well put to bed" any "arguments that maybe we should have a smaller nuclear deterrent, maybe without as many legs of the triad."

Paul Ferraro, president of air power for Raytheon Missiles and Defense, speaking during a panel discussion moderated by Dawkins, said all three elements of the triad offer an equally important, but unique, element to strategic deterrence.

"The sea leg offers survivability. The land leg, for the ICBMs, bring responsive deterrence and deterrence in numbers. And, then the air leg provides a visible and flexible response, and that visible and flexible response can compel behavior internationally," he said.

The Air Force announced in April 2021 that Raytheon will be the "sole-source contractor" for the highly classified LRSO program's Technology Maturation and Risk Reduction (TMRR) phase, removing competitor Lockheed Martin. The $900 million TMRR deal is expected to run through 2022.

Ferraro said Raytheon is using model-based engineering and digital engineering to "meet the stringent performance requirements" for the weapon, and it's designing maintainability into the program early on so it can last for decades to come.

Early in the design phase, Raytheon brought in Airmen from Vandenberg Space Force Base, Calif., Minot Air Force Base, N.D., Tinker Air Force Base, Okla., and Barksdale Air Force Base, La., to work with the design team. That collaboration "really informed the design process and informed some of the design attributes," Ferraro said. Raytheon then used a 3D printer to make a translucent model of the missile itself, ran the wiring harnesses through the mocked-up version, and asked the Airmen to perform the maintenance procedures that had been drafted so far.

"We really took note of what worked, what didn't, and where we needed to modify the design, so that it would be maintainable, as intended, throughout the lifetime of the product," he added. "And, then updated our cost model accordingly to really optimize the life cycle cost of the weapon system. Some pretty, pretty exciting stuff."

NUCLEAR COMMAND AND CONTROL

Lt. Gen. Thomas A. Bussiere, deputy commander of U.S. Strategic Command, said all that modernization is really "underpinned with our ability to command and control it."

Sometimes referred to as the "fourth leg of the triad," the 204 systems that make up today's nuclear command and control enterprise—of which the Air Force owns 70 percent—were designed decades ago with outdated technology for a completely different threat environment.

Through what is being dubbed "NC3 Next," the Defense Department is looking to leverage modern-day technology, such as artificial intelligence and machine learning, with the advancements it's making in joint all-domain command and control.

"We want to leverage what we can from JADC2," Dawkins said. "Why spend double the money on two different systems?"

Christine Jeseritz, director of nuclear command, control, and communications (NC3) for Lockheed Martin, said investments being made in 5G.mil, agile communications, and zero trust "encompasses both requirements and needs" for NC3 and JADC2, while operating in a benign state.

"But it also has to remain survivable through conflict," she acknowledged. "And so, traditionally, that survival line between the President and the nuclear forces has been called the thin line. Today, we have the technology to be able to thicken that line."

Anticipating degraded communication in any future conflict, Jeseritz said Lockheed is working with business partners "to provide persistent communications through contested and denied environments in order to deliver those important messages to shooters."

The company is also looking at AI and machine learning solutions, "because once everything is connected, you then can have data aggregation, and … you're able to distill large quantities of data quickly, and really be able to get after increasing that decision-making timeline for the decision-makers and senior leaders."

Jim Kowalski, vice president and corporate lead executive for the USAF customer relations team at Northrop Grumman, said, "The fundamentals of deterrence have not changed. It's about adversaries' perception of our will and our capability."

The retired three-star general who last served as deputy commander of U.S. Strategic Command, added that recapitalizing all three legs of the triad with new systems designed with modern technology for 21st century threats, "not only puts the marker on the table for pacing the threat with capability, but just as importantly, if not more importantly, it shows that the will of the United States to remain the responsible global leader is still there. You get both of those with recapitalizing the force. This is foundational to everything we do." ✪

Replacing Aging ISR

It's time for military tech to catch up with military needs.

By Abraham Mahshie

Air Force Secretary Frank Kendall's three times mentioned the "aging and vulnerable legacy systems" JSTARS and AWACS intelligence and early warning systems in his opening address at the AFA Warfare Symposium. Both are in high demand, and also in dire need of replacement.

JSTARS, the E-8C Joint Surveillance Target Attack Radar System is a modified Boeing 707-300 series first deployed in 1991. It is used for ground surveillance, or ground moving target indication (GMTI) capability. AWACS, the E-3 Sentry, is a modified Boeing 707/320 first used in 1977.

The Air Force still maintains 16 JSTARS and 31 AWACS.

Kendall said the airborne surveillance systems are difficult to defend against modern threats and are manpower intensive in an age where artificial intelligence might be highly useful in processing data about air and ground targets in motion..

The Air Force's Advanced Battle Management System (ABMS) is a system of systems approach to this problem. It seeks to achieve DOD's vision for Joint All-Domain Command and Control (JADC2) by means of a complex battlefield network of next-generation sensors and shooters.

"What enables our aforementioned ABMS investments to be successful starts with the ability to acquire targets using sensors and systems in a way that allows targeting data to be passed to an operator for engagement," he said.

Kendall added: "By using modern networking and communications capabilities in tandem with artificial intelligence for battle management and data collection from numerous sources, we can effectively process information to support superior operational decision-making, substantially improving the performance of our forces."

The call was for a new intelligence, surveillance, and reconnaissance capability.

WHAT'S NEXT FOR ISR

Great power competition requires a different ISR capability than the past, a March 4 AWS industry panel on ISR and remote sensing asserted. That capability may not take the form of the aerial platforms the Air Force uses today. It must be more mobile for protection, be more dispersed, and have higher computing power.

"Where we need to go for a future peer conflict is very different than what we've been doing for the last two decades," said Brad Reeves, director of C4I solutions at Elbit Systems of America, told Air Force Magazine after the AWS panel discussion.

"Our nation needs the capability to find mobile and moving targets," he said. "We need proliferated ISR sensors."

Reeves said the Air Force needs the ability to find, fix, and track mobile and moving targets. This includes sensors like radar and and the computer power to process that information and distribute it through a command and control (C2) system to process that information. Unmanned and autonomous drones are capable of carrying sensor payloads to accomplish the task.

C2 will inherently evolve over time, Reeves estimated, first by pushing the data from the platform to an operator in the rear, away from the threat areas. Eventually, it will be on board the platform itself.

"We will utilize onboard AI, edge processing to make sense of the data and push recommended actions straight to operators,"

Reeves explained.

The new ISR sensor capability will be able to operate autonomously at the edge, or the point of collection, with an artificial intelligence capability to make sense of the information it is gathering and deliver that back to the warfighters.

"The good news is, I think it's all very doable," Reeves said.

"I don't see big, huge heavy platforms to make that happen," he added. "I see it as small, decentralized mobile, survivable—I'm going to call them command and control nodes."

The movement is away from centralized, brick-and-mortar ISR structures to "decentralized, dispersed, tactical-level ISR structures."

When Kendall spoke about aging JSTARS and AWACS, Reeves understood that the Secretary was emphasizing the vital importance of AMTI and GMTI in the joint fight.

"What I hear him saying is we have to replace the capability," Reeves said, with a nod to the "crowdsourcing" gathering power of dispersed sensors.

"Those capabilities we have to have," he summed up. "Now, where do you to get them from? It could be satellites in space."

SPACE FORCE ISR AND SENSORS 'LOOKING UP'

U.S. Space Force Director of Intelligence, Surveillance, and Reconnaissance, Air Force Maj. Gen. Leah G. Lauderback believes replacing the aging Air Force ISR platforms with a synergized network of sensors means developing assets that can gather intelligence in a denied or restricted area, something uniquely catered to the space domain.

"We have an opportunity here to truly develop a service ISR capability," she said.

"The Secretary talks about aging capabilities in those contested and denied areas that we can't even take aircraft into, or maybe even people on the ground," she explained. "You've got to have a very robust space architecture that is looking down in order to help out all of those in the joint warfight."

When Lauderback served as the director of intelligence for U.S. Space Command from July 2019 to July 2020, she saw what American space ISR looked like, and what it lacked.

"We definitely have some capabilities," she said.

"We don't have enough," she added. "We don't have persistence. And we don't have high fidelity sensors to be able to truly characterize something that is in low-Earth orbit (LEO) or something that is even in GEO [geosynchronous orbit]."

Lauderback said Space Force has the ability to get data it needs from the space layer and send it down, but the future fight requires a new capability.

"Now we need to be thinking about the looking up part," she said, addressing the need for sensors to look at what is happening in low-Earth orbit with enough definition to attribute an act to a particular country.

"All of those LEO constellations, that if you just turn them around, maybe they could start looking up," she said. "So, can we put dual sensors on those capabilities? And the answer is yes."

Evolving America's ISR capability requires holistic thinking about the ISR constellation, including space, air, ground, and maritime.

Chief of Staff of the Air Force Gen. Charles Q. Brown, Jr. called ISR a core mission at a March 4 AWS media roundtable.

"We cannot do many things with a fighter aircraft, with the missions that we have, without the ISR to set us up for success to be able to manage the kill chain, moving targets, and scales that the Secretary described," Brown said in response to a question from Air Force Magazine.

"It's a constant battle, I mean, calculating the risk associated with a particular mission area," he added, describing how he makes the case for priority investments.

Lauderback said ISR for today's near-peer fight may not be about replacing platforms with an upgraded model.

"It's not replacing this airplane with another airplane, perhaps," she continued. "It is trying to develop an architecture that allows us to gather the intelligence or the information that we desperately need for probably the next contested fight." ✪

Mike Tsukamoto/staff, Air Force Magazine

Brad Reeves, director of C4ISR for Elbit America; Luke Savoie, president, of Intelligence, Surveillance, and Reconnaissance for L3Harris Technologies; and Mike Shortsleeve, sector vice president at General Atomics Aeronautical Systems, Inc., were some of the industry leaders that spoke at the AFA Warfare Symposium in early March.

Mike Tsukamoto/staff, Air Force Magazine

Gen. John "Jay" Raymond, USSF Chief of Space Operations, spoke about the changing threat landscape and satellite vulnerabilities at the the AFA Warfare Symposium March 3.

Resilience or Bust

For the Space Force, year three is about defining a defense space architecture.

By Amanda Miller

The Space Force's vision for a proliferated, resilient "space order of battle" has begun to take shape.

After a year of inventing the new service and another of figuring out where it fits within the wider Department of Defense, the Space Force plans to make the more resilient combination of satellites and external data sources its "No. 1 priority" in Year 3, said Chief of Space Operations Gen. John W. "Jay" Raymond.

A number of Space Force leaders, including Raymond, commented on the reason behind designing the new so-called "space order of battle" and on progress to date during the AFA Warfare Symposium.

The world is experiencing a uniquely complex security situation at the same time countries such as China, in particular, and Russia mature technology that could pose a risk to the U.S. vulnerable satellite fleet, Raymond said.

"The constellations that we have in space today ... were designed for a peaceful, benign environment without a threat," Raymond said. "They're exquisite capabilities. They're the world's best capabilities, but again, they're designed for a different environment—and they're hard to defend."

Space Force leaders have also referred to the resilient space order of battle as a "resilient space architecture." The Space Force hadn't responded by press time to a request for clarification of why its leaders have made this change.

Raymond said USSF's Space Warfighting Analysis Center (SWAC) has completed its force design for one segment of the architecture, that of missile warning and tracking. Next it will move on to ground moving target indication and a constellation, or "layer," of satellites to transport data around space and back and forth to Earth.

Meanwhile, the DOD has already awarded $1.8 billion to three companies that will build the first 126 satellites in a data-transport layer being planned by the Space Development Agency (SDA).

GLOBAL INSTABILITY AND VULNERABLE SATS

The U.S. military's large, "exquisite" satellites have become susceptible to the likes of electromagnetic spectrum warfare, cyberattacks, ground-launched anti-satellite weapons, and other satellites—an altogether different set of circumstances from even just a few years ago, Raymond said.

Meanwhile, the world has entered "probably the most dynamic and complex security environment in three generations," Raymond discussed in a talk in which he appeared jointly with Air Force Chief of Staff Gen. Charles Q. Brown Jr.

"And I will tell you, on the space side of the house, the Air Force built the world's best Space Force," Raymond continued. "We've had the best capabilities. The best people. We've integrated most effectively into the fight, starting with Desert

Storm. But I will tell you, it's a service that was built for a different domain than we're operating in today."

In the past three years alone, the total number of objects the Space Force tracks, including debris, has doubled to close to 50,000, while the number of satellites has tripled to about 5,000.

"Then if you look at those capabilities"—and how China, in particular, has "integrated those capabilities into a warfighting architecture," Raymond said:

"If deterrence were to fail, we are now going to be up against an adversary that has the same advantages that we've enjoyed. And they've built it over the last 30 years, and they've built it for a purpose. That, coupled with the spectrum of threats that we're seeing—from low-end reversible jamming to high-end kinetic disruption—it's a different domain."

RESILIENCY AND FORCE DESIGN

Researchers at the SWAC have already cleared their first hurdle, the force design for the missile warning and defense segment of the more resilient space architecture. The Space Force hadn't responded to a request for more details about the force design by press time.

With the overarching plan for missile warning and defense out of the way, SWAC's experts will focus on ground moving target indication and the data transport "layer" of satellites in the coming year, Raymond told reporters attending the symposium.

David Voss, director of the SWAC's Spectrum Warfare Center of Excellence, will be focusing on the force design for data transport, he told Air Force Magazine in an interview ahead of the conference.

The work will entail thinking about, "how do we make things interconnected and interoperable across the breadth of the role that space could potentially play" throughout DOD, Voss said, for example:

"Does it make sense to continue to acquire kind of along certain phenomenologies and certain users, or does it make sense to look at it more as [part of] a larger transport architecture?"

Voss characterized the Space Development Agency's transport layer, for which it awarded contracts for 126 satellites in February, as "a really exciting component to an integrated transport community."

On the other hand, "the SWAC's goal is to really look at comprehensive [needs] across the space community, really anchored in the intelligence and the complexity of the threat," Voss said.

The war in Ukraine provided a backdrop for the symposium.

The involvement of U.S. space companies such as Starlink, prominently supplying internet service, and Maxar, publicly circulating surveillance images, demonstrates the potential "dual use" of space equipment and how commercial services could form a part of the resilient architecture, Raymond told reporters.

With access to space becoming widely available, it's no longer the domain of great powers. Instead, "we now have students putting satellites in orbit," Raymond said. "So as the barriers to entry are reduced, and as technology allows smaller satellites to be more capable, you're going to see a number of mission areas that are now commercially viable."

With the force designs complete, the service will shift into "turning those into requirements," Raymond said.

AN ORBITAL TRAINING RANGE

The resilient architecture will spread out the ways the Space Force does its core activities in space—tracking space objects; position, navigation, and timing; missile warning; weather; and communications—but the Space Training and Readiness Command is creating a part of the architecture that will be a first of its kind for DOD.

The service has decided it wants training satellites in orbit to form a range there, said STARCOM's Commander Brig. Gen. Shawn N. Bratton during a press briefing.

Bratton said carving out a part of Earth's orbit for a range and "aggressor portfolio"—like USAF training ranges on Earth—isn't feasible. He mentioned the idea of a range being activated or deactivated accordingly, with a system to inform the space community when that's happening.

STARCOM is approaching its plans for the range, or National Space Test and Training Complex, in terms of "what are the capabilities that we need to have," he said—not just "physical things" but also, "how do we think about the digital aspect of that?"

Bratton said a program office has stood up within Space Systems Command and that staff have started to arrive in Colorado Springs, Colo.—STARCOM's temporary headquarters—to "do the procurement actions for the range."

So far, the design of the range has amounted to "a lot of discussions with SWAC and SCC" on "what things do we need to do live and actually fly a spacecraft on orbit, to be able to instrument it—gather data for test or training activities; and what things can we do purely in the digital space," according to Bratton. "There's certainly things that, whether for expense or security, that we will do in the digital space. But we feel, particularly on the training side but probably equally true for test, that there are some things that we'll need to do live on orbit

"And then how do we think about the on-orbit range—very different, I believe, than a physical range that you might see in a place like the Nevada Test and Training Range," Bratton said.

He hopes the range will afford trainees "some realistic activities" such as "what does it look like when one spacecraft approaches you—what indications do you get of that? What do the sensors see? If someone's trying to conduct rendezvous operations with your spacecraft, how do you know in a domain where you can't look out the window and see another ship or Soldier or aircraft."

SUSTAINING THE INDUSTRIAL BASE

The SDA plans to launch the first 126 satellites in its data-transport layer by 2024 after awarding the contracts in February. The expectation of that kind of turnaround time—fast by satellite standards—could present a challenge to the industrial base that the Space Force relies on, which Raymond characterized as "fragile."

Raymond cited a report by the Air Force Research Laboratory and Defense Innovation Unit that called the industrial base "tactically strong but strategically fragile."

The report "State of the Space Industrial Base 2021: Infrastructure and Services for Economic Growth and National Security," published in November 2021, suggests that increasing Pentagon spending on commercial space technology would prompt private investors to invest even more. Its authors deemed that sustaining investors' confidence was a "major concern" requiring "urgent action.

Raymond told the crowd at AWS22 that the Space Force perceives "opportunities for a national-level vision on the industrial base." He said in the past, proposed activity in the space sector has fizzled out.

"We need this to materialize," Raymond said.

Eric Dietrich/USAF

Air Force Chief of Staff Gen. Charles Brown Jr. during a livestreamed event at the Pentagon celebrating Black History Month on Feb. 9., has announced modifications to his top four Action Orders to more align with Secretary of the Air Force Frank Kendall's priorities.

Brown Modifies Action Orders

CSAF aligns priorities with SECAF, acknowledges frustrations with bureaucracy.

By Greg Hadley

Air Force Chief of Staff Gen. Charles Q. Brown Jr. modified his four central Action Orders on Feb. 18 to align them with Air Force Secretary Frank Kendall's top operational priorities and to finally make progress in combating bureaucracy.

The four original Action Orders were released in December 2020 following Brown's "Accelerate Change of Lose" white paper. The orders focused on Airmen, Bureaucracy, Competition, and Design Implementation, detailing Brown's vision for the force.

"While 'Accelerate Change or Lose' is enduring, like any operation order, the Action Orders are meant to be iterative—continually assessed, adapted, and improved," Brown said.

The modified Action Order starts with an acknowledgment that bureaucracy remains a stubborn problem for the service.

"After over a year of analysis and work, significant progress on this Action Order has proven elusive," the order reads. "More specifically, current Air Staff decision-making remains cumbersome, slow, allows 'soft vetoes' without accountability, and prioritizes compromise and consensus over decision quality. Mired in hierarchical processes and content with the status quo, the Air Staff must adapt to mission command and collaborative approaches to address the 21st century threats and competitive strategic environment."

While the original Action Order focused on clarifying roles and responsibilities within Headquarters Air Force and between major commands, the modified order presses for more open communication, calling for the Air Staff to "ensure wide dissemination [and] provide clear understanding of CSAF intent" of key decisions and documents, as well as practicing "radical transparency."

"Bureaucracy exists in all large organizations and changing culture and practices that prevent timely and effective decisions is difficult—but it starts with the Air Staff," Brown relayed in a statement.

The modified order calls for "empowering Airmen to make decisions at the appropriate levels," and sets a goal of the Air Staff adapting "its staffing processes to enable empowered decision-making" by the end of 2022, with quarterly progress assessments.

Action Order C, focused on competition with China and Russia, also underwent significant modifications, now accounts for Kendall's stated imperatives, the evolution of the Joint Warfighting Concept, and the "development of other strategic documents." The Biden administration released its Interim National Security Strategic Guidance in March 2021 and is slated to release a new National Defense Strategy and Nuclear Posture Review in the coming months.

"The Action Order is designed to transform the USAF to be operationally superior and strategically successful relative to our potential adversaries by driving threat-informed decisions through comparative analysis and candid assessment of our relative advantages and disadvantages," the order states.

Action Order D, focused on force design, aims to align "future force design with fiscal realities," and the modified order calls for the Air Staff's planners to "determine the necessary capabilities and capacity within the USAF's force-structure needed in fiscal years 2025, 2030, 2035, and beyond," taking into consideration Kendall's stated priorities. ✪

Zelensky Appeals for No-Fly Zone, Biden Pledges More Aid

By Air Force Magazine Staff

Ukrainian president Volodymyr Zelensky made an emotional pitch directly to a joint session of Congress on March 16 to establish a no-fly zone over his beleaguered nation. U.S. President Joe Biden, speaking a few hours later, spoke of the more than $1 billion in aid for Ukraine appropriated in the past week and pledged a steady flow of other kinds of weapons and assistance for Ukrainians.

Zelensky, appearing in a live video message, asked for Russian-made S-300 air defense systems, new aircraft, and the no-fly zone.

"Is this too much to ask? … For a … humanitarian no-fly zone?" Zelensky said. "If it is, we offer an alternative. You know what kind of systems we need: S-300 and other similar systems." He also asked for "aircraft that can help Ukraine."

The U.S. does not have any Russian-made S-300 systems to offer, but Biden said that, "we have identified, and are helping Ukraine acquire, additional longer-range anti-aircraft systems and munitions for those systems." Pentagon and diplomatic sources said discussions are taking place about transferring some S-300s from NATO countries that still have them, to be backfilled by American systems. Slovakia has S-300s and MiG-29s but won't give them up until it has replacements in hand.

Slovak Ambassador to the U.S. Radovan Javorcik told Air Force Magazine that discussions are underway between Defense Secretary Lloyd J. Austin III and Slovak Defense Minister Jaroslav Nad about ways Slovakia can support Ukraine without undercutting its own defense needs.

"This is the largest military operation ever for Slovakia," said Javorcik. "We're … emptying our own warehouses in Slovakia and providing the Ukrainians with air defense [and] land-based things," he said.

Across their common border, Slovakia has provided Ukraine with ammunition, rockets, rocket launchers, anti-tank and anti-missile systems, man-portable anti-aircraft missiles, de-mining equipment, and fuel for Ukraine's air and ground vehicles.

To help backfill Slovakia's air defenses, the Netherlands announced March 8 that it would deploy a Patriot air defense system there, but the system likely won't be in place until April.

Poland, which has done the most to facilitate weapons transfers to Ukraine, doesn't have S-300s, but does have Russian-made SA-8s and SA-12s.

The U.S. recently repositioned two Patriot missile defense systems from Germany to Poland to provide greater protection.

Midway through his speech, Zelensky showed a video of still and moving images, first of Ukrainians in idyllic, pastoral, and family settings, suddenly offset by graphic images of missile attacks, dead bodies, burning homes, morgues, and refugees. He invoked Pearl Harbor and Sept. 11, 2001, saying that what America experienced on those days, Ukraine is experiencing every day.

He also said that Ukraine is singularly shouldering a bloody fight for democracy and against autocracy and evil, and that all freedom-loving nations must come to its aid.

Zelensky offered profuse thanks for aid from America and other nations thus far, but said that "it is not enough" and that his country can't hold out indefinitely. He also demanded that new sanctions be introduced against Russia weekly; and that no Russian products should be allowed to enter American ports. His speech was greeted with three separate standing ovations from assembled lawmakers.

Biden praised the bravery of the Ukrainians and Zelensky personally, and promised the U.S would do all it could. America "is determined to make Putin pay a heavy price" for the invasion, he said. Economic sanctions on Russia will "only get more painful over time," Biden said, noting that Russia's economy is nearing collapse and that America is focused on "making sure Ukraine will never—never—be a victory for Putin."

To that end, Biden said the U.S. has been providing weapons since last March and that the Ukrainians had them in hand when the invasion began. Over the past year, the U.S. has provided Kyiv with "hundreds of anti-air systems, thousands of anti-tank weapons, transport helicopters, high-mobility vehicles, radar systems to track incoming artillery, and unmanned drones," as well as communications and satellite imagery analysis capability.

The U.S. has provided "9,000 anti-armor systems," Biden said. "These are portable, high-accuracy, shoulder-mounted missiles that the Ukrainian forces have been using with great effect against invading tanks and armored vehicles." Another 7,000 small arms have been provided—automatic rifles, shotguns, grenade launchers, and mortar rounds—as well as "20 million rounds in total" of ammunition.

Future assistance "will include drones, which demonstrates our commitment to sending our most cutting-edge systems to Ukraine for its defense," Biden pledged. He did not name the unmanned systems to be sent. A White House fact sheet specified that "100 tactical unmanned aircraft" will be provided.

Ukraine does not have any American-made, remotely piloted aircraft. Military experts later wondered if Biden meant he would send Ukraine more Turkish Bayraktar TB-2 drones, which the Ukrainians already have and have used productively, both in surveillance and target-designation mode.

Addressing U.S. citizens, Biden said, "I want to be honest with you: This could be a long and difficult battle. But the American people will be steadfast in our support of the people of Ukraine in the face of Putin's immoral, unethical attacks on the population. We are united in our abhorrence of Putin's depraved onslaught." He promised that the U.S. will "continue to have their backs" as Ukrainians fight to preserve their nation and freedom. He also pledged another $300 million in humanitarian assistance for the 3 million Ukrainian refugees now in other NATO countries; and thanked the allies and partners for both taking in the refugees and for "facilitating" the supply of materiel to Ukraine.

Lawmakers came away from Zelensky's speech impressed and anxious to help.

"We must keep them in the fight," said Rep. Ann Wagner (R-Mo.). Providing MiG-29s "that they have been requesting for some time is no different" than the aid and weaponry the U.S. has already provided, she said. "We must work with Poland to make that happen." ✪

Staff Sgt. Jonathan Snyder

Retired Col. Gail Halvorsen, the "Candy Bomber" who dropped sweets with tiny parachutes to German children during the Berlin Airlift, posed in his uniform in 2013; he died in February, having lived to 101.

Gail Halvorsen, USAF's 'Candy Bomber,' Dies at 101

By John A. Tirpak

Col. Gail S. Halvorsen, who came to fame as the "Candy Bomber" of the Berlin Airlift, earning international goodwill for the United States and the Air Force, and who worked on Air Force space projects such as the Titan III, X-20 Dyna-Soar, and Manned Orbiting Laboratory, died Feb. 16 at the age of 101.

Halvorsen grew up in Utah and earned a private pilot's license at the age of 21, when he joined the Civil Air Patrol. Following the outbreak of WWII, Halvorsen joined the Army Air Forces and flew ferry flights of C-46s and C-47s in the South Atlantic theater of operations.

He stayed in the Air Force after the war and in July 1948 was assigned as one of the pilots in the Berlin Airlift, flying C-54s and C-47s into Tempelhof Airport with crucial sustenance for the citizens of divided Berlin, who were cut off from land resupply by a Soviet blockade. On a sightseeing tour of Berlin during time off, he saw children watching the cargo aircraft operation. Talking to them, he was touched by their appreciation for the airlift and one's comment that "when the weather gets bad, don't worry about us. We can get by on little food, but if we lose our freedom, we may never get it back." He offered them a few sticks of gum, which 30 children shared eagerly but politely. He resolved to do more and promised to drop candy to them from his plane the next day. He would "wiggle" his wings to let them know which plane to watch for.

Starting with candy rations pooled with friends, Halvorsen devised small parachutes made from handkerchiefs, so the falling candy parcels wouldn't hurt the children waiting below. For three weeks, he made candy drops once a week. As the weeks passed, the number of children waiting below grew.

The commander of "Operation Vittles," as the Berlin Airlift was called, was Lt. Gen. William H. Tunner. When he found out about Halvorsen's unauthorized airdrops, he approved and ordered them expanded as Operation "Little Vittles." Soon Halvorsen's whole squadron was buying candy and gum and assembling the parcels with small parachutes. As word reached the U.S. of the mini-airlift, American schoolchildren and confectionary companies donated candy, and soon many other pilots were making candy drops as well. Halvorsen became known as "Uncle Wiggly Wings" or "The Chocolate Flier," among other names, by the children of Berlin, and the "Candy Bomber" in the U.S.

"Little Vittles" continued from September 1948 through May 1949, when the Soviet Union lifted its blockade and the larger airlift ended. Halvorsen had rotated home in January 1949, but the operation was taken up by his squadron mate, Capt. Lawrence Caskey. "Little Vittles" had dropped an estimated 46,000 pounds of candy tied with more than 250,000 parachutes, and Halvorsen received international attention for his efforts. In his autobiography, Halvorsen recalled that a Berlin child told him the candy was not just chocolate, "it was hope."

After the airlift, Halvorsen received a permanent USAF commission and earned bachelor's and master's degrees in aeronautical engineering from the University of Florida. He worked on cargo aircraft development at Wright-Patterson Air Force Base, Ohio, from 1952 to 1957 then joined the new Air Force Space Systems Division in California. There he worked on the Titan III launch vehicle and the X-20 Dyna-Soar reusable spacecraft programs, serving with Air Force Systems Command through 1962. Subsequent assignments took him back to Germany and technology offices at Headquarters,

USAF. He developed plans for the Manned Orbiting Laboratory program, which would have put a small Air Force space station in orbit for reconnaissance purposes. He commanded the 6596th Instrumentation Squadron at Vandenberg Air Force Base, Calif., supporting space launch and satellite operations.

In 1970, Halvorsen was assigned as commander of USAF's air base group at Tempelhof. His final USAF assignment, as a colonel, was as the inspector general for Ogden Materiel Center at Hill Air Force Base, Utah. He retired in 1974 with more than 8,000 hours of flying time.

During his time commanding operations at Tempelhof, Halvorsen earned a second master's in guidance and counseling and in retirement served as assistant dean of student life at Brigham Young University in Utah. He and his wife Alta also served as Mormon missionaries in England and Russia in retirement.

Halvorsen organized or supported candy drops in other war zones during his career as well, in Japan, Albania, Guam, Bosnia-Herzegovina, and Iraq. He was also a continuous goodwill ambassador for the Air Force and the United States, making thousands of speeches and visits, especially to schools, to discuss Operation Little Vittles.

He wrote the books "The Berlin Candy Bomber" and "The Candy Bomber: Untold Stories from the Berlin Airlift's Uncle Wiggly Wings."

Among his many awards and honors, the Air Force presented Halvorsen with its Cheney Award for humanitarian service as well as the Legion of Merit. It also named an award for outstanding achievement in air transport for him. In addition, the service named a key piece of cargo-handling equipment the Halvorsen Loader and named the C-17 Aircrew Training Center in Charleston, S.C., for him. In 1974, the West German government awarded Halvorsen its Order of Merit service cross. He was inducted into the Utah Aviation Hall of Fame in 2001 and received the Congressional Gold Medal in 2014. The Utah legislature recognized him with a resolution in 2017 praising him for "unselfish acts" that brought honor "to himself, his family, the United States Military, the citizens of … Utah, and the citizens of the United States."

"During Berlin's darkest hour, he was the light that shone through," Chief Master Sergeant of the Air Force JoAnne S. Bass said of Halvorsen on Twitter. ✪

Staff photo by Amanda Miller

USSF VCSO Gen. David Thompson (2nd from right) was among top Air and Space Force leaders at the Air Force Academy's Leadership Symposium. Also on stage: CSAF Gen. Charles Brown Jr., CMSAF JoAnne Bass, Cadet 1st Class Andrew LaRocca, and CMSSF Roger Towberman.

AI That Kills is Inevitable, USSF Vice Chief Says. Get Ready.

By Amanda Miller

The Space Force's second-in-command told Air Force Academy cadets attending a leadership conference that the U.S. will need machines to make decisions that kill—and that confronting the inherent ethical dilemmas "can't wait."

Vice Chief of Space Operations Gen. David D. Thompson brought up lethal autonomous weapons systems during a question-and-answer panel conversation during the Air Force Academy's National Character and Leadership Symposium on Feb. 25 that also featured three other senior leaders: Air Force Chief of Staff Gen. Charles Q. Brown Jr. and the Chief Master Sergeants of the Air Force and Space Force, JoAnne S. Bass and Roger A. Towberman.

Lethal autonomous weapons, which are expected to rely on artificial intelligence, are inevitable, he said, due to "the speed of war—how quickly things are going to have to happen in the future." His remark followed the United Nations' failure in December 2021 to make headway toward a treaty that would ban them.

"We're going to have to have machines that make decisions—like Chief Towberman talked about—that kill people." (Towberman had talked about the ethics of killing more broadly.)

"And we can't wait," Thompson continued. "We cannot let technology drive that, and we can't wait until it's thrust upon us to think through and understand how we have to deal with that ethically—when, how, and should we let machines make decisions to kill people. And we have to deal with it because that's exactly where our adversaries are going."

In terms of hypersonic weapons—those able to fly five times the speed of sound—Thompson said they're ethically "not that much different than things that we've done in the past. It's a tremendous operational and technical challenge. We need to make sure that they're part of our arsenal. We need to develop defenses against them. And we will."

He suspects the instability will come with adding a nuclear component.

"When you couple hypersonic weapons with nuclear weapons, it's tremendously unstable in a strategic sense," Thompson said. "And we have to understand [how] to deal, again, with a period of strategic instability they might produce—like we frankly saw in the nation back in the early days of the Cold War." ✪

Cyber Troops Stretched Thin in Ukraine

By Shaun Waterman

The war in Ukraine has provided a wake-up call for U.S. military cyber defenders, who are facing hard choices about how to deploy limited resources, said Air Force Brig. Gen. Chad D. Raduege, the chief information officer of U.S. European Command.

"There's been a realization that, quite frankly, we can't protect everything we have," Raduege told a virtual luncheon hosted by the Gabriel Chapter of the Air Force Association on March 9.

He added that this realization had been growing for some time. In his prior job in 2021 as chief information officer of Air Combat Command, "we found ourselves … identifying the key [IT] components for us to fly, fight, and win. And we were applying mission defense teams from a cyber component against those weapon systems and saying, these are our crown jewels that we need to protect."

But faced with a crisis that is demanding agile U.S. deployments alongside a wide variety of partners, meaning small teams operating from unfamiliar locations, there weren't enough cyber defense teams to go around, Raduege said, answering an audience question from retired Maj. Gen. Burke E. "Ed" Wilson, the former deputy assistant secretary of defense for cyber policy, who previously commanded Air Forces Cyber.

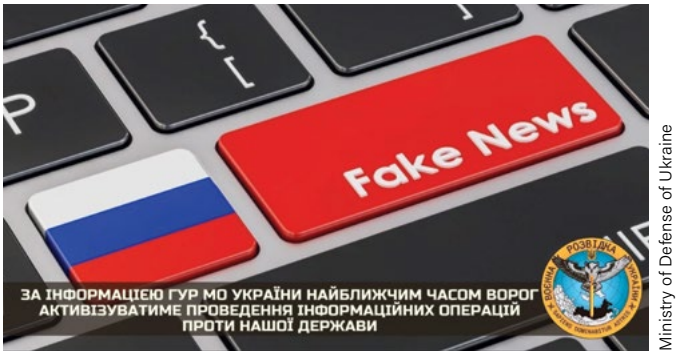
"I think the area that we've got to continue to figure out is this idea that we were going [to] protect the weapon systems themselves, protect those smaller groups, with our mission defense teams. That's a really great vision. What we found is we didn't have enough capacity in the cyber realm to even stand up some of those capabilities," Raduege said.

He said the Air Force is deciding which weapon systems it can afford to protect.

"The Air Force, right now, through Air Combat Command, is working through a prioritization of which weapon systems we will apply those mission defense teams against," he said. The overwhelming "demand signal" for cyber protection, Raduege said, was driven by the circumstances of the U.S. response to the Ukraine crisis, which combined NATO military operations with humanitarian relief efforts involving a much wider alliance of partners—all requiring connectivity.

"There's an insatiable appetite to have connectivity. And we're seeing not only fielded forces at the home stations, but now we have all of these tactical edge airfields and logistics hubs that are standing up," Raduege said. "We have fielded forces all over the place that have an air picture that they want to share. … We have logistics hubs that are all over the European theater right now. … We're seeing our own nation want to put donations and goods into the European theater. And so we're seeing coordination centers stand up" to manage that flow of incoming goods and their onward distribution.

Coordination was required, not just with the 30-member NATO alliance, but with "a whole bunch of other allies and partners for this current fight," he said. "And the ability to track all of that aid, all of that hardware and software that is going into different places … requires information-sharing requirements at a protected military level," Raduege said.



Ministry of Defense of Ukraine

Cyber warriors are working day and night to combat misinformation and fend off cyber attacks on U.S. and allies' assets.

That secure connectivity required developing the mission partner environment, or MPE, "a coalition network," which could move data, classified as highly as "secret," securely between the military networks of allied nations. The MPE was an alternative to the "sneaker net"-style of manual exchanges NATO partners had to cope with for many years in Afghanistan, but Raduege suggested that some kinks still being worked out.

"Every nation brings their NIPR [Non-secure Internet Protocol Router] and their SIPR [Secure Internet Protocol Router] or computers, and then they want to join them together. So how do you work through those joints? How do you work through that federation to make mission happen?" he asked. "I will tell you, the amount of information sharing requirements that are taking place right now is off the chart," he added, citing a common NATO air picture as one result.

Link 16, the NATO standardized line-of-sight communications protocol that can be used by fourth- and fifth-generation fighters, "is more important than it has ever been," Raduege said. He said new nations were keen to join the Link 16 club.

Raduege noted that open-source data was also increasingly being used in creating a common operational picture, even superseding, in some cases, traditional intelligence feeds available to commanders.

"Every morning, I get up and check my open-source app to get the latest on the Ukrainian front. Because open-source intel provided by a commercial partner is providing as much information as our J2 [joint intelligence function at EUCOM headquarters] is able to pull. Now, of course, our J2 has more exquisite information—they fill in a lot of the seams. But that open-source intel allows us to rally around things quite a bit." ✪

Airman 1st Class Yosselin Perla

Four F-35A Lightning IIs fly in formation during a training mission over the Indo-Pacific, March 10. On that same day, the Senate finally passed a massive omnibus spending bill to fund the federal government for the rest of fiscal 2022.

Budget Goes To Biden's Desk

By Greg Hadley

Late on the evening of March 10, the Senate passed a massive omnibus spending bill to fund the federal government for the rest of fiscal 2022, sending it to President Joe Biden for his signature.

For the Defense Department, in particular, the bill will provide $728.5 billion in discretionary spending for defense-related activities—roughly 5 percent more than the funding in fiscal 2021 and above the $715 billion requested by the Biden administration. It also includes $13.6 billion in aid to bolster Ukraine in its response to Russia's invasion.

The 68 to 31 vote in the Senate comes after months of delays, disagreements, and negotiations that led to the federal government operating under continuing resolution (CR) for more than five months—one of the longer periods in recent history. The fiscal year will end Sept. 30.

While the government never shut down, top Pentagon officials repeatedly pleaded for lawmakers to pass a full-year budget and bemoaned the effects of operating under a CR, saying it hurt readiness, hampered their ability to start new programs, and slowed modernization.

The delayed process began in May 2021, when the the Biden administration released its budget request late, as has become typical for Presidents in their first year in office.

Democrats and Republicans then took months to make progress in negotiations—a bipartisan framework for the appropriations bill wasn't announced until Feb. 9, and the actual text of the bill wasn't released until the early hours of March 9.

From there, however, lawmakers pushed the bill through Congress at breakneck speed. The House passed the $1.5 trillion bill the night of March 9, and the Senate followed suit the next day, avoiding the need for another short-term CR—the previous one had been scheduled to end March 11.

Now, with regular funding restored, the Air Force should be able to proceed with 16 new starts and four production increases that it previously said had been delayed by CRs. And the Space Force will be able to move forward with the transfer of satellite communications capabilities and personnel from the Army, Navy, and Air Force.

The bill will fund a 2.7 percent pay raise for service members, previously authorized by the 2022 National Defense Authorization Act. It will also provide funds for military families struggling with housing and food because of the COVID-19 pandemic, and it includes nearly $100 million for the DOD to implement the recommendations of the Independent Review Commission on Sexual Assault in the Military.

The funds in the spending bill will also buy 48 F-35s, 12 F-15EXs, and 14 KC-46s for the Air Force, all equal to its budget request. It also pays for the procurement of 20 extra C-130Js, 16 for the Air National Guard and four for the Air Force Reserve; and four MQ-9s, despite the Air Force not asking for any.

While the 2022 budgeting process has finally come to an end, the fiscal 2023 cycle is set to begin soon. Defense Department officials have said they expect their budget request for the upcoming fiscal year to be released in the coming weeks. With the ongoing war in Ukraine and continued concern over competition with China, the topline will be closely watched—Republicans are likely to push for a large increase, while Democrats may argue for smaller growth or even cuts. ✪

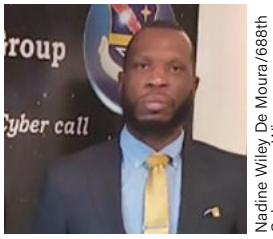
FACES OF THE FORCE

Maj. Carlos Roja/courtesy

Air Force Reserve Maj. Carlos Rojas was aboard American Airlines Flight 1775 in February when a passenger became disruptive, trying to open the plane's emergency exit. He and an Army officer subdued the individual so the pilot could make an emergency landing. The airline issued a statement expressing appreciation for "the customers who stepped in to assist our crew." Rojas is a member of the 701st Combat Ops Squadron at March Air Reserve Base, Calif.

A1C Sebastian Romawac

When **Staff Sgt. Garrett Bodie**, saw sparks beginning to catch fire and plumes of smoke from the undercarriage of a truck driving by he pursued the vehicle, reached it at a red light, and informed the elderly driver of the danger, despite a language barrier. Bodie used a fire extinguisher from a local convenience store to contain the fire until emergency personnel arrived.



Nadine Wiley De Moura/688th Cyberspace Wing

William Rice added another title to his portfolio: Modern-Day Technology Leader, an honorific awarded to him by the 2022 Black Engineer of the Year STEM Conference. Leaders are men and women who are demonstrating outstanding performance in science, technology, engineering, and mathematics. "To be recognized as an African American engineer means that others can see my accomplishments and know that it is possible to overcome all stereotypes," he said.

Rodney Speed/USAF

Neil Grimsley and **Melissa Rice** became the first civilians to graduate from Airman Leadership School at Robins AFB, Ga., on Feb. 10. ALS is the first level of Professional Military Education for enlisted Airmen, designed to be a leadership enhancement course to prepare Airmen for positions of greater responsibility. More and more bases, however, are allowing civilian workers to take the course as well, and Grimsley and Rice are leading the way for more civil servants to follow at Robins.

Sgt. Wesley Parrell/National Guard

In August 2019, **Chief Master Sgt. Wes Hudgins** suffered a serious accident on a dirt bike. The result was 29 broken or fractured bones, including a potentially life-threatening crack in his pelvis. After months in the hospital and multiple surgeries, Hudgins returned to his job in February as the 161st's Ops Group Senior Enlisted Leader, with plans to keep recovering and eventually run and lift weights again.

Courtesy photo

Tech Sgt. Amanda Osborne was selected in January to become the Executive Assistant for SECAF on the strengths of her initiatives. She arrived in Australia in early 2019, geographically separated from her wing at Yokota Air Base, Japan. Osborne took on responsibilities as a financial management Airman, the liaison for the Department of Defense Education Activity, Non-DOD School Program, a Tricare liaison, and an additional First Sergeant.

Staff Sgt. Kayla White

Tech. Sgt. Damien Sawyer was named the Volunteer of the Year for Joint Base Anacostia-Bolling, Wash., D.C., in recognition of his extensive efforts on and off base to mentor and support disadvantaged children and families. Sawyer personally sponsors graduation packages for lower income honors students from his alma mater in New Orleans, has contributed funds to offset travel costs for the school's girls' basketball team, and provided students with supplies for summer camp. He also volunteers to distribute food to the local community once a month and mentors students at Anacostia High School. On base, he reads to children at the installation library's twice-weekly, and he also served as his unit's interim First Sergeant, providing mental health support, material care, and resolving disciplinary issues for members.

Master Sgt. Rachelle Morris

Tech. Sgt. Kinga Cummings immigrated to the U.S. from communist Poland at the age of 14, the descendant of concentration camp survivors. After joining the Air Force in 2009 and gaining years of experience in intelligence work, she was invited to join an investigative team with the Defense POW/MIA Accounting Agency, which helps to locate and return lost U.S. aircraft and service members. Twice now, Cummings has returned to Poland with the DPAA to look for 21 aircraft crash sites that could lead to 67 missing service members, as well as 29 service members who died in POW camps during World War II. As part of that mission, the team interviews local witnesses and their families and uses metal detectors and ground-penetrating radars to search for anomalies in the ground. So far, their efforts have garnered leads on 13 missing people at nine locations for which they secured dig permits.

Tell us who you think we should highlight here. Write to afmag@afa.org.

New Power for the B-52

A new engine is the centerpiece of a package of upgrades that will keep the B-52 relevant into the 2050s.

Senior Airman Michael Richmond

Airmen service one of the B-52H's 60-year-old TF33 engines during January's Red Flag exercise at Nellis Air Force Base, Nev. The new engine will never need to come off-wing for overhaul before the bomber retires.

By John A. Tirpak

Forty years since the Air Force first started thinking about replacing the eight engines on the B-52, the job is finally underway. The re-engining is the centerpiece of an upgrade that will keep the Stratofortress operationally relevant for another 20 to 30 years.

The contract for the B-52 Commercial Engine Replacement Program (CERP) was awarded last fall and the program is moving forward quickly. Two new F130 engines have been built and if development and testing proceeds as planned, the first re-engined B-52s will be operational in about five years.

"All the things are in place that are really defining what the B-52 looks like … into the 2030s," said Brig. Gen. John P. Newberry, program executive officer for Air Force bombers. He said upgrades include "new engines, a new radar, Advanced Extremely High Frequency and Very Low Frequency communications improvements, data link updates and cryptologic improvements, as well as several smaller efforts."

"All the things are in place that are really defining what the B-52 looks like … into the 2030s."
—Brig. Gen. John Newberry, PEO for Air Force bombers

The B-52 will also be the initial platform for the AGM-183 Air-launched Rapid Response Weapon, or ARRW, USAF's first hypersonic missile, as well as the sole platform for the nuclear AGM-181 Long-Range Standoff (LRSO) missile.

The F130 is a militarized version of Rolls-Royce's commercial BR725, which the Air Force flies on its C-37 VIP transport and E-11 BACN (Battlefield Airborne Communications Node). After a three-year contest in which Rolls bested GE Aviation and Pratt & Whitney, the company won a $500.9 million initial contract in September 2021, to develop and test the F130 on the B-52. Once complete, Rolls will provide some 650 F130s to equip 76 B-52s. Each F130 engine will replace one Pratt & Whitney TF33. The overall program is valued at about $2.6 billion.

Rolls will provide the engines directly to the Air Force, and Boeing, the B-52s' original builder, will integrate them on the bomber, ensuring that the new powerplants do not negatively affect the function of existing or new equipment. All the upgrades are expected to be installed concurrently during depot visits.

In January, Boeing trucked a retired B-52 carcass from Arizona's Davis-Monthan Air Force Base "Boneyard" to the Oklahoma City Air Logistics Center, where it's being set up in a new building built expressly to test the bomber's new systems in a hands-on setting, validating the digital designs by upgrade suppliers.

The "high bay" at Oklahoma City Air Logistics Complex is "a Boeing facility that we built specifically for this program and the RMP," or Radar Modernization Program, said Jennifer Wong, Boeing's senior director for bombers. "The point is to have a full-scale replica—basically, a mock-up of the aircraft—that we can use for engineering" purposes.

That includes "form, fit function-type testing," she said, as well as hands-on experience for engineers who have never "been able to touch" a B-52 or crawl around in it.

"Being exposed to the hardware is going to provide tremendous value," she added.

The mockup will also be used for risk-reduction efforts, to "solve some of the … hydraulic component" challenges "that will be part of the CERP program," Wong noted.

The F130 should deliver about 30 percent better fuel efficiency and far fewer maintenance hours, while eliminating the TF33's "vanishing vendor" supply chain problems. That fuel efficiency will pay for the upgrades as much as a decade before the bombers retire circa 2050.

The engine upgrade will not impact the aircraft's thrust or speed.

"One of the key things we've got to do on this program is stay on schedule," Rolls-Royce B-52 Program Director Scott Ames said. The first major milestone, Preliminary Design

Review, is expected this summer, and ground testing will proceed throughout the year.

Boeing will show how its part suppliers and initial design is "coming together in a virtual system prototype … a digital environment [in which] the engineers can make sure they're making the right design choices."

Boeing is designing a new engine nacelle to house the F130, and much of the testing in the next couple of years will ensure the engine upgrade has no unintended effects on B-52 performance, such as how the aircraft behaves in crosswind conditions, Ames said.

As is true today, the eight engines will fit in four nacelles. While USAF once considered four large-fan commercial engines instead, it stuck with eight to avoid substantial redesign of the wing, cockpit, and other components, and to minimize risk and delay.

Rolls-Royce is finishing a new $600 million production facility that will be dedicated to the B-52 work at its Indianapolis plant and has begun hiring people for the effort.

"It was a state-of-the-art modernization project and gave us the most competitive offer for the B-52," according to Ames. "We've started the process of procuring all of the tooling and production fixtures we need to build this dedicated assembly line."

The new plant has benefitted from "everything we've learned" producing the BR family of commercial engines, he said. "We've got a … dedicated test cell here … that was used during the proposal phase to demonstrate the F130, and it performed flawlessly." Now, "we've got to do some more work to make it fit for a production-type operation, but that's been launched, as well."

The two test engines will be evaluated at NASA's John C. Stennis Space Center in Mississippi, where Rolls-Royce has an outdoor jet engine test facility. "We'll run the engines in a prototype nacelle configuration to test operability and crosswind effects," according to Ames.

Ames said he expects the Critical Design Review, the next major milestone, in 2023. Between now and then, physical testing of F130s with and without Boeing's nacelle will produce new performance data, updating predicted values from software models. That data will inform the control system to be jointly developed by Rolls and Boeing.

The nacelle is one of the crucial elements. The "twin-pod arrangement is fairly unique," Ames said. Boeing and Rolls share a digital model of the B-52's wing so that both are working from the same baseline.

The digital design and "constant integration meetings" ensure components do not interfere with each other and that the final configuration is easy to maintain. Ames said, "At Stennis, the two-engine pod and nacelle will be mounted on a test stand and run at various power settings, and under various weather conditions to gain "insight into how the engine is operating" and also provide feedback on the control systems.

Boeing is responsible for wiring and hydraulics that connect the cockpit and the engines.

Boeing will modify the first two B-52Hs with the F130 engines in 2024, doing the work at its San Antonio modification facility. The first eight planes will join a B-52 test force at Edwards Air Force Base, Calif.

In addition to new engine controls, the engine replacement work includes "physical wiring, hydraulic changes, power changes, [and] cooling changes", Wong said.

The controls will be "what we're calling a hybrid mechanical to digital throttle system. … When you're in the cockpit, and you're controlling the aircraft, there will be a mix between digital and wire."

Two aircraft will be assigned to test the engine; two to test the new radar; and two each to test the new ARRW and LRSO missiles.

The flight-test effort is notionally to run from 2025-2026, Newberry said. "In very short order" after demonstrating safe flight, one aircraft will be modified with the new radar to begin collecting data on how the two function together.

The other upgrades will then be added one at a time, Newberry said. There are "many interdependencies."

Newberry said the bomber directorate is working closely with the Air Force Sustainment Center to increase capacity at Tinker Air Force Base, Okla., where the installs will be done. "We have to be mindful of readiness and keeping a certain number of aircraft in the operational fleet, so we can't take too long," he said.

It's still premature to gauge when the low-rate initial production and Milestone C, or full-rate production decisions will come, Newberry admitted. Those decisions will determine how fast the modifications take place. But at the rate of 10 to 11 a year, production will run to about 2035 to complete all 76 aircraft.

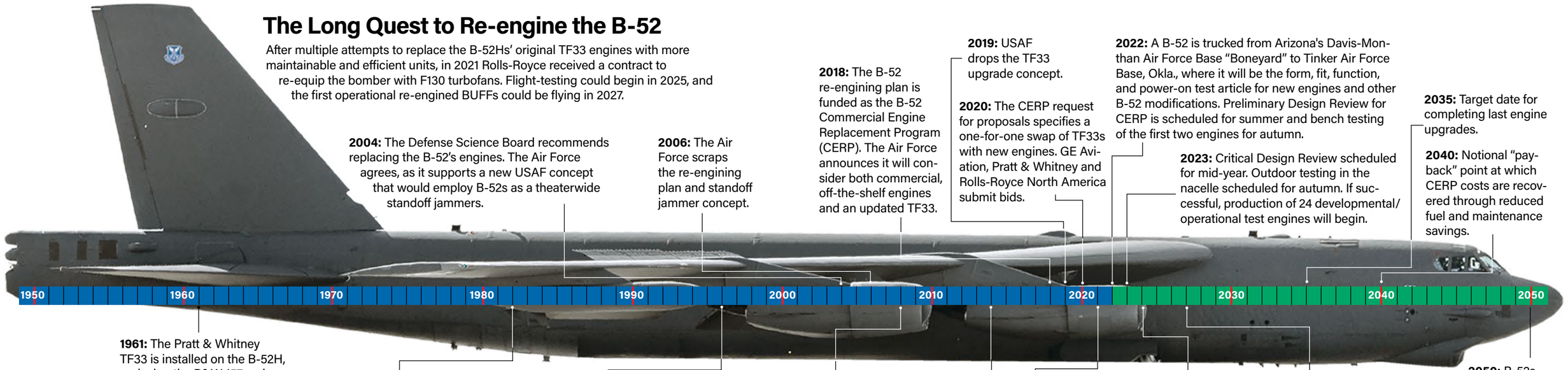
"We're working with Global Strike Command on future roadmaps across all capabilities," Newberry said. The time is now to begin "planning and preparing for what the B-52 of 2035 to 2040 looks like."

Structurally, the B-52s are in great shape. While the bomber is 60 years old, "we have a great depot program and the iron is young," Newberry stated. Years of sitting runway alert did not wear out the airframes.

Boeing is "very confident in the structure of the aircraft,"

The Long Quest to Re-engine the B-52

After multiple attempts to replace the B-52Hs' original TF33 engines with more maintainable and efficient units, in 2021 Rolls-Royce received a contract to re-equip the bomber with F130 turbofans. Flight-testing could begin in 2025, and the first operational re-engined BUFFs could be flying in 2027.



1961: The Pratt & Whitney TF33 is installed on the B-52H, replacing the P&W J57 series of engines that powered the A-G models. The last B-52H is delivered in 1962.

1982: Pratt & Whitney studies a plan to replace the eight TF33s with four modern and more powerful engines, but the Pentagon decides instead to replace the B-52s with B-1Bs and B-2As.

2004: The Defense Science Board recommends replacing the B-52's engines. The Air Force agrees, as it supports a new USAF concept that would employ B-52s as a theaterwide standoff jammers.

1996: Boeing and Rolls-Royce propose replacing the B-52's TF33 engines with new, leased powerplants. The Air Force rejects the plan.

2006: The Air Force scraps the re-engining plan and standoff jammer concept.

2008: The re-engining standoff jammer concepts are revived, but only briefly. The following year, budget pressure kills both once again.

2014: Air Force Global Strike Command concludes the over-engineered B-52 can fly until 2040 or later, but its TF33 engines, now 52 years old, should be replaced.

2018: The B-52 re-engining plan is funded as the B-52 Commercial Engine Replacement Program (CERP). The Air Force announces it will consider both commercial, off-the-shelf engines and an updated TF33.

2019: USAF drops the TF33 upgrade concept.

2020: The CERP request for proposals specifies a one-for-one swap of TF33s with new engines. GE Aviation, Pratt & Whitney and Rolls-Royce North America submit bids.

2021: Rolls-Royce North America wins the CERP with its F130 engine, a military derivative of the commercial BR725. The $500.9 million contract covers about 650 powerplants, valued at up to $2.6 billion. Boeing, as the Air Force's B-52 modernization integrator, is designing new engine nacelles.

2022: A B-52 is trucked from Arizona's Davis-Monthan Air Force Base "Boneyard" to Tinker Air Force Base, Okla., where it will be the form, fit, function, and power-on test article for new engines and other B-52 modifications. Preliminary Design Review for CERP is scheduled for summer and bench testing of the first two engines for autumn.

2023: Critical Design Review scheduled for mid-year. Outdoor testing in the nacelle scheduled for autumn. If successful, production of 24 developmental/operational test engines will begin.

2024: Two B-52s to be modified by Boeing with eight F130s each for flight-testing in 2025.

2027: Target date for F130 production contract. Depot installs begin at notional rate of 10 to 11 per year, concurrent with radar and other upgrades.

2035: Target date for completing last engine upgrades.

2040: Notional "payback" point at which CERP costs are recovered through reduced fuel and maintenance savings.

2050: B-52s begin to be retired, 98 years after the design's first flight.

Past **Future**

Timeline by Air Force Magazine. Sources: Air Force Magazine; U.S. Air Force Life Cycle Management Center; Congressional Research Service; Boeing; Rolls-Royce North America

Dash Parham and Mike Tsukamoto/staff; USAF; Rolls-Royce North America

April McDonald/USAF

A B-52 carcass from the "Boneyard" enters the home stretch of a 1,500-mile, month-long journey to Tinker Air Force Base, Okla., where Boeing engineers will test-fit new engines, radars, and other gear for the Stratofortress fleet.

Wong said. The B-52 was designed "with a lot of structural margin."

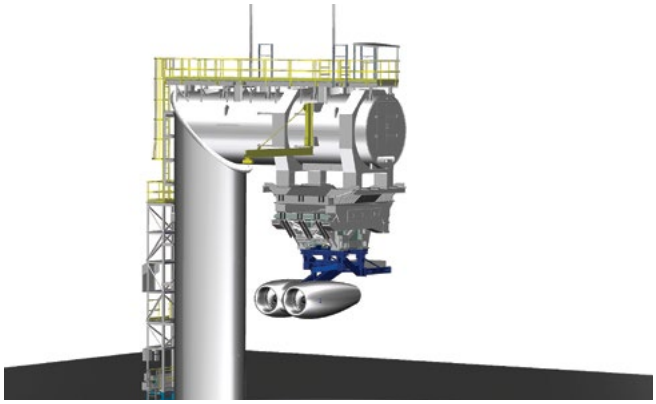
Newberry said the B-52 CERP was a pathfinder for accelerating an acquisition using an all-digital approach, but the program will be converted to a standard Engineering and Manufacturing Development (EMD) effort sometime this year. By using "other transactional authorities," the Air Force saved a lot of red tape. It ended up as a "standard, best-value competition," but the approach compressed the schedule, saving "years of schedule" by being able to "jump into actions with the contractor faster" and by accelerating the requirements process by skipping the Joint Capabilities Integration and Development System (JCIDS), Newberry said. In all, that saved "roughly three years over a traditional … approach."

The CERP is now being regarded as "our flagship program" for doing a digital acquisition of an off-the-shelf product. While other programs, like the Ground-Based Strategic Deterrent and Next Generation Air Dominance are also using digital prototypes, creating a "digital twin" of the B-52 is not necessary, Newberry expressed. Digital twins are created for "the propulsions system … the wing … the electrical," but not the full aircraft, the new systems won't impact the bulk of the airframe.

The initial contract will carry the program through development and production of 24 engines: Four, for ground test and 20 for the test airplanes and spares, Ames said. It is not clear yet if the test engines will eventually join the pool used by the B-52 fleet. The first ones will be heavily instrumented, so it might not be cost-effective to remove that equipment for operational service.

A production contract would come right around the time EMD concludes, Ames said. But before that can happen, "there's a big milestone hanging out there that could flow left or right a bit, called 'production rate readiness.'" The PRR milestone certifies that all the suppliers and materials are ready to support production, and much of that is government-furnished equipment outside the scope of Rolls-Royce's contract.

As for simulators and training devices for maintainers, "it's early days for that," Ames reported.



Rolls-Royce North America

A computer rendering of F130 engines being tested in a new nacelle on a test stand.

"We have demonstrated, through some of our augmented reality and virtual reality tools, some different training packages we can offer the Air Force," he said.

Rolls-Royce can "leverage what we've done on other programs" and provide USAF with "a fantastic solution to maintenance, support, and training." By 2026, "we'll have a lot more clarity" on what the production and fielding element of the program will look like, he added.

It's "premature" to assign the upgraded B-52H a new designation, although "B-52J" has been mentioned. That will be a "future conversation," he said.

"The reason we do letter designations like that really has to do with operations and training," he explained. If there's a "significant difference" in how the aircraft is flown and employed, "the aircrew need to be fully aware" and nomenclature accomplishes that.

"This is the … largest modification to the B-52 in its history," said Newberry, noting that April marks the 70th anniversary of the B-52 prototype's first flight, "and we're going to ask …the B-52 to continue to 2050." Its long life is a testament, he acknowledged, to the bomber's design and value. ✪

Kimberly Dickman, assistant professor in the Center for Character and Leadership Development, speaks to cadets and Air and Space Forces leaders at the Air Force Academy's 2022 National Character and Leadership Symposium.

Prioritizing Ethics and Human Dignity in War

War is hell. Recognizing that, yet still embracing your own and others' humanity, is vital.

By Amanda Miller

Flying from a combat zone to a 120-degree Fahrenheit desert air base and back, the C-17 crews of Operation Allies Refuge loaded their airplanes with more people than they'd ever carried. The medical teams, trained to treat American troops, took care of entire families from an unfamiliar culture. Aircrews and medical personnel alike had to make decisions without any precedents to rely on, and they often had to break the rules.

Flight nurses weren't technically allowed to treat patients whose names weren't already on a flight manifest, yet many such patients received treatment and a ride out of the country, including the victims of a suicide bombing.

"It's a really serious, ugly business we're in." —Chief Master Sergeant of the Space Force Roger Towberman

Stuck on the tarmac at Al Udeid Air Base, Qatar, for hours with passengers on board, waiting for a bus, one C-17 crew made the call to let everyone off the plane to wait on the flight line. The heat inside had become unbearable.

Their dilemmas and the mission's undisputed success brought three of the Airmen who took part in Operation Allies Refuge to the Air Force Academy in February where they added their voices to those of top leaders from the Air and Space Forces, among others, during the Academy's 2022 National Character and Leadership Symposium.

Organized around the theme of "Ethics and Respect for Human Dignity," these were some of the lessons

that cadets or anyone could learn:

COMPASSION AS A HUMAN EVOLUTIONARY ADVANTAGE

From their reclined seats inside the darkened dome of the Air Force Academy Planetarium, Kimberly S. Dickman, assistant professor in the Center for Character and Leadership Development, prompted cadets to do the wave and to stomp-stomp-clap the rhythm to Queen's "We Will Rock You."

The simple exercises demonstrated motor synchrony, the phenomenon "that when we are connected physically, when we do things together physically, then we connect—we belong—more," Dickman said. She teaches classes in human sex and sexuality and applied positive psychology—the field of psychology that looks at, 'How do we make a good life? How do we be happy? How do we flourish and grow?'"

In her workshop "Leading and Connecting With Compassion," Dickman dismissed old ideas that categorized compassion as a liability—the notion that only "the baddest, strongest, meanest people, the scariest ... on the savannah," would survive and that "there is no way that compassion is inborn within us."

By contrast, Dickman presented compassion—a feeling of concern coupled with taking an action to do something about it—as an inherent part of the human constitution by comparing human babies to other newborn primates. Comparatively, helpless human babies can't develop as far before they're born or their big heads wouldn't fit through their mothers' birth canals.

Her point: The human race survived precisely because of parents' compassion toward their infants.

"We need compassion to connect with others, and biologically, we know that we're made for that," Dickman said. She cited a study in which the brain scans of patients experiencing concern and caring "lit up" their brain stems—"the primitive part" of their brains.

She said leaders need to recognize that people on their teams could be struggling, such as with a personal problem, even if it's not obvious.

"As much as we would like to think that we can leave that at the door, when we enter into our office, into our cockpit, into wherever it is that you work, we often don't," Dickman said.

"When it comes to the issue of compassion, your voice makes a difference. What you say or what you don't say—whether it's with a partner, a child, your neighbor, someone in the cubicle next to you—what you say or what you don't say, what you do with your body or what you don't do, impacts them and impacts you as a leader."

USAFA

Gen. Charles Q. Brown, USAF's Chief of Staff, wants to invest in people.

Trevor Cokley/USAFA

Gen. David D. Thompson, USSF's Vice Chief of Space Ops, answered questions.

USAFA

CMSAF JoAnne S. Bass likes to drop in on Airmen unannouced.

USAFA

USSF's CMS Roger A. Towberman isn't caught up in the "leadership" approach.

PEOPLE FORM THE FOUNDATION

If Chief of Staff of the Air Force Gen. Charles Q. Brown Jr. could plus-up support for any part of the military, he'd invest in the people.

Brown attended the symposium in person alongside the Space Force's Vice Chief of Space Operations Gen. David D. Thompson and the Chief Master Sergeants of the Air Force and Space Force, JoAnne S. Bass and Roger A. Towberman. The four senior leaders answered questions posed by cadets.

In reply to a hypothetical query about how he'd spend money if he got to decide, Brown chose "some of our foundational areas, because we tend to focus on platforms and weapons ... and when I think about foundational, it's some of our Airmen programs and how we take care of Airmen and families."

High-performing organizations value the diversity of all the members and try to take advantage of that, Bass said.

"I often think back to what are high-performing teams and how ... they become high-performing teams," Bass said. "All of them, they value diversity and the strengths and the talents of every single team member."

Whereas Brown sets up breakfasts and brown-bag lunches to meet with troops where he travels, Bass likes to drop in unannounced:

"It's about listening to your folks and providing opportunities to do that," Bass said. "I love to just go in and visit places where they aren't expecting me to be there, and I'll just cold pop in and be real and really ask, you know, 'What are some of the challenges you guys are going through?'—and also kind of humanizing myself."

"So as you're getting ready to go out there and as you're, you know, leading in the capacity that lieutenants might lead," Bass advised the officers-to-be, "I would offer: Go out there and know your folks and look at the talent and the strengths and the diversity that those folks bring to the team."

Towberman doesn't like to get too caught up in the idea of "leadership." His approach instead is:

"Every day I just hope to make every person I meet's life a little better," Towbernan said. "It really is the little things that will matter the most. So I think if you ... value yourself by the change that you make in the world, by the changes that you make in the lives of other human beings, that developing leaders will sort of happen as a natural extension of you investing in every person

C-17 crew members Capt. Hannah Swysgood, left, Capt. Jasmine Leyro, and Lt. Col. Alex Pelbath participated on an Aircrew Panel, sharing their experiences in Operation Allies Refuge, helping evacuate around 120,000 people from the Kabul, Afghanistan, airport last August.

Justin Pacheco/USAFA

that you meet."

Towberman offered a tip as well—that cultivating a wide variety of interests can help spark a connection. For example:

"It's important to know that when you meet someone from Connecticut to remind them that they're officially known as Nutmeggers," he said. "That's just fun, right?"

TAKING STOCK OF BIASES AND BREAKING ONE RULE EVERY TIME

Flight nurse Capt. Hannah Swysgood's first mission of Operation Allies Refuge carried civilians who'd been hurt in the suicide bombing while they waited to get through the Abbey Gate security area and into Hamid Karzai International Airport in Kabul.

"We carried a lot of children on that flight, and they were very wounded, and we took care of them," Swysgood said. In nursing, "human dignity is a huge part of what we do. We work with a variety of people every single day, and you have to understand each individual person and their culture and their background while working with them," she acknowledged.

As a woman, Swysgood treated other women. Meanwhile a male medical crew director could step in "if we needed a male to take care of something."

A technique she said worked for her team was taking stock of their own biases that may have gotten in the way of their work:

"So we acknowledged them," Swysgood said. "We talked about the limitations that those biases might have had, and then we put them aside."

Helping to seat families together turned out to be one of the most compassionate acts the medevac teams could perform—"allowing people to board and making sure that their family members are with them, keeping them together, trying to seat them appropriately so that there's not the fear aspect. They're not freaking out. They're not panicking. Their family is with them."

Early in the evacuation, her chief nurse decided they would break a rule—the one about not treating patients who weren't on a manifest.

"Our chief nurse said, Day One, he was like, 'I will give you top cover.' He said if there is someone standing out there that needs a ride, you will bring them on board. That had not been passed down from any other leadership at that point in time—it was very early on. He made it very known," said Swysgood. "So we broke those rules every single time."

A FLIGHT CREW THAT CHOSE GRATITUDE

Asked about good habits to start forming, C-17 co-pilot Capt. Jasmine G. Leyro—whose missions as part of Operation Allies Rescue included letting off the sweltering passengers on the flight line in Qatar—zeroed in on "choose your perspective."

"We get so caught up in this feeling that the system is out to get us, or we're not being met where we are, or we're not being treated properly—and the system is ambivalent to us," Leyro said.

"The important thing is to wake up every morning and choose your perspective. You get to choose to be good, to be noble, to live gratefully. … I had an awesome experience because of my crew, and we chose to have a perspective of gratitude every day."

Their trick for maintaining morale: a daily "vibe check" started by another co-pilot.

"He would start every day with a vibe check. Everybody would be on the headset, and he would be like, 'Vibe check, guys.' We'd be like, 'Word up—vibes are good. Vibes are through the roof. Vibes are to the moon!' And it was a way to keep our heads in the game, to keep morale—maybe not its highest because things were kind of intense. But to keep everyone focused."

FACING THE ULTIMATE ETHICAL DILEMMA HEAD ON

The military's very existence poses an ethical dilemma, said Towberman, the Space Force's top enlisted leader.

And being ready in a difficult situation could come down to facing that fact upfront.

"We're in the business of killing people, which we don't think is OK, right?" Towberman asked.

"And I've had many instances in my career where seconds after I made a radio call, I knew someone was going to die. And they did. And I always, myself, knew that that was about saving lives and that there was a choice that needed to be made. But I'll tell you, I never scrambled after the mission to find the video so I could high-five everyone over a life that was lost.

"It's a very serious business that we're in, and the better that we wrap our heads around that from a very early age—the more open we are about talking about those hard choices—the more, the better we prepare for those, the easier we'll navigate a real ugly, difficult business that we're in." ✪

Staff Sgt. Jessica Montano

The Combined Air Operations Center at al Udeid Air Base, Qatar, provided command and control for airlift operations during the withdrawal from Afghanistan last August. The Air Force's Kessel Run software rolled out updates in real time to support the operation.

Making the Kessel Run

How a handful of Airmen brought DevOps to USAF, then used it to save more than 123,000 lives.

By Col. Brian Beachkofski

Kessel Run was founded on a hypothesis that by bringing commercial DevOps practices to the Air Force, warfighters could get better software, faster, for less money. Our experience over the last four years has borne that out. Our critical change was putting the developers, the security operations, and IT operations together in a single team to make a DevSecOps [development, security, and operations] unit. Traditionally, dev responsibilities fall within Air Force Materiel Command and IT operations within the operational MAJCOMs; this split slows down real time delivery. In August 2021, Kessel Run showed that developing software solutions in real time has real world impact and helped save the lives of more than 123,000 people. We have the results from the experiment, and the data show clearly that the Kessel Run model, the DevSecOps unit, should be the standard for Air Force software factories.

__Col. Brian Beachkofski__ is commander of the Air Force Life Cycle Management Center's Detachment 12, an agile software development lab known as "Kessel Run."

It's Aug. 24, 2021, and tension is in the air inside the Combined Air and Space Operations Center (CAOC) in Al Udeid Air Base, Qatar. There's only a week left before the Taliban deadline to evacuate the remaining Americans, interpreters, and others who had helped the United States in Afghanistan over the two decades since 9/11. Many are young enough to only have vague memories of what life was like prior to the Americans' arrival in 2001. It's here, at the CAOC, where the airlift is being planned and managed.

The situation in Afghanistan is similarly tense. Around 6,500 people are at the airport waiting for

a flight out of the country. A week earlier, desperation led people to chase after or hide in the wheel wells of departing C-17s. Horrifically, some fell to their deaths when the aircraft took off. Now, the crowds are drawing the attention of ISIS-K, which is planning an attack that will come only two days from now. The need for an orderly plan to evacuate as many people as possible was clear.

Back at the CAOC, the team of air planners is trying to use Kessel Run's software to plan the missions that will ferry people out of Kabul on planes from the United States and many other countries. A proper plan is critical because the air traffic control at Hamid Karzai International Airport (HKIA) is not used to this level of traffic, so the planners must space out the arrivals and departures into very precise time slots.

However, the software isn't working.

The team is going to the Slapshot website, but it's not loading. This was a known risk. As a development Minimal Viable Product (MVP), Kessel Run's applications were designed to accommodate the number of missions in steady state operations. The changes needed to scale to over five times as many missions were in the backlog, but deferred for higher priority work until next summer. Now, the evacuation has driven the mission count up 10 times in a matter of days. If this evacuation fails, thousands of people would be stranded as the Taliban take control of Kabul and the rest of Afghanistan. It's a literal life and death situation.

In the midst of the flurry of action on the CAOC ops floor, a young government civilian calmly goes to his computer at the back of the room and submits a message to a team in the United States. It's a similar message to others the team has sent before, but this time the stakes are much higher.

"We are experiencing intermittent loading issues with Slapshot. The exercise theater does not load. We need to call an outage so that we can fix the issue," he said.

BACK TO OCTOBER 2016—THE BEGINNING

Eric Schmidt, then executive chairman of Alphabet, Inc., Google's parent company, served as a member of the Defense Innovation Board (DIB). The board worked to find ways innovation could address future challenges to DOD. As part of that work, the board went to the same Operations Center in Al Udeid where this story began.

Famously, he saw Airmen planning refueling missions on a whiteboard with tape grids, magnetic pucks, and dry-erase marker lines connecting the puck together to define the plan.

When he later asked the Air Operations Center (AOC) commander what his biggest concern was, the commander said: "Well, frankly, ... I don't want them to erase my whiteboard."

Shocked that an eraser created one of the biggest threats to the air war supporting operations across Iraq and Afghanistan, the board members pressed the team about why better tools don't exist. He asked if they even had modern software. He was told, "Yes, but it doesn't work." This failed modernization effort left the AOC with the nearly the same system that was originally developed in the 1990's—20 years and several software lifetimes ago.

This effort to modernize the AOC 10.1 software was called the AOC 10.2 program. The Capability Development Document of 2006 formalized key functional requirements for the AOC and in that same year Lockheed Martin was awarded a $589 million contract in order to "standardize, modernize, sustain, and transform" the AOCs. Under traditional acquisitions, this was pre-Milestone B "risk-reduction" activity. In 2013, Northrop Grumman won the development award and began work on the 10.2 program. By the fall of 2016, Northrop was already three years behind schedule and estimated development costs had ballooned from $374 million to $745 million. It was a decade after the requirements were identified and no code was delivered to the field for use. This is the scene that the Defense Innovation Board walked into when they visited the CAOC.

Raj Shah, a Managing Partner at Defense Innovation Unit (DIU) at the time, was with the Defense Innovation Board, and literally called Col. Enrique Oti, an officer at

The whiteboard on which tanker refueling operations were planned was like a game of Tetris. While one teammate enters data into an Excel spreadsheet, another moved magnetic pucks and laminated cards around the whiteboard. Kessel Run converted the manual system into an automated software program.

USAF/courtesy

USAF

Capt. Gary Olkowski demonstrates "Jigsaw," the digital tanker planning tool built for the Combined Air Operations Center at Al Udeid Air Base, Qatar. Developed in just four months, Jigsaw paid for itself within six months of being deployed.

DIU, that night, and said that he would commit $1M of DIUx's money. The goal was to get a new tanker planning tool and demonstrate DevOps can deliver solutions faster than traditional waterfall and Joint Capabilities Integration and Development System (JCIDS) development.

The Air Force team, led by Oti, sat side by side with Airmen in the CAOC to design a warfighter-friendly tool. The resulting Jigsaw Tanker Planning Software turned an eight-hour task for six people into a three-hour activity. By April 2017, four months after work had started, the tanker planning tool was in use in Qatar.

Within six months, the Jigsaw application had essentially paid for itself. The efficiency it had created saved 400,000 to 500,000 pounds of fuel each week and required one less refueling aircraft. This saved the Air Force $750,000 to $1 million every week.

Remember, Raj only spent $1 million on the entire effort.

It's no wonder that the 10.2 program received a stop-work order on April 19, 2017, and was terminated in July. The Air Force needed to do things differently to avoid the same outcomes. There was a team—also an experiment—that could lead that new approach. This new team of coders was going to build on Jigsaw's success and modernize all of the AOC's software.

Jigsaw was combined with the Targeting and GEOINT program office (also using DevOps to modernize their tools, led by Capt. Bryon Kroger), and the government team who was sustaining the AOC 10.1 system within PEO digital.

That team was named "Kessel Run," both as an homage to "Star Wars" smuggler who could bring outside things (like DevOps) to a bunch of rebels, but also because Han made the Kessel Run in 12 parsecs, a hyperspace distance shorter than anyone else had done before. That was our mission: Shorten the time and distance it took to get to our destination.

Here are some of the ways that we close the gap.

USER-FOCUSED DESIGN

Jigsaw began with our dev-teams sitting down with the users in the AOC to understand their value chain, and how they could be more effective and productive. We have continuous user interviews and track customer satisfaction scores. Getting software into users' hands as soon as possible has led to our users coming up with new use cases. Today, we have our team members embedded at the 609th CAOC every day.

As we add new applications or features to our scope, we start with a discovery and framing session with our users. We don't turn to requirements documents first or trust that documents written in 2006 represent the world as it is today. Instead, we work with the users to scope a MVP and then begin iterations of the build-test-learn cycle.

We map out their processes so we understand what the users need.

After that, we start designing the solution. We co-design with the users and start to map the data flows so we can see the interdependencies between applications and workflows.

Finally, the goal isn't to provide a mock-up or a prototype, but to build an MVP that users can test and use to support operations. Having users test thin slices of the ultimate system starts the build-test-learn cycle and gives us constant feedback on our software to continuously learn what is working and where the gaps are.

This is very different from traditional acquisitions where only finalized systems are made available to users. It can create challenges since we release versions that we know don't meet the entire set of needs, but can provide value that can grow over time. For example, our Kessel Run All Domain Operations Suite (KRADOS) in August had known issues around scaling for major operations.

More on that later.

Continuous delivery, in practice, means changes to the software are happening on a regular basis, multiple times a day, eventually adding up to major changes over time.

For example, Jigsaw has been used for every air refueling mission in the CAOC since December 2019 as a stand-alone application. Slapshot, the tool for planning the rest of the air missions, has also been used for every mission at the CAOC since December 2019. Again, it was used as a stand-alone application for over a year because we didn't have the

connection to a common data layer built yet. However, the integrated suite of 10 applications with a common data layer was released as an MVP in January 2021. It was accepted, and used for planning the Master Air Attack Plan at the CAOC, since May 2021.

Let's dive a little deeper on how we make those changes to production software.

CONTINUOUS INNOVATION AND DELIVERY

At Kessel Run, we have a different challenge from commercial software-as-a-service providers. We don't have a single internet that we're deploying to. We have 10 different environments because of users on unclassified, secret, and top secret networks—and the different variants of those networks for different coalition partners.

In order to manage deploying software to these regions, maintain version control, and reduce human touch points in the deployment process, we rely on automated continuous integration and continuous deployment pipelines.

That starts with our developer pipeline, which takes the application code from their workstations and puts it into the Gitlab repository where we maintain our code. When the dev-team thinks the changes are ready to deploy to our staging environment, they push the code through the CI pipeline along with a deployment manifest. The security release pipeline is part of this release, which includes code scanning, vetting dependencies, and putting the artifacts into our Nexus repository. Once there, they are available in the staging environment for testing and verifying integration with other applications and services.

When those changes are ready to be promoted to production, the immutable images are moved from Nexus into our purpose-built deployment manager (RADD) into the production environments. Our Continuous Deployment pipelines depend on whether the deployment is going to our AWS unclassified cloud, on-prem Secret, or Top Secret cloud.

We use these pipelines multiple times each day. On average, we deploy code through a deployment pipeline once every 3.3 hours. From the time the dev-team is ready to deploy, on average, it is only eight hours before the changes are available in production environments. Much of that time is spent moving artifacts from unclassified networks up to classified, which still requires burning CDs and rescanning on both sides of the air gap. We hope to have a cross-domain diode that will take the human touch point out of the process. That should speed the deployment times further and help us get to the self-service deployment using full automation.

FOCUS ON APPLICATIONS IN-PRODUCTION

While many teams see the job as finished when code gets into production, we see that the job is only partially done. While we haven't yet established service level objectives, or agreements with our users, a point of pride for Kessel Run is our ability to service apps in production, respond to issues, and never have the same outage twice.

Our teams provide security support and monitor applications to ensure they are available. When we have an issue, on average we have it resolved in under 120 minutes. After every outage, we conduct a no-fault retro to identify root causes and assign fixes to the backlog.

That process begins with a report in our MatterMost channel for outages. That brings us back to Aug. 24, 2021, when our liaison officer at the 609th submitted the outage report.

DEVOPS IN PRACTICE

It was 2:49 a.m. in Boston. Remember, that we knew that the production version of our applications couldn't handle the growth in mission counts that we saw in the evacuation effort. Now the software was being asked to do exactly that.

Meanwhile, the crowds outside HKIA grew and the deadline to get everyone out wasn't going to change just because we had an outage in production.

Our platform team noticed spikes in latency seven minutes after the call was initiated. Along with the LNOs, the on-site platform team started collecting data on the classi-

Sgt. Isaiah Campbell/USMC

The evacuation from Hamid Karzai International Airport, Kabul, Afghanistan, resucued more than 123,000 people. On-the-fly software updates made that possible.

fied network to help pinpoint the problem when the dev-teams in Boston get into the office.

At 4:03 a.m. in Boston, the outage team began the response and began to work with the product manager to determine potential fixes. At 7:09 a.m., the dev-teams joined the outage call and confirmed the root cause. There was a setback at 8:28 a.m. when the apps completely crashed and the LNOs notified the center's operations floor.

Still, only 12 minutes later, the platform team has cleared the bin files that had taken up all available disk space after the app lost connection to the SQL database. By 9:07 a.m., the team had doubled the number of compute instances available to Slapshot. At 10:25 a.m., the development team added a "theaters" feature to the production version of Slapshot that cut the number of missions displayed into smaller chunks.

That afternoon, at 1:44 p.m., additional compute instances were shifted to the 609th Slapshot, and it looked like the issues had been mitigated. At 4:06 p.m., our liaison officers confirmed with users in the 609th that the issue was resolved and got feedback on the new theater feature. They had positive feedback and the outage call ended.

The call ended only 12 hours and 3 minutes after the product manager was woken up at 4 a.m. to start the call. In those 12 hours, the team was able to shift compute and store resources to United States Central Command's apps to improve performance, fix the SQL database connection errors, clean out the bin files, and add new features to help slice the data and improve load times. Our dev-teams and IT ops teams worked together—from Boston and in Qatar—to identify the issues, propose solutions, and implement them in a single day.

USAF/courtesy

USAF set a record on Aug. 15, 2021, when one flight safely transported 823 Afghanistan refugees on a single C-17 flight.

The airlift was able to continue.

Interpreters who had helped Americans and our partners were moved to safety. Women and girls fearful of a life under the Taliban were brought to safety where they could pursue their dreams. All American forces were out of Afghanistan by the Aug. 31 deadline.

To me, those 12 hours are the defining moment for Kessel Run. What started with Eric Schmidt's disbelief in how planning was being done five years ago became an experiment to show a government-led DevOps team could deliver software better than traditional government acquisition. For comparison, that five years is the same time it took 10.2 to go through "risk-reduction" and start a development contract. Since the DIB visited the CAOC, we've been in use by users for all but the first six months of those five years. We add new features every week and move from stand-alone apps to an integrated suite. Kessel Run has shown that the full promise of DevOps is not something to see in the future—it's happening now.

When lives depended on us, when the world challenged us, our DevOps Team delivered the software solutions our warfighters needed. In doing so, we demonstrated why DevOps—why the Kessel Run model—is an imperative for the Air Force. ✪

Mike Tsukamoto/staff

Senior Master Sgt. Brent Kenney, center, won the Spark Tank competition for his "Project Arcwater" idea, which narrowly bested "Custom Facemasks for Fighter Pilots and Beyond," developed by Maj. Ryan Sheridan. Here, he hoists his trophy in the company of (l-r) CMSSF Roger Towberman, CSO Gen. John Raymond, Vitamin Shoppe CEO Sharon Leite, Undersecretary of the Air Force Gina Ortiz Jones, Productable CEO Rachel Kuhr Conn, and CSAF Gen. Charles Brown Jr.

Spark Tank Catches Fire

The Air Force's competition for innovative Airmen with big ideas is coming into its own.

By Greg Hadley

Six teams gathered on the stage at the AFA Warfare Symposium (AWS) in Orlando, Fla., in early March, taking part in the final round of Spark Tank, the Air Force's flagship innovation event modeled after the popular "Shark Tank" TV show.

They could hardly have been more different in experience—pilots, a prosthodontist, a "blood banker," a civilian-led trio, a noncommissioned officer, and a cadet. Yet they each had the chance to convince the top leaders in the Air Force that their idea was best.

In the end, it was the Senior Master Sgt. Brent Kenney who hoisted the trophy above his head as triumphant music swelled—his "Project Arcwater" idea narrowly bested "Custom Facemasks for Fighter Pilots and Beyond," developed by the dentist, Maj. Ryan Sheridan.

The two received three votes each from the panel of seven "celebrity" judges, leading Air Force Chief Information Officer Lauren Barrett Knausenberger to take the stage, huddling briefly with the judges before declaring Project Arcwater the winner.

However, the trophy that Kenney received—3D printed, as the competition's emcees point out every year—isn't the real prize of the competition. Sure, the winner gets to keep it for a year, a little piece of physical bragging rights to go on the desk. But ultimately, it is almost beside the point. Indeed, the five other teams on that stage, smiling and applauding their rival in the competition, had already won almost as much. In fact, so had several other teams that didn't even make it to Orlando.

"The whole process ... helps encourage Airmen to take ownership of the things they do, as subject-matter experts in their area, and to think about how to do it better."
—Brou Gauthier, director of Spark Tank

'THE REAL VALUE' OF SPARK TANK

When Spark Tank first began in 2018, Air Force Secretary Heather Wilson challenged Airmen to "share their best ideas that build upon senior leader priorities to restore readiness, increase the lethality of the force, and drive innovation to secure our future."

In the first few years, hundreds of ideas poured in from "intrapreneurs"—a hybrid term describing entrepreneurs from inside the organization. But when it came time to actually implement some of the very best, officials ran into a problem.

"One of the things that we noticed over the first couple of Spark Tanks was, it was really on the passion of that intrapreneur ... the subject-matter experts who see a better way to do this, they come up with this idea, and largely the work has been on them to make it real," Brou Gauthier, director of Spark Tank, told Air Force Magazine.

The passion of individual Airmen, Guardians, and

civilians was admirable, Gauthier said, but it had limitations. For one, those service members were often pursuing their ideas as a side project—and their main job in the Air Force often took precedent. For another, they sometimes lacked a broader context to assess whether the idea they were pitching was feasible to scale up.

The pageantry of the on-stage event was good—"It plays the role to generate that excitement piece," Gauthier admitted—but after the ceremony ended and the high-level leaders returned to their daily jobs, it was a struggle to translate ideas into action and, by Gauthier's own admission, the program didn't have the needed structures in place.

"It's great when the Secretary or the Chief or the Chief Master Sergeant of the Air Force, or somebody says, 'Yeah, this is a great idea, let's go do it,'" Gauthier said. "But the staff [at the Pentagon] still has to be convinced, right? Because the staff is kind of the guardians of the checkbook and capabilities and that kind of thing."

Over the past few editions of the competition, Gauthier has sought to rectify that problem. Now, every idea that makes it to the semifinals or further is assigned to a lead staff member at Headquarters Air Force in the Pentagon. From there, the member of the Air Staff investigates the idea to decide if it is viable and worthwhile to pursue.

If it is, the staff then works with the individuals who pitched the idea to help it come to fruition. But now, it isn't entirely on the Airman or Guardian who pitched it to keep pushing the idea.

In some cases, like that of Senior Master Sgt. Bartek Bachleda, it's been easy—Bachleda's idea to re-engineer the boom operator instructor's position for the entire KC-135 fleet to reduce injuries won the inaugural Spark Tank in 2018, and he was subsequently assigned by Air Mobility Command to help oversee the program. His idea became his job.

But not every competitor has that option, and the Air Force can't afford to let good ideas go unexplored.

The competition "was almost really incomplete without the follow-on stuff," Gauthier said. "And so we've spent the last several years building out that follow-on stuff, so that you actually go from ideation through decision and a full communication cycle back to the intrapreneur."

As of early February, Gauthier had tracked 73 ideas, most from Spark Tank, some from the Vice Chief's Challenge, a similar competition, as well as a few others. Of those 73, roughly 10 percent have been completed, 30 percent have been terminated, and 60 percent are still in progress.

In addition to the KC-135 boom operator idea that won in 2018, the Air Force has also implemented ideas for a mobile pod test stand, also a finalist in 2018, and pre-formatted templates in Microsoft to conform with Air Force style, Gauthier said.

Not all of these ideas have become official programs of record, Gauthier added. But they have reached a stage of implementation akin to full operating capacity, he said.

"If you're really like a venture capitalist, and you're starting to say, 'Well, yeah, not every idea that hits Silicon Valley is going to play out.' So, what does 'good' look like? How many wins does it take for you to actually say that the program is successful?" Gauthier said. "And I would say about 10 percent of our ideas have completed."

Even the ideas that have been "rejected" have provided valuable lessons, Gauthier said, raising questions that those in the Pentagon might not have considered.

"For every one of these grassroots ideas, it's been an Airman who, this has been a personal pain point for them, and they think deeply about how to solve it, and to do better with it. So they went through and came up with these ideas, and then they submitted into the process, and it's a decent idea," said Gauthier. What holds back some, though, is a lack of planning for how members of the Air Staff can take the idea and move it forward, Gautier added.

The team members of every rejected idea receive a personal letter from the functional lead in the Pentagon who studied their idea, Gauthier said, thanking them for their contributions. Ultimately, it's not all that different from what the Spark Tank winners or those whose ideas are pursued get—there's no prize money or guaranteed promotion in the competition.

Instead, "the real value … in the Spark Tank process is the feedback that we give that intrapreneur, that their idea was good or wasn't good because of these things, and it keeps going or doesn't based on the merits of that idea and the problem it's solving," Gauthier said. "So the whole process ultimately is one that helps encourage Airmen to take ownership of the things they do, as subject-matter experts in their area, and to think about how to do it better."

So even though it was Kenney getting congratulated on stage with the trophy at AWS, taking photos with Chief Master Sergeant of the Air Force JoAnne S. Bass, his fellow finalists aren't done with Spark Tank just yet. Indeed, in the months and years to come, at least some of their ideas are likely to become part of the Air Force, one way or another—now's the time to familiarize yourself with them before they do.

BLOOD DELIVERY BY UAV

The "blood banker" community in the Air Force is small but vital—when things go wrong and the delivery of blood can mean the difference between life and death for a service member, "you can't fail," Maj. Giselle Rieschick told Air Force Magazine. "Missions get scrubbed, people get hurt."

Yet when Rieschick, a member of the 99th Medical Support Squadron at Nellis Air Force Base, Nev., was deployed recently to Al Udeid Air Base, Qatar, she encountered a frustrating problem. There was a service member in need of blood, and a team with that blood got within 20 minutes of the member's location. But the supplies never got there—the risk was too great to send a helicopter full of soldiers.

The service member managed to survive, but the incident sparked Rieschick and her team to start exploring a new way to ensure blood supplies can get to service members in need.

Currently, Rieschick said, the Defense Department spends millions supplying individual units with "just-in-case inventory"—a little bit of blood in case something goes wrong. This system has mostly been in place since the 1990s, she said, but it isn't very practical. Often, when a service member needs blood, they quickly exhaust the supply their unit has.

"So what if, when they needed the help and they radioed it in to their nearest blood detachment center, that team sitting in that building with those products could load it and send it?" Rieschick said. "They wouldn't have to go to the flight line, they wouldn't have to go through all these channels and say who can help me get this blood here?"

The use of unmanned aerial vehicles, or drones, to deliver medical supplies is not a new idea. It has been used everywhere from Africa to Israel to North Carolina to get supplies to remote locations, limit contact, or increase convenience.

In a military context, however, the idea could be especially potent, Rieschick noted. Low-cost attritable aircraft like UAVs can be sent into dangerous situations without added risk to hu-

Mike Tsukamoto/staff

Maj. Giselle Rieschick pitches Blood Delivery by UAV to Spark Tank judges at the Spark Tank finals. Life-saving blood delivery is sometimes thwarted by hostile ground forces.

man life and simplify what is now a complicated logistical effort.

And this technology won't just benefit blood delivery.

"What I see is that this capability to deliver things to a pinpoint location is not going to be limited to blood. Whether you're going ship-to-shore in [INDOPACOM], or you're doing logistical support in COCOM … they're going to use this for other things that are needed, because there are many, many crazy makers where you're just like, 'I just … need this sent here,'" Rieschick said.

AERIAL TOW REHOOKUP

Cadet Grant Schlichting may be young, but his idea has roots deep in Air Force history.

Taking part in the glider program at the U.S. Air ForceAcademy (USAFA), Schlichting noticed paintings of World War II gliders on the walls. Intrigued, he started doing research into the Air Force's history with gliders and towing.

From that initial curiosity was born Aerial Tow Rehookup (ATR)—a system whereby drones can latch onto aircraft midflight using only a tow rope and mechanical connection and be towed to their destinations, extending their range.

The idea would be especially useful, Schlichting argues, as the Air Force looks to develop new autonomous drones to serve as "loyal wingmen" for fighters and bombers and as ISR assets.

Schlichting is just the second USAFA cadet to have reached the Spark Tank finals—in 2019, Preparatory School Cadet Usama Bamieh made the final six with his software program designed to help weather forecasters. Knowing Bamieh had made it that far, Schlichting said, encouraged him to enter the competition.

"And hopefully [we] will be an example for other cadets and other spark cells and people that may be new to the Air Force, that just because you're new doesn't mean that you don't bring up a fresh perspective and a good idea that can help the future fight," Schlichting said.

For his own idea, Schlichting already knows what he wants the next steps to be—first more experiments with the emerging technologies combat training squadron at Edwards Air Force Base, Calif., then a manned flight test. Then, if the idea is still viable, he wants ATR to be "a methodology for the Air Force, not just it's for one drone [but] that any drone you can combine to it."

To make that happen, Schlichting is ready to pass off ATR to others to push forward. He still would like to stay involved as an innovation manager or reference for the program manager, but in the end, "I'm just shepherding this idea along, this is to help the Air Force," he said.

DAGGER: GAMES FOR ENHANCED READINESS

At their core, pilots in simulators aren't all that different from Airmen playing on an Xbox, contends Matthew Correia of the Eaker Center at Air University in Maxwell Air Force Base, Ala. And the Air Force should be taking advantage of that to train Airmen using the very thing so many already use regularly—video games.

"Simulators are unique, one-of-a-kind products, but in a true sense, they're actually games," Correia told Air Force Magazine. "They're specific, but they're actually games, just like League of Legends."

The thought of using something like League of Legends, a multiplayer online game where players battle using fantastical characters, to train Airmen and Guardians will strike many as strange, Correia acknowledged.

But the new Airman Leadership Qualities, announced in February 2021, include skills such as teamwork, communication, decision making, and innovation, and those are things video games can teach, Correia said.

"Let's practice the competencies of the executive functions, such as critical thinking, resource management, creative thinking, those things," Correia said. "And within a game, you have the opportunity to do that. The game can be created, or the games actually already exist, where the solution is not one answer, it can be a range of answers, which is what true life is."

Comparing the idea to an obstacle course or escape room used in a team-building exercise, Correia sees video games as a digital, and therefore global asset.

"I could go on to a cyber leadership reaction course here in the United States, with someone in Germany, someone in Korea, and quite literally, so long as the forward operating base has internet access, I could [work with] that person whatever continent they're on," Correia pointed out. "And we could practice our competencies."

Correia's vision extends further than that, though—the services should "embrace this opportunity to shift from lectures or computer-based training to game-based training or game-based learning," he said.

CUSTOM FACEMASKS FOR FIGHTER PILOTS

Maj. Ryan Sheridan of the 10th Air Base Wing, Colorado Springs, Colo., (USAFA) is a dental specialist, not a pilot, but he stumbled on a problem one day while speaking with the flight surgeon responsible for fighter pilots—pilots were experiencing pain from their oxygen masks, with some even removing their masks during flight.

It's not the first time that medical professionals have expressed concern about oxygen masks—a 2013 academic study found that half of F-16 pilots surveyed in the Royal Netherlands Air Force had discomfort or pain around the nose as a result of their masks.

Studying the issue further, Sheridan discovered something about the standard MBU-20/P oxygen masks that surprised him—they only come in five sizes. Given his professional background, Sheridan was confused.

"For me, making a crown for a patient or making a tooth for a patient, the notion of taking like 10 different stock sizes of crowns and trying to make them fit every single tooth that I have to fix, the notion is just absurd," he said.

Sheridan had previously worked on an idea early during the COVID-19 pandemic to build customized N95 masks, taking

Mike Tsukamoto/staff

USSF Chief Master Sergeant Roger Towberman inspects a prototype custom face mask manufactured by Maj. Ryan Sheridan, whose concept narrowly lost out on the trophy, and will receive more analysis in the coming year.

advantage of the computer-aided design and manufacturing technology already widely used in dentistry, facial scanning technology available on smartphones, and 3D printers. He then simply shifted the idea to creating custom silicone inserts for oxygen masks.

The technology already exists and is widely available, and Sheridan said he's already spoken with pilots who are excited about the idea. Moving forward, the goal is to gather data on how big the problem is and what it will cost to fix.

"Do we need to make these for every single pilot? I don't know. I don't know if that's the case," Sheridan said. "But I think that the biggest thing that we can do is just kind of collect data and allow our senior executive officers to … interpret that data and help them figure out where we need to go with the next steps."

PROJECT FOX

Every day, millions of people across the globe go to Apple's App Store or the Google Play Store and download apps. Could the Pentagon one day have its own version?

That's the idea behind Project FoX—fighter pilots across different planes, able to access and use the same software, software that is developed and fielded in a fraction of the time it takes today.

For now, the idea championed by Maj. Allen Black is focused on the F-22, which was recently upgraded with an Open Systems Architecture Rack, reducing the need for custom-made software to integrate with the fifth-generation fighter's hardware.

Instead, the fighter can now take better advantage of commercial technologies, something Project FoX intends to take even further by using commercial tablets with a universal government interface that can display aircraft data in a common format, allowing developers to create their own apps.

This method also has the benefit of "segmenting the developmental code from an aircraft's operational code," Black said.

"As a result, changes can be made rapidly without impacting the airworthiness of the aircraft, taking the time required for testing cycles in software updates from months to days," he added.

Black's team is planning a demonstration in the coming months, using an app developed and tested on the F-35 that assists with the evasion of enemy surface-to-air missile on an F-22, with no redevelopment.

"But this is only the start," Black added. "We're working to make this a reality on any platform that can connect to their data."

The future, Black believes, is "a DOD App Store filled with cutting-edge technologies."

PROJECT ARCWATER

The Air Force's official doctrine note defining Agile Combat Employment articulated five core concepts: posture, command and control, movement and maneuver, protection, and sustainment. But the way the Air Force currently operates, that last element of sustainment presents a particularly large challenge.

"Imagine this: You're on a mission with your team in the middle of nowhere. You have a tough job ahead and unfamiliar territory, but the space to take what you need is limited," Kenney told the judges. "What do you cut? Fuel? Water? Tools? Teammates? Is your choice the right choice? … The most precious resource we have in mission-planning is pallet space. Pallet space determines what goes and what stays."

The biggest non-negotiables are often fuel and water, and those can often take up large amounts of space. In March of 2021, Kenney teamed with Tech Sgt. Matthew Connelly to tackle the problem, stitching together ideas with the common goal of reducing the logistical footprint.

The end result is a three-pronged system. First, there's the lightweight solar panels, so efficient they generated power during a test run even when it was snowing, Kenney said.

Second, there's the water harvesters. Using solely the humidity in the air, one water harvester can generate nearly 30 gallons of water per day.

Finally, there's an HVAC unit for heating and cooling workspaces that uses a third of the power of traditional units.

"Essentially, we're taking independently conceived components out in the commercial world and we're sewing them together into a package that fits the mission set of Agile Combat Employment: Small teams, very little resources, big tasks," Connelly said.

Currently, "we buy fuel to fly fuel to transport fuel just to burn that fuel," Kenney said. But the maturation of eco-friendly technologies makes that not only expensive, but unnecessary, he argued—Project Arcwater promises to cut costs by 98 percent for a standard mission while returning 60 percent of pallet space and reducing setup time for a forward operating location by more than 95 percent. ✪

Tech. Sgt. Matthew Connelly

Project Arcwater, developed by Senior Master Sergeant Brent Kenney, fuses several commercial technologies to drastically decrease supply chain reliance by using renewable clean resources to generate power and water on-site.

The F-35 Full Mission Simulator includes a 360-degree visual display that accurately replicates sensor warnings and weapons employment.

Talk to Me

F-35 simulators overcome policy and technical roadblocks to finally communicate effectively with allies' systems.

By Abraham Mahshie

EINSIEDLERHOF AIR STATION, GERMANY

In a dimly lit room in a nondescript yellow building at the U.S. Air Forces in Europe and Air Forces Africa's Warfare Center (UAWC) near Kaiserslautern, Germany, a Russian Su-24 appeared on a radar simulator, dangerously close to Dutch and American F-35s. The pilots, one in the Netherlands and the other in Germany, could communicate and rehearse strategies for confronting the threat together, and even pause and debrief at the unclassified level.

Just a few months prior, this kind of rehearsal would have been impossible. The allied pilots could neither speak openly during simulated joint exercises nor debrief together. After years of effort, this is finally beginning to change, thanks to a new effects-based simulator designed by the Air Force at a moment when allied air power requires unity.

"We're trying to break down those walls all the time, and this is a great step forward to doing that."
—Maj. Dan Prudhomme, F-35 pilot

"Even in this theater, when we're right in the middle of Europe, where there are F-35 partners everywhere, there are still a blockage of communication," said Maj. Dan Prudhomme, an F-35 pilot who is helping with training on two new, effects-based simulators at the UAWC.

Prudhomme, who is assigned to the 495th Tactical Fighter Squadron at RAF Lakenheath, U.K., taps the touchscreen and the radar locks on a red jet heading in his direction. An indicator identifies details about the Su-24. A Dutch pilot symbolized by a green jet on his touchscreen, is nearby. He clicks a red button and a projection screen displays the smoke plume of a fired missile.

"We're trying to break down those walls all the time, and this is a great step forward to doing that," he told Air Force Magazine during a Feb. 4 visit to Einsiedlerhof Air Station, a short drive from Ram-

stein Air Base, Germany. "There is a huge emphasis on allied and U.S. cooperation, collaboration, communication."

The new Air Force simulator enables pilots to communicate with each other over an unclassified network, honing their tactics and overcoming communications challenges.

Prudhomme explained that communicating directly with another pilot goes beyond relationship building and preventing communication breakdowns.

"It just provides a much higher degree of debrief capability and root-cause analysis on mission success or failure," he said. "Without that sort of live, actual communication with a real person who that comes from—communicating directly with another pilot really doing it—I don't think that's possible. That's something that we have a huge problem with right now."

While lacking the enhanced resolution, helmet-mounted display and other effects in the more expensive Lockheed Martin version, the Air Force-developed simulator for the first time allows allies to train and talk to one another from globally dispersed locations. The Full Motion Simulators are not expected to do the same until 2023, according to the Air Force.

Erik Etz, Lockheed Martin senior manager of new business, strategy and roadmaps, said that only the Lockheed Full Mission Simulator allows F-35 pilots to "train like they fight."

"The full mission sim is a dome-based solution. So, it provides an immersive experience for the pilots to train in a very realistic environment," Etz said by phone from the Lockheed training facility in Orlando, Fla.

"We are currently across the F-35 enterprise in discussions about what it would take to bring that same capability to the F-35 partners and allied nations as well," he added. "We have the technical capability."

Etz said simulators are now able to talk to U.S. Air Force bases through "Distributed Mission Training (DMT)," but he declined to say whether they were at U.S. air bases overseas. The F-35 Distributed Mission Training system provides secure network interoperability for training, including large force exercises, between F-35s and with other platforms like F-22s, F-16s, F-15s, and E-3s for pilots at U.S. locations.

Lockheed said it is working on a lower-priced, smaller footprint simulator similar to the one at UAWC called "MRT Light" that would be DMT compatible with allies and partners.

Lockheed could not provide a timeline for when its simulators would allow allies to train together from globally dispersed locations.

The Air Force said a limited test between RAF Lakenheath and RAF Fairford is not expected to yield results until late 2022 or early 2023. Lockheed could not confirm this timeline.

Lt. Col. Lee Stanford, commander of the 5th Combat Training Squadron, confirmed that allies possess Lockheed simulators, but not the ability to establish full communications.

"They have them out to other foreign countries, but the ability for U.S. and the foreign F-35s to connect has not been established yet," he said.

Meanwhile, the UAWC simulator is getting the job done.

"It is high enough fidelity that you can do mission training with it, testing with it, tactics development with it between countries," Stanford added, noting American F-35 pilots are already talking to the pilots from the Netherlands and Norway. Soon, the United Kingdom, Italy, and Australia will also be connected.

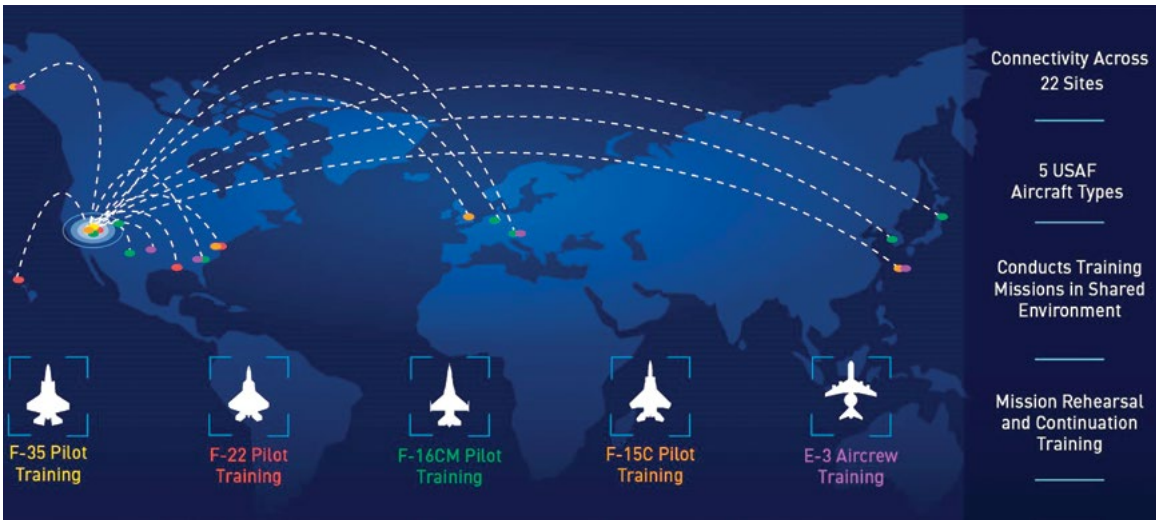
USAFE PRIORITY

Four F-35s are now deployed to the 48th Fighter Wing at RAF Lakenheath, and USAFE-AFAFRICA Commander Gen. Jeffrey L. Harrigian has made allied F-35 integration and joint training opportunities a priority.

Harrigian worked closely with the Royal Air Force to ensure their training area worked for both British and American F-35s, as well as accommodating fourth-to-fifth generation integration. The commander then flew to Decimomannu Air

Tech. Sgt. Rachel Maxwell

USAF and Royal Netherlands Air Force F-35A Lightning II aircraft conduct a bilateral air-to-air training exercise. New simulators allow F-35 pilot's from the two countries to communicate and train together more effectively.



Lockheed Martin graphic

Lockheed Martin, the Joint Program Office, and the U.S. Air Force successfully connected F-35, F-22, F-16, and E3 Sentry simulators to simulate highly contested operations during a Distributed Mission Training final test.

Base, Italy, to discuss flight distances, altitudes and emitters that would be appropriate for real-world air training.

But, Harrigian said, "there are some things you just can't do out on the range with these fifth-gen airplanes."

"As we bring on fifth gen, we have to have the simulator capability, the virtual capability to go train at the very high end," he said in an interview on the sidelines of the African Air Chiefs Symposium in Kigali.

Harrigian explained that integrating F-35s and fourth-generation capabilities with partners in theater "really drives home the interoperability requirements," building trust and confidence between squadrons to work together.

"We're working very hard to ensure that we can connect in the simulators our F-35s with the U.K., and then with all our F-35 partners, such that we can train together in the virtual environment," he said.

Getting the simulators to talk to each other to improve the allied force was "fundamental to our long-term success."

Capt. Daniel de La Fé

Aaron Corales directs a training scenario inside the battlefield dome simulator at the U.S. Air Forces in Europe and Air Forces Africa's Warfare Center at Einsiedlerhof Air Station, Germany. Corales operates simulators for joint terminal attack controllers.

"It's powerful, and that's the path we're on and we're going to figure that out," he stated. "If something happens here, we're going to be in it together. So, we don't want to have to figure it out on Day One."

FUNDING AND POLICY ROADBLOCKS

With F-35 flight hours and training opportunities limited, the new UAWC simulator allows allied pilots to train more at a critical moment for the NATO alliance, with Russia threatening in the East. Congressional funding is not the only problem the program faces. Allied F-35 pilots cannot talk to each other at a classified level.

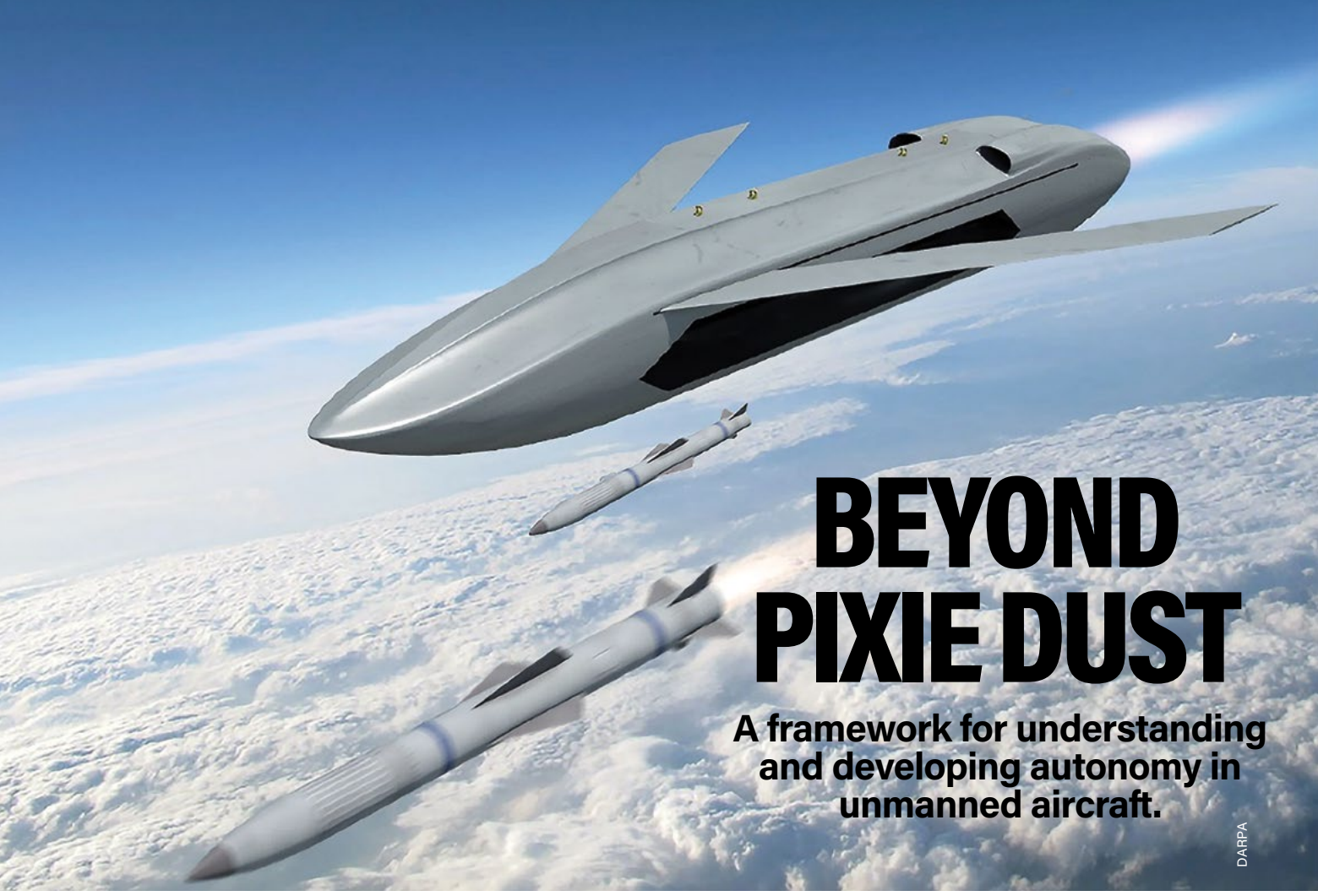
"Having discussions with our foreign partners at a common level is absolutely vital to coordination, interoperability, and training," he explained. "Any barriers that lay in the way of that need to be broken down."

Prudhomme said the American and allied restrictions that prevent pilots from speaking freely to each other and debriefing together put the force at risk.

"The people that are putting themselves at risk, the operators that are flying, they understand that they must trust the partners and allies," he said.

Sitting in the effects-based simulator, Prudhomme underscored that it is now technically possible for the heavy data flows to move back and forth between simulators while pilots communicate in real time. The virtual training opportunity is a fraction of the cost of real-world training—without the logistical challenges—and allows pilots to stop and rehearse scenarios over and over, then debrief and discuss best practices. Policy only needs to catch up.

"The operators are willing to accept the risk of sharing sensitive information because it's what allows us to win in a collaborative conflict," Prudhomme said. "If they're unable to communicate with them, that trust is going to disintegrate." ✪



BEYOND PIXIE DUST

A framework for understanding and developing autonomy in unmanned aircraft.

DARPA

An unmanned aircraft launches conventional air-to-air weapons in this conceptual illustration. DARPA is developing an autonomous aircraft with the ability to counter adversarial threats.

By Heather R. Penney, Maj. Christopher Olsen (USAF), with **Lt. Gen. David A. Deptula, USAF (Ret.)**

Nearly every vision, strategy, and flight plan the U.S. Air Force has released over the past decade identified next-generation unmanned aircraft, autonomy, and artificial intelligence (AI) as technologies that are critical to securing a decisive combat advantage in future battlespaces. The future battlespace will not be entirely all manned or unmanned—it will be a hybrid. USAF warfighters have long envisioned using autonomous unmanned aerial vehicles (UAVs) to perform missions that otherwise require either human control, whether in the cockpit or remote.

Teaming such autonomous aircraft with manned fighters and bombers is the next step in the development process. The goal of manned-unmanned teaming (MUM-T) is to significantly enhance operational capabilities and capacity by combining the advantages of both manned and autonomous aircraft, including cost, survivability, and judgment. For MUM-T to work in the operational realm, manned and unmanned aircraft must be able to collaborate closely and in ways that are effective and trusted by human warfighters. Pragmatic reliability and dependability are key benchmarks, but the captain on the flight line will be the ultimate arbiter of whether these new solutions add value.

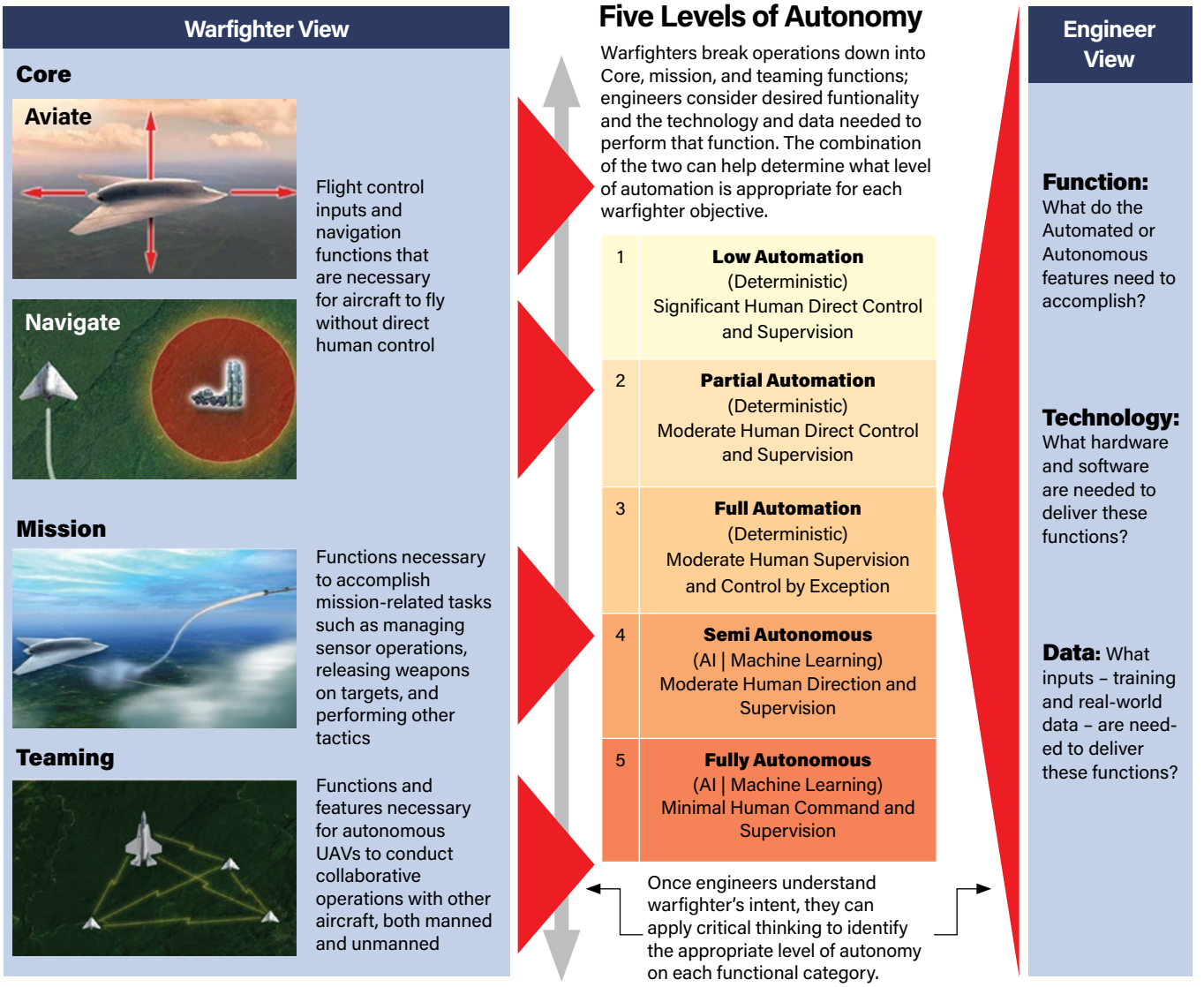
Lt. Gen. David A. Deptula is the dean of the Mitchell Institute for Aerospace Power, and ***Heather Penney*** is a senior fellow. ***Maj. Christoper Olsen*** is an Active-duty Air Force officer in the Air Force's Chief Software Officer; opinions expresssed here are his own and do not reflect any USF endorsement. Download the entire report at *http://MitchellAerospacePower.org.*

For that to happen, engineers and warfighters need a common understanding of how autonomous technologies map to combat performance. Yet as important as this is, the software algorithms that underpin their behavior and performance are generally not well understood outside technical circles. Although USAF's warfighters and acquisition professionals intuitively grasp the potential for autonomy and artificial intelligence to transform warfare, most lack in-depth knowledge of what is needed to make these algorithms combat viable. Instead, autonomy and artificial intelligence technologies are often treated as "pixie dust"—just sprinkle a little on top to solve hard problems and magically make weapon systems autonomous. It will take more than this cursory understanding to meet tomorrow's demands.

The Air Force is rapidly evolving new concepts for teaming manned fighters and bombers with autonomous unmanned aircraft to perform strikes, counter-air, electronic warfare, and other missions. The goal is to significantly increase operational capabilities and capacity. Artificial intelligence, autonomy, and machine-to-machine learning is fueling an explosion of ideas on how AI can enhance existing capabilities. The challenge is getting these technologies across the chasm

Understanding Autonomy: Warfighters and Engineers

Warfighters and engineers each speak their own language, approaching problems from their own perspective. To accelerate development of autonomous systems, a common framework could help practitioners from each discipline collaborate to determine the appropriate level of autonomy for each system function.



Mitchell Institute, Heather Penny, Maj. Christopher Olsen, Kamilla Gunzinger, Zaur Eylanbekov and Dash Parham/staff

between the world of research and development and the operational force.

To achieve that hybrid vision, the Air Force must develop a far more robust and shared understanding among engineers and warfighters than exists today. Warfighters lack sufficient comprehension of the kinds of autonomy that are possible and how much automation is appropriate; engineers often do not fully understand warfighters' operational needs. Significantly, there exists no framework to help bridge these gaps.

Fostering a better understanding of autonomy in general is necessary to prevent mistrust and miscommunication between strategic planners, operational warfighters, and aerospace engineers. National defense professionals urgently need a common framework that can help participants in these discussions demystify the technology and effectively communicate across their respective disciplines.

TODAY'S UNMANNED AIRCRAFT

Remotely piloted aircraft like the MQ-1 Predator and MQ-9 Reaper have transformed elements of warfare over the past two decades, but largely in permissive environments where remote-control aircraft face few direct threats and where speed is not a requirement. As new threats emerge, the Air Force must look to the next step in unmanned aviation: autonomous aircraft that can operate effectively without reliance on extended-range datalinks, substantial satellite bandwidth, and intensive effort on the part of remote operators.

Current remotely piloted aircraft technologies are not viable in the highly contested battlespace of the future. A single "24/7" RPA orbit/CAP/line, for example, demands continuous, high-bandwidth connectivity and some 200 people. Long distances impose time delays in RPAs' operational cycle; data from the aircraft's sensors must be transmitted to remote operators, who assess it and determine the appropriate action before transit control signals can be sent back to the RPA. The process is slow and subject to disruption by sophisticated adversaries.

The inherent lag between control inputs and RPA re-

The Two-View Framework: How it Applies to a Missile Truck

By aligning and comparing Warfighters' and Engineers' perspectives on core functions of any unmanned system, weapons developers can more rapidly achieve operational capability. Here's how the construct would work in the case of a notional "missile truck" UAV.

	Warfighter View		Engineer View
Core Aviate	Must be able to handle all phases of flight from takeoff to landing without any need for direct control from a remote pilot.	Autonomy Level: Level 3 Full Automation to Level 5 Autonomous (desired)	Full autonomy may be beyond the capabilities of current technologies, and thus increase time and cost of development. Pursuing Level 3 could help speed a minimum viable capability to the field while work on incremental software or hardware upgrades to increase autonomy continues
Core Navigate	At a minimum, must be able to maintain designated formation positions without hitting the ground, its flight lead, or other aircraft. At more advanced levels, might be able to fly dynamic tactics and conduct threat avoidance and defeat maneuvers	Autonomy Level: Level 3 Full Automation to Level 5 Autonomous	Level 4 Semi-autonomous may be faster to develop and train than a Level 3 system. Engineers can discuss the tradeoffs in development and fielding of pursuing higher or lower levels of autonomy.
Mission	The human in the lead aircraft selects which ordinance to use, when, and on which target. Additional autonomy may provide extra options that increase lethality and mission effectiveness.	Autonomy Level: Level 1 Low Automation to Level 3 Full Automation at a minimum	The benefit to the warfighter of a higher level of automation may be initially outsized by increased cost and impact on a UAV's development. Conversely, higher levels of mission autonomy may eventually provide even more benefit, to the point where the missile truck truly becomes a smart teammate. This depends on increasing warfighter trust in autonomy.
Teaming	Partial automation is sufficient to merely exchange data directly to a flight lead, assuming little need for onboard data processing or data fusion.	Autonomy Level: Level 2 Partial Automation at a minimum	Teaming at higher levels of autonomy would increase focus on processing and machine decision-making capabilities, which would also increase the need for real-time data. Increasing warfighter trust in autonomy will be key to maturing teaming capabilities and operations.

sponses can put RPAs out of synch with their environment. Lag times can be reduced by exchanging distant operators and global satellite links with forward-deployed pilots and low-latency line-of-sight datalinks, but in a spectrum contested battlespace, these control datalinks may be degraded or even unavailable, while the forward-deployed pilot presents adversaries with a valuable target. If datalinks are disrupted or denied, the RPA will "go stupid" and automatically revert to lost-link procedures such as flying a triangular pattern until it nears minimum fuel and returns to base. In 2009, Iraqi insurgents hacked an MQ-1 Predator feed to monitor and exploit its operations. While encryption was eventually installed to secure RPA control links and prevent such intelligence gathering, long-range, high-bandwidth datalinks remain crucial vulnerabilities in RPA operations.

More recently, the Department of Defense has pioneered manned-unmanned collaboration with impressive results, and it is time to take this partnership to a new level. Next-generation UAVs must match tactical speeds and dynamic maneuvering to effectively team with high-performance fighters and bombers in order to operate in contested battlespaces. A new type of UAV is needed for these new operational concepts.

MUM-T OPERATIONS

The Air Force faces both a quantity and cost problem. It has fewer aircraft than it needs, and the cost to buy new ones is more than it can afford. Unmanned systems, without the life-support requirements of manned aircraft, can be part of the solution. As Secretary of the Air Force Frank Kendall said, these unmanned platforms will be the key to giving the Air Force "the quantity we need at a reasonable cost."

Future autonomous teaming aircraft (ATAs) must be capable of flying, maneuvering, managing sensors, and executing missions all without a human to provide close control inputs.

Broadly conceived, ATAs will be wingmen to manned flight leads who monitor their autonomous operations and direct them only as necessary. In command-and-control terms, this means humans will be tactically "on the loop" for ATA operations, instead of "in the loop," as they are with today's RPAs. Autonomous teammates will fly, maneuver, and contribute to the flight's mission with varying levels of independence while human flight leads or mission commanders will retain positive control in order to verify and consent to any weapons employment.

The U.S. Air Force, other agencies in the Department of Defense, and the defense industry are all engaged in programs to develop autonomous functionality. The Air Force Research Laboratory's Skyborg program aims to develop "full-mission autonomy" in a Low-Cost Attritable Aircraft System. Skyborg is not an aircraft, but an open-system architecture of autonomous technologies intended to be broadly compatible with a range of aircraft. Skyborg autonomy

Zaur Eylanbekov/Mitchell Institute

In a manned-unmanned teaming construct, an F-35 pilot would direct, but not operate, its unmanned wingmen, which could operate autonomously and augment the F-35 with additional weapons and sensors.

took flight in 2021 aboard both a Kratos Mako drone and a General Atomics RQ-20 Avenger. Both aircraft successfully navigated inside required airspace boundaries, responded to navigation commands, demonstrated coordinated maneuvering, and honored flight performance envelopes.

The Defense Advanced Research Projects Agency's Air Combat Evolution (ACE) program has also pursued AI capable of maneuvering in relation to a highly dynamic fighter aircraft. ACE's "Alpha Dogfight" virtual trials tested its AI against a human pilot in basic dogfighting maneuvers; the AI won in all five engagements. Lockheed Martin's Have Raider MUM-T demonstrator, Northrop Grumman's autonomous Model 437 aircraft, and Boeing's Loyal Wingman UAV have likewise demonstrated the potential to deliver new AI-enabled ATAs.

AN AUTONOMY FRAMEWORK

The UAV framework now used by DOD and the Air Force establishes five categories or "groups" for unmanned aircraft. Under this categorization scheme, unmanned aircraft are assigned to groups primarily based on their gross takeoff weights, although their normal operating altitudes and airspeeds are also considered. But in the context of autonomous aircraft, this grouping is no longer appropriate. Weight, altitude, and airspeed are no longer the correct metrics for grouping aircraft intended for MUM-T operations.

In its place, the Air Force needs a framework for addressing unmanned aircraft that brings clarity, coherence, and rigor to its pursuit of autonomous capabilities. Such a framework should:

- Provide a consistent structure for developing autonomy capabilities;
- Engender greater fidelity in describing autonomous capabilities for developing concepts of operation;
- Enable rational and deliberate prioritization of autonomy-enabling technologies;
- Clarify the role of humans in autonomous aircraft operations;
- Establish common reference points for all stakeholder disciplines, from science and technology, to acquisition, operation, and policymaking;
- Empower policymakers to make informed tradeoffs between capabilities, risks, and costs;
- Encourage specificity and precision in language to reduce miscommunication and misunderstanding among stakeholders.

The ultimate objective: This autonomy framework for unmanned aircraft should facilitate better communications between warfighters and engineers.

We propose a two-part framework that addresses unmanned aircraft, respectively, from the perspectives of the warfighter and the engineer. The Warfighter View, in which we break down into Core, Mission, and Teaming, mirrors pilot cognitive tasks and are intended to be intuitive to warfighters and their requirements for how autonomous systems should perform. "Core" encompasses flight control inputs and navigation functions necessary for autonomous flight, and breaks down into "Aviate" and "Navigate" responsibilities intended to capture the basic and advanced flight skills learned in pilot training.

Core Aviate refers to all automatic features and functions that enable the aircraft to fly during all phases of flight. The core responsibility for pilots is to always control their aircraft, whether managing an autopilot, using digital flight control technologies, or manually manipulating controls that move aircraft flight control surfaces. This can be seen as "stick and rudder" operations—making continuous flight control inputs that cause specific aircraft responses within very short feedback loops—the basic and advanced aircraft and flight control skills ranging from takeoff, to climb, level off, turn, descend, accelerate, decelerate, approach and land. More tactically, one might think of flying at high angles of attack, setting the lift vector, establishing roll rates, and pulling Gs. Each aircraft will have unique attributes associated with its design, and unique tradeoffs necessary in speed, altitude, and thrust to successfully perform specific actions. These maneuvers must be in relation to the physical world, includ-

Airman 1st Class William Rio Rosado

The MQ-9 Reaper was a game changer over the past two decades, but to operate in tandem with manned aircraft and in contested airspace, future unmanned systems must be able to fly autonomously—that is, without the aid of a remote pilot.

ing weather and terrain features, runway locations, and the aircraft's available fuel, as well as the battlespace environment. Finally, the Aviate subcategory includes preventing and handling flight-related contingencies and emergencies such as wing stalls, engine failures or battle damage, like the loss of one or more control surfaces.

Core Navigate tells Aviate where an aircraft should go to accomplish a mission and breaks down into absolute and relative navigation. "Absolute Navigation" covers route planning and determining a course to fixed locations in space, avoiding terrain and no-fly zones, and remaining within permissible airspace boundaries. "Relative Navigation" covers an aircraft's position and vector relative to weather, other aircraft and the battlespace. Relative Navigation functions include avoiding bad weather and collisions, conducting aerial refueling, flying in formation, maneuvering to engage dynamic targets, avoiding threats, and taking other offensive or defensive actions.

The "Mission" category includes functions necessary to accomplish mission-related tasks such as managing sensor operations or releasing weapons on targets. This is a complex category that spans multiple iterative temporal loops that inform and drive each other. For example, a combat pilot must always consider what had already happened in the battlespace that either constrain or enable current or future options; make decisions and actions now to mission execute; and simultaneously think about, prioritize, and plan for future actions, maneuvers, and other mission options—and assess how these desired options affect current decisions and actions. The Mission category interacts with Core and Teaming functions to achieve desired operational outcomes.

"Teaming" covers functions and features necessary for autonomous UAVs to conduct operations in collaboration with other manned and unmanned aircraft. Teaming encompasses all elements of tactics and mission integration in modern combat operations. Like the framework's other categories, mission timing and scale are critical elements to success. Coordinating, integrating, and synchronizing individual actions across time and space with mission partners is essential to achieving desired operational effects. Teaming functions include flying, maneuvering as part of a team, information sharing within aircraft formations and with external entities, and synchronizing the effects multiple teammates create in the battlespace.

FIVE LEVELS OF AUTONOMY

We propose subdividing each of these three major categories into five levels of autonomy, ranging from Level 1–minimal automation to Level 5, which is full autonomy.

The automotive industry follows a similar model. The Society of Automotive Engineers' (SAE) J3016 "Levels of Driving Automation" framework defines six levels of driving automation—from no automation (Level 0) to full automation (Level 5), which defines vehicles that require zero input from a human driver.

Mitchell's proposed framework has three levels of automation and two levels of autonomy in each of the three Warfighter View categories. Automation is an action or set of actions that are performed according to predetermined rulesets when commanded by a user. Autonomy transforms inputs to outputs according to a more general set of rules by drawing on a deep stack of inter-connected decision-making algorithms fed by volumes of data from multiple sources. In order of increased decision-making capability, Level 1 is Low Automation, Level 2 is Partial Automation, and Level 3 is Full Automation. Level 4 is Semiautonomous and Level 5 is fully Autonomous.

Full automation still requires humans to assume a supervisory role for unpredicted stimuli; anyone familiar with advanced flight management systems, autopilots, and auto-throttles can understand this level of automation. From takeoff, climb, enroute, descent, approach and landing, the aircraft performs its assigned tasks exactly as prescribed by the human.

Level 4 and 5 systems act in an unscripted way. A human may still dictate the tasks the aircraft is to perform, but now the direction is more of a "mission command" or effects-based tasking rather than specific control and direc-

tion. The machine may determine the order and manner of execution and some tasks may not be performed at all. The machine will perceive its environment, its internal state (such as how much fuel is left), or even the activities of its teammates in its "decision" process. Thus, the behavior of a semi-autonomous or autonomous system is logical, but not always predictable. The difference between Level 4 Semi-autonomous and Level 5 Autonomous is the robustness of an unmanned system's ability to manage unanticipated things that may occur during a mission and how much supervision and direction is required by the flight lead.

Using levels to define these requirements will help aerospace engineers, technologists, and warfighters describe and understand with greater precision what unmanned aircraft can and cannot do. The criteria and language derived from the Warfighter View will be the basis for conveying to engineers, senior leaders, policymakers, and industry how warfighters intend to use the platform operationally.

THE ENGINEER VIEW

This same approach can be applied to explain the engineering perspective. We propose an Engineer View that can serve as a kind of "true north" for developing unmanned aircraft systems, ensuring the collection of functions and technology they design aligns with the warfighters' vision for how it will be used.

The following are illustrative examples of functions, technologies, and data relevant to the Core, Mission, and Teaming autonomy categories, and help make these relationships less abstract.

Core Aviate key functions and sub-functions include maintaining aircraft altitude, adjusting its pitch angle, executing coordinated turns, deflecting control surfaces, and adjusting engine power. The technologies necessary to implement these functions may include fly-by-wire flight controls, air data sensors, and a digital flight computer. Core Aviate auto-features will require similar data to information provided by a traditional human-readable flight instrument cluster such as aircraft altitude, airspeed, and bank angle along with more detailed data such as the angle and rates for roll, pitch, and yaw.

Core Navigate auto-features will be supported by functions such as flight path planning, waypoint following, and navigation relative to other aircraft. Relevant technologies might include cameras, radars, and path planning algorithms. To support navigation, the aircraft's systems will need to access data such as the aircraft's current location, altitude, airspeed, and groundspeed as well as the location of any known obstacles or threats and the boundaries of permissible airspace and no-fly zones. Relative navigation will require data on the distances, closure rates, and vectors from the ATA's manned and unmanned teammates, other friendly forces, and threats.

In the Mission category, relevant functions include sensor operation and determining aircraft positioning for optimal sensor performance, target identification, and task sequencing. Technologies might include sensors, hardware, and software for processing sensor data, task optimization algorithms, or neural networks trained for automatic target recognition. Data needs for Mission may include aircraft orientation, distance to a target, munitions remaining, and training data to "teach" a systems algorithms sequencing and decision-making.

For Teaming, functional analysis will determine what information should be shared across different teammates or other entities to allocate and coordinate their tasks for an operation such as cooperatively engaging a target. Technologies for sharing this information would be things like computers for on-board data fusion, and algorithms that allocate tasks, and radios to transmit data. Data needs may include current location, the locations of teammates, both raw and processed sensor data, or a database of proven tactics and techniques.

In practice, the Engineer View would translate the desired operational capabilities into the hardware and software components needed to create a fielded system.

RECOMMENDATIONS AND CONCLUSION

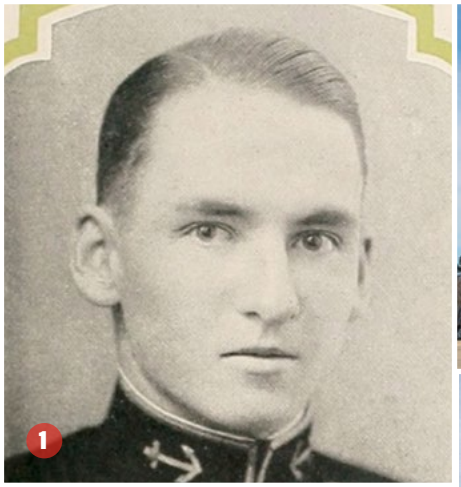
To gain the fullest benefits of a new framework, early and continuing close collaboration is needed to better link warighters and engineers throughout the lifecycle of unmanned systems. We propose four key steps to achieve this objective:

1. The Air Force needs an autonomy framework to guide its next-generation UAV requirements definition, acquisition programs, and CONOPS and TTP development. Air Force warfighters, aerospace engineers, and acquisition professionals lack a framework today that helps them gain a shared understanding of autonomy and how it can be applied to future MUM-T operational concepts and aircraft.

2. The proposed split-view framework offers a model to facilitate greater collaboration between warfighters, technologists, and aerospace engineers. Based on the mental tasks and functions of combat pilots, this framework can help warfighters understand autonomous systems in operational terms they are familiar with, and then translate those operational perspectives for technologists and aerospace engineers to guide systems development. This approach facilitates communication and collaboration to accelerate development and fielding of MUM-T UAVs, without constraining either warfighters or engineers.

3. The Air Force Deputy Chief of Staff for Strategy, Integration, and Requirements (AF/A5) should have formal ownership of this framework, in collaboration with the Deputy Chief of Staff for Operations (AF/A3), Air Combat Command, and Global Strike Command. With a mix of combat-experienced operators and planning infrastructure, AF/A5 has both the charter and operational expertise to apply the autonomy framework effectively across the range of necessary stakeholders. On the Air Staff, the AF/A3 has deep ties into the operational community, the Air Force Warfare Center, and the warfighting major commands. Together, the AF/A5 and AF/A3 can champion and implement the Two-View Autonomy Framework for Unmanned Aircraft in the service's requirements definition and the acquisition and development processes.

4. Stakeholders across the enterprise should use this framework to guide autonomy research, development, and experimentation, as well as to inform the development of new CONOPS and TTPs. Using the framework to its fullest potential will require the A5's and A3's staff, operators, acquisition professionals, technologists, and industry to maintain a tight and collaborative interaction throughout the requirements definition, acquisition, and development life cycle. Employed throughout aircraft's life cycle, this framework can encourage greater creativity as warfighters and technologists collaborate to develop innovative autonomous teaming aircraft, CONOPS, TTPs, post-fielding experiments, and continuing modernization upgrades. ✪



USNA; Airman 1st Class Kimberly Varrer; USN

1. Seymour Anderson Johnson at USNA.
2. 4th Fighter Wing technicians at Seymour Johnson.
3. Grumman F4F-3 Wildcat, the type in which Johnson perished.

SEYMOUR JOHNSON

Navy Blue

Rare is the USAF base that bears the name of a naval officer. There have been only three.

Moffett Army Air Corps Base, Calif., (1935-42) honored Adm. William A. Moffett, father of Navy aviation. Beale Air Force Base, Calif., (1942-) offers tribute to Lt. Edward F. Beale, a Civil War Sailor and later a major California power broker. Both were famous personages.

Third, and less well-known, is Lt. Cmdr. (sel.) Seymour Anderson Johnson, namesake of Seymour Johnson Air Force Base, N.C. Who was he?

The first thing to know about Johnson is that he was a top-drawer test pilot who died in the line of duty, but there is more.

Born in 1904 in Goldsboro, N.C., "Andy" Johnson, as he was known, had a precocious streak. He was barely 16 years old when he entered the University of North Carolina in 1920, but he breezed through his first three years on campus.

Then, lightning struck. A coveted appointment to the Naval Academy came his way and, though Johnson was nearing graduation at Chapel Hill, he abandoned UNC to become a Plebe in Summer 1923.

Johnson was a strong student. He was also a four-year member of the wrestling team. Evidently, he had numerous girlfriends. His class yearbook, "Lucky Bag," says this: "He is slow and easygoing, never hurrying. ... The Navy has done Andy a world of good."

After seven years of college, Anderson finally graduated in June 1927. He spent two years at sea, first on board USS *Florida,* a battleship, and then USS *Galveston,* a cruiser.

In mid-1929, Anderson entered flight training at Naval Air Station Pensacola, Fla., and soon received his "wings of gold" and a promotion to lieutenant (j.g.).

He served in a Scouting Plane squadron aboard USS *Chester,* a Fighting Plane squadron aboard USS *Ranger,* and an Observation Plane squadron aboard USS *New Mexico.* He rose to the grade of lieutenant.

In 1937, Anderson volunteered for duty as a test pilot, then—as now—a dangerous pursuit. He moved to NAS Anacostia, in Washington, D.C., in 1938. He never left.

In the next three years, Anderson was an active flier, accumulating more than 4,000 hours in various aircraft. He was selected for a June 1941 promotion to lieutenant commander.

On March 5, 1941, Anderson climbed aboard a Grumman F4F-3 fighter and took off from Anacostia. The brand-new Wildcat was having teething problems, one of which concerned the oxygen system. At 43,000 feet, Anderson warned he was running low on oxygen. Those were his last words.

The fighter crashed in Norbeck, Md., 16 miles due north of the White House. Anderson died instantly. He was 37. His promotion was never executed.

Goldsboro officials immediately petitioned the War Department to name a North Carolina air base after the local hero, and in 1942 they succeeded. Today, Seymour Johnson Air Force Base rates as a key Air Combat Command facility. It is home to the 4th Fighter Wing, an F-15E outfit, and numerous other organizations. ✪

SEYMOUR ANDERSON JOHNSON

Nickname: Andy
Born: Feb. 15, 1904, Goldsboro, N.C.
Died: March 5, 1941, near Norbeck, Md.
Colleges: University of North Carolina, U.S. Naval Academy
Occupation: U.S. naval officer
Service: United States Navy
Main Era: Interwar Period
Years Active: 1927-41
Combat: N/A
Final Grade: Lieutenant commander (select)
Award/Honor: American Defense Service Medal
Interred: Arlington National Cemetery

SEYMOUR JOHNSON AIR FORCE BASE

State: North Carolina
Nearest City: Goldsboro
Area: 5.2 sq mi/3,300 acres
Status: Open, operational
Opened as Headquarters, Technical School: June 12, 1942
Renamed Seymour Johnson Field: Oct. 30, 1942
Deactivated: May 1, 1946
Reactivated as Seymour Johnson AFB: April 1, 1956
Current owner: Air Combat Command
Former owner: AAF Technical Training Command, USAF Tactical Air Command
Home of: 4th Fighter Wing

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