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Army Betting Big
On Small Arms

PAGE 28

Space Force Embraces
New Challenges

PAGE 24

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CONTENTS

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SMALL ARMS 28

- The Army is creating a wish list of what features it wants for its next-generation machine guns, sniper rifles and mortars — along with the ammunition that goes with them. Lighter, more powerful and more accurate would be nice.



SPACE FORCE 24

- Fighting in the space domain is more about the radio spectrum, ones and zeroes and software than ray guns and blasters, the service is discovering as it enters its fourth year.



National DEFENSE

WELCOME TO THE METAVERSE 30

- The metaverse is a buzzword that means a lot of different things to a lot of different people. But what does it mean when applied to military training and simulation? Experts explore the possibilities.



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CONTENTS



4 EDITOR'S NOTES

From the desk of the editor in chief
BY STEW MAGNUSON



6 EMERGING TECHNOLOGY HORIZONS

Looking toward the tech of the future



8 DISPATCHES

News from the U.S. and around the world
COMPILED BY STEW MAGNUSON



14 ALGORITHMIC WARFARE

What's coming in artificial intelligence, big data and cybersecurity
BY MEREDITH ROATEN



16 BUDGET MATTERS

Who's funding what in Washington
BY SEAN CARBERRY



18 VIEWPOINT

What You Don't Know About Lobbying Can Hurt You
BY GENE MORAN

20 COMMENTARY

Civilian Space Tracking Program Key to Sector Growth
BY CHRISTIAN ZUR

22 DIRECTED ENERGY

Navy Destroyer Adds HELIOS Laser to Arsenal
BY MEREDITH ROATEN

24 DIGITAL WARFARE

Entering Year Four, Space Force Focusing on Cyber Issues
BY JOSH LUCKENBAUGH

26 COMMAND AND CONTROL

Air Force Laying Foundations For its Version of JADC2
BY MIKAYLA EASLEY

28 ARMAMENTS

Army Making Big Push to Update Small Arms
BY SEAN CARBERRY

30 COVER STORY

How Interconnected, Simulated Worlds Could Transform Military Training
BY MIKAYLA EASLEY

34 TRAINING AND SIMULATION

Air Force Aims for Common Virtual Training Environment
BY SEAN CARBERRY

36 TACTICAL AIR

New Jet Trainer Taxiing for Low Rate Production
BY MEREDITH ROATEN

37 T-7A Explores the Metaverse

39 LAND WARFARE

Army Training Takes into Account New Realities
BY STEW MAGNUSON

41 NDIA POLICY POINTS

Views from the association's policy division

42 GOVERNMENT CONTRACTING INSIGHTS

Analysis of the newest rules and regulations
CONTRIBUTED BY COVINGTON & BURLING

43 NDIA NEWS

Happenings at the association

44 NDIA CALENDAR

A complete guide to NDIA events

48 NEXT MONTH

Preview of our next issue

48 INDEX OF ADVERTISERS

Connect with our sponsors

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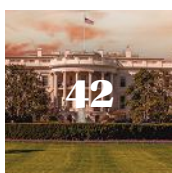
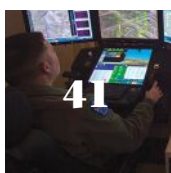
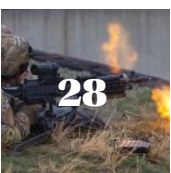
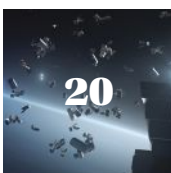
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Ukraine Called the First 'Broadband War'

ABOARD THE HMS QUEEN ELIZABETH — The Atlantic Future Forum is perhaps one of the more unique annual security conferences.

Now in its fifth year, the forum is held aboard one of the United Kingdom's aircraft carriers. There are rows of chairs, a small stage, an impressive audio-visual system and about a dozen industry booths, just like a regular trade show.

The major difference is that it takes place in the hangar below deck where helicopters and jet fighters are normally kept.

The invitation-only event is the brainchild of Lord Sedwill, former NATO diplomat, cabinet secretary and national security advisor to British prime ministers. This year was the second time it was held in New York Harbor. Annapolis, Maryland, and Portsmouth, United Kingdom, have also hosted. Organizers announced that it will be held in a European port next year.

It is an opportunity for the Royal Navy to practice a bit of public diplomacy and for defense and security thinkers to focus on the bilateral security ties between the United States and United Kingdom.

It is also a fascinating experiment. There was no Wi-Fi or wireless connectivity below deck, and participants are stuck aboard the ship until a ferry arrives late in the day.

Their smartphones rendered useless, participants were forced to actually pay attention to the keynote speeches and panel discussions.

Naturally, the war in Ukraine was a major topic.

Among the many thought-provoking discussions was a "fireside chat" with two men with very different backgrounds, both of whom had recently visited Ukraine.

One was an active-duty military officer: British Army Gen. Sir Patrick Sanders, chief of the general staff. The other, a one-time "captain of industry," former chairman and CEO of Google, Eric Schmidt.

The first impression Schmidt had during his trip to Kyiv was the train from Poland. He assumed in the middle of a war it would be a rough journey. Instead, the luxurious new

train featured 200-mega-bit Wi-Fi connectivity.

"For the Americans, try that on Amtrak," he quipped.

That connectivity in the train would serve as an example of what he discovered: a wired, tech-savvy nation ready and able to use information age tools to fight back against a powerful aggressor.

"I was really impressed that this was the first broadband war," Schmidt said.

One of the Ukrainian government's first actions as Russian forces gathered on its borders was to do away with bureaucratic rules on what could be stored in the cloud.

Servers are targets, and if the country was overrun, essential data could have been lost.

Next, Elon Musk assured connectivity to the outside world by donating thousands of terminals connecting to SpaceX's Starlink space-based broadband system, ensuring Russia couldn't cut Ukraine's internet off from the world.

"He's a real hero in all this," Schmidt said, although he noted there were other U.S. and U.K. companies that stepped in to assure Ukraine kept its connectivity.

This paved the way for what has been called "tweets against tanks."

Schmidt described in detail how any Ukrainian — combatant or noncombatant — can take a picture of a tank or other military target with their smartphone, then send the photo along with the geospatial



data over a purpose-built app to the ministry of defense where analysts look it over and decide whether or not to target it — all made possible by broadband, of course.

"It's a completely different way of running a war," Schmidt said.

The new form of broadband war is going to include cloud services and satellite-based communications, which is protected from jamming, he said.

The career officer Sanders had a slightly different take. In many ways, the Ukraine war is "regressive," he said. "There are elements to it that look no different than in the 1960s and 1970s," he said. It has degenerated into a war of attrition, he added.

Yet, overlaid on this traditional, bloody war is what a military can do to use digital technology to gain an upper hand, he said. The flat network — which lacks a hierarchy — that uses social media and the app for targeting is one example, he said.

"Right now, you're seeing how you can combine that sort of innovation and creativity with the stuff that will never change in warfare — close combat, attrition, mass" effects, he said.

"It hasn't been decisive, but what it has allowed [Ukraine] to do is to fight in a way that avoids a symmetrical fight, so they can take much more indirect approach," Sanders said.

For Schmidt, who served as an advisor to the U.S. military for five years, decentralization is another key lesson learned. The use of inexpensive drones shows that the United States is too focused on exquisite, high-tech platforms. He would rather have 100 drones than a jet fighter.

"It's centralization versus decentralization and decentralization is your friend in war because it means you have less failed points," Schmidt said.

Nevertheless, what worked for the Ukraine may not be applicable to other conflicts, such as a China scenario, Sanders warned.

"I need a system that is resilient," he said.

"But how do you design that in a way that doesn't lead you to having a symmetrical fight with a very, very high-tech adversary?" he asked.

"I'm not sure I can see a way through that," he added. **ND**





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SCAN ME

Make Hypersonic Defense a Priority

Picture a U.S. carrier battle group operating in the South China Sea. At the center of this fleet is a Ford-class nuclear-powered aircraft carrier. The ship has more than 70 aircraft onboard and cost the United States \$13 billion to construct.

It has multiple layers of protection, including a screen of Aegis-equipped warships and a combat air patrol of jet fighters, supported by an E-2 airborne early warning aircraft.

Suddenly, explosions rock the carrier. A volley of hypersonic impactors has struck the ship from different directions. They were detected far too late for any meaningful defensive measures to be activated. At best, the carrier is now heavily damaged and must depart the combat zone to make repairs.

The loss of a carrier's capability in the opening stages of a conflict would hinder the U.S. military's ability to operate in the area, perhaps decisively. This is a central concern for U.S. strategic planners. It is also cited as an example of the value of hypersonic weapons technology.

Yet it is important to remember that the lesson of this scenario is not the capabilities of hypersonic weapons, but the threat posed by them. The ability to place carriers at risk could affect future defense posture and raise doubts among allies and adversaries alike about U.S. resolve.

Hypersonic weapons are tactical weapons with strategic implications. As such, the development of defenses or countermeasures against hypersonic weaponry is as important to U.S. military power as hypersonic weapons themselves — if not more so.

Despite this, the Defense Department is requesting for fiscal year 2023 almost 20 times as much for offensive hypersonic systems as for hypersonic defense, according to the Congressional Research Service. This gives far too little funding to defensive systems, given U.S. security needs.

Weapon systems that disrupt the status quo are usually more harmful to the stronger power. Over the past half-century, the United States and its allies have built up an almost unassailable advantage in conventional capabilities. Recent operations have given U.S. adversaries plenty

of opportunity to identify vulnerabilities. Having put some hypersonic systems into service in recent years — with Russia claiming to have used theirs in combat in Ukraine — they clearly feel that hypersonic weapons provide a cost-effective way of countering that superiority.

History shows that the ability to defend against or neutralize a new weapon is often of great importance to the status quo power. During both World Wars, British control of the sea was challenged by submarines. Development of countermeasures against submarines, such as depth charges, sonar and radar, was critical to British security. Realizing this, Britain made sure to lead the world in these technologies through World War II.

Hypersonic weapons specialize in hitting the types of targets that give the United States its edge. They are useful against important, heavily defended targets — both mobile targets such as command and control and aircraft carriers, and fixed sites such as airbases and heavy air defense systems.

Moreover, an adversary would have greater difficulty striking these targets with conventional systems than the United States would. Allowing an

killed directly, either kinetically by an interceptor or via directed energy. It might even be more effective to prevent the weapon from completing its mission without destroying it; this is known as a “mission kill.”

A hypersonic weapon may be unable to reach the target if forced to maneuver excessively to evade interception. It might also be possible to use directed energy to blind its sensors or jam onboard guidance.

Given such weapons' range, there is the age-old method of limiting an opponent's intelligence, surveillance and reconnaissance. This includes shooting down reconnaissance aircraft, jamming satellites, or employing deception to blunt the effectiveness of long-range weapons. This would be particularly important for the defense of a moving target such as a carrier. These possible solutions need to be explored further to determine which work best.

This is not to say that offensive systems should not be pursued, indeed some synergy can be found in their development. For example, to intercept a hypersonic weapon, a kinetic interceptor would itself probably have to be hypersonic; its development would require knowledge of hypersonic dynamics, control and sensing. Also, a key strategy in countering hypersonic weapons could be to proactively attack their launchers. Hypersonic weapons would be effective in this role.



opponent to use hypersonic weapons freely levels the playing field, negating the effort and resources the United States has put into conventional superiority. This is true regardless of which hypersonic systems it possesses. The countermeasure is at least as important as the weapon itself.

Weapons development has always been contextual. It is important that the U.S. military pursues development while considering its own needs. There are several capabilities that could prevent a hypersonic weapon from hitting its target. It could be

When discussing emerging technology in weapons development, it is important to acquire the right weapons for the nation's needs.

Hypersonic weapons may be an asset to the United States in their own right, but their greatest strategic impact is that they reduce the nation's relative combat advantage. If it is possible to mitigate this effect, then it is of the utmost importance that we procure these capabilities. **ND**

James Krasner is a former ETI research intern.



The U.S. Army's Next-Gen Virtual Collective Training Software

Bohemia Interactive Simulations' (BISim's) flagship product, VBS4, is a whole-earth virtual and constructive simulation that allows military units to create and run any imaginable military training scenario. VBS4 is a core component of the U.S. Army's Synthetic Training Environment (STE), the next generation collective training capability.

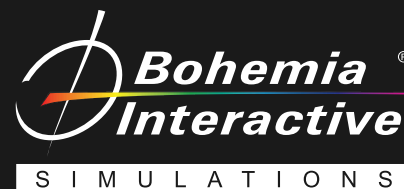
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DISPATCHES

NEWS FROM THE U.S. AND AROUND THE WORLD COMPILED BY STEW MAGNUSON



Startup Finding Special Ops Customers for Jetpack

BY STEW MAGNUSON

ABOARD THE HMS QUEEN ELIZABETH — Attendees being ferried to a security conference held aboard one of the United Kingdom's two aircraft carriers in September were greeted by two men dressed in fatigues flying jetpacks.

One was Gravity Industries Founder and Chief Test Pilot Richard Browning, who took off from the HMS Queen Elizabeth's temporary loading dock and flew around the starboard side of the ferry. A specialist with a pistol mounted on his shoulder took the port side. Hundreds of smartphones recorded the surprise demonstration.

There is a fun side of the jetpack business and a serious side, Browning said in an interview after the demonstration, on the sidelines of the Atlantic Future Forum.

"The serious side is maritime assault, search and rescue and special operations mobility," he said.

The company has collaborated with six special operations customers for the suits so far, although he declined to name them. It also supplements its income flying the machines for entertainment purposes. He recently appeared in Monaco at a yacht show where he flew around in a dinner jacket.

"It's not an everyday occurrence to be flying off an aircraft carrier in the shadow of New York and the Statue of Liberty."

The jetpack concept is not new. NASA developed one for astronauts and the first to fly was in 1961. Browning started tinkering on a modern version in his garage in Surrey,

United Kingdom, in 2016 and a year later, had a working prototype and funding from a venture capitalist.

Gravity is applying advanced technologies such as 3D printing to shave pounds off the system. The suit is currently 75 pounds and provides about 1,000 horsepower.

It runs on jet aviation fuel, diesel or kerosene, which gives a 170-pound pilot about five minutes in the air. That's enough time to make a surprise boarding on a ship, or go ship-to-shore depending on the distance, Browning said.

It could be constructed larger for longer flying times, but for the military market, the company wants to make the whole system fit into one case, he said.

The mock pistol mounted on the shoulder could be fired as a special operator is boarding to provide cover, although the accuracy wouldn't be great, Browning said. When flying, both hands are needed to steer.



SEE THE JETPACK IN ACTION

Gravity recently tested its suits for ship-to-ship fast boarding with Royal Marine commandos off the shores of England to see if it could replace fast-roping on to ships from helicopters, according to the Guardian newspaper.

While some have likened the jet suit to a "real life Iron Man," Browning said it would be foolish to hover over a position strafing it with gunfire. It's better to land behind some cover, put the engine on idle, then start shooting from a more protected position.

If the operators want to fly to a more advantageous positions, they can do that. Or take the suit completely off so they can be free to fight.

"It's not trying to compete with a helicopter ... It's sort of minimalist equipment to make you mobile within a couple of miles radius," he said.

The company is looking beyond the military market and offers custom-made suits to the general public for 380,000 pounds, plus tax or the opportunity to come to its facility south of Heathrow Airport to experience the flights for a little less than 3,000 pounds.

Browning also envisions a day when there is an international jetpack racing circuit. **ND**

Stew Magnuson photo

Air Force Vendors Look for 'Head Start'

• Air Force Secretary **Frank Kendall** took a spin around the exhibition hall at the Air and Space Forces Association's annual confab and liked what he saw. And that was a lot of vendors who were spending their own funding to develop technologies for the service.

The Air Force has defined what problems need to be solved "and that gave industry some information that they could use to make their own investments. And I think they've reacted to that," he told reporters.

"What I've told the industry repeatedly is I don't want you waiting for the [request for proposals] to come out. I want you thinking about how to solve our problems. And if we adopt your solution to our problems, obviously that gives you a head start," he said.

"We're trying to communicate as openly as we can with industry," he said. **ND**

Digital Engineering: Making it Real

• The new era of digital engineering is causing some minor problems — at least in terms of public perceptions, said **Jim Kowalski**, vice president, government programs at Northrop Grumman.

Early work on programs the company is working on, such as the B-21 bomber and LGM-35A Sentinel rocket, is now done on computers, so they can't physically show anyone the progress being made.

As for the Sentinel, which is designed to deliver nuclear weapons as part of the Ground-Based Strategic Deterrent program, it was conceived to be digitally designed from the beginning. "And that has led to a lot of really great progress," Kowalski said at the AFA's annual conference.

"A lot of times until you actually see something fielded, a lot of people are not really sure if it's a program," he said.

However, the company recently moved from the digital world to "reality" when it cast the program's first inert stage-one and stage-two solid rocket motors this summer.

"I assure you, GBSD is a real

program," he said. Meanwhile, the Air Force and Northrop Grumman during the conference announced that the top-secret B-21 bomber would make its public debut in early December. **ND**

U.K. Sea Lord Discusses COD

• No one knows exactly when the V-22 Osprey manufacturing line will close down, but with the Marine Corps' fleet nearly completed, a date could be set in the near future.

So, wouldn't the United Kingdom's Royal Navy like to purchase some models while it still can? That question was posed to First Sea Lord and Chief of Naval Staff **Adm. Sir Ben Key** at the recent Atlantic Future Forum, which was held aboard the HMS Queen Elizabeth in New York Harbor.

The nation has two aircraft carriers, but does not have an established carrier onboard delivery, or COD, system to resupply the ships by air. The U.S. Navy is acquiring 44 of them to replace the fixed-wing Greyhound resupply aircraft.

The Royal Navy is having a competition for autonomous aircraft to do the mission, he told reporters at the forum.

However, those won't be used to move personnel.

"We're just beginning to understand what those long-term solution spaces may be. Undoubtedly, we need something," he said.

"The Osprey is a possibility, but we have not settled on the long-term solution yet," he said. **ND**

The Power of 'Operational Dirt'

• **Will Roper**, former undersecretary of the Air Force for acquisition, technology and logistics, said Western military technology has an advantage over some of its adversaries: "operational dirt."

In other words, allies have proven that their platforms can collaborate in real-world fights.

"The fact that they have operational dirt on them is really important as a strategic message internationally that our systems are not just good on a blue-sky day, but they are operating in the real world together under tough conditions," he said at the Atlantic Future Forum.

"Maybe we should quit putting out photographs always operating with blue skies. Maybe gray skies would be a better message," he said. **ND**

For more on the Atlantic Future Forum, see page 13.

A Straight Shooter In the Army

• **Col. Scott Madore** — the Army's project manager for soldier lethality — is in charge of fielding small arms for the service, including the Next Generation Squad Weapons: the Sig Sauer XM5 Rifle and XM250 Automatic Rifle.

Along with the rifles, the service is fielding the XM157 Fire Control system, which is manufactured by Vortex Optics and currently undergoing qualification testing.

How good is the fire control system? Madore addressed the question recently at NDIA's Future Force Conference in Austin, Texas.

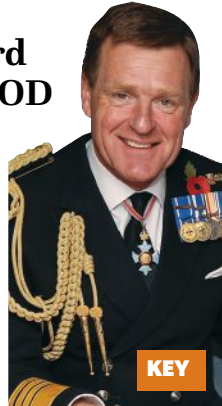
He vouched for it himself. He has fired it numerous times and called it a "phenomenal capability."

The proof: "I'm a terrible shooter," he confessed.

Despite the fact that the PM in charge of small arms is by his own admission a poor marksman, "it's hard to miss at very long ranges," he said.

There are discussions in the Army about the future of next-gen fire control and expanding the XM15's deployment beyond the close combat force, he said. **ND**

For more on small arms, see page 28.



Innovation Nation Vendor to Compete for New Robotic Mule Contract

BY SEAN CARBERRY

AUSTIN, Texas — The Army is preparing to launch a competition for the second increment of the Small Multipurpose Equipment Transport, or SMET, better known as its “robotic mule.” The service has pursued

a platform that can take the burden off foot soldiers and carry backpacks, supplies or wounded troops since the beginning of the defunct Future Combat Systems program. FCS was canceled in 2009, but the Army continued to pursue the concept, especially as infantry fought in the rugged Afghanistan mountains.

General Dynamics was awarded an increment 1 contract for \$249 million in 2020 for its Multi-Utility Tactical Transport.

The increment 2 requirements document is still in development and expected

to be approved in early 2023 with a request for proposals later in the year, according to the Program Executive Office Combat Support and Combat Service Support.

HDT Global, which lost to General Dynamics in increment 1, announced recently that it will enter the competition with its Hunter WOLF 6x6 robotic vehicle, a revised version of what it offered for increment 1.

Polaris Government & Defense and Textron’s Howe and Howe also competed for the first SMET increment.

“It has got an extended silent run capacity and so we’ve got a much larger battery pack in it ... and we have been focused on ensuring that the vehicle is rugged, robust and reliable,” Tom Van Doren, HDT’s chief technology officer, said at the National Defense Industrial Association’s Future Force Capabilities Conference in Austin, Texas.

Despite losing the increment 1 contract, HDT is

fielding the Hunter WOLF to other customers in the Army, Marine Corps and Australian Defence Force, Van Doren said.

The WOLF on display at the conference was kitted out with a 30mm cannon and a set of robotic arms. Other optional payloads include intelligence, surveillance and reconnaissance, door breacher, trail clearance and water purification.

It also has a 16-kilowatt generator and can offload up to 15 kilowatts of power, which makes it a “self-propelled generator,” he added.

The diesel-electric hybrid has a 200-mile range, can travel 7.5 miles in silent mode, can haul 2,200 pounds and fits in a V-22 Osprey, he said. HDT has also developed a basic autonomy kit that can follow waypoints and avoid obstacles.

“The key thing that we will be showing to the acquisitions folks is we’ve got even more than we showed them last time,” he said. **ND**



Marine Corps Pursues Multi-Purpose Ground Robot BY MIKAYLA EASLEY

ARLINGTON, Virginia — The Marine Corps is turning to unmanned ground vehicles that can shoulder the burden of moving supplies and perform dangerous missions.

The Marine Corps awarded a Small Business Innovation Research contract in September to Colorado-based Stratom to develop the Remote Expeditionary Autonomous Pioneer, or REAPr, system. The company will spend at least six months developing the unmanned ground vehicle that will be a “workforce multiplier” for the service, said Ross Wehner, senior analyst for corporate development and strategy at Stratom.

Wehner called REAPr a “Swiss Army knife” because it consolidates different missions — such as logistics, tool changing and mine clearing — in one unmanned platform.

“The idea is to create a single vehicle that can be versatile to address a lot of those challenges and objectives,” he

said.

The platform will be an off-road, remote-controlled vehicle that features an attachment system that can be retrofitted for specific missions with different instruments, including those already in the Marine Corps’ toolbox, Wehner said. As a result, Marines can conduct dangerous expeditionary tasks from a distance, he said.

“Having the remote control capability ... allows one operator to potentially control a number of different vehicles, but it also lets them do so from a secure location rather than being out in harm’s way,” Wehner said.

Eventually, Stratom envisions incor-

porating autonomous capabilities into REAPr, he said. The company’s modular software, called the Summit Off-Road Autonomy Platform, will serve as the basis for the platform and enable autonomy in the future, he added.

The system will also be deployable from an MV-22 Osprey aircraft — a critical requirement as the company designs REAPr, said Mark Gordon, Stratom’s president and CEO.

The Marine Corps is currently undertaking a service-wide modernization effort known as Force Design 2030, spearheaded by Commandant Gen. David Berger. The plan focuses on transitioning the service into an expeditionary force ready for conflict in the Indo-Pacific.

“This is very much in alignment with those thoughts on, ‘How do you operate and execute mission sets in a very austere environment over a large, global terrain?’” Gordon said. “We are taking that into consideration in terms of mobility.” **ND**



HDT photo, Marine photo

Boeing Reveals Classified Composite Fabrication Center

BY JOSH LUCKENBAUGH

MESA, Arizona — Phantom Works, Boeing's research, development and prototyping division, recently opened a new, classified facility to produce advanced composite components for future combat aircraft.

Situated on Boeing's campus in Mesa, Arizona, the 155,000-square-foot Advanced Composite Fabrication Center is expected to be fully operational this fall as the company looks to further digitize its production system, company executives said.

While the work done at the center will be classified, the facility will leverage "best practices" from new programs like the unmanned aerial vehicles MQ-28 Ghost Bat and MQ-25 Stingray, as well as the T-7A Red Hawk jet trainer. The facility will "enable Boeing to scale a platform-agnostic, modular and flexible digital production system across future [Boeing] programs, providing unprecedented speed, agility and cost efficiency," a statement said.

The fabrication center is the first in a series of innovation factories Boeing is constructing. The company is building several new facilities in the St. Louis region — including a specialized laboratory, advanced assembly facilities and a post-production assembly center — which will come online over the next few years, Steve Nordlund, Phantom Works vice president and general manager, said at the opening event for the Advanced Composite Fabrication Center on Sept. 12.

All told, these new facilities represent "well over half a billion dollars" of investment for Boeing, he added.

Digitally modeling products will lead to greater manufacturing efficiency, Boeing Defense, Space and Security CEO Ted Colbert said.

"When you start with ... a model-based engineering approach to developing our products, it gives you a digital product definition that serves as the foundation for yielding value across the entire value stream, from engineering to manufacturing, through the supply chain, and, of course, out

into the sustainment world," he said.

"It is all informed by the next generation of products, which have to be digital in their foundations to allow for flexibility and adaptability through a dynamic set of missions changing around the world," Colbert added.

This flexibility will allow the components designed at the center to be interoperable with a variety of platforms, Nordlund said.

"Our customers [go] to war with many products — we want a lot of them to be Boeing — but they're going to war with a lot of different products, and that interoperability and that open architecture is something that we drive for and we demand. And we think our customer expects it, and so we're very

focused on that," he said.

The center's digital production system will allow Boeing to pull real-time data, adapt to changes such as updated requirements, and bring those updates "directly to the shop floor quickly," said Dave Hilliard, Phantom Works Operations senior director.

The significant investment in these new facilities is a "bet" for Boeing on projects it has not won yet, Colbert said, but the company believes these facilities will put it in the best position to deliver the necessary capabilities if and when called upon.

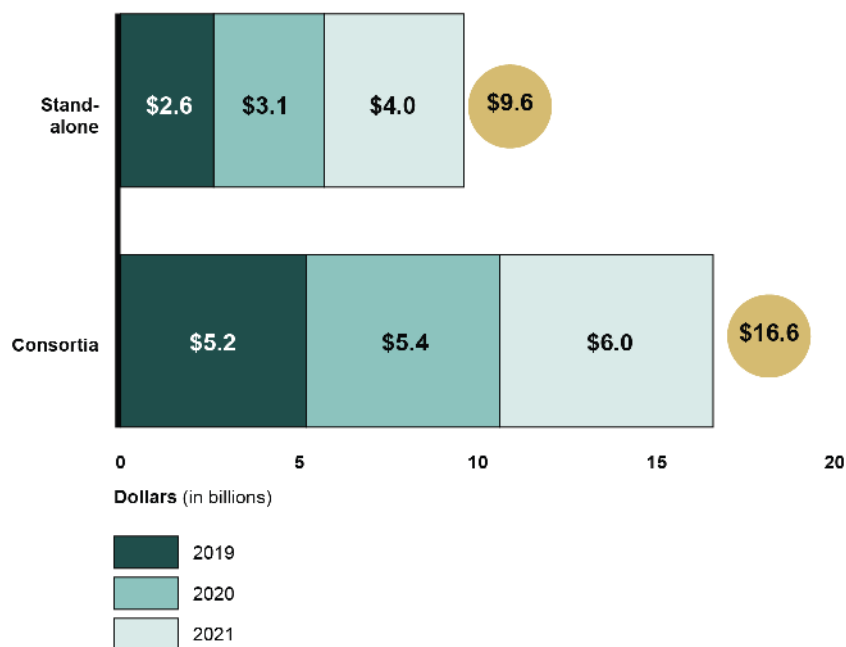
"We don't know ... exactly what the future will be," Colbert said. "We believe it's our responsibility to make sure that we have offerings that would fit into any next set of missions, and that's why we make the investment."

"We highly believe that the future of all aerospace will be about a digital twin, a digital thread and driving it from the software to real hardware," Nordlund added. **ND**

BY THE NUMBERS

Obligations on DoD's Consortia-Based and Stand-Alone Prototype Other Transaction Agreements Not Related to COVID-19, Fiscal Years 2019-2021

Other transaction agreement type



Source: GAO analysis of Federal Procurement Data System, Department of Defense (DOD) and industry data. | GAO-22-105357

Note: Obligation amounts were adjusted for inflation using the Fiscal Year 2021 Gross Domestic Product Price Index. Numbers may not add due to rounding.

Army Expanding Range, Role for Aerial ISR Tech

BY MEREDITH ROATEN

ABERDEEN PROVING GROUND, Maryland — The Army is in a “campaign of learning” phase for its newest intelligence, surveillance and reconnaissance aircraft that will increase the speed, range and altitude of the service’s intelligence gathering, officials said.

The multi-domain sensing solution program is one of the Army’s 28 “key-enablers” that support the service’s modernization effort. One of the major capabilities coming out of the program is the high-altitude detection and exploitation system, or HADES, spy plane.

The development for its sensors is currently ramping up thanks to data from soldier touchpoints and intelligence, surveillance and reconnaissance aircraft, said Ronald Rizzo, deputy project director for Sensors Aerial Intelligence. The program office awarded an other transaction authority agreement for the second part of the sensor development for HADES in September to L3Harris and Raytheon Technologies.

The Army expects to field the



Airborne reconnaissance and electronic warfare system (ARES) during its first flight

uncrewed vehicle by 2028 and could purchase as many as 16 systems, Rizzo said during a recent Army event at Aberdeen Proving Ground.

The Army has not decided what platform will carry the sensors, but one system that the service is learning from is the ARTEMIS jet, or airborne reconnaissance and target exploitation multi-mission intelligence system.

The aircraft flies in the European Command and is a “high-demand asset,” Rizzo said. It’s meant to prove the Army can put its latest intelligence tech on a more modern aircraft, he said.

“It’s collecting, we’re learning from it. It comes back to the states every few months. We iterate on software, we iterate on different sensors, hardware, and back out again,” he said.

Another system is the L3Harris-designed airborne reconnaissance

and electronic warfare system, or ARES, that flew in the Pacific theater earlier this year, he said. ARES will also fly in the upcoming Project Convergence demonstrations — the Army’s contribution to joint all-domain command and control.

“All of this is to inform how we will ultimately build the HADES program of record,” he said.

The range of both platforms have exceeded the Army’s expectations, he noted. Similar ISR planes from the Cold War-era were limited to patrolling the length of the German border, but the modern tech demonstrators can cover longer distances.

“It opens up the aperture from a mission perspective,” said Rizzo.

The last phase of the tech demonstrator will be called the Athena and will be a bridging concept between the legacy fleet and HADES, he said. **ND**

Hello, Goodbye

• **Gen. James E. Rainey** is now leading Army Futures Command, taking over from acting commanding general, **Lt. Gen. James M. Richardson**, who is retiring.

The Defense Department has established the Arctic Strategy and Global Resilience Office and named **Iris A. Ferguson** as the deputy assistant secretary of defense to lead the operation. Prior to her appointment, Ferguson was a senior advisor on

Arctic and climate security issues for Air Force Futures and the Air Force deputy chief of staff for operations.

Some Navy news: **Rear Adm. Jeffrey S. Spivey** will be assigned as deputy commander, Military Sealift Command, Norfolk, Virginia.

Capt. Michael S. Richman, selected for promotion to rear admiral, will be assigned as deputy commander for cyber engineering at Naval Sea Systems Command, Washington, D.C.

And **Capt. Andrew J. Schreiner**, selected for promotion to rear admiral, will be assigned as deputy commander, Naval Special Warfare Command in San Diego.

Tim Cahill is the new executive vice president of Lockheed Martin’s Missiles and Fire Control business. He succeeds Scott Greene, who will retire after more than 41 years at the company.

Cahill is currently senior vice president of Lockheed Martin’s Global Business Development and Strategy.

Ed Swallow is the new CFO and treasurer at the Aerospace Corp. after serving as senior vice president of the nonprofit’s civil systems group for six years.

BAE Systems opened a new \$150 million engineering and production facility in Austin, Texas. The 390,000-square-foot facility is in Parmer Austin Business Park. Half of the facility will be dedicated to manufacturing and the other half to engineering design, laboratory and office space.

Northrop Grumman opened its Maryland Space Assembly and Test 2 facility at the company’s Baltimore campus. The 55,000-square-foot facility provides a digitally integrated manufacturing, assembly and test hub to support the company’s growing space payload and ground systems capabilities. **ND**



RAINEY



FERGUSON

Ukraine Looks to U.S. Defense Industry to Secure Victory **BY SEAN CARBERRY**

AUSTIN, Texas — Ukraine's successful counteroffensive shows that Russia's military is in decline, and with continued support from U.S. industry, victory for Ukraine is certain, a senior Ukrainian defense official told *National Defense* in an exclusive interview Sept. 20.

Retired Maj. Gen. Volodymyr Havrylov, deputy defense minister for armaments, said he is confident that the U.S. defense sector can provide Ukraine with the systems and ammunition it needs to prevail in the war with Russia. Havrylov was attending the National Defense Industrial Association's Future Force Capabilities Conference and Exhibition in Austin, Texas, and meeting with members of industry.

"I'm here ... to understand the capacity and potential of U.S. industry — in the current crisis of supply chains and other things — to have a realistic picture of what we can expect and what is not going to be done this year — or maybe next year," he said. The conversations he has had with defense executives have all been positive, he added.

"We had a number of meetings here with different companies and also been introduced to some new designs and developments, especially in ammunition and demining," he said. Ridding the nation of mines and unexploded ordnance will be a long-running concern

after the conflict, he said. Meanwhile, ammunition is a persistent need.

The Future Force Capabilities Conference — now in its second year — brings together the munitions, armaments, ground robot and explosive ordnance disposal communities.

"I've been very impressed with the level of development of this area of ammunition in the United States," he said. "I saw a lot of kind of startups or ideas with the precision strike capability with artificial intelligence."

The U.S. military and industry are working on next-generation capabilities, which are appealing to Ukraine, but will not be ready to help the current fight, he said. However, there are plenty of existing technologies that Ukraine needs.

"We will win this war through the technological superiority, through situational awareness and through the motivation of our troops," he said. "Technological superiority means that if we use for example artillery, we have to use artillery with smart munitions. If we use a precision strike capability, it should be long-range precision strike capability like [multiple launch rocket systems] or [high mobility artillery rocket systems], which we already have.

"If we are thinking about counter-battery radars or the anti-drone systems, we need them now because drones in this war is like regular and ammunition — they use it in swarms, in numbers — and so we have to address this issue with the right instruments, and those instruments are available here," he said.

To maintain the momentum gained from the counteroffensive, Ukraine needs large volumes of ammunition and drones, he said.

"But most importantly, it's about the relation-

for right signal from the politicians here from the government," he added.

Ukraine recognizes the challenge for the United States in providing weapons and ammunition, and balancing the country's needs to maintain certain inventories and have production capacity to backfill what the United States provides to Ukraine, he said. He noted that prior to the war, the U.S. industrial base had been spooled down and perhaps the war will help the United States regain its defense industrial superiority.

Regarding the success of the counteroffensive, Havrylov said the lessons learned from the first six months of the conflict — and the increased training and motivation of Ukrainian troops — were critical.

"But of course, because of the new weapon systems

... we received from the United States, first of all, and from our partners in Europe, with a guaranteed supply of artillery and ammunition at the same time," he said. That allowed Ukraine to stop the Russian advance.

"Then, with that technological superiority and situational awareness, we started the counteroffensive," he said. **ND**

— Posted on NationalDefenseMagazine.org on Sept. 20.



ship with the industry here, because U.S. industry is capable, with the right investments, to increase dramatically ... production," he said.

He expressed confidence that even if the war is prolonged, U.S. industry has the will and capability to keep supplies coming, if the political, regulatory and financial environment is favorable, he said. "Industry here is very motivated and just ready to assist us and they're only waiting

COMING SOON

• As it stands at press time, the locations of the two major events *National*

Defense covers every November were hit by major hurricanes. Fiona ravaged Nova Scotia, Canada, followed by Ian devastating parts of Florida.

The Halifax International Security Forum in Halifax, Nova Scotia, is

expected to take place Nov. 18-20.

The National Training and Simulation Association's Interservice/Industry Training, Simulation and Education Conference will be held in Orlando Nov. 28 to Dec. 2. **ND**



Industry Prepping AI Tech for Next-Gen Aircraft

NATIONAL HARBOR, Maryland — The Air Force wants its sixth-generation fighter aircraft to have a squad of uncrewed systems flying at its side. Before the autonomous aircraft becomes a program of record, the aerospace industry is eager to tackle the challenges of manned-unmanned teaming.

Secretary of the Air Force Frank Kendall has pitched the Air Force's Next-Generation Air Dominance program as a package deal of crewed and uncrewed systems. While the collaborative combat aircraft program isn't funded to start until 2024, industry executives said they are gearing up their autonomous capabilities to expand the potential for manned and unmanned teaming.

While there is certainty in the service that the uncrewed aircraft is the future, there are no requirements in place yet, said Gen. Mark Kelly, commander of Combat Air Command. Discussion is ongoing about how the acquisition



process will work, he said.

Autonomy is one of three must-haves for the system, along with resilient communications links and the authority for the system to freely move. More testing and experiments will fill in the blanks, he said.

"I'm an advocate to iterate our way there because I think there's so much we don't know," he said during a media roundtable at the Air and Space Forces Association's annual conference in National Harbor, Maryland.

Operational tests for the collaborative combat aircraft will take place in two or three years, he said.

Industry needs to participate in the experimentation that will shape the autonomous capabilities, said Mike Atwood, senior director, advanced programs group at General Atomics Aeronautical Systems.

One area for industry to navigate alongside the Air Force is how it will face other artificial intelligence-based systems, he said during a

panel discussion at the conference. That challenge could shape the ethical limits of autonomous systems.

The ADAIR-UX program — which is developing an AI-piloted aircraft with General Atomics for fighter jets to train against — will build awareness about the difficulty of facing AI as students at weapons schools practice against adversaries with lightning-fast decision making, he said.

"I think that will be maybe the Sputnik moment of cultural change, where we realize when we saw ... F-22 and F-35s in the range, how challenging it is to go against that," he said during a panel at the conference.

A new advancement in autonomous capabilities with potential for future AI-controlled aerial vehicles is reinforced learning, he said. Using algorithms, an operator can define the world that the machine is allowed to operate in and give it a set of actions. The machine can then self-learn all the possible combinations of those actions in the set environment.

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This type of learning could be reassuring to those with concerns about AI, especially as the military begins to test its largest class of unmanned aerial vehicles, he said. Setting the limits of what the machine can do can be comforting, but it still allows the system to innovate, Atwood said.

“What we’re finding now in manned-unmanned teaming is the squadrons are ready to start accepting more degrees of freedom to the system — not just going in a circle, but maybe cueing mission systems, maybe doing electronic warfare [or] doing comms functionality,” he said.

He added programs like the loyal wingman program Skyborg — for which General Atomics provides core software — are advancing the autonomous capabilities needed for the aircraft of the future.

The AI-enabled system that controls unmanned vehicles will officially become a program of record in 2023. The program, alongside the Air Force’s three other Vanguard systems, will add data for programs like the next-generation air dominance family of systems, according to the Air Force.

“I think we’re on the precipice of something very, very special with the



collaborative combat aircraft,” Atwood said.

Lockheed Martin has been internally considering how it could pull off industry collaboration similar in scope to the Manhattan Project, said John Clark, vice president and general manager at Skunk Works.

Given an urgent, national need, companies could band together to create a capability in 12 to 18 months, he said.

“The environment is not quite to that point, but it’s maybe one day or one event away from having that sort of environment,” he said during the panel.

Clark said losing the AlphaDogfight competition — a series of trials testing manned-unmanned teaming capabilities run by the Defense Advanced Research Projects Agency — called for an examination of Lockheed’s AI boundaries. During the competition, Lockheed limited AI control to follow Air Force doctrine, but the

winner — Heron Systems, which was bought by software company Shield AI — was more flexible.

The Air Force and industry need to discuss where the range of acceptable behavior is for AI and how to build trust within that range, he said.

“We’re going to have to fail a few times and learn from those failures and then move forward with, ‘This is the right way to go through it,’” he said. “I think that that’s the No. 1 thing that’s keeping us from being able to really make the leap forward with this technology.”

Industry also wants to emphasize the importance of science, technology, engineering and math education for future pilots and operators, said Ben Strausser, principal lead of mosaic autonomy research at General Dynamics Mission Systems.

“Other discussions have talked about the importance of STEM education and making sure we have that level of understanding of literacy, so when we want to communicate what our unmanned systems are doing, there’s a level of ... understanding for what the semantic descriptions of those algorithms mean,” he added during the panel. **ND**

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Congress Leaves Defense Department Hanging

During the spring and summer, there was a common refrain coming from the hawks on the Hill: the president's fiscal year 2023 budget proposal short-changed national security. The \$773 billion request for the Defense Department — \$813 billion total for national defense — simply would not cut it in the current environment.

"I am very concerned that this budget would result in real cuts in defense spending at exactly the wrong time," said Sen. Susan Collins, R-Maine, during a May 3 hearing.

"In a fiscal environment with 8.5 percent inflation, the department's budget request equates to a cut to our national defense at a time of unprecedented security risks," said Sen. Richard Shelby, R-Ala., at the same hearing.

Similar concerns were raised in the House about the request, which was a 4 percent increase above enacted 2022 funding.

Both chambers walked their talk when drafting versions of the 2023 National Defense Authorization Act. The House bill, passed in July, added \$37 billion to the White House proposal, and the Senate Armed Services Committee mark added \$45 billion.

In a statement about the SASC's passage of the 2023 NDAA, Sen. Jack Reed, D-R.I., stated that Russia's invasion of Ukraine and worldwide inflation required the committee to increase defense funding.

"This year's markup advances U.S. military capabilities in response to China and Russia," he said. "It targets research-and-development investments that will give our forces major advantages."

Since then... crickets.

In September, the National Defense Industrial Association issued a white paper warning Congress that since 2021, inflation has eaten up \$50 billion in Pentagon purchasing power. The lack of real growth in defense spending has also resulted in a \$110 billion execution loss.

Yet, the full Senate did not vote on the draft NDAA before the end of the fiscal year, and Congress failed to pass any spending bills before Sept. 30.

Instead, Congress once again



resorted to a continuing resolution to keep the government funded until Dec. 16.

That resolution meant that the Defense Department started fiscal

year 2023 with the same funding as 2022, and no adjustment for the roughly 9 percent inflation since the beginning of fiscal year 2022.

The resolution expressly prohibits new starts, production increases or "the initiation, resumption, or continuation of any project, activity, operation, or organization ... for which appropriations, funds, or other authority were not available during fiscal year 2022."

One program caught up in this is the Rapid Defense Experimentation Reserve, which is designed to take promising prototypes and run them through practical experimentation to validate and transition to production. The program received \$35 million in initial funding in 2022, and the Pentagon was seeking \$358 million for 2023, which is supposed to be the program's first full year of operation.

National Defense asked the Pentagon how the reserve would move forward and for examples of programs and initiatives stalled by the continuing resolution. The response was a pithy but clear, diplomatic message to the Hill.

"Under a CR we cannot start new initiatives, including increased investments in cyber, nuclear modernization and missile defense, and we lose buying power," said spokesperson Lt. Cdr. Tim Gorman in an email. "Timely enactment of appropriations allows the department to spend taxpayers' money in the most deliberate and efficient manner to implement the National Defense Strategy."

So, for all the talk in Congress about the need for the Defense Department to procure more new platforms and speed up innovation and modernization to keep pace with China, Congress tied the department's hands most likely until early next year when the next Congress can get around to passing 2023 funding bills.

Of course, this is nothing new.

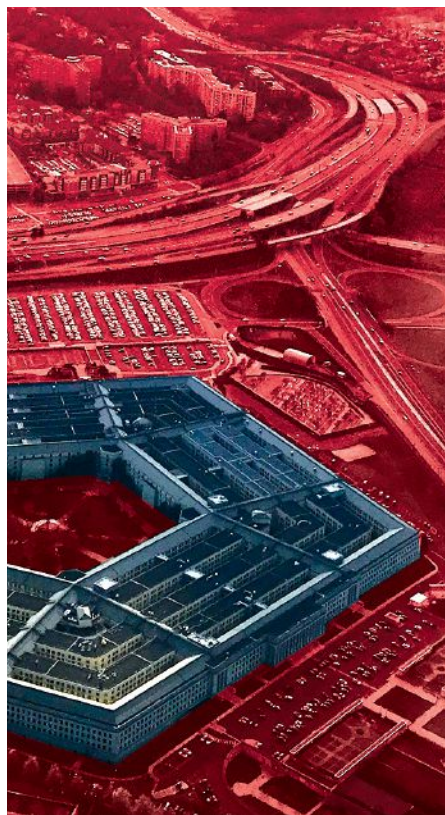
Only eight times since 1977 has Congress passed an NDAA prior to the beginning of the fiscal year. The average is 42 days after, according to the Congressional Research Service brief, "FY2023 NDAA: Status of Legislative Activity."

The offices of the chair and ranking member of the Senate Armed Services Committee and the Senate majority leader did not respond to requests for explanations as to why the Senate, for all its bluster about the need to boost the defense budget, didn't bother to pass an NDAA or funding bill before the start of the new fiscal year.

The one positive note in the continuing resolution was that Congress appropriated \$12.3 billion in additional funding to support Ukraine.

According to a House summary of the resolution, that amount includes \$3 billion for the Ukraine Security Assistance Initiative, which provides training, equipment, weapons, stipends, sustainment and intelligence support for Ukrainian forces. There is \$1.5 billion to replace equipment drawn from U.S. stocks to send to Ukraine, \$540 million to ramp up production of critical munitions and an authorization for the president to draw down another \$3.7 billion of U.S. defense articles to send to Ukraine.

It's another example of how Congress can respond to a crisis, yet it can't complete its annual business and provide the national security resources it says the country needs. **ND**



NDIA BY THE NUMBERS

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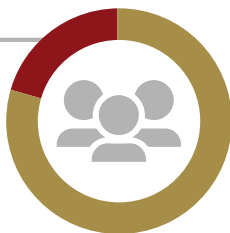
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VIEWPOINT

What You Don't Know About Lobbying Does Hurt You

BY GENE MORAN

There are three categories of lobbying in the defense industry: those who lobby; those who lobby but don't think they lobby; and those who have no real awareness of how lobbying could help them.

The best-performing federal contractors — as identified by Bloomberg Government — all lobby. Academic research confirms that lobbying in the executive branch and Congress can influence more favorable contract outcomes.

I sought to understand why so few defense companies lobby Congress when it can be advantageous.

It is no secret that several factors shape the consolidation of winners of defense contracts over time, including a shrinking industrial base, offshoring of critical manufacturing capacity, the introduction of other transaction authorities, indefinite delivery, indefinite quantity contracts and the relative increase in lobbying activity since the post-World War II era.

Over the past 30 years, registered federal lobbyists grew to more than 12,000, yet fewer than 1,000 registered lobbyists represent defense interests. Defense lobbying does not rank even among the top 10 industries that lobby Congress. How does that number of registered defense lobbyists align with the number of companies within the defense industry?

There are hundreds of thousands of companies competing within the defense industrial base. A Defense Department report on the defense industry in 2019 acknowledged it doesn't know the exact size of the defense industrial base, but that it could be one million companies.

For the sake of discussion, let's say that the number is only 250,000. That artificially small depiction of the industrial base still reveals a dramatic imbalance of registered representation. A fraction of one percent of defense companies is registered to lobby.

Prior research confirms half of defense acquisition dollars go to 50 companies and their subcontractors.

Annually, the congressionally mandated small business set aside goals strive to assure that 25 percent of contract awards go to specific socioeconomic categories of small businesses. In defense, that 25 percent equates to roughly 50,000 companies annually.

While acknowledging the mix of dollars versus contracts in these statistics, the odds appear indeed long for the remaining companies vying for the last percentages of opportunity. If the competitive opportunity is so fierce, why would more companies not use every tool in their toolkit to gain better leverage?

The cynic might accept this as a question of a company's ability to allocate corporate resources of money, people and time to the lobbying process. Sadly, more powerful but addressable reasons help explain the lack of lobbying participation.

My recent academic research identifies facilitators of and barriers to congressional lobbying as perceived by defense executives. The perspective of defense executives toward congressional lobbying has not previously been subject to academic scrutiny. The study's findings are informative and may help companies think about their own executives' levels of understanding of complex processes. The findings might also inform Congress as it regularly revisits lobbying rules.

My research focused on companies with annual defense revenues between \$5 million and \$1 billion. Using recognized qualitative research techniques specific to analyzing interviews, I identified six themes that point to dynamics more nuanced than the easy-to-reach large company versus small company conclusion. Defense executives in key decision-making roles that determined the company's decision to lobby Congress provided answers to an identical set of questions about the overall business development and sales process, including consideration of congressional lobbying.

By applying widely accepted thematic coding procedures, executives'

responses generated six themes: awareness, experience, outcomes, investment, size and type of business and compliance. The theme of awareness contained two subthemes: communications and connections.

Below is a very high-level summary of each theme and subtheme.

"Awareness" captures an executive's ability to synthesize specific sub-elements of the budget cycle to include lobbying knowledge,

experience, connections, appropriations, authorizations, networks, working with Congress, strategy and colors of money. The awareness theme is evident in the responses of all participants and overshadows other relevant themes by a factor of 10 in its sheer dominance of the data. Some participants demonstrated sophisticated levels of awareness, while others demonstrated a lack of awareness.

As for "process," lobbying requires that a defense executive synthesize complexities of the budget, legislative and lobbying processes and their interrelationships. Defense executives who possess an awareness of process knowledge perceived lobbying Congress as a tool or lever at their disposal. Conversely, defense executives with low process knowledge did not have the same perception of lobbying.

The communications and contacts subtheme integrates how an executive may draw on distributed networks to communicate effectively throughout the federal sales cycle in support of the lobbying decision. Robust networks with effective and timely communications support those executives with adequate process awareness. Support from mentors and knowing with whom to speak can serve those with high levels of process awareness.

Defense executives spend considerable time and energy determining with whom they must communicate amid a government audience that frequently changes positions and does not routinely publish useful contact information directories. Communications in the executive branch and Congress are governed by rules and norms, each requiring varying degrees of sophistication that coincide with the executives' level of awareness. Higher levels of awareness facilitate the decision to lobby, while lower levels of awareness present a barrier to the decision to lobby.

"Outcomes" include winning contracts, generating sales and earning revenue. Participants universally



identify outcomes for their relevance to business success. Executives must consider whether lobbying investment would lead to the desired business outcome. Levels of executive awareness inform whether rewarding outcomes of congressional lobbying are attainable.

For those executives able to foresee future favorable outcomes, they are a facilitator to congressional lobbying. Outcomes can be a barrier to congressional lobbying for those executives lacking the awareness to

return on investment of lobbying requires high levels of awareness.

“Experience” — as indicated by multiple participants — contributes to developing awareness and requires a combination of education, time in the industry, mentorship and practical on-the-job training. All participants identified experience issues required to function well in their roles and on behalf of their companies. Where and how each gained such experience varied. On-the-job training was the most

VIEWPOINT

Executives with experience perceive facilitators to congressional lobbying in themes of awareness, outcomes and investment. Those with less experience perceive barriers to congressional lobbying in those same themes.

As for “size and type of business,” all participants perceived them as relevant to business success and to the consideration of lobbying Congress. Research data indicated that it was not always simply a matter of small versus large companies, though most acknowledged that large companies have advantages attributable to their size. Conversely, the agility of small companies was seen as advantageous by some executives of larger companies. Most executives saw the large company advantage evident in the presence of large business development teams able to support multiple simultaneous opportunities.

Defense executives of manufacturers and product providers perceived more significant opportunities for return on investments that yield outcomes along a more robust horizon worthy of the required investments.

The types of appropriated funds such as research-and-development or procurement that support the manufacture of products have a longer lifespan, allowing more time for the future outcome to develop. On the other hand, service companies limited to using one-year operations-and-maintenance funds don’t see the same time horizon. While the interrelationships of multiple themes were evident, product manufacturers see size and type of business as a facilitator of lobbying, while service company executives perceive a barrier.

“Compliance” was also an issue. Participants consistently revealed incorrect terminology and a general lack of understanding of lobbying compliance issues. Nearly all would respond to lobbying and political giving questions, for example, in the context of prior ethics training that had no direct relationship to the lobbying dynamic. Lobbying registration rules do not appear well understood by those who do not lobby.

The Government Accountability Office’s annual report of lobbying compliance only examines the reporting of registered lobbyists, and in those cases, lobbying reporting compliance consistently rates above 95 percent. There is no systemic measure of the well-researched concept of “shadow

see the potential future results.

As far as “investment,” several activities, such as communications, relationships with Congress, research and development and training, cause internal competition for limited resources. The decision to invest in lobbying requires practical tradeoffs, regardless of whether the lobbying function is executed by an in-house employee or contracted support.

Dedicating resources such as time and funding to lobbying Congress requires an executive to assess the tradeoff and likelihood of its positive impact on relevant policy, sales or revenue outcomes. Calculating

often cited method of accumulating the requisite experience to succeed.

Time in the industry alone does not necessarily equate to experience, although is often perceived as a valued measure by executives. Executives interviewed possessed decades of experience “in defense,” with the majority claiming credit for prior military service. However, the time in their current corporate role averaged 6.3 years with a mean of five years. None possessed formal acquisition or government relations training beyond “101-level short courses.” Experience, as perceived by defense executives, does not equate to expertise.



lobbying,” those who lobby but fail to report the activity.

The perceived barrier to lobbying, or those executives with low compliance knowledge, was understood well enough that executives believed they could address and remove it. Their most common plan to assure compliance was to seek counsel from a mentor within their network.

The research findings confirm certain perceptions of defense executives that present barriers to or facilitators of congressional lobbying, depending on the situation’s specifics. An executive’s awareness of the process, communications, and connections can allow the executive to perceive facilitators and barriers to the decision to lobby Congress.

Further, an executive’s experience, focus on outcomes, understanding of investment return and knowledge of compliance also present perceived facilitators and barriers to the defense executive’s decision to lobby.

Lastly, the size and type of company influence whether an executive perceives a facilitator or barrier to the decision to lobby Congress. In some cases, the presence of a theme can be a perceived facilitator, while its absence can be a perceived barrier. These findings may inform policymakers and decision-makers of considerations for ongoing and future reforms associated with congressional lobbying.

Budgeting, legislation and federal contracting are each inter-related and practical aspects of the performance of democracy. This research attempted to look beyond large versus small company comparisons and is distinct from ongoing research and efforts in the acquisition, campaign finance and lobbying reforms.

Understanding how defense executives perceive the lobbying decision and environment can inform all such reforms. **ND**

Gene Moran, Ph.D., is an award-winning defense lobbyist and author. His most recent book, co-authored with Alan Weiss, Ph.D., is “Million Dollar Influence: How to Drive Powerful Decisions Through Language, Leverage, and Leadership.”

COMMENTARY

Civilian Space Tracking Program Key for Sector Growth

BY CHRISTIAN ZUR

In keeping with the pace of the commercial space sector, the Biden administration is advancing a long-anticipated policy initiative to transfer responsibility for tracking objects in Earth’s orbit from the U.S. military to the civilian National Oceanic and Atmospheric Administration.

To make this move happen, the president proposed an increase in fiscal year 2023 of \$78 million to develop a publicly available database that companies and countries can use to avoid collisions in space. Recently, Congressional appropriations committees passed bills largely supportive of this budget request.

The origin of space surveillance goes back to the earliest days of the Cold War. By the 1980s, the Air Force operated a network of more than 20 ground-based electro-optical telescopes and cameras, passive radio frequency sensors and phased array radar stations located predominately in the Northern Hemisphere to provide an early warning of over-the-Arctic ballistic missiles threats.

After the 2009 collision between Iridium and Cosmos satellites, the U.S. military was authorized to share cursory conjunction analy-



sis with commercial companies and foreign governments.

By 2010, the Air Force program expanded to include space-based surveillance systems orbiting at 627 kilometers above sea level and able to monitor altitudes where most commercial satellites operate.

Today, these sensors collectively detect, track, identify and catalog all human made objects orbiting the Earth and serve as the baseline information for a tracking program known as the U.S. Space Surveillance Network, which is managed by the Combined Space Operations Center at Vandenberg Air Force Base.

Collectively, the network’s worldwide ground stations and space-based sensors perform approximately 100,000 satellite observations per day and track objects around 10 centimeters and potentially as small as five centimeters at lower altitudes and highly inclined orbits which are easier to observe.

Currently, the catalog contains approximately 47,000 items and is used for object identification, notification of satellite flyover and space treaty compliance, as well as scientific and technical intelligence gathering. The center releases this data publicly on SpaceTrack.org.

However, such data has limited



value for purposes of predicting and avoiding satellite conjunctions. SpaceTrack.org modeling largely relies on a range of two-line element inputs which specify object location along a limited timeframe. Thus, this orbital data can only convey a generalized picture of risk, at times up to several kilometers of variance with the actual location of an object.

Because of the limitations of baseline data, the center has entered into agreements with companies to share more precise orbital modeling, which includes two-line element as well as ephemeris data while adjusting for atmospheric drag and gravitational influences, among others.

However, even that degree of detail is insufficient for the complexity of space operations. Indeed, a study conducted by the National Academy of Public Administrators in 2020 stated, “Commercial operators increasingly view today’s DoD surveillance and warning system as inadequate to achieve safe operations in today’s commercial space environment.”

The study further asserted that “as the space economy expands and new pressures confront the orbital environment, DoD is facing challenges

in providing up-to-date surveillance and warning services for the non-national security-related sector. That sector requires much more precise information than the DoD system was designed for. Also, the DoD system is not scalable to meet the demands of a growing number of objects in space and to deal with an increasing number of space operators.”

The beginning of a policy solution was sought in 2018 with the promulgation of Space Policy Directive 3, or SPD-3, which directed the Defense Department to transition functional responsibility of space tracking to the National Oceanic and Atmospheric Administration within the Department of Commerce.

However, implementation was slow due to inadequate funding to fulfill the mission authority granted to NOAA. With the Biden Administration’s 2023 budget increase, NOAA is now moving quickly to develop an open architecture data depository, which will integrate existing network information with commercially acquired sensor and analytical data into a robust space tracking system as a free service for companies and governments to use to support accurate risk assessment

COMMENTARY

and collision avoidance maneuvers.

According to the Department of Commerce, the funding is necessary to support NOAA’s efforts to accelerate the development of the depository from a pilot demonstration to an initial operating capability no later than fiscal year 2024, with full operational capability expected by 2025.

Notably, NOAA plans to rely on commercial companies for cloud services, data and infrastructure in the program’s execution.

No different than sea and air domains, space must be governed by safe and transparent operating standards. The Biden administration’s open architecture data depository proposal to leverage public and private sectors is a significant step toward sustainable use of space for the benefit of all — citizen, country, and company alike. **ND**

Christian Zur is vice president for policy at the Commercial Space Initiative, a non-partisan think tank dedicated to sustainable growth of the space economy.



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Directed Energy

Navy Destroyer Adds HELIOS Laser to Arsenal **BY MEREDITH ROATEN**

Threats to Navy vessels continue to grow in the form of drone swarms and anti-ship missiles. Now, after decades of experimentation, the Navy is closing in on a low-cost solution that can deter and defend against aerial threats at sea.

The Navy received its first high-energy laser with integrated optical-dazzler and surveillance, or HELIOS, system in the third quarter of fiscal year 2022 from manufacturer Lockheed Martin, according to the company. The system — which can blast more than 60 kilowatts of directed energy at targets up to five miles away — is currently being installed on a Flight IIA Arleigh Burke-class destroyer that is undergoing upgrades, a company spokesperson told *National Defense* in an email.

“HELIOS enhances the overall combat system effectiveness of the ship to deter future threats and provide additional protection for sailors, and we understand we must provide scalable solutions customized to the Navy’s priorities,” said Rick Cordaro, vice president for Lockheed Martin advanced product solutions in a press release. “HELIOS represents a solid foundation for incremental delivery of robust and powerful laser weapon system capabilities.”

HELIOS is part of the Navy Laser Family of Systems, a collection of platforms that the service envisions as “the foundation of an incremental strategy for increased laser weapon capability,” according to Navy budget documents.

The service requested about \$35 million for the family of systems for its 2023 budget, during which the first system is expected to be operational at-sea.

The weapon system “addresses anti-surface warfare and counter-intelligence, surveillance and reconnaissance gaps with the ability to dazzle and destroy unmanned aerial systems and defeat fast inshore attack craft,” the documents stated.

The technology represents significant advances over current systems

and options for countering UAVs and anti-ship missiles. Surface-to-air missiles and Gatling guns require magazine depth on ships and have poor cost-exchange ratios when deployed against inexpensive drones, the Congressional Research Service said in an August report.

Plus, reloading Navy surface ship magazines requires the vessels to travel potentially hundreds of miles over a period of hours to get to a safe zone, said the report, “Navy Shipboard Lasers: Background and Issues for Congress.”

An adversary such as China has access to multiple UAVs and anti-ship missiles, and Beijing has a “high capacity” for producing more. This could price out the Navy’s ability to defend itself affordably, the report said.

“The biggest concern right now in the emerging threats envelope is, how do you target, how do you track and how do you disable potential swarms or saturation attacks by small unmanned vessels like micro UAVs, or even small surface vessels since the Navy has concerns about that,” said Tristan Sauer, land domain analyst at data analytics and consulting firm GlobalData.

As manned-unmanned teaming — collaboration between a crewed platform and one or more drones — becomes a more feasible technology, it is proliferating throughout the battlefield, even in countries with fewer resources, he noted.

“That’s where laser weapons systems come in because they have this extremely low cost per shot, there’s this whole deep magazine,” Sauer said.

The Russian invasion of Ukraine has highlighted how debilitating a lack of munitions stockpiles can be, he noted. Some defense companies have expressed their struggle to keep up with production demand while simultaneously dealing with supply chain issues related to the COVID-19 pandemic.

“The fact that these weapons require so little energy just to deliver such significant effects, either lethal or

nonlethal — this makes them just key and critical to ensuring sustainability of operations, particularly in the case of high-intensity conflict,” Sauer said.

The previous iteration of the solid-state laser quick reaction capability Laser Weapon System, or LaWs, was a temporary installation on the USS Ponce. The system struggled to identify tiny targets, such as the smallest class of drones, he said.

That’s one of the problems HELIOS is meant to address. The system is designed for continuous operations using available ship power instead of adding another energy magazine, according to Lockheed Martin.

Similarly, the new system has advantages over past laser weapons in terms of power and positioning, a company spokesperson said. LaWs could only go up to 30 kilowatts of power and wasn’t intended as a long-term installation, they noted.

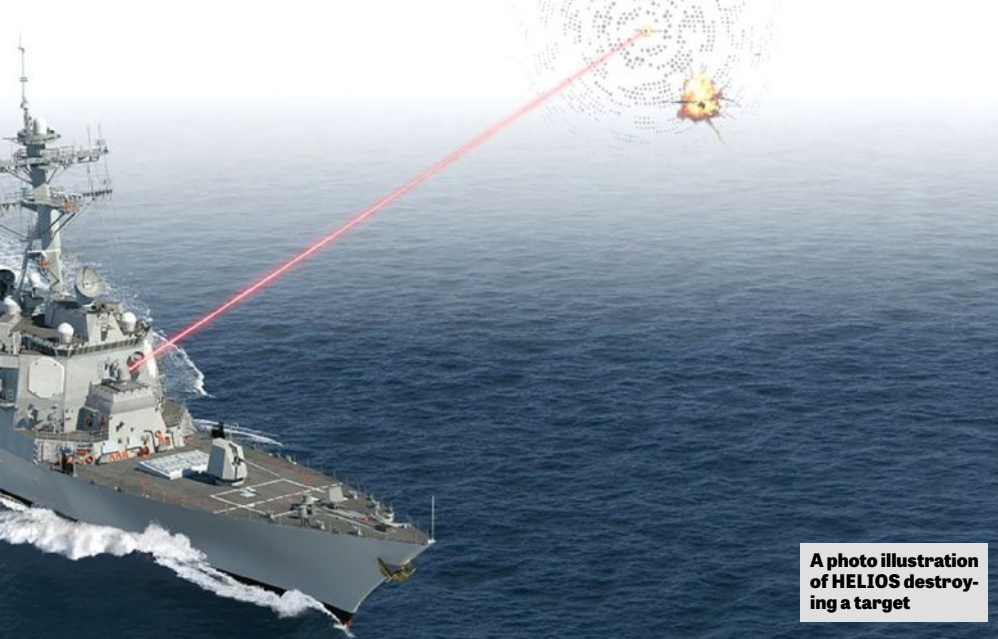
The HELIOS installation is taking place at the same time as an ongoing Aegis modernization effort in San Diego, California, the spokesperson said. The Aegis Weapon System, or AWS, is the Navy’s command-and-control system that has been operational since the 1980s. Lockheed Martin also has a contract to modernize the system across destroyers and other vessels.

HELIOS is being integrated into its vessel and the Aegis combat system, allowing permanent installation. The weapon uses spectral beam combined fiber lasers, giving it a higher beam quality than the “incoherently combined” six high quality fiber lasers of LaWs, the spokesperson said.

Because the laser has the option to dazzle satellites in addi-



Lockheed Martin illustration



A photo illustration of HELIOS destroying a target

tion to destroying capabilities, it has “game-changing” warfighting capabilities, they added.

The system has demonstrated that it can repeatedly hit a high-speed target at tactically extended ranges, according to a white paper Lockheed Martin published last year. It closed the fire control loop on a track provided by the Surface Combat System Center’s Aegis Combat Sensor after achieving coarse and fine optical tracking, the paper said.

The Optical Dazzling Interdictor Navy, or ODIN, enables the system’s dazzling technology by disrupting the electro-optical and infrared sensors on enemy platforms. It’s a capability that exists on other vessels, but the HELIOS program is the first time a ship has the system fully integrated into its command-and-control architecture.

The laser weapon also has a surveillance mission in addition to its laser destroying and dazzling capabilities. The spokesperson declined to comment on how its surveillance capabilities are being tested.

“HELIOS is a multi-mission laser weapon system and all of its missions, including surveillance, will evolve over time as the Navy conducts at-sea operations and develops tactics, training and procedures for this new warfighting capability,” they said.

How the weapon will be used in the maritime domain is still up for debate. When asked if the Navy is considering other vessels for installation of the laser weapon, Lockheed Martin’s spokesperson declined to say.

“HELIOS is scalable and adaptable to other ship classes and combat systems,” they said in an email.

The Navy has shown interest in laser weapons across different vessels. Last year, it tested another system — the Solid State Laser - Technology Maturation Laser Weapons System Demonstrator — on the San Antonio-class ship USS Portland. The service used the LWSD to disable a drone during an at-sea test in 2020.

The Navy’s 2023 funding request would support de-installation and hardware disposition of the 100 kilowatt system, according to the service.

The next step for the HELIOS program is taking the system through its paces after its installation. At-sea testing will begin in 2023, according to the budget request.

“The Navy will learn a lot about the employment of this game-changing multi-mission capability once warfighters begin using HELIOS in operational maritime environments beginning in [2023], and the lessons learned will inform future development efforts,” the spokesperson said.

The laser completed land-based testing earlier this year in Wallops Island, Virginia, they added.

The biggest challenge coming up for the program is continued incorporation into the Navy’s layered defense.

“Integration, into both the ship and combat system, and marinization are critical to providing directed energy warfighting capability in a stressing maritime environment,” they said.

“The system must operate as an integral part of a layered defense architecture such as the Aegis Combat System on DDG 51 class destroyers, and be able to fit within the space, weight and power constraints of the ship.”

While the laser is designed to meet the space, weight and power

requirements for the Arleigh Burke-class ships, they noted it would need to be redesigned for integration with different ship types or ships that have a combat system other than Aegis. Its “inherently scalable and modular design architecture” enables that process, they added.

The system could scale to 120 kilowatts and higher depending on the space and power restrictions of the vessel, according to the white paper. This could even include ships in the Navy’s future fleet such as the Constellation class of guided-missile frigates and the Next-Generation Guided-Missile Destroyer, the DDG(X).

“The Navy I see as being the natural first step for laser weapons system deployment in the U.S. military, because Naval Surface Warfare vessels have large energy supply,” Sauer said.

However, when it comes to installing the laser on smaller ships, space and power constraints are critical design hurdles that the Navy still has to overcome, he said.

As the United States works on developing laser technology, its adversaries are not far behind. While neither China nor Russia has the kind of advanced laser systems available in the United States, lasers could be more proliferated across domains in a few years, said Mick Ryan, a Center for Strategic and International Studies fellow.

“Putting them on a ship ... is one thing, but I think that when you see them in the land environment, that might be a little way off,” he said.

In particular, Russia has boasted of its use of an experimental laser system Zadira during its invasion of Ukraine, he noted. It’s not likely that the system has had much impact given the nation’s propensity to exaggerate its technological capabilities, but the use of UAS in the conflict will push the technology to advance, he added.

The Navy’s laser weapon — and other Pentagon directed energy technologies such as the Army’s Directed Energy Maneuver-Short Range Air Defense system — can send a strong message to adversaries, he added.

“You’re seeking to deter a potential adversary through your possession of these advanced technologies, but you’re also wanting to ensure that if the deterrence and influence doesn’t work and you have to fight, that it’s effective,” he said. **ND**

Digital Space

Entering Year Four, Space Force Focusing on Cyber Capabilities

BY JOSH LUCKENBAUGH

NATIONAL HARBOR, Maryland — When one thinks of a traditional warfighter, they picture an operator engaged in conflict in a physical domain: a soldier moving through enemy terrain, an amphibious assault ship sailing across the ocean or an F-35 fighter jet soaring in the air.

But for the Space Force, the primary battlespace is not material — it's digital.

"If you look at the space domain, the way you experience that domain is through data," Chief of Space Operations Gen. John "Jay" Raymond said during a panel discussion at the Air and Space Forces Association's annual Air, Space and Cyber event in National Harbor, Maryland.

As the United States' youngest service enters its fourth year, the Space Force is reevaluating "what readiness means to a force that is primarily employed in place rather than waiting to deploy overseas." That includes contemplating new approaches to training, sustainment and reporting data to the Pentagon, Raymond said during his keynote address at the event.

In particular, the service is expanding its exercise program "to increase readiness of our squadrons," he added.

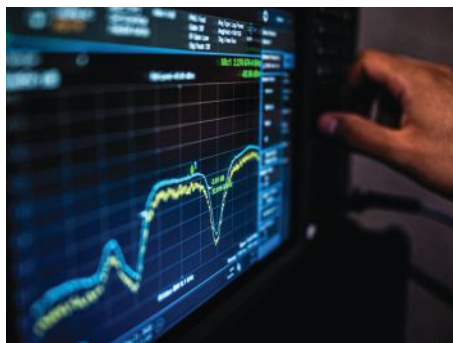
The same week of the AFA conference in September, Space Force operators were participating in a new exercise called "Black Skies."

Focused on electronic warfare, the exercise "trains the force in a realistic threat scenario," Raymond said.

At Black Skies, warfighters experienced "a mix of live fire and constructive" training activities, Maj. Gen. Shawn Bratton, the commander of Space Training and Readiness Command, or STARCOM, told reporters during a roundtable discussion.

"We have the ability to conduct live fire activities, monitor those for safety and security purposes, and observe and then provide feedback and lessons from the training," he said.

Black Skies is the "first of a



An operator participates in STARCOM's electronic warfare exercise "Black Skies."

series of exercises STARCOM will develop to build the readiness of operating in this new warfighting domain," Raymond said.

Along with Black Skies, the Space Force is planning to conduct "Red Skies," an exercise focused on orbital warfare to train soldiers on combatting threats in space.

"For Red Skies, we'll need orbital warfare capability for sure," Bratton said. "Whether that's [actually] live flying an asset on orbit, I would say that's unlikely for 2023, as much as my team is super excited about doing that."

"But then we move into the digital space, and what are we going to do in the virtual constructive space with the tools available to us? What can we bring on board? So I think we'll see, and we're investing now in really the digital side," he added.

Red Skies will be followed by a cyber warfare exercise called "Blue Skies," Bratton said. Red Skies is scheduled for 2023, with Blue Skies expected to occur in 2024, he added.

These new exercises will provide insight not just for the Space Force, but the entire U.S. military, giving "a more holistic view of the joint-force's readiness," Raymond said.

In addition to this new series of exercises, STARCOM is introducing more digital capabilities at its joint training exercise known as "Space Flag," Bratton said.

An iteration of Space Flag was completed in August and involved warfighters from the Space Force, Air Force and Army, according to a

press release. Members of the Marine Corps' Marine Space Support Team were also on hand to observe with an eye toward having them participate in future iterations, the statement said.

The August series was the first time a cyber component was included in the exercise, Bratton noted.

"We learned a lot," he said. "What we did this time was we actually brought the cyber team in like a week or two ahead of time and executed the ... cyber portion of the exercise. And then the outcomes of that impacted the space operations piece."

"That was a good first step, but we really need to integrate them together," Bratton added. "We need to bring [them] all in the same room, planning activities that are synchronized."

Another iteration of Space Flag is scheduled for December and the cyber team will have more collaboration with the rest of the participants. The goal is to have them "fully integrated" in the 2023 editions of the exercise, he said.

This greater emphasis on cyber capabilities in the Space Force has also impacted the way the service recruits as it looks to expand its pool of digital talent.

"We're ... looking at less traditional ways to assess talent," Raymond said. "This summer, we accepted six cyber professionals to commission directly into the Space Force from industry. We're bringing them in anywhere from a first lieutenant to a lieutenant colonel based on the credit that we've given them for the experience that they've had with industry."

The first of these direct commissions, 1st Lt. Jessica Thompson, is currently at officer training school, he said. Once graduated, she will serve as a cyber warfare operations officer, according to a release from the Naveen Jindal School of Management, where Thompson earned master's degrees in Business Administration and Information Technology and Management.

In this role, Thompson will "command a Space Force crew and oversee cyberspace weapons systems" as well as "assess intelligence information and maintain vigilance across all cyber channels," the release said.

Along with recruiting from industry, the Space Force is looking for ways to increase the digital capabilities of its enlisted force, Raymond said. One of those methods is through the service's Supra Coders program, which trains warfighters to become software developers.

"We're trying to build indigenous software experts inside of our service," Raymond said. "I think ... we've got just shy of 100 that have gone through this program, and then we've got more being developed over time."

Once trained, Supra Coders are placed throughout the Space Force in "software factories," such as in the Space Command and Control program, also known as Kobayashi Maru, he said.

"We're putting them in innovation cells ... to be able to give them the tough challenges to work on, and see if they can write code to be able to help us," Raymond said.

Supra Coders have produced results, he added.

"We've developed some apps that have been on our command-and-control systems," Raymond said. "We had a young guardian at one of our units build a digital representation of some equipment that we used to have to take offline to train on ... it was all done in-house."

"We're purposefully assigning those folks in critical positions to help us harness the innovation that we think is out there," he added.

The Space Force's digital push comes at a time when the service is consolidating many important Defense Department programs into its portfolio.

The Army's satellite communications mission was officially transferred to the Space Force in August, following the transfer of the Navy's Satellite Operations Center in June. This marks the first time all Defense Department military satellite communication functions have been consolidated under a single service, a Space Force release said.

The Space Development Agency has also transitioned into the Space Force as of Oct. 1. The agency has been developing the National Defense Space Architecture, a constellation of satellites that will provide increased communications, missile warning and tracking and position, navigation and timing capabilities to warfighters across the globe.

The agency will begin launching its Tranche 0 satellites later this year, said SDA Director Derek Tournear during a panel discussion at the conference. This initial launch will include 28 satellites bearing missile warning and communications payloads "so that the warfighter can actually start to use that to develop their techniques," he said.

In 2024, the agency will launch about 150 satellites to perform the global beyond-line-of sight targeting and advanced missile detection mission, Tournear added.

Additionally, the Space Force is "in talks" with the Army to take control of the joint tactical ground station, or JTAGS, mission "over the next year," Maj. Gen. Douglas A. Schiess, vice commander of Space Operations Command, said during a panel discussion at the conference.

The stations receive, process and disseminate direct down-linked infrared data from overhead sensors to "provide commanders with real-time warning, alerting and cueing information on ballistic missile launches," according to the Army's Acquisition Support Center website.

The transfer would bring all space-based missile warning systems for all of the combatant commanders into the Space Force, Schiess said.

With all of these programs now part of the Space Force's responsibilities, the service will need to develop or acquire further capabilities to perform these critical missions. The solutions won't come from hardware, but rather software, said Maj. Gen. DeAnna Burt, special assistant to the vice chief of space operations.

"We are in the digital age. We need to step to that next level if we're going to win against our potential adversaries," Burt said during a panel discussion at the conference.

Raymond also drove home the need for more advanced software capabilities.

"One of the things that I have long thought of is that we were too hardware-focused rather than software-focused," he said. "We needed to have the agility ... to be able to ... harness that data [and] apply some analytical tools on top of that to solve some of our tough problems," he said.

The Space Force has introduced several initiatives to increase collaboration with industry partners, such as setting up a "commercial front door at Space Systems Command," Raymond said.

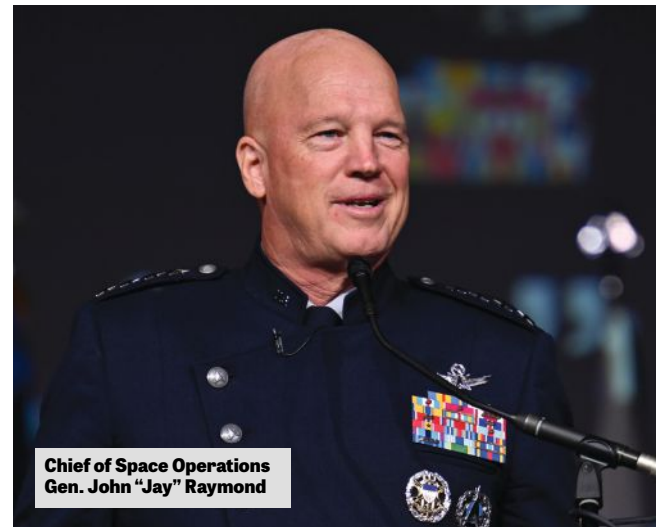
"For all the new companies that have come in that might not have had the experience of working with the department, we provide them

with a sponsor, if you will, somebody that's there that can help them walk through the process and help us work better together," he said.

As part of its efforts to fulfill Secretary of the Air Force Frank Kendall's first operational imperative of "defining resilient and effective space order of battle and architectures," the Space Force is also working on new designs to diversify the architecture in space in the face of a growing threat to U.S. space capabilities, Raymond said.

Led by the service's Space Warfighting Analysis Center, this force design work has been done "all digitally," he said.

"Using model-based systems engineering, [we] came up with the digital models — both of the threat that we see, and the architecture design that we want to move to," Raymond said.



"Rather than just print out documents, we actually did the computer models, and we handed that to industry and said, 'Here's what we think, let's have this ... conversation.'"

Ideally, the entire effort of developing and then fielding the capabilities for these space architectures will all use "that same digital thread," Raymond said. But there's still some ways to go before that's a reality for the Space Force.

"That's the nirvana," he said of the digital thread. "We're not close to that, but ... we've taken a good first step."

"We've done the digital design work, we're figuring out what a digital requirements process is, and I think it's going to pay significant dividends for us as we move forward," he said. **ND**

Command And Control

Air Force Laying Foundations for Its Version of JADC2 *BY MIKAYLA EASLEY*



NATIONAL HARBOR, Maryland — After years of experimentation and planning, the Air Force and industry are taking the first concrete steps to turn the Defense Department's concept of connecting battlefield sensors and shooters from across all domains into a reality.

The service is honing in on efforts to take the Advanced Battle Management System beyond conceptual phases, from creating new leadership roles focused on technology integration to making investments in capabilities that will mature the system to operational success, said Secretary of the Air Force Frank Kendall during his keynote address at the Air and Space Forces Association's annual conference in National Harbor, Maryland.

The Advanced Battle Management System is the Air Force's version of joint all-domain command and control, or JADC2.

At the same time, industry is making key developments they believe could one day enable ABMS, company leaders said.

The Pentagon-wide goal is to employ advanced networking and communication capabilities that connect platforms across all domains under one battle management system. At the same time, artificial intelligence and machine learning will process information gathered from those platforms. The result will be quicker and more accurate decisions on the battlefield, according to the Air Force.

Each of the services is pursuing and funding its own JADC2 program. The Navy calls it Project Overmatch, while the Army's is Project Convergence. To connect previously stovepiped systems into one joint battle management network, a range of next-generation capabilities are under development, according to the services and industry executives.

Some of the JADC2 technologies both industry and the service leaders have expressed interest in are data handling and storage mechanisms, software that can create information out of that data, computer processors with high levels of security to process that information and methods to connect platforms so they can "talk" to one another and send information to the right users.

"This has got to be about balanced operational success out on the battlefield against our pacing adversary," said Brig. Gen. Jeffery D. Valenzia, Advance Battle Management System cross functional team lead at the Department of the Air Force.

"We need a disciplined, describable and defensible way that we're going to build combined arms in a data-centric world," he said during a panel discussion at the conference.

ABMS is one of Kendall's seven operational imperatives — a list of modernization efforts the service must invest in to prepare for potential combat with U.S. adversaries.

He said the service has made progress on ABMS, but it needs to match the large-scale effort required to mature the technology.

"Our efforts to date have not been adequately focused nor have they been adequately integrated," he said.

To keep ABMS and various technologies that enable it on track, the service has appointed Brig. Gen. Luke Cropsey as the new integrating program executive officer for Command, Control, Communications and Battle Management, or C3BM, the service announced in September.

The Air Force's JADC2 efforts will fall under Cropsey, Kendall said. He will also supervise architecture and system design, systems engineering, configuration management and interface control, he added.

The new program office should result in better integration across several programs that have elements

that can enable JADC2, Valenzia said. It will help the service redefine acquisition strategies that in the past have focused on buying systems that aren't interconnected, he added.

In order to refine future capability requirements for ABMS, the Air Force is leveraging a model-based systems engineering approach that uses digital models, rather than physical models, to develop the technology.

During the conference, the cross functional team introduced a digital model to industry that depicted a future battle management scenario, Valenzia said. The service will be sending the model to industry to explore.

Lanny Merkel, director of JADC2 capabilities and proprietary programs at Collins Aerospace, said using model-based systems allows industry to experience the nuances of battle management that otherwise would be lost in traditional requirements documents.

The method will help companies with different types of technologies understand what they can bring to the JADC2 effort by breaking down its different layers and components, he said at the conference.

"Then we can see that decomposition, so then I can have a more direct line of sight to capabilities that I have that can support individual pieces and how those capabilities need to be developed and integrated in order to support the larger enterprise," he added.

The model allows both the service and industry to go from broad, conceptual ideas about ABMS to more disciplined, connected conversations about the system where everyone is speaking the same language, said Ron Fehlen, vice president and general manager for Air Force programs at L3Harris.

"What are the ground rules that we're going to use behind that model? What are the assumptions that we're making within that model? And what are the boundaries associated not only with the model in totality, but with the



An F-16 Fighting Falcon at a simulated austere base during the Advanced Battle Management System exercise on Nellis Air Force Base, Nev.

different elements in that functional architecture?” Fehlan asked. “This is a ... necessary ingredient that’s going to be a recipe for making JADC2.”

Another component to getting the system off the ground is building its digital infrastructure, Fehlan said.

The Air Force recently awarded five companies — SAIC, L3Harris, Leidos, Raytheon and Northrop Grumman — a contract to be a part of the ABMS Digital Infrastructure Consortium, which will be overseen by the service’s Rapid Capabilities Office. The consortium’s goal is to work together to design, develop and field the “JADC2 backbone” that integrates several data-centric capabilities, said Jenna Paukstis, vice president of communications solutions at Northrop Grumman.

“It’s working with industry to figure out what are the right technical and business roadmaps to make sure we can field that capability much faster,” she said on the sidelines of the conference. The consortium will focus on four areas of development: secure processing, connectivity, data management and open architecture, she added.

The value of the industry consortium is that it will let members work closely with each other to take readily available technology from the commercial sector and apply it to the Air Force’s needs, Paukstis said.

“The technology exists. So, we need to figure out how to make it work in that warfighting ecosystem, get through the multiple levels of security [and] make sure we can trust the data and where it’s coming from,” she said.

One of the commercial technologies Northrop Grumman is trying to make more applicable for the Pentagon’s JADC2 goals is 5G networks. The company announced in April it will partner with AT&T to prototype, demonstrate and test an open architecture solution

called the “digital battle network” that takes the company’s commercial 5G capabilities and adapts them for military environments with “high throughput, low latency, resilience [and] scalability — all of which are really critical in a net-centric fight,” she said.

Northrop Grumman is conducting a series of technology demonstrations that showcase the power of 5G networks in the battlespace, such as integrating tactical radios with commercial hardware and networking capabilities to demonstrate a tactical radio access network, Paukstis said. Northrop is also working on a satellite launch partnership that will bridge the company’s networking capabilities and 5G in proliferated low orbit, she added.

At the same time, Lockheed Martin is also making investments in key space-based architecture that could enable the Advanced Battle Management System.

The company is preparing for three self-funded launches of small satellite constellations in 2023 and 2024 that are aimed to demonstrate how space will bolster battlespace awareness and connectivity, said Paul Koether, program management director for mission solutions at Lockheed Martin Space.

The launches will establish the company’s first space-based joint all-domain operations test bed, according to the company.

The first of those launches will be two Pony Express 2 small satellites, a follow-on to Lockheed Martin’s Pony Express 1 mission launched in 2019. The two satellites will demonstrate tactical communications and mesh networking, a type of network in which devices are linked together and branch off other devices or nodes. The satellites are scheduled to launch in the first three months of 2023, Koether said.

The satellites will also demonstrate the company’s software-defined satellite computing technology called SmartSat, “which allows us to upload different applications or change applications on orbit,” he said in an interview.

Koether compared the technology to applications on a smartphone: “You can download new apps, you can update your apps, you can cyber-protect them as updates come — we’re doing the same things with our satellites.”

In summer 2023, Lockheed will launch its Tactical ISR Satellite to demonstrate on-orbit processing, communications and intelligence, surveillance and reconnaissance sensing capabili-

AIR FORCE

ties. The satellite is based on the Space Development Agency’s Transport Layer Tranche 0 design that will take sensor data from platforms and then transmit them to users, Koether said.

To test onboard processing capabilities, the satellite will feature an infrared sensor provided by Lockheed Martin’s missiles and fire control partners, he added.

The mission will also host the company’s first 5G.mil on orbit, Koether said. The technology is its solution to provide reliable 5G networks for military missions in austere environments using space-based architectures.

“This is our ability to actually demonstrate true 5G, non-terrestrial networks in space direct to 5G users,” he said.

Lockheed Martin will also launch a fourth satellite in 2024 called the Active RF that will serve as a technology demonstrator, he added.

Because the launches are company investments, it’s a way to show the Air Force and Pentagon the realm of possibilities for joint all-domain command and control capabilities to determine requirements instead of traditional acquisition pathways, Koether said.

“This is what we think space would have done, but this is what space is actually going to do,” he said. “The satellite will talk to the F-35 — we want to actually demonstrate that. Yes, you can close that commlink, and this is the type of data that you can pass ... so that we have real information to make informed decisions on what those requirements and acquisitions need to be.”

While Valenzia noted the progress on the modeling and technology side, he emphasized that the Advanced Battle Management System will need a clear concept of operations informed by both warfighters and industry. JADC2 critics have highlighted this lack of clarity.

Valenzia said it is needed for cross-domain command and control to be successful. The service needs to consider the assumptions and assertions of the pacing threat to develop an informed, contextualized CONOPS, he added.

“A model is just a model, and a model alone isn’t going to solve this. A model becomes the disciplined foundation that we can enter the conversation with, but a model then has to be informed by a CONOPS,” he said. **ND**

Flexing Guns

Army Making Big Push to Update Small Arms

BY SEAN CARBERRY

AUSTIN, Texas — Ukraine has centered attention on drones, artillery, armored tactical vehicles and other heavy platforms and systems. But small arms are a big part of the fight, and the Army is quietly in the process of evaluating and fielding a range of new small arms weapons and related technologies.

The service has several small arms priorities, said Col. Scott Madore, the Army's product director for soldier lethality. These include developing a weapon to engage targets in defilade, ensuring communication across enablers and weapons, producing effective suppressors that do not require extensive field maintenance, reducing size and weight of weapons and addressing toxic fumes, he said.

"A lot of the products are in production and deployment," he said at the National Defense Industrial Association's Future Force Capabilities Conference. Others are in earlier stages of development.

For example, the Army is conducting a 36-month Platoon Arms and Ammunition Configuration Study to assess future medium machine gun needs and options.

"This examines the full trade space of feasible combinations of fire control, ammunition and weapons capable of performing in a dismounted and platform-mounted configuration," said Maj. Marcus Farmer, lethality branch chief for Soldier Requirements Division.

The study will determine options such as improving the existing M240, transitioning to a new caliber or developing an entirely new weapon to replace the M240, he said. The study will run through the end of fiscal year 2023, with preliminary results expected in the second quarter of 2023.

One of the high-profile weapons in the early stages of fielding is the Next-Generation Squad Weapon.

Earlier this year, the Army selected the Sig Sauer XM5 Rifle and XM250 Automatic Rifle, along with the Vortex Optics XM157 Fire Control system, for the Close Combat Force.

Testing of the weapons — and the new 6.8mm ammunition — is focusing on "dispersion, reliability and toxic fumes," and assessing technical performance improvements based on the data received from the prototype, Farmer said.

The weapons will be put through their paces during a Nov. 20-22 soldier excursion, he said.

This excursion will use close combat force soldiers to execute live-fire tables to inform the product manager and Soldier Lethality Cross-Functional Team on the operational effectiveness of the weapon system, he added.

Fielding of the new squad weapons is expected to begin about a year from now, according to Sig Sauer. In the meantime, the Army is looking for ways to improve the M4, more than 500,000 of which will remain in service for years, said Barbara Muldowney, the Army's deputy product manager for individual weapons.

"Anything that we can improve as far as capabilities, we're always looking to evaluate if there is something already out there, or if there isn't anything commercially available, we can always do unsolicited proposals," she said. "We can always evaluate that and see what the benefit would be — not only from the increased capability for the soldier, but also from the cost and sustainability."

Her shop has had a busy 2022, with the delivery of the Sig Sauer M17 and M18 service pistols across the services and the fielding of the first Mark 22 Precision Sniper Rifle, which can fire 7.62mm, .300 Norma Magnum and .338 Norma Magnum Ball rounds, she said.

"Right now, we're waiting on the ammo for some of that, but we're fielding with the 7.62," she said. "We also completed deliveries of the M110A1 Squad Designated Marksman Rifle."

In addition, they optimized more than 1,500 of those systems, which increased reliability tenfold, she added. It was achieved by changing the vent hole within the system. "It was a huge effort between the

vendor and the government ... but it proved out to be a good investment."

Fielding of the M110A1 should be completed early next year, while the fielding of the Precision Sniper Rifle will continue through fiscal year 2024, Farmer said. Fielding of the three varieties of ammunition will take until 2027, he added.

One of the top priorities in small arms is developing a precision grenadier system: a man-portable, counter-defilade weapon to strike enemy forces hiding behind walls, vehicles or buildings, he said.

It is envisioned as "a flat trajectory, high-velocity, semi-automatic, multi-shot weapon system with firefight-ending lethality and precision compared to the legacy M320 grenade launchers," he added. It would conserve ammunition, reduce the need to maneuver, and thereby reduce exposure to enemy fire or risk of fratricide, he said.

"Over the years we have tried a number of different efforts to fill that capability," Muldowney said. "We were not successful."

Army Futures Command has given her "a thumbs up to write a requirements document and as soon as we have a draft, we will be going out with industry days to share that with industry and get some feedback on what's doable, what's not doable," she said. "Hopefully that will help us to narrow down to the final requirement, and we're anticipating a program of record to be initiated in 2025."

The expectation is that the requirements will be caliber agnostic, she said. "This is your set of targets; this is the time frame and this is the effects on



target that we want. Design a system for it.”

The initial intent is to have a complete system of weapon, ammo and fire control, she said.

Another weapon in the works is a single-use, multi-target shoulder-launched munition.

“Our current soldier-launched munitions are niche capabilities designed for specific target sets and do not address the multidomain operational environment,” Farmer said. “We don’t have one shoulder-launched munition system that can be fired from enclosure and defeat all target sets and that’s what we’re trying to get after here.”

The solution in the works is the XM919 Individual Assault Munition, which is intended to be a lightweight, multi-target weapon that can be fired from within an enclosure and pack enough punch to take out a concrete bunker or an armored vehicle. The XM919 is expected to replace the M72, M136 AT4, M136A1 AT4 and M141 munitions.

The fielding anticipates an Army Requirements Oversight Council approval in the fourth quarter of 2023 and a Milestone C decision in third quarter 2024, he said.

Mortar modernization is also proceeding with a goal of providing heavy firepower at the start of air assault and airborne operations, he said. “The current 120-millimeter mortar provides range and lethality but not the mobility and survivability against adversaries’ three-minute counter-battery capability.”

The modernization program is focused on improving lethality through

increased range and accuracy and better mobility by integrating the system onto a vehicle platform, he said.

The mortars team recently collaborated with the Maneuver Battle Lab at Fort Benning, Georgia, to conduct a constructive simulation discovery experiment, he said. The purpose was to assess the effectiveness of a mobile brigade combat team equipped with an enhanced 81mm cannon and ammunition.

“Preliminary results show that the E81 was extremely effective and advantageous against the enemy counter-battery,” he said, adding that a final report was expected in October.

In the field of crew-served weapons, there is a mix of old and new.

“A lot of times there’s an impression that we’re just buying new old stuff,” said David Oatley, product director for crew served weapons. “But the truth of the matter is that we’re continuously evolving these systems, and so the weapons that we are procuring now are not necessarily the same weapons that we had 20 years ago.”

“We have been producing these systems for a long time, and we have a lot of technical expertise within our organization to be able to modify these systems and add improvements over time,” he added.

Oatley’s office has a large customer base across the Army, Defense Department and foreign military sales, he said. “So, when you put it all together, what it really does is allow crew served weapons to not just procure items, that allows us to be able to develop solutions to whatever application is required. ... There’s a lot of potential for future development.”

Guns like the M249, M240, Mark 19 and M2A1 will continue to be fielded along with newer developments like the Saab-produced 84mm M3A1 Multi-role Anti-armor Anti-personnel Weapon System, he said.

“We’re also developing a suite of ammunition that leverages that capability for a significant increase in lethality,” he said. “We are currently qualifying the HE441E air-bursting munition for that system, which when coupled with the integrated fire control is a significant increase in lethality at extended ranges.”

And while platforms might not change much, accessories are constantly evolving, he said. “We have the improved MK93 mount for the M2 and the MK19 and that’s heading into production now. We also have

SMALL ARMS

the mounted machine gun optic for the MK19, the M240 and the M2A1.”

One of the largest items in the portfolio is the Common Remotely Operated Weapon Station, or CROWS.

“Several years ago, we initiated an effort to really address obsolescence issues on the CROWS system, because that has been continuously fielded for many years,” he said. “In that effort, we overhauled the CROWS system architecture in a way that allows us to more easily upgrade the system in the future and also allows us to maintain a single software baseline for the system.”

The office recently released the CROWS technology refresh variant, “which is a significant increase in capability,” he said. “We’ve got CROWS Javelin, so that’s really a big success for us. ... We finally began fielding and successfully handed off the first [Stryker Brigade Combat Team] out of Fort Carson.”

“One of the most visible changes on the tech refresh configuration is that now you have a high-definition screen and also you have improved sensing within a situational awareness strip across the top,” he said. That “allows you to have a wide field of view while you are also zooming in on a target.”

The next development for CROWS will be capabilities to counter Group 1-2 drones — small platforms less than 55 pounds. The capability is being developed by Army Combat Capabilities Development Command’s Armaments Center in coordination with Oatley’s office, he said.

“Probably the most exciting aspect of this is when we talk about counter-UAS, we hear about sometimes standalone equipment that is used for it,” which can require additional manpower or vehicles to employ, he said.

“However, what’s been demonstrated here is the ability to use the organic armament system that is already proliferated with CROWS, and to add on to this capability to allow any CROWS that’s out in the field to be able to engage [UAS] targets,” he said.

Using the organic capability of the CROWS platform makes it easier to deploy counter-UAS capabilities and lowers the cost per kill by using existing weapons, he said.

“It’s shown a high degree of maturity, and we’re looking forward to seeing where we could take that in the future,” he said. **ND**

M240



Army photo

WELCOME TO THE METaverse

How Interconnected, Simulated Worlds Could Transform Military Training

BY MIKAYLA EASLEY

Earlier this year, two Berkut 540 aircraft — codenamed Red 1 and Red 2 — raced down the runway of Santa Monica Airport and climbed into the California skies. As the two planes flew over Ventura County, a KC-46 Pegasus Tanker came into the pilots' view.

The tanker flew adjacent to Red 1, and the pilot navigated into position so the KC-46 could refuel the aircraft while Red 2 observed.

However, anyone looking up from the ground would have only seen two planes in the sky.

The third plane that “refueled” Red 1 wasn’t real — it was generated using augmented reality. Once in the air, the Berkut 540 pilots entered a common network. This allowed them to see and interact with the AR tanker in real time from their separate aircraft while communicating with each other.

Controlled by Florida-based startup Red 6, the exercise was one of the first successful training flights that linked multiple real-world platforms with synthetic assets, according to the company.

The demonstrated extended reality and networking capabilities are just some of the many technologies ushering in a new era of military training — one operated in the metaverse.

The idea of the metaverse has dominated the commercial space in recent years. While tech giants and small startups

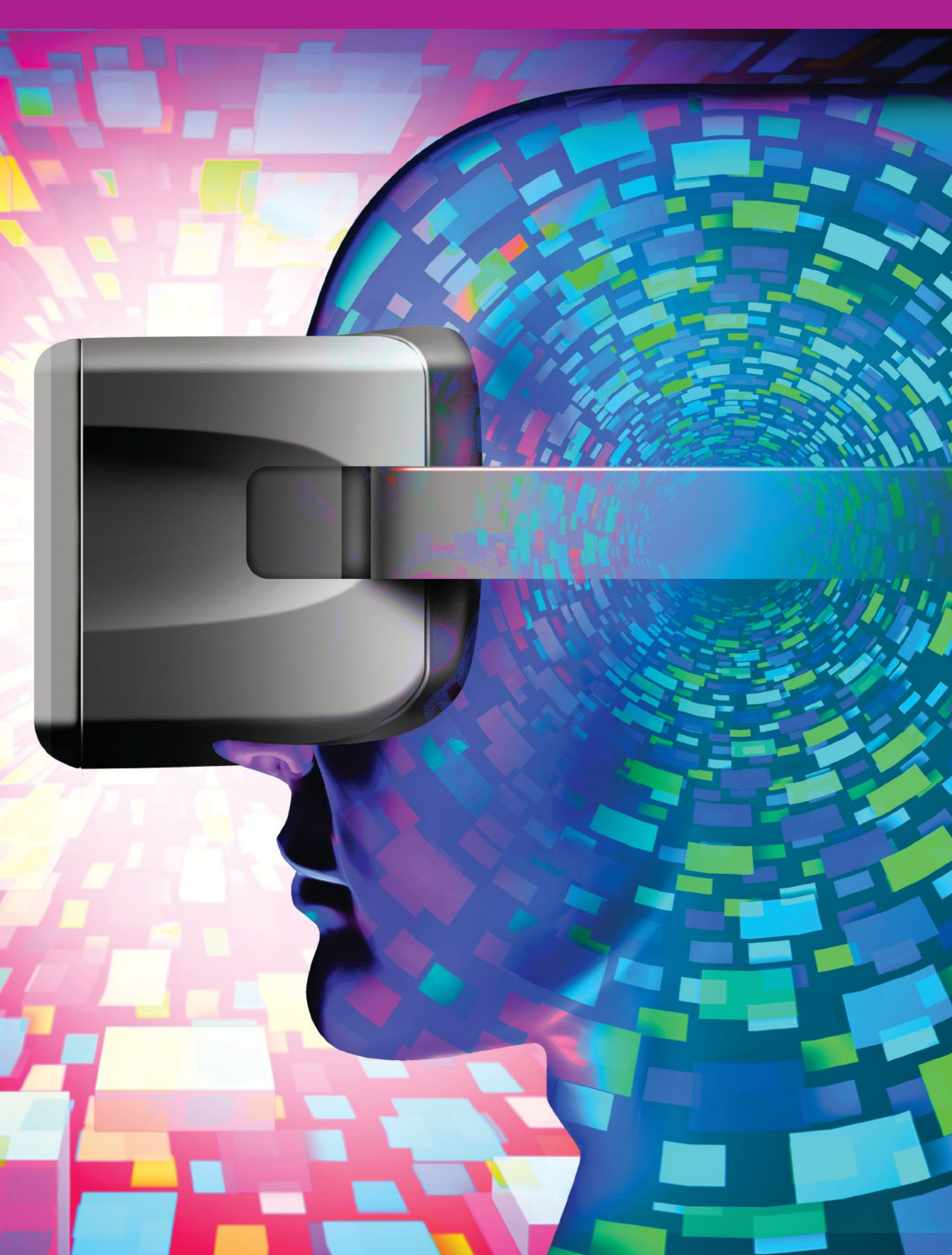
alike have hopped on the bandwagon, the U.S. military has also been interested in and developing its own “military metaverse” that can be harnessed to train thousands of warfighters simultaneously in realistic battlefield simulations.

“The metaverse means a lot of different things to a lot of different people,” Brig. Gen. William Glaser, director of the Army’s Synthetic Training Environment Cross Functional Team, said in an email. “Microsoft may be focusing on a collaborative work effort. Facebook may focus on the social aspect. If you talk to Amazon, they may say it’s about an improved shopping experience.”

Despite differing use cases, experts share some common understanding of what the metaverse is. The idea is to create a single, simulated 3D world that exists online and that multiple people can access through a device, such as a headset or tablet, from anywhere around the globe. Once inside the metaverse, a person’s “avatar” can interact with the virtual world and others in it.

Juliana Slye, founder and CEO of consulting firm Government Business Results, said the metaverse has become a viable reality due to “the commoditization and commercialization of the necessary hardware and software and other devices that make it happen.”

These include hardware components — such as headsets or tablets — that allow users to enter the metaverse, as well as advancements in high-fidelity graphics and power from gaming engines by



software companies, she said.

The metaverse would be so realistic that it suspends one's disbelief that it's a simulation, tricking their minds into thinking they are in those conditions when physically they are somewhere else, said Bob Kleinhample, business line executive at software company Improbable.

"It's like muscle memory. If [a warfighter is] training in something that's realistic, in an environment they're getting ready to go into, and the conditions are realistic, that's much more meaningful of a training experience," he said.

This means tech replicates the complexities found in real life — from the way buildings, terrain and weather shape an environment to how populations interact with one another, he said.

Software company Bohemia Interactive Simulations is developing technology for the Army's Synthetic Training Environment, or STE, that creates high-fidelity simulations for soldiers to train anywhere in the world.

Called One World Terrain, the software combines 3D data collected from satellites, sensors or scanners and combines it with additional information to render high-fidelity terrain simulations, said Pete Morrison, the company's chief commercial officer.

The Army's Synthetic Training Environment is an example of how the service could evolve live-virtual-constructive, or LVC, systems — which combine simulated and physical elements for training — into a single system to train ground, dismounted and aerial platforms, Glaser said.

The service began developing the program long before the metaverse became a buzzword in industry, Glaser said. The system is one of the service's top modernization priorities and is currently expected to be fielded in 2023.

STE's digital world will be manipulated with artificial intelligence and machine learning to achieve specific training results, he added. For example, inexperienced soldiers might enter the simulation and find perfect weather. As they get better through training, the system introduces different environmental and operational conditions, he explained.

"We want to meet the training audience where they are at, not where we want them to be and gradually

move them along," Glaser said.

Red 6, the company that controlled the simulated refueling exercise, is focused on merging synthetic and live training capabilities. The company is using AR-focused technologies to evolve pilot training, said Dan Robinson, co-founder and CEO of the company.

"The problem with LVC is as soon as you transition from beyond-visual-range to within visual-range, the whole training system collapses," he said. "There's no way of putting synthetic adversaries into the field-of-view of pilots and have them behave in a manner representative of real-world threats."

Red 6's advanced tactical augmented reality system, or ATARS, improves upon LVC capabilities and allows pilots to see augmented reality-generated objects through a headset in real time and in high-speed environments, Robinson said. When paired with the company's combined augmented reality battlespace operational network, or CARBON, multiple users can enter the same digital space and train together, he said.

These systems can realistically generate augmented reality in outdoor environments, allowing pilots to train for difficult refueling maneuvers or even high-speed dogfights, he added. Both were used during the company's summer exercise that demonstrated two aircraft communicating and interacting with an AR-generated KC-46 during a refueling mission.

Along with complete immersion

facilitated by hardware and software, the metaverse also must be a "persistent world — one that continues to exist after a user has left. Another user could go back in. The world lives outside of users," Slye said.

The digital world of the metaverse also needs to be adaptable, Robinson said. Otherwise, "it's just a video game," he said.

During combat, missions are planned and executed after an evaluation of previous outcomes and actions of enemy forces, he explained. Warfighters must adapt to changes in personnel, equipment and landscape from earlier events, he said.

"When we train — in contrast to operations — we can't do that," he said. But with an adaptive metaverse, "we can now put living, breathing walls in there with an enemy force that is driven by either human input or AI algorithms that's reacting to the outcomes of our training measurements."

This would allow the services to conduct campaign-level training over multiple weeks, where warfighters, combat commanders and senior leaders can exercise large-scale operational plans, Robinson said.

To achieve training at that scale, thousands of users need simultaneous access to a single synthetic environment. This makes the metaverse attractive for military training, Improbable's Kleinhample said.

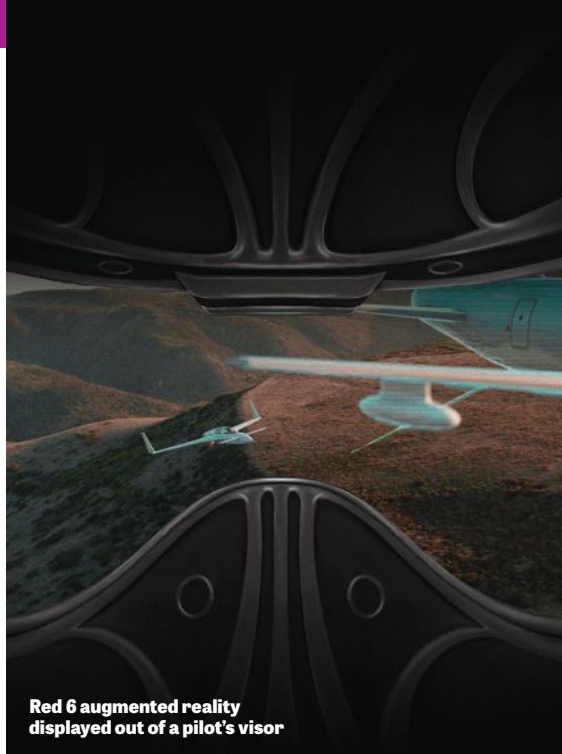
Improbable is one company working to improve the computing and networking capabilities the military would need to connect multiple users into a single metaverse training environment to the scale of multi-domain operations — which require a lot of virtual elements to render and then react naturally.

"The more dense you get, the more that stuff has to go on at microsecond levels — really straining the compute power," Kleinhample said.

The company is addressing the need for increased scale and complexity with Skyral, a platform-enabled ecosystem that facilitates collaboration and development for synthetic environments, he said.

It creates a "marketplace of capability" that will be needed to build and maintain these environments, without bogging down or crashing legacy computer systems, he added.

Improbable also offers M2, a



Red 6 augmented reality displayed out of a pilot's visor

networking capability that brings multiple unique users into virtual worlds simultaneously using its Morpheus networking technology.

The company recently held a “stress test” of the technology that had 20,000 bots interacting in a dense simulation using the technology, paving the way for having the same amount of service members enter a synthetic world for a training event, he said.

Kleinhample added that cloud computing — a network of remote servers hosted on the internet — will also help get the metaverse to the edge of operations where warfighters are located.

Data collected about an environment from deployed units can be used to recreate that theater in the metaverse, Morrison explained. Then, warfighters who are preparing to go to that environment can train alongside those who are already there.

“That’s really powerful,” he said. “We can give troops the ability to do the same convoy driving that they’ll do in theater in the environment they’re about to deploy to.”

The training benefits are not just limited to warfighters. Glaser noted that the metaverse lets Army leaders better understand its soldiers, the enemy and terrain.

“This allows commanders to improve their speed and effectiveness of their decision-making,” he said. “What we

do in a collective training environment is about synchronizing assets in time and space which requires our units to look ‘inside-out.’”

Military leaders can also harness the vast amounts of data created in the metaverse for insights on how the entire force is performing in specific exercises, Morrison said. Machine learning and data analysis on data from the metaverse could make informed suggestions for improvements, he said.

Once that data exists, it can be used to customize training based on a warfighter’s strengths and weaknesses, Robinson pointed out.

“How we’ve traditionally done it is we have a common syllabus for all students, and I think that’s a flawed concept,” he said.

In the metaverse, data produced by a warfighter’s experiences would be so accurate that it’s an actual representation of their real-life capabilities, Kleinhample said.

The military could then focus training where someone might need more practice while also letting them quickly move through other areas they naturally excel, all while keeping historical records of improvements.

It’s clear the benefits of multi-user simulated military training are indisputable — so much so that the Defense Department has been toying with the idea since the 1980s, almost a



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decade before science fiction author Neal Stephenson first coined the word “metaverse” in 1992, Slye noted.

In fact, many of the services are going virtual today, she said.

The Space Force earlier this year awarded a contract to develop a digital-twin space simulation and astrodynamics training platform. The Air Force is employing a synthetic training program known as the Operational Training Infrastructure 2035 Flight Plan, from which the Navy has derived its own version called Naval Aviation Training Next — Project Avenger. Likewise, the Marine Corps’ recent modernization efforts call for increased use of immersive training environments.

Their development reflects progress in the commercial world, where individual companies are creating “a metaverse” that theoretically could be connected into one giant virtual world, Slye said.

“There are multiple metaverses that are actually being engaged in today within the military,” she said. “I think we’re leaning toward ‘the metaverse,’ but there’s a gap between where we are today and where we can get to with ‘the metaverse.’”

However, there is no concrete plan at the Defense Department to create and invest in an enterprise-wide metaverse. Instead, each service’s separate development of metaverse-enabling technologies are based on their own training needs.

Glaser emphasized that the term “military metaverse” can be misleading, as it doesn’t entirely reflect the Synthetic Training Environment’s capabilities. While there could be a military metaverse years from now, the service is going to let industry lead that effort, he said.

Just like the multiple definitions of what the metaverse will look like, experts described many paths on how and when the entire world will get there. But if the metaverse is ultimately where the military decides to head with their training, they would have one key advantage: a clear goal.

“In the near term, it will be training and eventually we might leverage a collaborative planning environment in order to plan military operations in a distributive fashion,” Glaser said. “There are significant differences, but it all comes down to the purpose.” **ND**

Soaring Simulations

Air Force Aims for Common Virtual Training Environment

BY SEAN CARBERRY

Exceeding the limits of an F-35 during a training exercise comes at a steep price: the loss of a pilot and an \$80 million aircraft. But if that exercise takes place in a virtual environment, then there's no harm in pushing the envelope. In fact, it can yield important data on the capabilities of the aircraft and the pilot.

Advances in technology are facilitating more detailed simulations of weapons and operating environments. That's allowing the Air Force to transition more training from the real to the virtual world.

The Air Force today has some 2,400 virtual devices globally — used by the service and foreign partners — ranging from desktop trainers to full-motion simulators with 360-degree domes and aircraft cockpit hardware, said Col. Charles Ryan, senior materiel leader for the simulators division, agile combat support directorate, which is responsible for sustaining, modernizing and developing Air Force simulators and training devices.

There are two major activities ongoing to boost the interoperability and functionality of simulators, he explained during an interview.

The simulator common architecture requirements and standards initiative, or SCARS, is a sustainment effort designed to “incrementally establish open architecture for Air Force simulators,” which involves defined standards and common applications, software and hardware, he said.

Last year, the service was looking to create a consortium with industry to inform the development of a common synthetic training environment based on SCARS, he said.

“The idea there was to define the attributes and to do experimentation to understand the performance needs of a common environment, understand where those technical risks are, and develop capabilities to get after that environment,” he said.

However, earlier this year, the service determined it didn't need to reinvent the propeller. It already had most of what it needed in the joint simula-



tion environment, or JSE, he said.

The JSE was designed to serve as a high-fidelity, virtual testbed to certify the capabilities of the F-35 so it could move into full-rate production. Like many aspects of the F-35 program, it is running four years behind schedule and is not yet capable of conducting the 64 trials necessary to certify the fighter. Hence, the F-35's Milestone C is years behind schedule, according to an April 2022 Government Accountability Office report, “F-35 Joint Strike Fighter, Cost Growth and Schedule Delays Continue.”

The report noted that F-35 production has gone on for years despite JSE not being ready, and the aircraft not completing certification. “If the full-rate production decision occurs in 2023, we estimate that the program will have delivered 1,115 aircraft before finishing operational testing,” the report said, noting that could involve substantial costs to rectify flaws discovered in the final testing.

That aside, while the joint simulation environment will not be ready to complete the certification testing for the F-35 until summer 2023, its simulation capabilities offer enough robustness that the service saw it as the alternative to the common synthetic training

environment to facilitate the service's virtual training objectives, Ryan said.

“It is not a complete product, but we do have a capability today, and we're looking to grow that and mature that and extend it and scale it,” he said.

“And we will do that by leveraging that SCARS program that ... does use a kind of a consortium approach where we have both government and industry players informing those standards and the architecture that comes with that.”

Nearly 100 F-35 pilots have trained in the environment, and many have provided strong feedback about the stability, fidelity, density of threat presentation, “and that it's exactly what they are looking for, for capabilities to understand how to train, how to hone tactics,” he said.

“So that is what really caused the pivot this year, to look at JSE as not just a test environment but a training environment as well,” he added.

“That is now where the Air Force is headed from the idea of a digital test and training range where you can go and do things that you cannot do on an open-air test or training range.”

The service is in the early stages of determining how it will all come together and what platforms will end up in the joint simulation envi-

ronment in addition to the F-35, he said. The F-22 will be added into the JSE in 2024, he said.

"This was a fairly recent pivot to move to JSE for that common synthetic environment," he added.

As an environment, it allows for different models and operators to interact and "have a true high-fidelity, realistic fight with an adversary," in particular a peer adversary, he said.

Simulations can reproduce weather conditions, electromagnetic phenomena and geography.

"All of those things are represented by this environmental ecosystem where I can now bring models that are high-fidelity models and, as best as we can, represent an actual weapon system," he said.

It is joint in nature, he noted, and the Air Force collaborates closely with the

Navy in the development of the environment and the weapons systems brought into simulations.

"We also are now beginning discussion with the Space Force with regard to joint simulation environment and trying to understand how we can leverage requirements and needs and efforts between those two services as well," he added.

The JSE has been government-owned since 2015 when it was transferred from Lockheed Martin. Again, the service has struggled to complete its development, but from a training standpoint, the fact it is government-owned is an asset, Ryan said.

"It allows us to be able to get after rapid updates as you have threats changing and adapting and as we have technology changing and adapting," he said. "We can change that ecosystem quickly to keep up with those things and to stay relevant for both test and training purposes," he added.

"SCARS awarded numerous contracts in [fiscal year 2022] for continued development of common standards and architecture ... and to develop common simulation applications," Ryan said. "JSE will require continuous development and integration to modernize the digital test and

training range as threats change, technology changes and new system models and capabilities are integrated into the environment," he added.

Operators provide regular feedback to developers on what is and isn't realistic so that developers can consistently improve the fidelity of the environment, he said.

"We also have operators from instructor courses and from line units that are able to use the simulation today for some aspects of training," he said.

It hasn't progressed to the level of taking an entire course or syllabus into the virtual realm, he said, "but there are specific training activities that they can accomplish today."

For now, the virtual training environments are location-based as they require complex hardware, such as replica F-35 cockpits, he said. Over time, the goal is to move more applications to the cloud and deploy edge devices so training that does not require fixed hardware interfaces can take place remotely, he said.

It's too early to tell how much SCARS and JSE can blend to facilitate off-premises, or desktop training, he said.

"There are efforts external to JSE, but they will likely bleed into JSE in the future," Ryan said. Efforts like using lightweight simulators and extended reality technology will provide immersive training for operators.

"You can have a maintainer put on goggles and have devices to interact with this virtual environment, and they can go in and no kidding, what they're perceiving is that they are working on the actual vehicle itself," he said. "And they are able to work through the checklist and understand where they made mistakes in executing the checklist."

That can lead to developing and improving checklists by testing the order of steps or breaking things virtually, he said.

"Those are things that we're exploring right now with some industry partners to understand, what can we do there? What is the opportunity space and how can we make training more affordable?" he said.

One of the service's major initiatives is the Next Generation Air Dominance platform, which is conceived to be a sixth-generation fighter complemented by unmanned aircraft. That will require new training.

It is too soon to tell what role

TRAINING & SIMULATION

the joint simulation environment could play in training for manned-unmanned teaming, Ryan said. "It's not something where we understand right now," but JSE offers opportunities to experiment with weapons system testing and training.

"I think that's a great place where the force could potentially look at that in the future of understanding those concepts and maybe training those unmanned systems or training operators to collaborate with those unmanned systems."

Another advantage of virtual training is the ability to tailor training to individual needs and learning curves rather than putting everyone through the same training at the same pace, he said. Taking advantage of that requires a learning management and data analytics capability.

"You're going to get lots and lots of data when you go interact with this environment," he said. "Everything is being recorded. So now you have the opportunity — perhaps with machine learning, things of that nature — to really take that data and break it down by operator to understand exactly where they're at in their training evolution," so you don't waste time with people who are ready to move to the next stage.

So far, qualitative data show that virtual training is effective and that students improve skills quickly, he said.

Instructors "are now adapting some of their syllabus to include more of that virtual training in that synthetic environment because it was so successful in training those operators," he added.

The tailored training could also help address pilot shortages by moving candidates along faster, he said.

"You could be very targeted with some of your training activity and accelerate those individuals that are ready to accelerate and focus more training time on those individuals that need more help," he said. That would result in moving the pipeline faster with less effort.

"I think we're still learning in most of these areas that we haven't gotten to the end conclusion yet," he said. "But we are viewing all these as opportunity cases that we can go after and explore and understand, hey, 'How much can we really get out of this? How much can we improve and then accelerate our pilot training?'" **ND**



Red Hawk

New Jet Trainer Taxiing for Low Rate Production

BY MEREDITH ROATEN

After overcoming developmental delays, the first prototype of the Air Force's new combat trainer — the T-7A Red Hawk — rolled off the production line this year, hitting a major milestone. But the program still faces an uphill climb.

As Boeing moves toward the production phase of its T-X program — which includes aircraft, ground simulators and other training technology — to replace the aging T-38 Talons, the company is fighting to make sure it stays on schedule and on cost, an executive said. The aircraft's progress could also open up opportunities for Boeing to pitch it to additional training programs and to international customers, analysts said.

Boeing is investing in the latest technology to make sure the platform stays competitive. First, the company is revolutionizing its own production technology. The engineering and development process has become more digitalized and includes the use of model-based design, said Paul Niewald, vice president of Boeing T-7 Programs.

Going digital has helped alleviate the impact of delays, specifically the work on the forward and aft fuselages, he said. The two parts can now be joined in less than 30 minutes — a 95 percent time reduction.

The change also resulted in a 75 percent increase in engineering quality, he said.

That time-saving effort has been much needed in the program. During high angle of attack testing, the company found a problem with wing rock in the platform's design that had to be corrected, pushing back a Milestone C decision to November 2023, the company announced last year.

Even though the T-7A program is



The T-7A Red Hawk in its new livery

still targeting a 2024 initial operating capability, it is still trying to manage the effects of a global pandemic.

"COVID-19 caused delays for suppliers, which had a ripple effect on scheduled deliveries and production," he said in an email. "Therefore, COVID-19 impacts did reflect on a delay in the proposed Milestone C date. We continue to identify opportunities to mitigate delays and gain back time."

Boeing is also investing in capital renovations to its facilities that will "integrate the latest advancements in model-based engineering, automation, augmented and virtual reality, full-sized determinate assembly, modularity and more," he said.

Additionally, Boeing is modernizing its approach to managing and processing data through a 10-year contract with L3Harris that was announced in September.

The processors will streamline data from different sensors on the aircraft using an open systems approach, said David Zack, L3Harris president for mission avionics.

"You can bring in multiple data feeds, whether they exist now or the additional growth capability that is coming in the future," he said. "When we do that in an open fashion, it gives our customer the ability to scale quickly. It gives them the ability to do that at a very low cost."

Two processors will be included on each Red Hawk, and each processor contains 10 slots. New sensor technology can be added and redundant sensors can be taken out of the processors through these slots, Zack explained. The company will also leverage commercial off-the-shelf technology and provide soft-

ware that runs at different levels

Both factors can speed upgrade cycles to one or two years when they have historically taken several, he noted.

Five of the 10 slots will be used on each aircraft, leaving the rest for expanded capabilities, according to L3Harris.

The same technology is on the F-35 jet fighter and the MQ-25 Stingray drone, making it more affordable for Boeing, Niewald said.

"The processors used in the T-7A Red Hawk share a commonality with other Boeing tactical aircraft including advanced thermal capabilities that provide significant processing power in a relatively small form factor," Niewald said.

Zack added that having the processors on other aircraft has provided data to help get the system where it needs to be for the jet trainer.

"We've been able to do that over many years of experience in evolving these systems using our own internal research and development," he said. "So that research and development really formed the foundation for that infrastructure that crosses the three platforms."

Going forward, Boeing is focused on lowering the risk for the program through testing while it awaits a Milestone C decision from the Air Force, Niewald said.

The program still could face future cost growth because of schedule delays, according to the Government Accountability Office's annual weapons program assessment published in June. The report noted the cost per unit already increased less than one percent from 2018

to 2020 to nearly \$7.2 million.

While procurement costs went up one percent during the same time frame, development cost went down about 2.5 percent, according to the report.

“However, while officials told us the fixed-price development contract limits the Air Force’s cost risk, it still faces schedule delays and the risk of future cost growth as the program moves into production,” the report said.

Niewald said the program is constantly looking for ways to decrease risk.

Taking its time with the test phase is one way that Boeing can keep concerns at bay, the GAO report noted. It draws attention to the roughly 18 months between the end of the design phase and the fully integrated prototype.

“Our prior work shows such testing is key to avoiding late discovery of design deficiencies that could cause

costly, time-intensive rework,” the report said.

The prototype aircraft is expected to undergo high angle of attack testing around the first of the year, according to Boeing.

“The testing will explore the aircraft’s departure resistance at the edges of the maneuver envelope, giving the digitally designed aircraft the opportunity to prove out its stability and performance for future fighter and bomber pilots,” Niewald said.

Boeing’s aircraft have flown more than 430 engineering and manufacturing development test flights to date, which “is burning down risk” and “enabling a shorter [engineering, manufacturing and design] timeline,” Niewald added.

This year, the prototype aircraft will fly out of the St. Louis area a few dozen more times during the EMD phase of testing, he said. Dur-

TRAINING & SIMULATION

ing each flight, the platforms are observed from Edwards Air Force Base in California using a digital link that distributes the test operations, “giving subject matter experts from the Air Force and Boeing the opportunity to work together in real-time.”

Niewald declined to say when the engineering, manufacturing and design phase will end to transition to low-rate initial production. The GAO report still estimated a November 2023 Milestone C production decision.

“Boeing is working in partnership with the U.S. Air Force to complete our EMD contract,” he said. “Deliveries for [low-rate initial production] will be awarded as EMD is completed.”

The first of five test aircraft will be delivered to the Air Education Training Command in 2023, but two

T-7A Explores the Metaverse BY MEREDITH ROATEN

NATIONAL HARBOR, Maryland — The T-7A trainer jet will be able to take pilots to new heights as they practice tactics, techniques and procedures similar to what they would face in a real air fight. But what if warfighters could actually see adversaries mid-flight while they train?

That vision could soon become reality as Boeing announced in September that it would invest in the training and simulation startup Red 6.

Using augmented reality, Red 6’s headsets project planes into a pilot’s field of vision that are so realistic that the company films promotional videos by hand, said Dan Robinson, CEO and co-founder of the company.

“It’s not rendered. It is completely raw. In fact, it’s so raw that this is projected by taking an iPhone [and] sticking it inside of a headset,” he said during a rollout event in September at the Air and Space Forces Association’s annual Air,

Space and Cyber Conference at National Harbor, Maryland. “It demonstrates just as you saw it, the progress that was made in such a short period of time.”

The company’s Advanced Tactical Augmented Reality System, or ATARS, will be first integrated onto an A-4 Skyhawk test and trace aircraft, said Dan Gillian, vice president and general manager of U.S. government services at Boeing’s global services division.

The AR system would help simulate adversaries for pilots to practice dog-fighting tactics. Air Force leadership has said the service should prioritize modernizing its training using the Joint Simulation Environment, which combines live training with high-end virtual simulations.

Red 6 ultimately wants to create a training metaverse, or a digital realm that is synchronous with real life, Robinson said.

“We’ve got the genesis now of a living, breathing digital world — a metaverse that can be continuous in

nature,” Robinson said.

Once the technology gets there, the service could attempt more complex exercises such as long-term campaign training, he said.

“That’s the way we want to transform how we’re going to train the future,” he said. *(Read more about the training metaverse on pg. 30)*

After the A-4 integration, Boeing will consider other platforms such as the Red Hawk, Gillian noted.

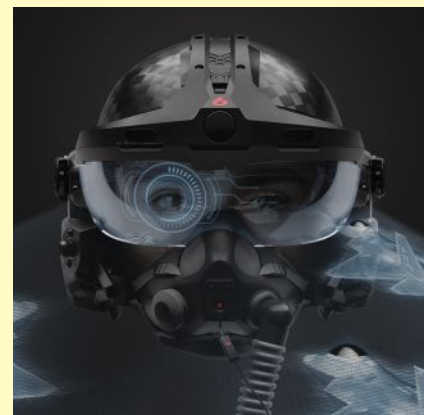
“As always, we’re spending our [internal research-and-development] dollars and our investment dollars to bring new technologies online to merge into our product lines down the road. And certainly we see a path like that happening,” he said.

He noted that any integration into the Red Hawk would happen with support from and coordination with the Air Force and would not jeopardize the program’s goals.

“It’s not affecting the near-term delivery schedule or commitment to T-7,” he said.

The T-7A is continuously exploring the latest tech in order to ensure the best technology is available for training pilots for the future fight, said Paul Niewald, vice president for the T-7 program at Boeing.

“We are confident that augmented reality with its



breathhtaking realism will be key to improving pilot training and decision-making in high-speed cockpit environments,” he said in an email. “The potential integration is an example of Boeing’s commitment to investing in technology and our drive to lead innovation in the aerospace and defense sectors.” **ND**

TRAINING & SIMULATION

fatigue and static articles will remain in St. Louis for "testing and proof of airframe integrity," Niewald said.

Meanwhile, Boeing's work on the technology behind the T-7A training system could help keep it competitive beyond the Air Force's program.

The company has expressed interest in producing an armed version of the Red Hawk, which could open up the doors for the light attack aircraft market internationally, said Ray Jaworowski, a senior analyst at defense and aerospace market outlook firm Forecast International.

"They built in a lot of growth potential into the design, so there is sufficient space in potential to incorporate a radar, to incorporate electronic warfare equipment," he said.

The aircraft has a weapon station under the fuselage, but more could be added on the wings, he noted.

The T-7A could serve as a replacement for the Dassault/Dornier Alpha Jet and Northrop Grumman F-5s that are flown in 26 countries around the world and are decades old, he said.

"The design is very flexible in that regard, and that was very, very smart," he said. "Boeing showed a lot of fore-

sight in doing that, so that opens up a lot of potential roles for the T-7."

Other opportunities to sell its training systems have opened up for Boeing inside the military, Jaworowski said.

A request for information was released last year for the Air Force's Advanced Tactical Trainer, another system which could be used to simulate adversary planes. Though there was no number officially attached, he said there could be hundreds of the aircraft purchased.

Jaworowski said the service might be interested in cutting costs through efficiencies. "Choosing the T-7 would give the Air Force some obvious synergies in terms of commonality," he noted.

The Navy also published a Sources Sought Notice for a Tactical Surrogate Aircraft last year, which mentioned the potential for 64 aircraft. The Navy will have to replace its T-45 Goshawk trainers, of which the service has nearly 200 in service, Jaworowski said.

"Right now, the services tend to use two-seat versions of their existing fighters for that role, but there is no two-seat F-35," he noted. "There's a gap there."

However, Boeing is not without its competitors. The Italian company Leonardo's M-346 and Korea Aerospace Industries' T-50 — in partner-

ship with Lockheed Martin — are two other jet trainers that could drive a wedge between the services.

But again, the T-7A's win in the Air Force's T-X program makes a compelling argument, he said.

"That certainly would give it maybe half a leg up on the competition," he said.

Congress and the Pentagon seem to support the program, Jaworowski said. He noted budgetary risks can affect any program, but it seems relatively safe.

Richard Aboulafia, managing director at forecasting firm AeroDynamic Advisory, agreed that the program seems relatively safe, but warned that excessive schedule delays could cause the Air Force to seek out interim capabilities.

Selling the trainer internationally is likely to only interest a few nations, Aboulafia said. He noted militaries around the world aren't willing to shell out as much as the U.S. Air Force, and some allies already send their pilots to train in the states.

"I'm afraid that historically the market's been pretty dismal, and it's gotten even worse because you know a few decades ago, you just didn't have international competition in this class," he said. **ND**

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Battlefield 2030

Army Training Factoring In New Realities

BY STEW MAGNUSON

With an updated field manual, an influx of new weapon systems, plus tactics used in Ukraine changing the nature of warfare, Army training is growing more complicated.

The service refined its move toward multi-domain operations and large-scale combat with the release of “Field Manual 3.0 Operations” during the biggest Army conference of the year in Washington, D.C. in October.

It called for multi-domain operations against peer competitors — who can challenge the service in land, sea, air, cyberspace and the electronic spectrum — to be the centerpiece of its warfighting concept through 2030.

Army Chief of Staff Gen. James McConville said in a keynote speech at the conference that the doctrine “recognizes that the Army will be tested in every domain — in air, land, sea, space and cyber — and that the future Army must prepare to fight in multiple domains at once.”

Brig. Gen. Thomas Feltey, commandant of the Army Armor School at the Army Maneuver Center of Excellence, said, “There is going to be a cascading effect across all of the institutions as we now have to begin operationalizing this new doctrine.”

For those who have been listening to Army leaders over the past five years, the new doctrine should come as no surprise.

“You have an ever-changing operational environment,” Feltey said during a panel at the Association of the United States Army’s annual conference. “Everyone can see it. If you’re reading the news, you see things are changing. Some of the character of war is a little different now than it was, and it’s continuing to change.”

In addition, with Army Futures Command’s push to modernize the service’s technology, new weapon systems will be flooding into the forces.

The command has vowed to field 23 new weapon systems by fiscal year 2024.

Items such as the Next Generation Squad Weapon are already in the pipeline and will require

updated training, Feltey noted.

Brig. Gen. Curtis Taylor, commanding general of the National Training Center at Fort Irwin, California, said, “We’ve got to think about how the NTC is changing now in light of the evolving character of war that we’re seeing and that are in Ukraine and in Nogorno-Karabakh,” he added.

Azerbaijan and Armenia fought over Nogorno-Karabakh in September 2020, and clashes broke out again in September of this year.

The Army’s Combined Arms Center at Fort Leavenworth, Kansas, is the organization in the service responsible for gathering “lessons learned” from the war in Ukraine

the “transparent battlefield” concept, which assumes that the enemy knows exactly where U.S. forces are and what they are doing.

The service must operate in an era of persistent overhead surveillance from remote sensing satellites in space or unmanned aerial vehicles.

“We are bringing the transparent battlefield to life at the National Training Center,” Feltey said.

That transparency is a two-way street. The Army is using electronic warfare to find, fix and destroy enemy forces. In a recent nine-day exercise, soldiers destroyed 54 command posts operated by blue forces, he said.

The two conflicts in Europe have shown the utility of small kamikaze drones that can be used as both surveillance platforms and munitions.

The training center recently held an exercise where a swarm of 40 drones attacked a defensive position, he said.

Brig. Gen. David Gardner, commanding general of the Joint Readiness



and disseminating them to the wider force. It also produced the updated version of FM 3.0 Operations.

The new doctrine defines multi-domain operations as “the combined arms employment of joint and Army capabilities to create and exploit relative advantages that achieve objectives, defeat enemy forces, and consolidate gains on behalf of joint force commanders.”

The new doctrine also puts forth

Training Center at Fort Polk, Louisiana, said soldiers must be trained to operate in transparent, congested, degraded and area-denied battlefields.

For example, if their GPS is denied, how do they “drop down” to analog systems or alternative precision navigation and timing devices.

“We have to pursue the realistic training devices that drive the training outcomes to counter that environment, to fight in that environment and to

succeed on the modern battlefield,” he said.

Gen. Gary Brito, commanding general of Training and Doctrine Command, in a statement said, “The TRADOC team is committed to building the Army of 2030 down to the soldier level through training, education and exercising our foundational operations doctrine.”

To ensure readiness and increase understanding of the new operations doctrine, the Army will use mobile training teams to introduce the revised FM 3.0 to leaders responsible for professional military education, at the combat training centers and in the operational force. Subject matter experts are also developing a series of training materials and presentations designed to augment the support to units, an Army statement said.

Meanwhile, the Army faces other training deadlines. The Program Executive Office for Simulation, Training and Instrumentation, has two of the 24 technologies the service has vowed to field by 2024 and supports a third under PEO Soldier.

Karen Saunders, PEO STRI’s leader, said in an email that those programs, which will be a part of the larger Synthetic Training Environment, are on track.

“As the Army’s top training modernization initiative, the Synthetic Training Environment brings together the live, virtual, constructive and gaming training environments, which will also eventually include interoperability with the intelligence and cyber components ... and replicates the challenges of training to fight in multiple domains,” she said.

One of the technologies that undergirds the Synthetic Training Environment is the One World Terrain database that will allow simulator programmers to add up-to-date 3D images of every part of the planet to make training rehearsals more realistic. Its open architecture software will replicate land, sea, urban, rural and the cyber environment.

Saunders said the first iteration of the database — a minimum viable capability release — will be fielded in spring 2023. It will then

be updated on an annual basis.

The second technology under the Army’s self-imposed deadline is the Squad Immersive Visual Trainer, which is part of the Integrated Virtual Augmentation System, which falls under PEO Soldier.

That is a heads-up display soldiers wear in the field that uses augmented reality to overlay information. The Squad Immersive Visual Trainer will use that system for training and leverage the One World Terrain database. Both are on track to meet the 2024 deadline, Saunders said.



PEO STRI is also working on the Synthetic Training Environment-Live Training Environment as its main simulator, and earlier this year was challenged by Army leaders to deliver it two years early in 2024.

This simulator will incorporate the One World Terrain database and the Squad Immersive Visual Trainer into its system.

To support the challenge in addressing technological advancements by fiscal year 2024, the office has stood up a STRI Agile Acquisition Response Team test bed alongside the Operational Test Command in Fort Hood, Texas, Saunders said.

“Through a series of soldier touchpoints, the testbed has assessed technologies across direct fires, indirect fires ... all supporting an assessment of a fielding delivery to the Joint Read-

iness Training Center in FY 2024,” she said.

The Army has a vision and a strategy to prepare the force for multi-domain operations,” she said.

“It is a comprehensive solution, which is codified in the Army Modernization Strategy. Within the training pillar, the Synthetic Training Environment is critical to that vision in that it will fundamentally modernize the way we train. It is designed to enhance soldier and unit lethality and training readiness by creating tough, realistic, iterative and complex training at the unit commander’s point of need,” she said.

Col. Scott Woodward, deputy commander of the Combined Arms Center-Training, one of the intended end users for the Synthetic Training Environment, said he is working closely with Synthetic Training Environment Cross Functional Team and Army Futures Command to ensure that all these technologies and concepts come together and are integrated.

“But don’t forget, we’re talking about 2030 here. This stuff won’t be ready tomorrow,” he said.

In addition, the Army must upgrade its ranges to fit the new doctrine and technologies, Scott said. The center is looking at upgrading and modernizing its facilities for home-station training and building ranges for multi-domain operations.

It is currently designing ranges to accommodate the Next Generation Squad Weapon.

High-tech moving targets will be a part of the modernized ranges. They incorporate electronic and thermal signatures to replicate different vehicles. By changing the configuration of the “multispectral targets,” the range can replicate eight different vehicles, he added.

New fighting vehicles will be among the technologies that soldiers will have to train on in the coming years.

Four of the Army’s major ground vehicle modernization programs are moving forward in fiscal year 2023, senior Army officials said at the conference.

The Armored Multi-Purpose Vehicle, Optionally Manned Fighting Vehicle, Mobile Protected Firepower and the Robotic Combat Vehicle are all entering new stages of development or fielding. **ND**

Transitioning from Human Pilots to Drones

The use of unmanned aerial vehicles is not a new phenomenon for the U.S. military. To the contrary, the Pentagon has been developing this type of platform as early as the 1990s. During this period, substantial government investment occurred, leading to numerous prominent systems that are now essential for U.S. national security.

These platforms proved to be invaluable tools for the U.S. campaigns in Afghanistan and Iraq. Not only did these drones provide options to exercise lethal force, but they were also essential in enabling successful intelligence, surveillance and reconnaissance missions.

While promoting unmanned aerial vehicles, the United States continues to invest substantial resources in manned aircraft to ensure continued air superiority. This is reflected in the sizable contracts awarded to manned aircraft programs, along with commitments to outfit allies with specific platforms.

Despite this commitment, some human-piloted platforms continue to encounter serious issues. For example, numerous pilots have experienced respiratory complications while using current generation fighter aircraft. This is particularly dangerous as it can result in potential incapacitation of the pilot if not quickly rectified.

Recognizing the importance of addressing this problem, the House Armed Services tactical air and land forces subcommittee requested a full investigation. However, this single issue is far from the only problem plaguing manned platforms within the military.

In recognition of this, the Pentagon should consider whether unmanned aerial vehicles should play a larger role in future military operations. Or, if the Air Force is adamant about maintaining the manned aerial vehicles, it should inquire about what the platforms can do to reduce the physical stress on the pilot.

Recently, a concept was unveiled that detailed a “crewed-uncrewed” platform to allow control of sophisticated airborne drones, equipped with sensors and fire capability, to fighter pilots in flight.

Such a plan would allow the military

to begin a transition toward UAV-dominated air forces. Not only would such a transition provide greater safety to the airmen and women who serve in the armed services, but it would allow platforms to achieve greater performance.

This system would be a part of what the Air Force calls collaborative combat aircraft, which will be part of the Next Generation Air Dominance family of systems. The purpose of this initiative is to surround a single manned aerial vehicle with “loyal wingmen” drones to allow faster and more efficient execution of the kill chain.

The United States cannot afford to postpone this evolution in combat as it has already witnessed how UAVs have impacted modern battlefields. The 2020 conflict between Armenia and Azerbaijan, for example, demonstrated how unmanned platforms can dominate and overwhelm traditional platforms used by conventional armies.

Azerbaijan’s drone fleet was able to target Armenian forces at a fraction of



the cost of those targeted platforms. Using such a tactic allowed Azerbaijan to achieve a swift victory, but one that could not be achieved without the use of subtle, small drones. By weakening Armenia’s defenses with drone strikes, Azerbaijan could advance with its own conventional forces.

The United States can learn from this conflict. Specifically, it showed the unique threat drones pose to the enemy consisting primarily of conventional forces. Should the nation find a need to support allies like NATO or Taiwan in conflict, it could provide low-cost drones



to overwhelm an enemy.

Drones could either be used as an effort to support allies without having to commit conventional forces or be part of a combined arms approach. In either case, the United States is currently exploring ways to diversify its drone forces, which will allow it to replace certain combat roles like bomber escorts.

The key aspect of drones is that they are expendable, unlike the latest fighter aircraft which have an average cost of approximately \$80 million per unit.

Since the U.S. military, or any nation’s military, is currently unprepared to completely replace all combat platforms with unmanned or autonomous platforms, the United States should not abandon its manned aircraft altogether.

Instead, it should invest its military funding and resources into fixing pilot-centered issues along with new drone platforms. This would allow for a smooth transition into Next Generation Air Dominance.

Admittedly, the drone “wingman” systems are still in development and will require extensive testing before the U.S. services can commit to such a revolutionary combat platform.

The Defense Department should focus on maintaining the strengths and unique characteristics of the current manned platforms while insulating the human pilots from strenuous physical limitations. Current fighter aircraft are certainly state-of-the-art but may better serve their purpose when matched with unmanned and autonomous systems.

This transition will not happen in the near future, so the Pentagon possesses adequate time to address the various issues imposed on human pilots. Furthermore, contractors will continue developing the drone platforms, sensor equipment and autonomous computing that will allow for the future of warfare to take the next step. The United States will have to find a way to balance its commitment between use of manned and unmanned platforms to lead its future combat forces. **ND**

David Winter is an NDIA junior policy fellow.

White House Pushes Domestic Manufacturing

On Sept. 19, the Government Services Administration issued a request for information regarding domestically manufactured solar photovoltaic panels and systems, as well as system installation. Responses are due Nov. 18. The RFI's emphasis on U.S. manufacturing and clean energy technology is no accident. Rather, it is a natural result of the Biden administration's intense focus on these policy areas.

The administration jumpstarted clean energy efforts in the procurement space in December 2021, when President Biden issued Executive Order 14057, "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability."

That order directed government to "transform federal procurement" and adopt sustainable practices, with the ultimate objective of net-zero emissions by 2050. To achieve net-zero emissions, the executive order and an accompanying federal sustainability plan set various policy goals, including an initiative to develop onsite "carbon pollution-free electricity" generation — defined as energy produced from various resources that generate little or no carbon emissions — for federal facilities, as well as an initiative to enter into power purchase agreements with carbon-free producers.

The administration's prioritization of clean energy has been mirrored by an equally intense focus on domestic manufacturing. In January 2021, President Joe Biden issued Executive Order 14005, "Ensuring the Future Is Made in All of America by All of

The Office of Management and Budget formally established a Made in America Office in April 2021, and the Federal Acquisition Regulatory Council subsequently issued the requested Buy American Act final rule in March 2022, which increased the domestic content threshold and established a framework wherein "critical" items would receive a higher price preference. The government reserved identification of those critical items for a subsequent rulemaking.

Other policy directives have focused on incentivizing domestic production. In June 2022, the administration invoked the Defense Production Act to accelerate domestic production of clean energy technologies, including "solar panel parts like photovoltaic modules and module components."

The Department of Energy is implementing that directive and recently issued a request for information seeking public comment on how the production act could best be used to accelerate domestic production of clean energy technologies. Comments are due by Nov. 30.

As it invoked the Defense Production Act, the administration implemented two additional changes to support the domestic solar manufacturing industry. First, it directed the government to enter "Master Supply Agreements" for "domestically manufactured solar systems to increase the speed and efficiency with which domestic clean electricity providers can sell their products to the U.S. government."

Second, it directed the government to establish "Super Preferences" to "apply domestic content standards for federal procurement of solar systems, including domestically manufactured solar photovoltaic components, consistent with the Buy American Act."

The Government Services Administration's latest RFI is another boost for the domestic photovoltaic industry. The RFI indicates that the government intends to use information collected from industry to develop a photovoltaic procurement strategy and a standard for use in future solicitations — including solicitations for power purchasing agreements, energy savings performance contracts, utility energy service contracts, solar array development contracts

and other acquisition vehicles.

The RFI also demonstrates how the administration's domestic manufacturing and clean energy policies interact with regulatory changes recently enacted into law by Congress.

For example, the RFI requests information regarding how U.S. manufacturers monitor compliance with the Uyghur Forced Labor Prevention Act. The act took effect in June 2022 and places strict limitations on goods produced in the Xinjiang region of China. This restriction has particular significance to the domestic solar industry, since the region is a major source of polysilicon, an essential material for solar modules. As such, the RFI directly asks whether the implementation of the act helps or hinders domestic manufacturing.

At the same time, the RFI asks contractors about their ability to comply with domestic content thresholds. This includes the new higher thresholds imposed through Executive Order 14005 and the subsequent March 2022 final rule. It also includes the infrastructure-related domestic content requirements enacted by Congress in the Infrastructure Investment and Jobs Act.

At a higher level, the RFI also seeks information about the tradeoffs that would be made if the government were to adopt a stronger preference, or "Super Preference," for domestically produced photovoltaic equipment. Thus, it asks for input regarding the likely impacts of new domestic content requirements — including a potential requirement for government-purchased solar energy to be generated using only domestically manufactured photovoltaic equipment — and similarly asks about how its procurement standards could be better tailored to encourage domestic manufacturing.

The RFI is just one part of a broader, government-wide focus on green energy and domestic manufacturing within the U.S. government contracts industry. More is sure to come, as high-level policy directives continue to be converted into practical requirements. **ND**

Nooree Lee is special counsel, Peter Terenzio an associate and Michael Wagner is a partner at Covington & Burling LLP.



America's Workers." That order was targeted at strengthening existing domestic preference laws, including by establishing a new Made in America Office to oversee domestic preference requirements in federal procurements and by issuing an updated final rule increasing both the domestic content threshold under the Buy American Act and the price preferences for qualifying products.

Association Welcomes New Board, Executive Committee Members

The National Defense Industrial Association appointed Michael Bayer, president and CEO of Dumbarton Strategies, as the new chair of the organization's board of directors. His two-year term began Oct. 1.

Bayer holds leadership roles on numerous corporate boards and has extensive experience in industry. He served every secretary of defense from Bill Perry to Mark Esper and has been

recognized for his contributions with the Defense Department's highest civilian awards: four Defense Distinguished Service Medals, two Navy Distinguished Service Medals and one Army Distinguished Service Medal.

Bayer succeeds Arnold Punaro, CEO of The Punaro Group. Punaro will continue to serve NDIA for two years as its chair emeritus, as well as chair of NDIA's nomination and governance committee and chair of the advisory board of the Emerging Technologies Institute.

"Bayer brings a highly experienced and successful leadership record to NDIA: in uniform, on Capitol Hill and in ever-increasing senior positions with the executive branch as well as in industry, his track record



is unsurpassed," Punaro said in a statement.

Lisa Disbrow, former undersecretary of the Air Force, was elected to take over from Bayer as vice chair after serving as NDIA's compensation committee chair.

The association also welcomed two new members to serve on

its executive committee: Paula Edwards is the founder, president and CEO of Lexair Corp. and M.L. Mackey is the CEO and co-founder of Beacon Interactive Systems.

"Both Paula and M.L. bring first-hand, small business expertise and proven track records to NDIA and its members," Punaro said. "These leaders bring exceptional business acumen and demonstrated leadership to NDIA." **ND**

NDIA Appoints New Executive Vice President

Jennifer Stewart has been named the new executive vice president for strategy and policy at the National Defense Industrial Association.

Stewart has 18 years of public service, including more than 12 years



of work in senior national security positions. She served as the chief of staff to the secretary of defense and was responsible for leading the secretary's executive staff and providing counsel and advice to him on all matters concerning the department.

She also previously served as both the majority and minority staff director for the House Armed Services Committee, as well as senior advisor to Army Gen. Joseph F. Dunford during his first term as chairman of Joint Chiefs of Staff. **ND**

Magazine Receives Record Award Nominations

National Defense reporters recently received nine nominations for the 2022 Defence Media Awards recognizing their achievements in defense journalism and publishing. Organizers of the event confirmed that the nominations were the most for any single publication since the awards were established.

Staff Writer Mikayla Easley was nominated for Best Young Journalist and Best Land Vehicles submission for her deep

dive into the Army's optionally manned fighting vehicle program.

Staff Writer Meredith Roaten received three nominations, including Best Military Rotorcraft submission detailing the Black Hawk replacement competition; Best Training, Simulation and Readiness submission for her story on haptic technology; and Best Cyber Security submission for her coverage of the Pentagon's terminated Joint Enterprise Defense Infrastructure program.

Editor in Chief Stew Magnuson also received three nominations: Best Breaking News Story for his detailed conversation with Ukrainian Defense officials; Best Defence Electronics submission for his coverage of Project Convergence 2021; and Best Technology Submission for his cover-story on the U.S. rare earth element market.

Former Senior Editor Yasmin Tadjdeh received a nomination for Best Land Vehicles submission.

The awards were pre-

sented Oct. 9 at the National Press Club, where Roaten won in the Cyber category and Magnuson won in the Technology category. **ND**



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industrial base and serving all military services. For more information please call our membership department at 703-522-1820 or visit us on the web at [NDIA.org/Membership](https://www.ndia.org/Membership)

NDIA CALENDAR

• The National Defense Industrial Association continues to follow all developments regarding COVID-19 and is diligently examining each event to determine the best course of action as we look forward to gathering leaders in government, industry and academia again to solve the most challenging issues in national security in person.

The health and safety of all our

registrants is our highest priority, and we will continue to follow local, state and CDC guidelines to keep everyone safe.

Visit [NDIA.org/events](https://www.ndia.org/events) for more information.

Christine M. Klein
Senior Vice President, Meetings,
Divisions & Partnerships

November

1-3

2022 Aircraft Survivability Symposium

SECRET/NOFORN

Monterey, CA

[NDIA.org/AircraftSurvivability22](https://www.ndia.org/AircraftSurvivability22)

1-3

25th Annual Systems & Mission Engineering Conference

Orlando, FL

[NDIA.org/SME](https://www.ndia.org/SME)

2

NTSA November Webinar

Virtual

[NTSA.org/Nov2022WebinarServices](https://www.ndia.org/Nov2022WebinarServices)

15-17

2022 NDIA Multinational Conference

Amsterdam

[NDIA.org/Multinational](https://www.ndia.org/Multinational)

16

NTSA November Webinar

Virtual

[NTSA.org/Nov2022Webinar](https://www.ndia.org/Nov2022Webinar)

17-18

33rd Annual NDIA SO/LIC Symposium

Washington, DC

[NDIA.org/SOLIC](https://www.ndia.org/SOLIC)

**FOR THE LATEST NDIA CALENDAR:
[NDIA.ORG/EVENTS](https://www.ndia.org/events)**

28-Dec. 2

I/ITSEC 2022

Orlando, FL

[IITSEC.org](https://www.iitsec.org)

2 0 2 3

February

22-24

25th Annual Expeditionary
Warfare Conference

www.ndia.org

27-Mar. 1

2023 Tactical Wheeled Vehicles Conference

Columbus, OH

[NDIA.org/TWV23](https://www.ndia.org/TWV23)

March

1-2

2023 Human Systems Conference

Arlington, VA

[NDIA.org/HumanSystems23](https://www.ndia.org/HumanSystems23)

6-9

2023 Pacific Operational Science & Technology (POST) Conference

Honolulu, HI

[NDIA.org/POST](https://www.ndia.org/POST)

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Disaster Relief/Planning Simulations
Distance Learning
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Educational Products & Services
Electronic Components

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Engineering/Damage Control Trainers
Exercise Management
Flight Simulation & Training
Gaming
Homeland Security Simulation &
Training
Instructional Systems Design
LVC (Live, Virtual, Constructive)
Manufacturing
Medical Simulation & Training
Mission Planning/Mission Rehearsal
Modeling Services
Oil, Gas, Energy
Operational & Maintenance Services
Operator/Driver Trainers
Physical Training Equipment
Pre-Brief/After Action Review
Research & Development

Shiphhandling Trainers
Simulation Security
Simulation Software
Simulation Toolkits
Small Arms Training
Small Business
Staffing/Logistics Support
STEM
Tactics Trainers
Trade Publication / Media
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Transportation
Vehicle Trainers
Verification & Validation
Visual Computing
Visual Display Products
Weapon Systems Trainers & Equipment

2023 TACTICAL WHEELED VEHICLES CONFERENCE

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How should the Department of Defense modernize and ensure the sustainment of the tactical wheeled vehicle industry?

Join us in Columbus, OH for the next Tactical Wheeled Vehicles (TWV) Conference to learn more.

Recognized as the industry's premier event, TWV is invaluable to military leaders, industry, prime and subcontractors, suppliers, and academia focused on the design, development, innovation, acquisition, production, delivery and sustainment of tactical wheeled vehicles.

With interactive panel discussions and bespoke networking events that offer direct access to OEMs and military leaders, you won't want to miss out.

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February 27 – March 1, 2023 | Columbus, OH | [NDIA.org/TWV23](https://ndia.org/TWV23)

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2023 PACIFIC OPERATIONAL SCIENCE & TECHNOLOGY (POST) CONFERENCE

Head to Hawaii for the Indo-Pacific's foremost event on regional security, hosted in-person by NDIA and the U.S. Indo-Pacific Command.

Pacing threats from near-peer competitors and belligerent actors are on the rise. Join experts in science, technology, and security who are set to meet on this year's theme "*Seizing the Initiative via Superior Innovation and Collaborative Partnerships*" and address the critical challenges facing the region.

Featuring DoD opportunities for joint research, development, and prototyping and experimentation in support of joint fires, information advantage, contested logistics and other joint warfighting challenges, this event is a premier networking opportunity.

Save The Date. Registration Opens in December.

March 6 – 9, 2023 | Honolulu, HI | [NDIA.org/POST](https://ndia.org/POST)



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33RD ANNUAL SO/LIC SYMPOSIUM

SOF - Building Enduring Advantages with Allies and Partners

Brought to you by the National Defense Industrial Association's Special Operations and Low-Intensity Conflict (SO/LIC) Division, this year's symposium doubles down on how the U.S. and our allies can combat the threat from near peer competitors.

Our adversaries don't rely on military power alone: they're deploying a wide array of military, economic, technological tools through disaggregated surrogates, proxies and cybercriminal syndicates.

Special Operations Forces (SOF) can't focus exclusively against one type of threat or even a single form of conflict. And in our hyper-connected global environment, we know that no single nation can compete and win alone.

Join the nation's top SOF leaders and experts as we unite to tackle these threats together.

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November 17 – 18, 2022 | Washington, DC | [NDIA.org/SOLIC](https://ndia.org/SOLIC)

NEXT MONTH

Carrier Capabilities

• Over budget and oft-delayed, the USS Gerald Ford is finally at sea. What does the newest carrier bring to the Navy?

Army Modernization

• Army Futures Command has a new leader in place and is receiving more scrutiny than ever as it continues its quest to modernize the service's technology.

CMMC

• A year after the Pentagon released its revamped Cybersecurity Maturity Model Certification guidelines, how are the standards impacting defense contractors and how they are adapting to compliance challenges?



Middle East Special Ops

• While the U.S. military has deemphasized combating terrorism, it is still a scourge in the Middle East. Special operators there are seeking new tech to help them do their jobs.

Project Convergence

• *National Defense* travels to Fort Irwin, California, to see how the Army, the other services and international partners plan to execute joint all-domain command and control.

Useful Fiction

• Peter W. Singer, one of the best-known names in warfare and strategic literature, shares how he's helping defense companies and Pentagon officials better communicate their messages through storytelling.

NATO-Japan Partnerships

• Japan has been building its relationship with NATO partners. How can the partnership be strengthened to address shared security challenges?

Climate

• The Army released its first-ever "climate strategy" earlier this year. Military and industry experts share insights into the threat of climate change and the capabilities needed to increase the Army's resilience.

Navy photo

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