

National DEFENSE

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Indo-Pacific Tech Review

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With Eyes on China Threat

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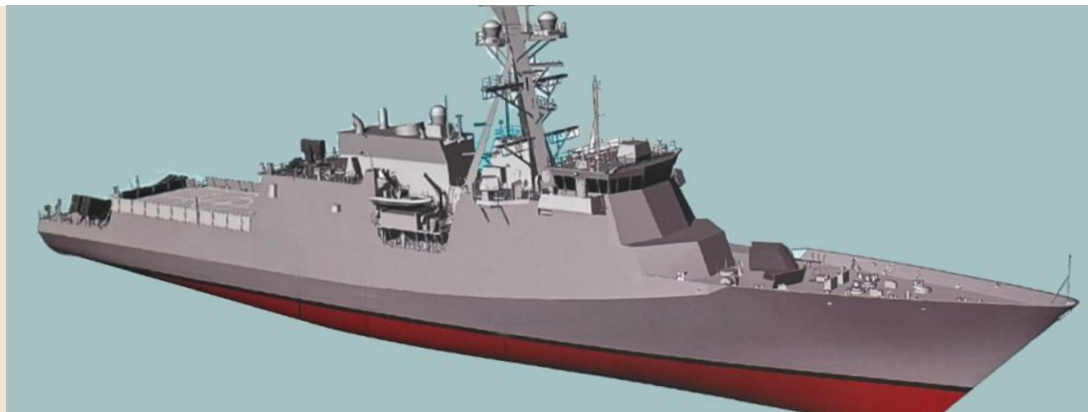
- Operation Absolute Resolve — with an objective to capture Venezuelan President Nicolás Maduro in early January — revealed lessons for military logisticians, who had to organize a mission in a region where the Joint Force doesn't have a lot of experience.

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- Wearable sensors for troops, island-hopping watercraft and semi-submersible boats are just some of the new technologies U.S. forces are looking at fielding to counter China and conquer the tyranny of distance.

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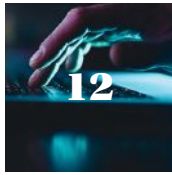
- The Navy is simultaneously embarking on two new ship programs — the Trump-class battleship and a second attempt at developing a new frigate.



COVER: Marine Corps photo

BPA *National Defense* (ISSN 0092-1491) is published monthly by the National Defense Industrial Association (NDIA), 2101 Wilson Blvd., Suite 700, Arlington, VA 22201-3060. TEL (703) 522-1820; FAX (703) 522-1885. **ADVERTISING SALES:** Kathleen Kenney, 2101 Wilson Blvd., Suite 700, Arlington, VA 22201-3060. TEL (703) 247-2576; FAX (703) 522-4602. The views expressed are those of the authors and do not necessarily reflect those of NDIA. Membership rates in the association are \$40 annually; \$15.00 is allocated to *National Defense* for a one-year association basic subscription and is non-deductible from dues. Annual rates for NDIA members: \$40 U.S. and possessions; District of Columbia add 6 percent sales tax; \$45 foreign. A six-week notice is required for change of address. Periodical postage paid at Arlington, VA and at additional mailing office. **POSTMASTER:** Send address changes to *National Defense*, 2101 Wilson Blvd, Suite 700, Arlington, VA 22201-3060. The title *National Defense* is registered with the Library of Congress. **Copyright 2026, NDIA**

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CORRECTION

In the February 2026 issue, the photo on page 35 misidentified the vehicle and gave the wrong credit. It was a BAE Systems AMPV C-UAS prototype equipped with the Moog Reconfigurable Integrated-weapons Platform turret. The correct photo credit is BAE Systems.

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Challenges in the Indo-Pacific Endure for Pentagon

The 2026 National Defense Strategy emphasizes the United States and the Defense Department must be clear-eyed and realistic about the speed, scale and quality of the People's Republic of China's historic military buildup.

It further states that if China or any other country were to dominate the Indo-Pacific region, it would be able to effectively veto the United States' access to the world's economic center of gravity, with enduring implications for U.S. national economic security and its ability to reindustrialize.

These are not academic concerns. Geopolitics are driving major government decisions and subsequent business strategy adjustments regarding the resilience and diversification of U.S. domestic manufacturing capacity and supply chains.

In the Indo-Pacific, U.S. allies and partners clearly articulate the daily impacts rapidly changing economic, diplomatic and security paradigms have on their economies and citizens. It is resulting in decisive action by national governments in the region to harden the resilience of civil societies and — in limited but strategic cases — to shift commercial production to dual-use or military production.

In this environment, senior military commanders emphasize preserving the conditions for strategic stability and deterrence. They are laser-focused on three megatrends shaping military strategy at the operational level in the Indo-Pacific, of which each is reducing indications and warning timing: ubiquitous information technology, which is volatile, salient and vulnerable; the commoditization of unmanned systems across every domain of warfare; and proliferation at scale of access to long-range precision penetration and strike capabilities.

And they are continuing to emphasize the imperative to rapidly improve capability integration and interoperability across U.S.

service components in the region, as well as with allies and partners.

Additionally, there is significant senior leader attention — both in the Pentagon and in Congress — to proactively address challenges with logistics

and sustainment in contested operational environments.

These challenges are compounded in the Indo-Pacific region, with the tyranny of distance and the extreme diversity of climates, ecosystems and geography, as well as limited land-based infrastructure from which servicemembers can operate and sustain themselves.

Here, too, there is more directness about the priorities — it is not just about operational employment of platforms. The availability of fuel, food, water, medical supplies and munitions are also top of mind for these leaders.

To maintain deterrence but prepare should conflict erupt, there are extensive ongoing efforts to preposition and stockpile equipment in places from which the U.S. military would intend for coalition forces to operate. This also includes hardening infrastructure and ensuring the availability of supplies in austere and expeditionary environments.

In addition, there is heavy emphasis on mapping and developing multimodal transportation routes. Based on the threat level, military transport will be the primary mode, but given the scale and complexity of the challenge, work is being done to build commercial and hybrid logistics and sustainment networks in the region.

This nests under strategic efforts to incentivize regional defense industrial base integration across U.S. allies and partners, to stress test processes intended to support in-theater maintenance and repair, to incentivize mass production forward and to mature technologies and processes around additive manufacturing.

Another angle on this challenge is ensuring reliable and resilient command and control — particularly for smaller units who would be widely distributed and operating under conditions in which they must remain

highly mobile and tactically agile. In this context, there is heightened interest from industry regarding the work that needs to be done in 2026 around applied artificial intelligence.

To date, most AI work has been done



at enterprise levels across the department under controlled parameters. Industry recommends this important work expand to include additional efforts to test under conditions more analogous to realistic deployed environments in order for senior leaders to learn more about what they need to see to gain confidence regarding operational effectiveness.

To responsibly start to reduce known friction points around fielding, testing, evaluating and validating AI-enabled data, industry is encouraging focus this year on systems reliability and on testing how to make imperfect models dependable in degraded or denied conditions, under which the assumption is that the data quality is uneven. The objective is to enable more precise examination of how to best utilize AI-enabled data under operational conditions, including helping policymakers and military leaders understand how to harness the power of these probabilistic systems, which are not designed to have perfect predictability.

From this, they will have more information to establish protocols for delegated employment authority, especially for nonlethal decision support, paired with best practices for auditability and, if necessary, the rollback of authorities.

Senior military leaders assigned to the Indo-Pacific region are demonstrating they understand the consequences of losing the global economic and technological competition means a negative impact on the values, standard of living and security of every American.

In engagements with industry over the last year, there is a palpable and honed focus in their eyes and crisp, precise language in their remarks covering their operational requirements. And they are professionally shouldering the weight of their knowledge of what the consequences will be for every U.S. soldier, sailor, Marine, airman and guardian should deterrence by denial fail. **ND**

Jennifer Stewart is the National Defense Industrial Association's executive vice president for strategy and policy.





UN-MAN THE MISSION IN CONTESTED ENVIRONMENTS



The **Smart Box** is an autonomous robotic system that is designed to provide standardized mechanical, electrical, and software interfaces to enable multimodal transport of up to 2000lbs of materials and supplies across disparate unmanned systems (air, sea, and land). The Smart Box enables true mission autonomy, enabling transport of supplies, equipment, and materials across great distances anywhere on the globe.



DISPATCHES

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



F-35 Lightning II

F-35 Presence Grows in Asia as Updates Roll Out

BY ALLYSON PARK

SINGAPORE — Lockheed Martin's F-35 stealth fighter jet is expanding its presence in the Indo-Pacific region as the company rolls out new tech updates to enhance its operational effectiveness.

The fifth-generation fighter's presence in the Indo-Pacific is "really growing," and Lockheed Martin's partnership with different militaries and governments in the region is "very, very strong," said Steve Sheehy, the company's vice president of international business development for aeronautics.

"You talk to the militaries, they're all focused on [the Asia-Pacific] region," he said during a media briefing at the Singapore Airshow. "It's really showing partnership in the region, with these nations increasing their aircraft in the area, increasing sustainment capability."

Sheehy estimated the F-35

presence in the Indo-Pacific will exceed 300 by 2035.

"One neat fact is many of the nations that are already flying the F-35 are buying second and third" installations, he said. "Even some nations that haven't received their first aircraft yet are buying more F-35s."

For example, South Korea — which is flying 40 F-35As today — wants to add five to 20 more aircraft to its fleet, he said.

Japan is the aircraft's biggest international customer, with a program of record of 105 F-35As and up to 42 F-35Bs, and is home to one of Lockheed Martin's F-35 final assembly and checkout facilities.

The Royal Australian Air Force operates a fleet of 72 F-35As, and the Republic of Singapore Air Force has ordered 20 aircraft.

"We've seen it on the production line. That's out there," Sheehy said. Singapore's Minister for Defense Chan Chun Sing in September visited Lockheed Martin's F-35 production facility in Fort Worth, Texas, "and literally they signed their names on the wing, so when that aircraft arrives in Singapore, it will have Singapor-

ean fingerprints already on it."

Along with building the aircraft, Lockheed Martin is currently working on two major upgrades for the F-35: Block 4 and Technology Refresh 3.

Technology Refresh 3 consists of both hardware and software updates to boost computing power, including more memory and data storage, and Block 4 upgrades the aircraft's weapons, sensors, electronic warfare capabilities and communications equipment. Though these upgrades have been plagued with delays, Sheehy said the Technology Refresh 3 backlog is now cleared.

The added computing power will be "sort of like getting your next iPhone. It's an increase in hardware is all it is, an increase in your computing power. Block 4 is that software push, that's getting an app updated or a new app," he said.

"The design of the aircraft was set up so we could improve it — not

with constant hardware changes — but mainly software changes," he said.

According to the Government Accountability Office, the Block 4 upgrades aren't expected to be completed until 2031 — a five-year delay from the original timeline. However, the software updates are full speed ahead, and "it will continue to be increased over time, incrementally," Sheehy said.

Last year, Lockheed Martin delivered 191 F-35s, which is a "huge, huge testament to the program," and this year, the company is on track to deliver 156 aircraft, which is "probably the sweet spot delivery," Sheehy said.

The company is also encouraging sets and reps in the Indo-Pacific theater, especially for U.S. and allied partners in the region.

"The biggest learning [moments] come out when these nations get the aircraft, and they really work the tactics, techniques and procedures of the aircraft," Sheehy said. "It's a phenomenal, proven aircraft, and they take it to its limits. They understand how to move deeper. It's almost an analogy of playing golf. The more you practice, the better you get." **ND**



CAUDLE

Caudle Gives Props To Think Tank

• Chief of Naval Operations **Adm. Daryl Caudle** delivered a major speech about the service's new "Hedge Strategy" in front of a few dozen attendees at the APEX Defense conference in Washington, D.C., in late January. The conference, in its second year, is not well established and unluckily took place two days after a major snowstorm hit the city.

The venue choice was undoubtedly because of **Bryan Clark**, senior fellow and director of the Center for Defense Concepts and Technology at the Hudson Institute, who is one of the brains behind the "Hedge Force," which calls for smaller, more tailored units that depend on uncrewed systems to serve as asymmetric deterrents against potential aggressors such as China.

"Together, these tailored capabilities will amplify and complement the main battle force," Caudle said.

The conference was organized with the help of the institute, and Clark served as the moderator in a fireside chat with Caudle after the speech, allowing for a sort of victory lap for the think tank after its concept managed to make the transition from a report to being adopted by one of the armed services.

"I've got my team working on this, but [where] I need help here is really an understanding by combatant commanders, the joint force, the chairman and our secretaries of what are the actual key operational problems we need to solve around the world," Caudle said.

"A lot of this is your idea, so thank you for that as well," Caudle told Clark. **ND**

Air Force Mad Scientists

• The Air Force is adopting a mad scientist mentality when it comes to developing munitions.

"If you think about how we've typically developed munitions, it is relatively platform-centric," said **Thomas Lawhead**, the Air Force's assistant

deputy chief of staff for strategy, integration and requirements.

"It needs to fit on this platform, this platform, this platform. That starts to describe attributes for it. But we tend to develop, or we have tended to develop, munitions that are very exquisite," Lawhead said at the APEX Defense conference.

"We might not always need that, but if I've got a [Joint Air-to-Surface Standoff Missile], I'm going to shoot a JASSM. Maybe a 2000-pound dumb bomb would work, but I got JASSM, I'm shooting JASSM," he said.

What the Air Force is trying to do is develop exquisite where exquisite is needed, and develop "more affordable munitions where we can," he added.

The key is a weapons open system architecture, Lawhead said.

"We can start to 'Franken-missile' weapons, to bring seekers from one vendor, guidance units from another vendor, start to bring them together into a single package. We're actively working on a family of affordable mass munitions, both lugged and palletized, that will start to bring range and capability where we can and need to use them," he said. **ND**

Uncle Sam Wants You, Grandma, Grandpa!

• The Defense Department's Office of Industrial Base Policy is working on a nationwide initiative that will link its more than 40 operational workforce development programs, and it's a generational effort, said **Michael Cadenazzi**, assistant secretary of war for industrial base policy.

The initiative's goal is to provide "the fundamentals for developing a new national campaign to connect people, not just with jobs, [but] with their careers in the skilled trades," he said during a recent Hudson Institute event.

In addition to connecting existing programs, the department also wants to "incentivize new and

other programs," which includes fostering local capabilities inherent to a particular region, he added. And that's a family affair.

"We want to ... make sure that we're touching base with the right people on the right levels. And that is a K-12 all the way through to grandma thing, because you [have] got to get the kids excited by fourth or fifth grade," Cadenazzi said. "If they're not excited about bending metal and about things exploding, you're not going to go ahead and get them later on down the line."

Parents need to "convince that kid that this is a good thing for them, and the grandparents who told their kids to go to college back in the 50s and 60s need to do the same thing. They all need to be on board that this is a great career," he said. **ND**

The French Way of War

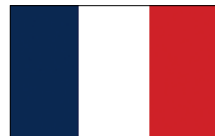
• Robust command-and-control systems are becoming essential tools on the modern battlefield, but soldiers can't let these powerful platforms lull them into a false sense of security, said **Gen. Pierre Schill**, French army chief of staff.

Having high-quality command and control is one of the main elements needed for the future fight, Schill said during a Hudson Institute event. However, "the C2 system of the new generation could give the illusion that ... the chief will know everything and will be able to give orders to everybody in a very precise" manner.

That will likely not be the case given the complexity of the modern battlefield, so soldiers must have the "ability to take the initiative in order to succeed on the mission," he said.

Schill recently wrote a book to explain to French army soldiers about the need to take the initiative and concentrate so they can face the complexities of the battlefield, as well as in their daily lives.

And because Schill is still leading the army, "I can say something to the soldiers, and they do what I say, because when I'm retired," they'll just say, "OK, that was a good book," and move on, he said, drawing chuckles from the audience. **ND**



Vendors Showcase Lethal Drones In Nevada Desert

BY SCOTT R. GOURLEY

LAS VEGAS, Nevada — In preparation for the Pentagon's Drone Dominance Program, several defense contractors took advantage of this year's SHOT Show to provide glimpses of their expanding lethality capabilities.

The Pentagon intends to spend \$1 billion on the Drone Dominance Program, which is designed to help industry organize around the need for low-cost, supply chain-secure small unmanned aerial systems manufactured at scale, according to Defense Department statements.

SIG Sauer created a pre-SHOT Show "defense demonstration day" to unveil some of the work being performed by the company's new Advanced Concepts

group, which was founded in North Carolina in mid-2025 to explore new remote control weapon solutions.

Group Director Ryan Scott demonstrated how one project modified a .22-caliber handgun by reducing the gun's weight and then mounting it on a quadcopter drone. The system was then flown into a nearby tent, where a hostile target was identified and subsequently shot at extremely close range.

Noting a company emphasis on design safety, he pointed to a security board that activates the servos to remove the gun's mechanical safety and allow trigger pull. If power is lost, a redundant safety feature included a fail-safe mode that renders all the servos back to the default



A SIG Sauer weapon station integrated on a quadcopter drone

lock-safe setting, he said.

At the larger end of the size spectrum, the company unveiled a "flying machine gun," which integrates SIG's 24-pound ultra-light weapon station and light machine gun with a quadcopter drone. The system, dubbed "Firestorm," provides small units with up to three hours of close air support.

On the sidelines of the show, an executive from Nammo Defense Systems Inc. said the company has already produced and delivered more than 20,000

fragmentation warheads designed to be deployed on drones for Ukraine.

"There aren't a lot of written requirements that define [drone] lethality, which is good, as in, we get to define the requirements," said Ben Carpenter, Nammo's director of field operations.

"We make what we think is the best, we get it out there and demonstrate it and then that allows the user to come back and tell us what they'd like to see changed," he added. "And then we can rapidly integrate that change into our warheads." **ND**

Startup Building Autonomous Amphibious Logistics Aircraft

BY STEW MAGNUSON

WASHINGTON, D.C. — San Francisco-based startup Poseidon Aerospace is looking to conduct test flights in mid-2026 of new cargo drones designed to take off and land on water.

Company CEO David Zagaynov said work on drones began when the company was founded in 2024.

"Our thesis here is that the future of air cargo [is] automated, unmanned platforms, and we believe that these need to be built and designed from the ground up for the specific mission set," he said during a talk at the APEX Defense conference.

Poseidon has secured \$11 million in seed funding from venture capital firms, a press release said.

The airplanes used now for transporting cargo are based on

antiquated airframes and were not designed for the middle-mile, regional air flights, Zagaynov said.

Commercially, the company is focusing on regional air cargo with autonomous or remotely piloted aircraft. On the defense side, it is targeting the U.S. military's need to tackle the contested logistics problem.

The company is developing fixed-wing aircraft for both land and maritime operations.

The Heron amphibious aircraft features a 51-foot wingspan, has 436 cubic feet of storage space and can carry 3,500 pounds for 1,550 nautical miles.

"We're sprinting towards first test flights this summer, and these, when

they fly, will be the largest unmanned cargo drones produced outside of China, who have actually developed these platforms and first flew them about six months ago," Zagaynov said. "So, we are sprinting to catch up to them as quickly as possible."

The smaller Seagull has a 13-foot wingspan and can carry 50 pounds for about 110 nautical miles, according to company fact sheets.

Zagaynov also touted the projected affordability, noting that a V-22 Osprey costs some \$30,000 per flight hour to operate.

"Our platform is magnitudes lower, and so we're able to, on an operational cost basis, be more effective per dollar spent," he said. **ND**



Seagull aircraft

Leonardo DRS Opens Naval Electric Propulsion Facility

BY STEW MAGNUSON

ARLINGTON, Virginia — Leonardo DRS in January opened a new naval power and propulsion manufacturing and testing facility near Charleston, South Carolina.



Leonardo DRS' new naval power and propulsion facility

The purpose-built 140,000-square-foot plant provides advanced manufacturing, final assembly, integration and testing space dedicated to large components for the

company's naval electric power and propulsion systems, John Baylouny, Leonardo DRS president and CEO, said in an interview. In addition to electric propulsion and power systems, the site supports naval steam turbine system design, manufacturing and testing, he added.

One of the main reasons the company built the new facility was to add itself into the mix of U.S.-based companies that can produce steam turbine generators, which are currently only made by one supplier, he said. "It's a bottleneck, frankly," he said. "In order to increase our submarine industrial base and submarine throughput, we need more suppliers

of things like that." The Navy has only one place to test finished steam turbine generators, so the facility will be able to put them through the paces, he added. "We know that we're part of the

DISPATCHES

submarine industrial base and that we're making, as a nation, something on the order of 1.3 or 1.5 submarines per year, and we really need three to four submarines per year, or three to three and a half," he said. "We're doing what we can to try to make sure that we're not the impediment and to make sure that we have the right throughput, the right capacity in those areas."

As the Navy fields more power-intensive weapons, sensors and computing systems, scalable integrated power architectures are essential to mission success, Leonardo said in a statement.

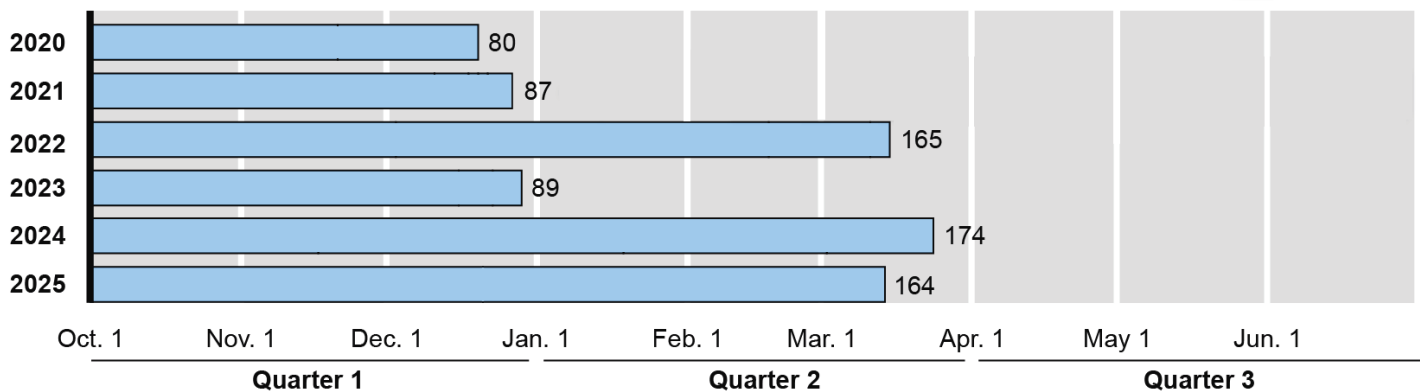
The company chose South Carolina to tap into the local workforce, Baylouny said.

"As you suck up all of the manpower that's available in the Northeast, you kind of run out. That's one of the reasons we went to Charleston ... to invest down there where there's more capability, and more people," he said.

Leonardo is expecting to hire 50 to 100 workers over the next year, he added. **ND**

BY THE NUMBERS

Number of Days Under Continuing Resolutions Affecting the Defense Department, Fiscal Years 2020 to 2025



Source: Government Accountability Office

Leonardo DRS photo, iStock photo

Companies Partner To Keep Military Equipment Dry

BY LAURA HECKMANN

ARLINGTON, Virginia — Two companies focused on protective technology — Pelican and DRYOUT — have teamed up to create a product that can protect sensitive gear against moisture and humidity.

The partnership leverages DRYOUT's moisture control insert panels specially engineered to integrate into a select range of Pelican's protective cases. The solution is built to prevent and eliminate moisture damage inside the cases, ensuring mission-critical gear stays dry, safe and ready for immediate deployment.

In military environments, protective cases are constantly moving through different climates and operating conditions, Shawn LaRowe, chief product and marketing officer at Pelican, said in an email interview. Those transitions can create moisture inside a sealed case, which can lead to corro-



A Pelican protective case equipped with a DRYOUT moisture protection panel

sion, fogging, degraded electronics and reduced equipment lifespan.

Pelican's partnership with DRYOUT "made sense" because internal moisture was a consistent problem Pelican encountered when examining real-world environments for its cases, LaRowe said. DRYOUT brought a technology that "directly addressed that challenge."

"By integrating DRYOUT directly into Pelican cases, we are able to manage that internal moisture," he said, protecting sensitive equipment such as optics, communications gear, batteries and electronics in the field.

The intent is that when a case is opened, the equipment inside is ready to perform without moisture-related issues, he said.

The DRYOUT panels use patented moisture-wicking and super-absorbent technology that pulls moisture from the internal air and from the surface of equipment and then absorbs and holds the moisture until it evaporates. This reduces overall humidity inside the case over time and protects the contents from moisture damage.

Because it does not require power or batteries and can be reset for reuse by drying and replacing, the system provides ongoing moisture control that matches how operational gear is actually transported and stored, he said.

DRYOUT panels are designed to integrate across a range of Pelican case sizes and configurations — providing flexibility that is important in military use, LaRowe said.

"Teams often rely on standardized cases across many different systems," he said. "Having moisture control built into the case helps support consistency and simplifies how equipment is protected across missions."

The solution is effective in tropical, maritime, desert and cold environments, or "any situation where condensation can form inside a sealed case," he said. **ND**

Hello, Goodbye

• The Senate confirmed Marine Corps **Gen. Francis Donovan** as U.S. Southern Command commander. Donovan succeeds Navy **Adm. Alvin Holsey**, who announced his retirement in October. Donovan previously served as vice commander of U.S. Special Operations Command.

Space Command appointed Army **Maj. Gen. Terry Grisham** as the command's transition team director for its move from Colorado to Huntsville, Alabama. Grisham will lead the program management office in Huntsville and oversee the relocation support.

The Aerospace Corp. selected **Blake Bullock** as

its executive vice president. Bullock will lead Aerospace's technical organizations and most

recently served as vice president at Northrop Grumman, leading military and missile defense space businesses.

Australian counter-UAS company DroneShield named **Michael Powell** as its chief operating officer. Powell brings more than 25 years of leadership experience across defense, aerospace, secure communications, simulation, railway and critical infrastructure markets.

Allient Inc., a manufacturer of specialty motion, controls and power products, appointed **Ben Vespone** as director of engineering at Allient

Rochester. Vespone will be responsible for new product development and value-add design and integration projects.

Concurrent Technologies Corp. Chief Executive Officer **Edward Sheehan Jr.** will retire in June following a 33-year career with the company.

Antenna Research Associates named **Frank Morgan** as its chief operating officer. Morgan will oversee company-wide operations, including manufacturing, supply chain, quality, engineering and program management.

Norwegian company Alva Industries, a manufacturer of frameless motors, will expand its North American presence with the establishment of a U.S. office and the appointment of **David Eidelshtein** as sales director for North America.

Swedish Space Corp. changed its company name to SSC Space, unifying all operations under a single international brand. As part of this change, subsidiaries LSE Space and Aurora Technology will also adopt the SSC Space name.

BAE Systems opened its new Utah office, located north of Salt Lake City. The facility will serve as a hub for intercontinental ballistic missile sustainment and modernization efforts, providing workspace for engineering, digital transformation and mission operations teams.

The Space Force Jan. 27 launched the GPS III-9 Space Vehicle 09, which is named in honor of Air Force **Col. Ellison Onizuka**, who perished in the 1986 space shuttle Challenger disaster. **ND**

— Compiled by Laura Heckmann



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India Defense Boom Prioritizing Private Sector BY LAURA HECKMANN

ARLINGTON, Virginia — India's fiscal year 2027 defense budget increases its overall defense spending by more than 15 percent, and its government wants to ensure the investment benefits its domestic and private industries.

On the heels of the country's Operation Sindoor — a series of military strikes launched by the Indian Armed Forces in May against Pakistan in response to an April terrorist attack — India's 2027 defense budget is valued at \$86 billion, according to a recent report by consulting firm GlobalData.

Of the budget's \$24.3 billion in acquisition funding, \$15.4 billion is allocated for domestic procurement — a move that is expected to create "significant opportunities for private sector companies in the domestic defense manufacturing space," a GlobalData release said.

As India pumps a historic amount of money into defense, ensuring domestic and private sector companies benefit from the investment is part of an ongoing effort to overhaul India's slow and outdated defense procurement process, said Abhijit Apsingkar, aerospace and defense analyst at GlobalData.

In the past, "many programs — especially those involving critical equipment — were handled sequentially under a rigid, 'one-step-at-a-time' approach, with files frequently stalled by bureaucratic red tape across multiple departments in the decision chain," Apsingkar said in an email interview. Critical procurement programs could take 15 to 20 years to

progress from requests for information and proposals to contract signature.

To address these delays, the Indian government introduced in 2020 the Defense Acquisition Procedure, a policy that moved away from the older sequential model to a more streamlined process, with a focus on local manufacturing.

It also introduced in 2025 the Defense Procurement Manual, which aimed to level the playing field between the private sector and government-owned Defense Public Sector Undertakings.

Previously, the system often favored the government-owned corporations, with private companies required to obtain a "No Objection Certificate" from a Defense Public Sector Undertaking to submit bids, Apsingkar said. The procurement manual removed this requirement, allowing private enterprises to bid more freely for defense programs.

The improved procurement framework "increasingly prioritizes indigenously designed, developed and manufactured equipment over imports," Apsingkar said, requiring the Indian defense ministry to exhaust domestic sourcing options before pursuing international suppliers.

The Defense Acquisition Procedure also mandated increased sourcing from domestic industry and limited reliance on overseas vendors for certain acquisition categories, Apsingkar noted — which could affect countries like the United States, for which India is a significant source of

foreign military sales.

The budget's "major portion" of acquisition funding reserved for domestic industry means less money for imports, he said. "While the policy does not explicitly target U.S. suppliers, it affects all overseas vendors, including both U.S. and European firms competing for the Indian market."

In addition to its ongoing efforts, the Indian government is also working to overcome a historic hesitancy from the private sector to be involved in defense research and development, Apsingkar said.

Under the earlier procurement regime, private firms could be heavily penalized for developmental delays, including substantial liquidated damages during development and prototyping, he said. Compounding the issue, the military was known to issue unrealistic requirements, making delays difficult to



avoid and increasing private sector risk, he added.

The Defense Procurement Manual removed liquidated damages during the research-and-development and prototyping phases, "acknowledging that innovation inherently carries risk and uncertainty," Apsingkar said. It also capped total late delivery penalties at about 10 percent, helping ensure that modest delays do not financially cripple domestic firms.

Additionally, the government is planning to scrap its "no-cost-no-commitment" approach in development contracting — a procurement policy that places all expenses for testing on the vendor. This will allow companies that participate in development and prototype evaluation to be compensated, even if they ultimately do not receive a production order.

India's domestic industry could be looking at significant opportunities over the next 10 years, as Apsingkar estimated the country's defense budget will surpass \$126 billion by 2031 and \$174 billion by 2036.

Long-standing territorial disputes with China and Pakistan will continue to fuel India's defense spending, and filling capability gaps against the rival nations is a driving factor, the GlobalData report noted.

Compared to China, India's defense industry is still developing, and the government is working to narrow the gap. Indian military planners typically focus on achieving parity in key capabilities rather than matching China across the board, Apsingkar said.

In contrast, India's focus toward Pakistan is to "restore and maintain a significant qualitative military edge," Apsingkar said. "The erosion of this edge — highlighted during Operation Sindoor — is a major concern for Indian planners. As a result, India's acquisition planning is shifting from today's near-parity back toward regaining and extending India's technological lead." **ND**

Posted Feb. 18 on NationalDefenseMagazine.Org.

Cyber Ops Increasingly Melding with Kinetic Conflict

Cyber operations underwent a major shift in 2025 as actions in the digital realm became increasingly intertwined with kinetic conflict, according to a recent report published by intelligence company Recorded Future.



The year was marked by fragmentation of the international geopolitical order, as “hard-power competition, transactional diplomacy and more frequent testing of geopolitical red lines became defining features of state behavior,” the company’s “2026 State of Security” report stated.

These geopolitical dynamics shaped state behavior in cyberspace, it said. Cyber operations increasingly became an integral part of kinetic conflict, with states deploying cyber capabilities to collect intelligence ahead of military action, pressure political leadership, intimidate civilian populations and shape how events were interpreted by domestic and international audiences.

As a result, 2025 served as an inflection point where “cyberspace became, in my opinion, inseparable from kinetic conflict,” said Alexander Leslie, senior advisor on government affairs at Recorded Future.

“What’s new here is not cyber and how conflict and cyber intersect — that’s been true for years — but it’s that in 2025 they [began] to synchronize,” Leslie said during a press briefing. “Cyber reconnaissance and persistence, amplification, influence operations, they’re all moving in the same tempo as kinetic escalation.”

Across the globe, “cyber operations were embedded into escalation management,” blurring the line between preparation and attack, shortening warning timelines and increasing the risk of miscalculation, he said. Whereas cyber espionage was the primary focus in previous years, “2025 marked the pivot towards cyber as a coercive instrument” for signaling and disruption in kinetic conflicts and gray zone scenarios.

For example, as Russia’s war with Ukraine stretched into its fourth year, Russian state-sponsored cyber actors maintained persistent pressure on Ukrainian and NATO-aligned critical infrastructure — particularly energy, logistics and communications sys-

tems — to collect intelligence, map networks and position themselves for potential disruptive actions, the report said.

“This approach allowed Russia to impose costs well beyond the physical front line, extending the conflict’s pressure into civilian life, allied infrastructure and European security planning,” the report said.

With Russia’s territorial gains limited, “Moscow will likely intensify coercive measures short of decisive battlefield breakthroughs, including disruptive cyber operations against Ukrainian critical infrastructure,” along with drone strikes on civilian centers and efforts to “stoke unrest, to pressure Kyiv and extend influence deeper into western Ukraine,” it added.

Additionally, Russia will likely step up its hybrid warfare activities across Europe, “reinforcing its ability to impose costs well beyond the physical front line while managing escalation risk,” the report said.

Many of Russia’s influence campaigns and information operations are backed by a “very resilient criminal base,” said Levi Gundert, Recorded Future’s chief security and intelligence officer.

“At the end of the day, we don’t see clean actor categories anymore,” Gundert said during the briefing.

“We’re seeing a lot more of state-sponsored campaigns leveraging criminal capabilities and tools.”

The June 2025 conflict between Iran and Israel known as the Twelve-Day War also “illustrated the growing synchronization of state-sponsored cyber, hacktivist and influence operations to project strength, undermine the adversary and shape perceptions beyond the battlefield,” the report said.

For example, Predatory Sparrow — a cyber threat group aligned with Israeli government national security objectives — targeted the Iranian financial sector to disrupt funding to the Islamic Revolutionary Guard Corps, while Iran utilized state-sponsored cyber organizations, proxy groups and semi-autonomous hacktivist fronts to conduct espionage, hack-and-leak operations, intimidation and influence campaigns.

While cyber operations increasingly melded with kinetic conflict in 2025, the “four most capable and consistently active hostile state cyber actors” — China, Russia, Iran and North Korea — largely did not rely on destructive attacks in digital environments, but rather “focused on the covert accumulation of access to identities, networks and edge infrastructure,” the report said, allowing them to “blend into normal operations while preserving options for sustained intelligence collection and rapid disruption should geopolitical tensions escalate.”

For powerful cyber actors, access has become the “strategic currency of power,” Leslie said.

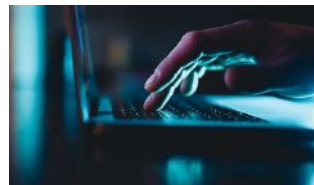
“States increasingly value that ability to quietly sit inside identity systems, cloud environments, telecommunications networks and edge infrastructure, because access creates options for them, and then the options create strategic leverage,” he said. This sustained pre-positioning enables persistent espionage in peacetime and creates latent capability for disruption during periods of crisis, the report noted.

With these types of activities occurring below the threshold of war becoming more and more normalized, it is increasingly likely that “geopolitical crises will

spill over into corporate networks, supply chains, regulatory environments and digital infrastructure with limited warning,” the report said.

Cyberattacks can no longer be treated as isolated incidents, but rather must be seen as “part of a greater ecosystemic risk to national security,” Leslie said. Organizations that invest in operational resilience against short-notice disruption, degraded connectivity and third-party failure will be better positioned to sustain operations in this increasingly volatile global environment, the report said.

The greatest risk to organizations is no longer a catastrophic event, Leslie said — it’s the “accumulation of persistent access, of fractured norms, of compounding uncertainty. It’s a world where escalation is managed rather than avoided, and where access matters more than attribution.” **ND**



U.S. Needs an Innovation Flywheel to Outpace China

A Chinese “Soaring Dragon” unmanned aerial system in mid-January entered Taiwan’s airspace over Pratas Island and loitered for four minutes.

Taiwan’s military could only watch — and broadcast warnings over international radio. Beijing had found another soft spot, demonstrating it could violate Taiwanese airspace with impunity.

Whether competition with China leads to armed conflict remains uncertain. What is beyond doubt is that the United States is already in a struggle with it for innovation and industrial dominance, and incidents like this one reveal who is leading.

Innovation and industrial strength are no longer just economic advantages — they are elements of deterrence. The drone didn’t materialize from nowhere. It is the product of a Chinese innovation and manufacturing ecosystem that is accelerating faster than the United States’ in critical domains.

The bipartisan U.S.-China Economic and Security Review Commission warned of exactly this dynamic in its 2025 report to Congress. China now possesses “a hyper-charged, state-directed manufacturing base without historic parallel,” it said.

This manufacturing base is increasingly fused with high-priority emerging technology sectors, such as artificial intelligence, synthetic biology, humanoid robotics and quantum computing. The commission calls this dynamic “interlocking innovation flywheels.” China’s innovation and manufacturing ecosystems now reinforce each other, allowing Beijing to accelerate at a rate unseen in modern history. State subsidies create markets, markets fund research and development, which feeds manufacturing, and manufacturing drives down costs and scales production.

The result is both military and commercial advantages that compound over time. China has dedicated significant resources to R&D in critical sectors, far outstripping U.S. investments even in areas deemed modernization priorities by current and past administrations.

The commission stated: “China is actively racing to develop cryptographically relevant quantum

computing capabilities and is likely concealing the location and status of its most advanced efforts.”

In biotechnology, China has established innovation clusters housing over 1,000 global biotech firms, building the next generation of advances in a sector with profound dual-use implications.

Competing effectively does not mean copying China’s playbook, its intellectual property theft, forced technology transfer or command-economy micromanagement. America has tools of its own.

These tools, however, require resources. Pentagon procurement reform and rising defense budgets are welcome, but only if funding flows to foundational research, not just platforms. American innovation doesn’t run on fairy dust. It runs on sustained public investment that gives private capital something to commercialize. The commission made several practical recommendations that should be strongly considered to build on these good efforts.

One centers on existing government loan and loan guarantee programs that are already on the books. They can bridge the gap between innovation and manufacturing in microelectronics, biotechnology and advanced energy. New public-private partnerships can enable rapid manufacturing of dual-use unmanned systems and support possible surge production capacity.

Congress has already acted here by increasing the lending capacity of the Defense Department’s Office of Strategic Capital and authorizing the Industrial Base Fund to provide market-shaping mechanisms like purchase guarantees and offtake agreements. These are essential tools for driving new innovations to scale.

Most urgently, the commission also called for a national “Quantum First” initiative to achieve U.S. advantage by 2030 in cryptography, drug discovery and materials science. First-mover advantage in quantum computing is not a talking point — it is a strategic imperative.

It is also critical to consider these technologies as converging — rather than separate — races. AI-enabled research is accelerating drug discovery, materials science and fundamental physics. Quantum sensing

and computing will multiply those capabilities. The nation that successfully integrates quantum with AI-driven research platforms will compound its advantages exponentially.

China’s centralized model is purpose-built to capture these convergence gains. The United States’ distributed innovation ecosystem can get there, but only with deliberate coordination and sustained investment.



Chinese “Soaring Dragon” unmanned aerial system

dination and sustained investment.

None of this works without people. Here, the United States retains a decisive edge. Despite all of its investments, China has not become the place where the world’s best scientists and engineers want to build their lives, raise their families and make their fortunes.

To win, the United States must not surrender its advantage as the magnet for the world’s talent or reduce investments in developing domestic talent to fill the pipelines of emerging technology sectors. The nation that locks in the tightest connection between innovation and manufacturing will own the industries of the future and the weapons they produce.

Americans have done this before. Vannevar Bush — who led the Office of Scientific Research and Development throughout World War II — marshaled the nation’s scientific and industrial resources to build a machine that made adversaries despair of ever matching the nation’s output.

Now we must do it again, building an innovation flywheel that makes Chinese planners feel the same futility. **ND**

Michael Kuiken is a distinguished visiting fellow at the Hoover Institution, managing member at Silver Valley Strategies and a member of the National Defense Industrial Association’s board of directors. Arun Seraphin, Ph.D., is the executive director of NDIA’s Emerging Technologies Institute.

COMMENTARY

What to Know About Patents for the Defense Industry

BY CHRIS GALFANO AND JASON SHULL



Innovation has always been a cornerstone of national security. From advanced radar systems to resilient communications networks and next-generation materials, technological advantage is inseparable from military strength.

Yet many defense contractors, particularly small and medium-sized companies, underestimate or misunderstand one of the most powerful tools available to protect and leverage that innovation: patents.

Patents are not just legal documents. In the defense sector, they are strategic assets that shape competition, influence procurement outcomes, attract investment and protect hard-won technological advantages in an increasingly crowded and fast-moving marketplace. Understanding the basics of patents is therefore not merely a legal exercise, it is a business and national security imperative.

A patent is a form of property that protects products of original human ingenuity. It is one branch of the broader category of intellectual property, which also includes copyrights, trademarks and trade secrets. While all four forms of IP can be important to defense contractors, patents — particularly utility patents — play a unique role in protecting technical innovations.

A utility patent protects an inven-

tion that is new and useful and falls into one of four statutory categories: a process — for example, a novel method of encrypting battlefield communications; a machine such as a new type of unmanned vehicle component; a manufacture, or an article made by humans; or a composition of matter including new materials, alloys or chemical formulations.

Utility patents also protect new and useful improvements to existing technologies, which is a critical point for defense innovators who often build incrementally on prior systems rather than starting from scratch. Once granted, a utility patent generally lasts 20 years from its filing date, assuming maintenance fees are paid.

For patents, the “inventor” also matters. An inventor is someone who contributes to the conception of the invention: the mental step of devising the novel idea. Simply reducing the idea to following instructions or performing routine engineering tasks does not make someone an inventor.

This distinction is especially important in defense programs, where large, multidisciplinary teams are common. Incorrectly naming inventors can jeopardize a patent’s validity while failing to include a true inventor can render a patent unenforceable. Careful documentation and early coordination between technical and legal teams are essential.

Only human beings can be inventors under U.S. patent law. While artificial intelligence and machine learning systems are increasingly used in defense and advanced technology programs to assist with modeling, optimization, target recognition, materials discovery and systems design, the law requires that an inventor be a natural person who conceives the inventive idea.

AI tools may support or accelerate innovation, but they cannot be named as inventors because they do not exercise the human judgment and creative conception required under current patent law.

So, what does a patent actually contain? A patent is not just a certificate. It is a technical and legal document with three principal components.

The first is the written description. In exchange for patent protection, the inventor must fully disclose the invention to the public. This disclosure requirement is why patents are sometimes described as a “bargain” with society.

Most patents also include drawings that illustrate the invention. In complex defense technologies — such as systems-of-systems architectures or mechanical assemblies — drawings can be critical for clarity and claim interpretation.

The second and most important part is the “claims,” which define the legal boundaries of the invention. They determine what the patent owner can exclude others from doing. In practice, patents are litigated, licensed and valued almost entirely based on their claims.

Think of the written description and drawings as context, and the claims as property lines.

Once all that is sorted out, the third component emerges: the patent owner’s right to exclude others from making, using, offering for sale, selling within the United States or importing into the United States the patented invention. Critically, a patent does not necessarily grant the right to practice the invention. A company may need licenses to other patents

or may be restricted by regulations, export controls or contractual obligations. In other words, the patent right is exclusionary, not affirmative.

In the defense sector, this exclusionary right can be enormously powerful. It allows a company to prevent competitors — including much larger competitors — from copying proprietary technology without permission.

Defense markets are increasingly competitive, with nontraditional contractors, dual-use technologies and commercial entrants challenging established players. Patents create legal barriers to entry by forcing competitors to either license the technology, design around it or abandon the market opportunity.

Design-arounds are not always trivial. Well-drafted patent claims can force competitors into inferior or more expensive solutions — an advantage that can be decisive in procurements.

Patents can also materially influence negotiations with the Defense Department and other agencies. They can strengthen a contractor's position in sole-source justifications; support valuation in mergers and acquisitions or investment discussions; provide leverage in data rights negotiations;

and demonstrate technological differentiation in competitive procurements.

Patents are often scrutinized during due diligence, particularly in transactions involving classified or sensitive technologies.

A robust patent portfolio signals that a company is serious about innovation. This can attract top engineering talent and encourage internal research and development by assuring teams that their work will be protected and valued.

Meanwhile, investors and acquirers routinely evaluate patent portfolios when assessing a company's worth. Even early-stage companies with limited revenue can command higher valuations if they control strategically important patented technologies.

A common misconception is that working with the government means surrendering intellectual property rights. This is not true. While government contracts often include provisions governing data rights and march-in rights, contractors can — and frequently do — retain ownership of their patents. Ownership typically starts with the inventors but is usually assigned to the company under employment or contractor agreements.

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With proper planning, contractors can protect proprietary technologies while still complying with government requirements. A well-crafted IP strategy is especially important for small defense contractors seeking to scale.

Meanwhile, Congress in 2011 enacted the America Invents Act, which fundamentally changed U.S. patent law. The United States moved from a "first-to-invent" system to a "first-to-file" system. Under the act, patent rights generally belong to the first inventor to file a patent application — not the first to conceive the idea. This shift places a premium on speed and strategy. In practical terms, delays in filing can be fatal, particularly in collaborative defense environments where disclosures, demonstrations or field testing may occur early.

One common protective tool is the provisional patent application, which establishes an early filing date, requires less formality than a full application and provides 12 months to file a non-provisional application claiming priority to it. However, a provisional application is not examined

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and never becomes a patent on its own. If a non-provisional application is not filed within one year, the benefit of the provisional filing date is lost.

For defense contractors, provisional filings can be particularly useful when technologies are evolving or when funding and program milestones are uncertain.

After filing a non-provisional application, the U.S. Patent and Trademark Office assigns it to an examiner with relevant technical expertise. The examiner reviews the application to determine whether the claimed invention is new and non-obvious over prior art.

Most applications receive at least one rejection. This is normal. The applicant and examiner then engage in a back-and-forth process to refine the claims and address legal issues. If successful, the result is an issued patent with enforceable claims.

Finally, public disclosure of the invention before filing a patent application can destroy patent rights, particularly outside the United States. Defense contractors must be especially careful when demon-



strating technology to government customers; participating in industry days; publishing technical papers; or collaborating with partners.

Non-disclosure agreements are an important tool for protecting sensitive technical information, particularly in the defense sector where collaboration with government agencies, prime contractors and subcontractors

is routine. The agreements can help preserve confidentiality, limit downstream disclosure and establish contractual remedies if information is misused. However, they are not a substitute for timely patent filings, and relying on them alone can create a false sense of security.

In the modern defense landscape, technological advantage is fleeting unless protected. Patents provide a powerful, legally enforceable means of safeguarding innovation, shaping competition and strengthening business outcomes.

For defense contractors large and small, patents should be viewed not as abstract legal instruments, but as core strategic assets. When integrated thoughtfully into a broader IP and contracting strategy, patents can help ensure that those who invest in innovation reap its rewards while supporting the broader mission of national defense.

Understanding the basics is the first step. Acting on them is what makes the difference. **ND**

Chris Galfano and Jason Shull are intellectual property law attorneys at the law firm Banner Witcoff, Ltd.

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VIEWPOINT

How AI Can Help Enforce The Biological Weapons Convention

BY ELISE ANNETT,
DR. JAMES GIORDANO AND BRENDAN MELLEY



President Donald Trump's recent proposal to the United Nations General Assembly regarding the use of artificial intelligence systems to support oversight and enforcement of the Biological Weapons Convention represents a significant milestone in focusing emergent technological approaches to international biosecurity.

The initiative recognizes both the growing complexity of biological threats and the potential of advanced technologies to address challenges that compromise traditional methods of surveillance, verification and compliance.

However, the path from conceptual ambition to operational reality requires prudent navigation of technical, strategic and ethical considerations that will be vital to establishing the extent to which this initiative becomes a transformative tool for global biosecurity.

Since it entered into force 50 years ago, the foundation of the convention is an almost universal commitment “never under any circumstances to develop, produce, stockpile, acquire or retain” biological weapons, and to destroy or divert to peaceful purposes any material that was previously developed.

Yet, in the administration's 2025 annual report to Congress on Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments, the United States assesses that Russia, North Korea, Iran and China are not fully complying with their obligations. The assurance of compliance is a technical, legal and diplomatic challenge as there is no verification mechanism in the treaty.

To properly assess the viability of AI-enabled Biological Weapons Convention verification, it's first important to establish a realistic understanding of the technology's current capabilities.

Large language models, computer vision systems and various machine

learning applications are certainly impressive, albeit in rather narrow domains of utility. To wit, these systems were not designed for the specialized requirements of biological weapons compliance monitoring. Operationally, deploying AI without acknowledging its domain-specific limitations invites systemic failure, and the diffusion of responsibility, turning what should be a tool of rigorous verification into a veneer of technological capability masquerading as evidence.

Current AI excels at pattern recognition within well-defined parameters, processing massive datasets and identifying anomalies that might indicate concern at speeds that far exceed that of human analysts. AI systems can potentially monitor scientific literature for dual-use research of concern, analyze procurement patterns that might suggest illicit biological weapons programs, process satellite imagery of facilities of interest and integrate diverse intelligence streams to identify emerging risks and threats.

These capabilities are genuinely valuable for biosecurity applications. However, these AI systems currently lack contextual understanding of strategic intent, cultural factors influencing biological research programs and nuanced diplomatic considerations essential to international verification regimes. Moreover, they cannot independently assess the legitimacy of ambiguous biological research, distinguish between bio-defensive and offensive weapons development or intuit the complex political dimensions of sovereignty and compliance that define the convention's enforcement challenges.

Additionally, the biological domain presents unique challenges for the deployment of AI. This problem is recognized in Executive Order 14110 of Oct. 30, 2023, “Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence,” where federal departments and agencies are tasked to evaluate the potential for AI to be

misused to enable the development or production of chemical, biological, nuclear and radioactive threats, while also considering the benefits and application of AI to counter these threats.

Unlike kinetic weapons systems that characteristically possess clear physical signatures, biological weapons programs can be — and notably have been — conducted in medical facilities with methods that are appropriate for research and healthcare applications. Thus, the distinction between permissible biodefense research and prohibited offensive weapon development often depends upon intent — an essential part of intelligence gathering — rather than objectively observable factors and parameters. Such discrimination requires human judgment informed by scientific, strategic and political expertise and insight.

That is not to say, however, that AI could not or should not be viable and useful to informing such practical wisdom. As we have noted, the integration of big data and AI are important force multipliers for bioscientific research and its translation, inclusive toward weapon development. But like any tool, the integrity of the instrument and rigor of its method of use are strongly constituent to its real-world utility and worth.

At least six core competencies are needed to apply this technology to the bioweapons problem.

First, there needs to be advanced natural language processing capable of understanding technical biological terminology when analyzing scientific literature, communications intercepts and open-source intelligence across multiple languages to identify research with dual-use implications.

Current commercial systems approach, but do not yet fully meet, this requirement.

Second, sophisticated computer vision and remote sensing analysis are necessary to identify biological production facilities, variant construction patterns, waste disposal methods and other physical indicators of biological weapons-relevant activities. This will require pattern recognition and contextual understanding capabilities to effectively and validly distinguish between legitimate pharmaceutical,



vaccine and biotechnology production, and covert weapons development.

Third, the system must entail network analytic capabilities to map resource procurement patterns, scientific personnel recruitment and collaborations, and organizational structures that are indicative of biological weapons programs. This extends simple pattern matching to a more granular understanding of how state and non-state actors structure illicit programs to avoid detection.

Fourth, predictive modeling and forecasting analytics are needed to assess emerging biological threats, anticipate and predict technological developments that could enable novel weapons capabilities, and identify vulnerabilities in regnant verification regimes. This requires integration of diverse data streams and the ability to reason about future trajectories of biological science and technology.

Fifth, AI analytic tools must address the dual problems of attribution and confidence: not only in identifying who may be responsible for any bioweapons-related developments in any given country, but in also assessing whether the AI tools themselves have been free from manipulation.

Sixth — and perhaps most critically — these systems must operate at a level of transparency viable to enable auditable decision-making processes as sufficient for international verification purposes, which can meet current standards of diplomatic and legal scrutiny.

Regardless of their technical sophistication, “black box” AI systems that lack even a human-on-the-loop presence cannot serve as the basis for determinations of international compliance that bear significant geopolitical consequences.

To this last point, possible development of a future mechanism for treaty compliance assessments, and potential enforcement actions, cannot and should not be fully automated. Human decision-making authority should be part of all consequential determinations while allowing AI systems to process data, identify patterns and generate recommendations at speeds and scales beyond human capacity.

In this architecture, AI serves as an analytical augmentation tool rather than an autonomous decision-maker.

This approach is essential because accusations of biological weapons

development can instigate diplomatic postures, economic sanctions and military responses. Human oversight is important to recognizing and addressing the inevitable limitations and potential biases of AI systems, as even sophisticated purpose-built systems may generate false positives and false negatives.

Humans in the loop can evaluate AI recommendations in contexts of broader strategic intelligence and apply the subtle judgment necessary to discern genuine threats from benign activities. In these ways, human oversight affords accountability essential for international legitimacy when compliance determinations are contested.

Ultimately, it is the responsibility of a senior leader to judge whether AI-derived information reaches an appropriate level of confidence to warrant further action. Confidence levels can rarely be pre-determined, and one chief executive’s threshold for action likely will be different than another’s, using the same information.

AI tools may produce factual outcomes, but context, intent, biases and personalities will play an outsized role in judging the results. This is another reason why AI cannot, by itself, solve the challenges of enforcement of compliance with the Biological Weapons Convention.

Thus, despite relative ease and apparent time and cost efficiency, it is recommended that temptations to repurpose existing commercial AI platforms for employment in the treaty enforcement applications should be resisted.

Purpose-built systems may offer several advantages. Namely, they can be designed from inception to incorporate expertise from biological weapons specialists, intelligence analysts, diplomats and ethicists, and developed to accommodate and engage the specific data types, analytical requirements and operational constraints of Biological Weapons Convention enforcement.

Their training data can be curated to most accurately reflect the realities of biological weapons programs, and their decision-making processes can be structured to provide the transparency and auditability required for international verification. This ensures that technical capabilities align with operational requirements and strategic objectives rather than forcing operational needs into the

constraints of existing technology.

To realize the potential of Trump’s proposal, it is recommended that a dedicated research-and-development program specifically focused on AI systems for bioweapons enforcement should be developed, which is adequately resourced and insulated from pressures to produce premature operational capabilities. This program must convene a ready working group of AI researchers, biological weapons experts, intelligence professionals and specialists in international ethics and law.

Also, international frameworks for AI-enabled verification should be created that establish standards for system reliability transparency, auditability and accountability. These frameworks must balance the security concerns of nations with the transparency required for effective verification.

Next, training and doctrine should be developed for the human operators of these systems, to ensure understanding of AI capabilities and limitations, and to foster preparation for exercising independent judgment when effectively leveraging tools.

It may be worth using an existing large set of well-understood data, such as information related to the spread of the COVID-19 virus, as a testbed.

Independent oversight mechanisms should be structured to rigorously audit AI system performance, identify and correct biases, and ensure continued alignment with strategic objectives and ethical principles.

Finally, this initiative should be multilaterally pursued, engaging allies and potential adversaries alike in developing shared norms for AI in verification. Unilateral deployment of AI systems for Biological Weapons Convention enforcement, regardless of technical sophistication, will undoubtedly face legitimacy challenges that could undermine effectiveness. **ND**

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The Military Drone Revolution Depends on Connectivity

BY DILLON HARR



Drones are arguably becoming the most transformative technology in modern warfare.

What began with simple reconnaissance platforms has evolved into a massive ecosystem that supports surveillance, warfare, electronic sensing and frontline communication.

This shift is already underway in conflicts such as Ukraine, where small, inexpensive drones are now as common as armored vehicles. The pace of adoption is accelerating, and drones are shaping up to define the next era of military and critical infrastructure operations.

Yet, even with better airframes or smart autonomy, the real driver behind drone innovation will be connectivity. The usefulness of any drone in military settings ultimately depends on how well it can communicate images or videos at extended range. The more stable and resilient the link between the operator and the drone, the more ambitious the mission can be. In many ways, drones will only advance as far as their communication technology allows them to go.

Traditional wireless methods such as standard radio frequency links or public-safety networks often struggle in contested environments. Signals degrade over distance, interference can interrupt control and adversaries can deliberately disrupt the spectrum. Even outside conflict zones, critical infrastructure environments like mining sites or industrial facilities can make reliable communication surprisingly difficult.

When drones cannot maintain a clean, secure, high-bandwidth connection, their effectiveness drops quickly.

These limitations are why the U.S. military has begun exploring alternative hybrid communication pathways that do not rely solely on open-air wireless signals. “RF over Fiber” is one popular method which uses fiber cables to carry radio signals with far greater protection against interfer-

ence, jamming and signal loss. It involves converting RF signal to light for fiber-optic communication and then converting that back into RF again at its destination. Because the signal travels through fiber for longer distance rather than exclusively over the air, this method provides a more stable and resilient link in situations where traditional radio frequencies are vulnerable. Optical communication is also immune to electromagnetic interference, providing further protection. These models are not theoretical. They are being deployed in real operations and point toward how drone systems will evolve in the years ahead.

One example of these models is tethered drones, which are physically connected to the controller through a lightweight fiber line that enables a stable and jam-resistant communica-



tion path. Because the connection is so consistent, the drone can remain airborne for long periods and serve as an elevated communication point when terrain, distance or interference would otherwise limit wireless performance. Emergency response teams and military units have already explored this approach because it adds resilience where wireless networks are unreliable.

Another model leveraging direct fiber connectivity is inexpensive one-way drone missions. In these situations, operators rely on a fiber communication path that remains stable from launch to impact using a spool of fiber that unravels as it moves closer to its target. The goal is to ensure that the drone behaves predictably and is not disrupted by interference. Although the drone itself may be expendable, the advantage comes from its ability to reach and destroy valuable targets without losing con-

trol along the way. Since the weakest link in this approach is wireless connectivity, that element is removed.

A third technique involves protecting the drone operators and extending the distance the aircraft can travel. In traditional drone missions, the operator is in a surface-level exposed location so the controller can maintain that wireless signal. The hybrid radio frequency-fiber system is designed to circumvent this issue by connecting the line from the controller to an optical drone unit farther away and then reconvert it back to RF. This model is particularly useful in battlefield conditions where safety, distance or environmental hazards make direct operation impossible.

Consider a soldier located in a protected bomb shelter 20 feet below ground. A fiber cable can run from the controller to a drone unit at ground-level and then reconvert that fiber signal to RF, so it maintains connectivity with the drone. Depending on where the unit is placed, it can dramatically extend the range of the drone and, more importantly, protect the drone operator from enemy retaliation.

Another common use case is when drones must investigate a small underground tunnel or other tight space. The operator can be above ground with the unit placed inside the tunnel so that the RF signal can communicate with the drone.

These models share a common purpose. They aim to deliver safer, secure communication links that are resistant to interference and more capable of supporting high-bandwidth data such as live video or sensor feeds.

The models also allow drones to shed unnecessary onboard electronics, reducing weight and improving endurance. All of this supports longer missions, better situational awareness and more predictable behavior — even when conditions are difficult.

As drones continue to expand in the military sector, the importance of reliable connectivity will only grow. Airframes will get lighter and sensors will get sharper, but the limiting factor will remain the communication pathway that ties the drone to its operator or network. The next generation of drone warfare will be defined by how well drones can stay connected in environments that challenge nearly every traditional wireless technology. **ND**

Dillon Harr is director of drone system solutions at Optical Zonu Corp.



A soldier tests a 3D-printed munition dropper during Exercise Combined Resolve 26-1 in Hohenfels, Germany.

ACQUISITION

New Army Program Funnels Millions Into Fielding Advanced Tech Faster

BY LAURA HECKMANN

WASHINGTON, D.C. — The Army in September launched a program that aims to pump about \$750 million a year into accelerating the discovery, development and deployment of emerging technologies.

The program, called Army FUZE, consolidates four innovation programs — xTech, Small Business Innovation Research/Small Business Technology Transfer, the Manufacturing Technology program and the Tech Maturation Initiative — into a unified, venture capital-style framework designed to speed up private development with \$750 million per year in non-dilutive research, development, test and evaluation funding, which doesn't require giving up equity.

Four months in, the program is going “really well,” said Matt Willis, FUZE program director within the office of the assistant secretary of the Army for acquisition, logistics and technology.

In addition to the four consolidated programs, FUZE is also part of the

Pathway for Innovation and Technology, an office created in November under the service's sweeping acquisition reorganization, Willis said. “We're basically the engine behind all of the different tech investments that are happening across the ecosystem.”

By consolidating multiple programs, FUZE provides more opportunities for companies to accelerate capability development, Willis said in an interview on the sidelines of the recent APEX Defense conference.

“It provides a lot more fungibility and agility for companies to move from one piece to the other, [versus] before having different program offices and different authorities and different stage gates that they had to go through,” he said. “We can basically identify capability and accelerate the companies that are showing promise.”

The program ran a competition for companies to pitch novel tech solutions in electronic warfare, unmanned aerial systems and counter-UAS in October at the Asso-

ciation of the United States Army's annual meeting.

Eight companies were selected, and “three weeks later, they were in Hawaii doing a demo” with the 25th Infantry Division, Willis said. One of the eight firms' capabilities will likely be scaled, he added.

“Things that typically take years we've been able to compress into just a couple of months,” Willis said. “And that's just one recent example of many that are coming.”

That timeline is “not trivial,” he said during a panel at the conference. “It's about bringing together the right stakeholders willing to take the right amount of risk, recognizing that ... we might break things, but ultimately, delivering capability to soldiers quickly is of tantamount importance for us to stay ahead of the curve.”

Speed is really what all the recent acquisition reform is about, he said. “What is abundantly clear across the department is the importance of speed,” and it is “of tantamount importance in everything we do.”

As the FUZE program finds its feet, Willis said the most pronounced growing pains have been around cultural change.

“The Army is a big organization,” and as the program identifies its priorities, “there are going to be some places that might get less funding than they may have anticipated,” he said. “That's sort of the challenge ... that it's not an

infinite amount of money.”
“In the grand scheme of things,” Willis said, \$750 million isn't that much “for trying to solve the Army's technology problems.”

But it is something, and Willis said the Army is “leading the way” in terms of “foundationally transforming how we work with startups, even large businesses, medium businesses, any business that's trying to break their way into” the Defense Department ecosystem.

Rather than telling industry how to solve its problems, the Army is shifting to saying, “Here are our capabilities,” or “Here are the missions we're trying to achieve,” and allow the private sector to leverage innovation that's happening across the ecosystem to solve our technical challenges,” he added.

A “big piece” of that is being more agile with funding and how capital is deployed to companies, he said. While there is value in mechanisms such as Other Transaction Authorities, “that's just a mechanism to get funding to a firm,” he said.

As the program looks to prioritize what technologies it pursues, soldier feedback is of “tantamount importance,” Willis said. The program employs four deployed acquisition officers that are co-located with every combatant command in the field and are getting “direct demand signals,” he said.

Army FUZE is currently focused on technology relating to contested logistics and expeditionary power at the edge, he added.

The program has “a number” of upcoming competitions that will be announced “very soon,” he said, “that should set some waypoints for where the FUZE organization is going.” **ND**

DISTRIBUTED OPS

Venezuela Mission Raises Questions for Military Logisticians

BY STEW MAGNUSON

WASHINGTON, D.C. — The U.S. mission to capture Venezuelan President Nicolás Maduro in early January has revealed some lessons learned for military logisticians.

Operation Absolute Resolve was carried out in an area of operations where the Joint Force doesn't have a lot of experience, said Brig. Gen. Tara Nolan, mobilization assistant to the commander of Air Forces Southern.

"It's a new theater, and we hadn't had a lot of time to figure out what is going to go where — and just a lot of questions came up logistically," she said at the APEX Defense conference held about three weeks after the operation.

The mission involved all of the military services, plus the National Guard and Reserves, who all had expectations that their equipment would be there waiting for them, which wasn't always the case, she said.

Some of the lessons centered on "what's the minimum amount we can send, but still be effective ... when everybody wants to be there ASAP?" Nolan said.

Another lesson was prioritizing and being clear on what had to be in place.

"Sometimes with limited airlift, if you actually effectively used maybe the sea or other means of transportation, your equipment could actually get there maybe faster than if you were just in the queue

waiting on that airlift prioritization," she said.

"And anybody who's ever been part of that process knows you can very easily be bumped," she added.

Some of the units were also slow to bring their logistics personnel into the planning process, she noted.

That "created the situation that instead of setting the theater, you're actually responding to problems in crisis management, which we're also very good at, but it's nice when you don't have to make it that hard on yourself," Nolan said.

The operation involved re-establishing the Roosevelt Roads Naval Station in Ceiba, Puerto Rico, which had partially been subject to the Base Realignment and Closure process. Parts of it had been auctioned off, and the past few years it has mostly been used by Cus-

toms and Border Protection and the Army Reserve.

"That was perfectly functional when I was flying, and then we had to set that back up," she said.

Beyond Puerto Rico, the military will have to use soft power to re-establish relationships with partner nations in the region, she said.

"With unlimited money, everywhere would have a runway and be perfectly set up and available for everything," she said. Since that is not the case, it makes the Navy and its aircraft carriers all the more important in the region.

"While we're trying to get different bases up and running for our operations, you can bring a carrier in, and that gets you up and going right away," she said.

The Space Force and the services it provided played a large part in the operation, but again, logisticians had an important but overlooked role, she said.

Space Forces Southern only began operations in January, so they're still "very highly integrated" with the Air Force logistically, she noted.

"We actually leaned forward and deployed some exquisite systems.

... People know how to use their equipment, but they rely almost 100 percent on everybody else to move their equipment, position it, protect it — all of those things. And so, you need logistics professionals to do that," she said.

"As we're developing new exquisite technologies, or even attributable technologies, it has to go hand in hand with how are we going to get it? How are we going to support it and make it a useful tool, not just a nice static display?" Nolan added.

One of the success stories was BIZINT, an unclassified Air Force web portal that connects the service to local businesses that can provide goods and services.

"That provided a lot of flexibility when we were looking in the local area about how we were going to set up, and what was going to be available on the economy," she said.

The downside is operational security. It could tip off adversaries that something is afoot.

"Once you start acquiring large warehouses, fuel, large orders of anything, it becomes hard to keep that operational security in place," she noted. **ND**



A Marine Corps pilot captain guides in an F-35B Lightning II following military actions in Venezuela in support of Operation Absolute Resolve.



Uncharted Seas

Navy's Two New Ship Programs Pose Different Challenges **BY STEW MAGNUSON**

When Eric Labs, senior analyst for naval forces and weapons at the Congressional Budget Office, put up a slide at a recent trade show that revealed his rough cost estimates for the Navy's new battleship, audible gasps and a wave of muttering arose from the audience.

The lead ship in the new class dubbed the BBG-1 could cost anywhere from \$14 billion to \$20 billion, with follow-on ships estimated to cost anywhere from \$9 billion to \$13 billion depending on the size the Navy ultimately settles on, he said.

To put that in perspective, the DDG(X) — the next-generation destroyer program that the Navy is abandoning in favor of the new battleship — had an estimated cost of \$4.4 billion per boat, according to CBO.

The new Trump-class battleship is just one of two programs the Navy is embarking on this year. The other is the FF(X) frigate, a restart of the failed Constellation-class program that was canceled in November after years of cost overruns and schedule delays.

The sea service is undertaking these two programs as it faces pressure to revamp its shipbuilding programs and — as is demanded of all the military services — deliver weapons systems at the speed of relevance.

Navy officials struck a positive and “can-do” attitude at the Surface Navy Association's National Sympo-

The Navy will base its new frigate on the Coast Guard's National Security Cutter.

sium in January, only weeks after the Constellation-class program was cancelled and President Donald Trump revealed the administration's intentions of developing a new battleship.

Chris Miller, Naval Sea Systems Command's executive director, in a panel discussion addressed the critics who believe that the Navy can't deliver the two ships.

“I'm here to say, ‘Yes, it can [be done],’” Miller said. “I believe in America, our workforce, our innovation, our ingenuity and our resilience. We have never lacked talent or the will to rise to the moment when we had to. Let's make no mistake, though, this is going to be hard. Hard is authorized, and we've done it before. ... We need to rise to the occasion.”

Miller showed two slides that featured the new BBG-1 battleship and FF(X) frigate.

The BBG-1, he said, “is on the high-end side, and it is meant to meet our high-end requirements by delivering ... high-volume, long-range offensive fires, integrated air and missile defenses, robust afloat command and control” and be highly survivable, he said. Miller's battleship slide showed a length of 840 to 880 feet, a 105- to 115-foot beam, 24- to 30-foot draft, 35,000 tons of displacement and the ability to sail at more than 30 knots. It estimated a fleet size of 15 to 25 ships.

It indicated that the battleship would be armed with sea-launched, nuclear-armed cruise missiles, Conventional Prompt Strike hypersonic missiles and a railgun, a technology the Navy abandoned in 2021 but has continued to be developed in Japan.

“This ship is meant to take a hit, stay in the fight and fight back,” Miller said.

Rear Adm. Derek Trinque, the Navy's director of surface warfare, said: “There are some folks who are really hung up on the term ‘battleship.’ This will be a battleship, because she will be the most powerful warship in the world.”

The battleship concept has grown out of the DDG(X) program, he said. The Navy wanted to boost its fire-

power with the upcoming hypersonic weapon, but found it would have to redesign the ships and make “terrible choices” and “trade-offs” to accommodate the new capability.

“When the administration and national leadership said, ‘Build a battleship,’ it helped solve the problem of what sort of trade-offs should we make? We don't need to make any trade-offs. We can incorporate an incredible amount of offensive capability into this ship,” he said.

The DDG(X) program will be halted as the Navy pursues the battleship, the officials said.

As for the second attempt at a new frigate, the officials said they would use an existing platform to jump-start the program right away and vowed to have the first ship in the class in the water by 2028.

The Navy is going with a proven design, deciding less than a month after the Constellation-class program was canceled to base the FF(X) on the Coast Guard's Legend-class National Security Cutters and tapped its builder, HII's Ingalls Shipbuilding division, to do the work.

“We are not doing anything fundamentally that is going to change this ship,” Miller said.

The Coast Guard National Security Cutter program ended at 10 ships. When it was terminated, there was already long lead time material at Ingalls Shipbuilding's Mississippi shipyard, Miller noted. The

Navy will be procuring that material to help it get a running start on building the first FF(X) ship.

From there, the Navy will start to iterate on the design as it builds out the fleet, he added.

The frigate will have a length of 421 feet, a 54-foot beam, 22-foot draft and travel at 28 knots. It will feature containerized mission payloads and a platform for unmanned aircraft or helicopters. The fleet size is estimated at 50 to 65 ships, according to Miller's slides.

Rear Adm. Brian Metcalf, program executive officer for ships, said the long lead time equipment for the 11th National Security Cutter "will roll straight into the frigate." HII has made investments in its facilities, there's a new wage agreement and a workforce retention program, so the yard is ready to begin work.

"I'm going to have a ship in the water by 2028, and it's exciting, and I can't wait, and it's fast, and that's okay," he added.

However, in a panel following the presentation, two government personnel tossed in a healthy dose of skepticism.

One was Labs and his preliminary estimates on the battleship's price tag.

He cautioned that he was basing his estimates on the scant information the Navy had provided, as well as previous costs for lead ships.

"You're talking about a lead ship in the range of \$18 [billion] to \$19 billion for the 35,000-ton displacement, north of \$20 billion if the displacement ends up being higher," Labs said.

There are scenarios where it could be less expensive, such as if improvements are made to the U.S. shipbuilding industry, he said.

"In my view, probably the biggest issue ... is the industrial base," he said. The historical data he drew upon was when the U.S. industrial base was in a better functioning and better operating condition. "Things have gotten a lot worse in recent years, just in the ships that we're currently building," he added.

There will be high costs integrating new nuclear weapons and a railgun, Labs said. "And then the ques-

tion becomes — as we build the ship, does the Navy control itself? Does it avoid requirements creep? Does it avoid adding stuff on as we get more and more into the program? That is something that has happened, unfortunately, historically, all too many times, and could easily happen with a ship this large."

As for the frigate, Labs noted that construction on the final ship in the Coast Guard National Security Cutter fleet began in 2019, and it was commissioned in 2024.

"That is a sort of typical type timeline for the industrial base right now for a ship of that type. ... We're going to have to do things differently if you're going to shave substantial amounts of time off that construction period," Labs said.

Ronald O'Rourke, naval analyst for the Congressional Research Service, said it was only a matter of weeks from when the Constellation-class frigate was canceled when the Navy decided on the National Security Cutter for the new hull.

O'Rourke since the panel discussion has retired after more than 40 years analyzing Navy and Coast Guard programs. (See story on page 26.)

He identified four different approaches the Navy could have taken, but said he doubted there was an analysis of alternatives done in the weeks that followed the cancellation.

He questioned whether Congress has enough information to assess what occurred with the restructuring of the frigate acquisition plan.

As for the battleship, O'Rourke said: "You can think of these in a Wall Street way as due diligence questions. The first one is whether an [analysis of alternatives] or some equipment study was done prior

to the decision to do this ship?"

"It's at least worth asking the question and understanding whether the program came first and the analysis came later or not," he said.

Shaun McDougall, U.S. defense markets lead analyst at Forecast International, said the two programs reflect "two kinds of impulses." For the frigate, it is to go fast. As for the battleship, "you're kind of going the opposite direction," he said in a Forecast webinar focused on military budgets.

"It's not a traditional battleship like you think of in history. It's closer to maybe a heavy cruiser, but it's something that will host a lot of missiles, hypersonic weapons, directed energy weapons," he said.

"Regardless of the label, you're talking about a large and expensive ship and something that's going to take years to design, test and build. So, it's kind of the opposite of getting ships into the water as fast as they can," he added.

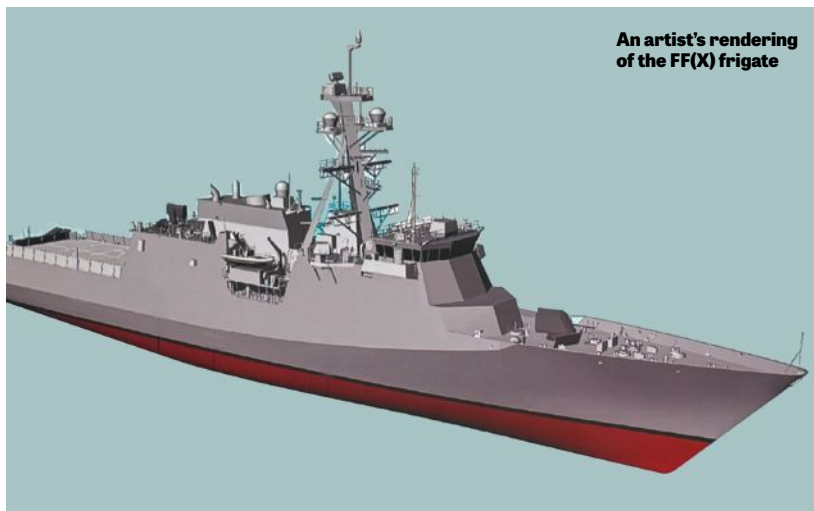
The Navy's emphasis on speed for the new frigate comes with tradeoffs, the main one being the lack of a vertical launch system, which makes the ship less capable and more akin to a Littoral Combat Ship, which is ironic, McDougall said.

"It's kind of interesting because it was a lack of firepower on the LCS that was really one of the drivers behind the Constellation class in the first place," he said.

Miller said he has heard the naysayers but indicated the Navy has no choice but to move forward.

"The thing we care the most about in shipbuilding right now is getting back to on time. That is our North Star. We have to execute with speed, and we will value being on time as the driving factor about how we think about things in the future," he said.

"We are going to have to prove ourselves, hold ourselves accountable and move with urgency. I have to prove to every single one of you that we are serious and we are going to go execute," he said. **ND**



An artist's rendering of the FF(X) frigate

Hybrid Fleet

Navy Working To Capitalize on Sea Drone Boom

BY LAURA HECKMANN AND ALLYSON PARK

The Navy is working to quickly and effectively integrate robotic and autonomous systems into its fleet in the wake of estimates that nearly half of the surface force will be unmanned by 2045.

Surface Force Vision 2045, which is Naval Surface Forces commander Vice Adm. Brendan McLane's vision for a hybrid fleet that is 45 percent unmanned by 2045, is a "foundational change" in how the admiral is approaching the future force when it comes to robotic and autonomous systems, said Capt. Garrett Miller.

Miller, commander of Surface Development Group ONE, a unit focused on integrating and developing unmanned surface vessels, said the Navy is trying to "really normalize" USV and robotic and autonomous system operations in the surface force. There's "lots of unmanned stuff happening," Miller said at the Surface Navy Association's annual symposium.

As part of the service's overall vision, Surface Force Vision 2045 instructs leaders to construct a hybrid fleet by operationalizing unmanned surface vessels in squadrons as "fully supported capabilities" rather than individual systems, he said.

In 2025, the Navy's inventory of small unmanned surface vessels was four, said Rear Adm. Christopher Alexander, special assistant to the commander of Naval Surface Forces. By the end of the year, it was close to 400, which he described as an "incredible change."

In fiscal year 2026, the Navy is investing nearly \$7 billion into autonomous systems, and in 2027, the inventory of medium unmanned surface vessels will be approxi-



Seahawk, a medium unmanned surface vessel prototype, departs Naval Base Point Loma, California.

mately 11, with small USVs somewhere close to 500, he said.

Lt. Miles Graham, commanding officer of Chimera Detachment ALPHA — a unit focused on integrating and testing unmanned surface vessels — called USVs the future of both the Navy and global military conflict, "whether you like it or not, so better start learning now."

Alexander said this "incredible pace of change" presents a unique opportunity, but also a challenge.

"First and foremost, we need to do this quickly. Second, the future is now — unmanned systems, autonomous systems, AI, it's not the future. It's happening right now," he said.

A week after the symposium, the service stood up three early-command USV divisions.

Miller said industry awards for the Modular Attack Surface Craft Program will go out "in the next few months," and two of the Navy's medium drone boats — the Sea Hunter and Seahawk — will be deployed in 2026, and one will be integrated with a carrier strike group.

"Those will no longer be experimental vessels," he said. "They will actually be under fleet control, assigned to surface forces to be able to actually go out and do great things."

As the Navy looks to effectively

employ unmanned systems — which officials emphasized will be additive capabilities and not replacements for the surface force — the service is making organizational and personnel changes to ensure it evolves with the technology.

Capabilities are developing so quickly in the robotic and autonomous systems space that "it is difficult for us to be able to effectively employ some of these systems," Alexander said. "It's probably a good problem to have, but it is still a problem."

Foundationally, the Navy's adaptive changes begin with standardized doctrine, organization, training, material, leadership, personnel and facilities solutions, better known as DOTMLPF.

Miller called for a "standard model" for these systems with full Navy support, including manned, trained and equipped operators.

Industry can also help with the DOTMLPF piece, Miller added. "Come up with great ideas and solutions for us [on] how we get out of some of those challenges we have, so that open dialogue between us."

Alexander added it is "imperative" that the military find ways for industry to view classified concepts of operations, "so that you can then help us with some of those DOTMLPF solutions" — solutions that he said need

industry insight, not just capability.

“How are we going to train on systems? What are the different training packages we can make to the systems and make them more effective? What’s the maintenance strategy for some of those systems? That’s what we need help with,” he said.

As the Navy develops a common operating picture for robotic boats, it wants fleet commanders to be able to pull data from one of the platforms and send it back to the command center.

“Whether it’s a strike [group] commander, fleet commander ... that data and that information has to flow in there and be useful. And some systems today don’t do that very well because they just haven’t been approved to go through that whole process,” Miller said. “And so, we’re driving for commonality, and really be able to drive to that common operating picture where it’s a game-changer. It makes the fleet commanders and our strike group commanders better at what they’re doing and able to make better decisions with that information.”

Ensuring sailors are prepared to operate these systems means, in part, evolving the structure they operate in.

“The secret sauce that we have about our systems here, it’s no surprise, just like any of our other manned systems, it’s our people,” Miller said.

Miller highlighted what he called “key” personnel changes within the 2045 vision — one being

an alteration to career paths for surface warfare officers. In addition to SWO - Conventional and SWO - Nuclear — designations that steer sailors’ career paths — Miller said the Navy is adding a third designation: SWO - Unmanned.

Surface Warfare Officer - Unmanned is “very similar” to nuclear, Miller said, which is more specialized than the conventional designation. “You follow that same model, where you do a tour in the conventional side, and then your next tour is in the unmanned side, back and forth.”

In another “really significant” change, unmanned surface vessel command officers will be sequential commander commands, Miller added.

That means they have to be a com-

manding officer of a ship and have that core competency prior to being a commanding officer of a USV squadron, he said. “And then we’re exploring looking at establishing two major commands as [Immediate Superior in Command] on each coast, as we expect to grow our USV squadrons to every fleet.”

“As we start to scale this, we will run out of people to manage all of the things,” said Capt. Jerry Daley, deputy assistant secretary of the Navy for robotics and autonomous systems. “So, those critical skill sets that they’re developing at the USV squadrons [are] critical for the next thing that has not come on to the field.”

In addition to preparing its people, the Navy also wants to ensure it’s adapting the way it acquires the systems.

“We all want to move fast on this, and it is a big team, so there’s a lot of the pieces and parts of that,” said Capt. Craig Trent, OPNAV N96F — a branch within the Surface Warfare



Sailors retrieve an unmanned surface vessel during Exercise Arcane Thunder 25.

Division responsible for requirements.

“We want to learn from the past,” Trent said. “We’re going to write these requirements, and we want to keep things open — open systems, open architecture. We want to move forward with just an 85 percent solution ... Learn, build something, prototype it, test it, learn from it.”

While the traditional acquisition system is designed to emphasize lengthy requirements generation and planning prior to purchases, technology moves much faster than that now, Daley said. Smaller systems deployed in mass will change every 12 to 18 months and every eight days, software will be updated around the globe, he said.

“So, if that cycle ... is inside of the requirements process, how do

we get after that? And that’s the challenge that we face,” he said.

And it’s not just getting the requirements right — the challenge also encompasses training and maintenance operations, Miller said. The Navy is working with vendors and program offices “to create what that looks like as a holistic model to be able to support those things going forward.”

The big danger with developing and operationalizing unmanned systems for the Navy’s surface forces is overstepping, getting “too far down the rabbit hole,” and then ending up with exquisite systems that can’t be mass-produced, Graham said.

Industry also needs to ensure it is testing these systems properly, he added.

Industry often tests unmanned systems in “perfect conditions,” but “you will likely, over the course of an operational lifetime, end up in conditions you didn’t plan for, so that’s what we need people to be doing,” he added.

Lt. Luis Echeverria, former commanding officer of Task Group 59.1 — a group created to team unmanned systems with manned forces in the Middle East — said he would “challenge industry” to ensure systems had been validated in all kinds of conditions before providing them to the Navy.

Lately, there have been “lots of acquisition strategies, lots of executive orders and directives,” Daley

said. “It’s tough just to sift through them all, whether you’re industry or whether you’re on the uniform side.”

Two-way conversations are important “and showing enough of a demand signal ... where you have to show those investors that you’re going to be able to produce and get to market with that particular capability,” Echeverria said.

Miller said while industry needs clarity and communication from the sea service, the Navy needs reliability and speed from industry.

“I need you to be on time. Because, you know, I’m trying to plan for where I’m going to put over 30 medium USVs by fiscal year [2030] in the Indo-Pacific alone, right? So, I need you all to deliver on those things,” he said. **ND**

Parting Words

Longtime Naval Analyst Delivers Prescription for Solving U.S. Shipbuilding Woes **BY STEW MAGNUSON**



O'Rourke

Congressional Research Service Naval Analyst Ronald O'Rourke announced at the Surface Navy Association's annual symposium in January that he was retiring after 42 years of providing reports to lawmakers on issues facing the sea services. He received a standing ovation in recognition for his work from the hundreds of conference attendees while assuring them that he would still be around to provide advice when needed.

The following is an excerpt of his presentation on how the nation can tackle its shipbuilding backlog. It has been edited for clarity and brevity.

If you're going to fix this problem ... you need to look at a substantial increase in worker wages and benefits, and if that puts the shipbuilders in a hole — especially for their long-term contracts — then you're looking at contract relief for the shipbuilders. On the Navy side, they will have to confront the fact that it will make the ships more expensive compared to airplanes or tanks or other things that are competing for defense dollars.

But I don't think you're going to solve the worker problem — which is central to this issue — unless you make [a] very substantial move on wages and benefits. And it's not just to reestablish the differential between shipbuilding wages and service sector wages, like working at a Walmart or a Taco Bell. It's to establish a greater differential between shipbuilding wages and other manufacturing sector wages. Because right now, there isn't much at all.

There's a lot of manufacturing jobs in this country that are going [unfilled]. People that want to go into manufacturing have a choice, and a lot of those choices are parts of the manufacturing world that are indoors, air-conditioned, and don't involve issues with parking lots and long commutes and maybe lifting heavy objects or whatever. And

so, I think we need to pay attention to that wage differential as well.

The other thing I think we need is to make sure that the Navy's acquisition executive ... needs to be someone who understands shipbuilding really well, like Sean Stackley did, and is willing to make bold decisions, the way that [James] "Hondo" Geurts did during the pandemic ... and then that person has to stay in that office a long time so that they can enforce their decisions and also be held accountable for the consequences of at least some of those decisions. And then the role of the [Navy secretary] now is to back that person up and to say, "listen to that person."

... We're treating the force-level goals as overly precise and durable, which they're not. We are designing ships one at a time and then stapling them together and then calling them a fleet. So, we are building a fleet without actually designing a fleet. What a lot of people refer to as "fleet design" is simply showing lists of numbers of desired ships. That's not fleet design. That's just force structure listing.

True fleet design means looking at the totality of where you want to go and doing enterprise-level design up front. And that's something fairly alien to the Navy — both within the bureaucracy and within the uniform branches. But it's something that the Navy is now going to have to learn how to do, even though it hasn't had to do that in the past, because of the complexity of what the Navy is attempting to do with its ships.

... Also, the Navy ship designs have very strong outward emphasis toward missions and threats, but there's not as much orientation to balance that [with] looking inward toward the capacity of American society to design and build and maintain these ships ... which naval fleet designers in other countries might tell you is really kind of crazy.

We've been able to get away with [this outward emphasis] for a long time and just throw the designs over to industry, and it all worked out. We're

not there anymore. So, we need to balance that, not by weakening [our] outward orientation, but by strengthening the inward orientation. You would do this to make the fleet intrinsically easier to design, build and try to maintain.

Right now, the Navy's approach to problem-solving is to wait for the problems to happen and then work really hard to try and fix it and do that over and over and over again.

This is an after-the-fact, ad hoc, plumber-like Mr. Fix-It approach to fleet design, building and maintenance, and this is why the Navy never is able to dig itself out of the hole on this problem It's not asking itself, "Wait a minute, what is it we're trying to do in the first place? Can we make that problem simpler so that the problems don't happen in the first place?"

... You move toward distributed shipbuilding, or federated shipbuilding. ... The Navy is doing this, and the submarine community is doing a lot of it, but the Navy can do more of it, and can do it on a more comprehensive, systematic and deliberate basis. The Navy has a long way to go further down the road on this and doing it more deliberately and not simply as an ad hoc collection of reactions to conditions that developed after the fact.

Same thing with moving the Navy toward a more modular kit-of-parts approach. The Navy's been going down this road for 20 or 30 years. There are pockets of where that's true within the Navy. But again, the Navy can do this in a more deliberate, systematic and comprehensive fashion up front.

A third thing is to adopt the South Korean approach to design for producibility, which is an approach that focuses on [minimizing] labor hours ... much more than on minimizing material weight and cost.

The final two parts are to move toward what I refer to as continuous production ... [The Navy has] never had to do it before. It's never taught itself how to do it. It's time for the

Navy — in my view — to teach itself how to do that and integrate it into its approach toward fleet development and sustainment in other fields of endeavor that are comparably complex to what the Navy faces.

You would establish a generalized fleet design framework that would then be used to vet new shipbuilding programs as they come up out of your office.

One of those elements of continuous production is conditions-based, minimal-loss transitions in classes. When you transition from one class to the other, we all know that No. 1 is a disaster. We know that No. 2 looks better. But in fact, it's very risky if the new program develops problems. ... You need to go to a new model that's more conditions-based and more flexible.

And it gets away from the idea of trying to preserve a learning curve between going from lead ship in that new program for ship No. 2, because that desire for that learning curve is a mirage. It's not going to happen.

and talking about the future. We need to back away from the idea — which we're all very used to — of talking about the future fleet as an end point in the future that's going to have a precise number of ships of certain kinds and numbers of different types. That's a mirage. It gets you into the problem of chasing those things and manicuring your procurement profiles and doing in the end what a dog does when it chases a car down the street and takes a curving path through the front lawn of the house. ...

What you want to back up to is a more generalized idea in which you say, "Well, we're going to have a bigger Navy. It's going to be between this many ships and that many. Not quite clear yet where that is — that will become more clear over time — but what I can tell you is that whatever that number turns out to be, we're going to get there by building ships at a certain steady drumbeat."

... This is adopting for the Navy the approach that Japan has long

then, as I said, you would vet new programs in relation to that generalized, pre-designed framework.

And these are the kinds of questions that programs would have to pass. If they didn't, the programs would be sent back to the shipbuilding office. We don't do this right now, and shipbuilding programs that are being proposed right now would not fare well against these. Again, it's alien and different and something I think we may need to think about doing.

Nothing that's said here gets in the way of competition and innovation.

So, there it is. That's the new approach. As I said, I spent three or four years trying to think my way through this problem, diagnose what I see is happening in the Navy, a lot of which involved noticing what's not there, noticing the dog that's not barking, noticing the wallpaper that we don't look



So, don't schedule a program hoping to get that if it then leads you to execution problems in that transition. Instead, accept that the first ship is a prototype. Be flexible about when you procure it and be flexible about when that second ship is procured. And in the meantime, keep procuring the old one. That, I think, is the model for the Navy to look at in the future and to transition between classes.

And then another part of continuous production is a different way of thinking about and characterizing

used successfully with its submarine force. They just build one submarine per year, regardless of their force level, and if they increase or decrease their force-level load, they just change the amount of time that they leave ships in service.

So, instead of changing things at the front end and managing procurement profiles and creating disruptions, you manage force size at the back end, through end-of-life decisions, to keep the procurement rates as much as possible in a steady fashion. And

at anymore [because] we're so used to doing things in a certain way.

But it's my belief that if you don't move to something like this — which you can refer to as the "new American naval system" — then the Navy will forever be in the pattern of waiting for problems to happen, trying to fix them after they happen, which is [a] very expensive and labor-intensive way of doing it, and then convincing itself that there's a light at the end of the tunnel, only to discover that that tunnel is going to go on forever. **ND**

Digital Design

Physics AI Models Have Potential to Speed Weapon Development **BY JAN TEGLER**

San Mateo, California-based startup Luminary Cloud has released three new physics artificial intelligence models aimed at dramatically accelerating the design of collaborative combat aircraft, submarines and pump systems.

The company's SHIFT family of bespoke physics AI models can speed analysis of different design options for military platforms and components by orders of magnitude, said Juan Alonso, co-founder and chief technology officer at Luminary.

"In the physical world, we're interested in designing all kinds of systems, some military, where you have to simulate airflows, heat transfers, electromagnetics, structural analysis, etc., and for which there are really no good solutions to iterate through various different designs and do so very quickly," Alonso said.

Applying AI bounded by the constraints of physics to simulation enables Luminary to rapidly craft models capable of assessing variations in design configurations or operating conditions, he explained.

"The idea is that if you can do simulations of the physical world way faster and many of them simultaneously, you can create sufficient data to leverage what we call the physics AI revolution," he said.

In other words, Luminary can integrate its SHIFT physics AI models into a client's engineering workflow seamlessly via a secure cloud to help fast-track the design process.

"Say you're designing a new underwater drone. You can check different shapes. Let's put the fins in different places. Let's design propellers for these underwater drones, and let's assess the performance," he said.

An engineer can send a new design to the cloud-based SHIFT model, "and almost immediately out comes the actual performance of the proposed new design," he added. "We have built a platform that effectively automates most of the work such that instead of spending years trying to build one

such model, you can do it in a week."

In a late October press release, Northrop Grumman announced a collaboration between the defense giant, Luminary and NVIDIA's Computer Aided Engineering product team to create a new physics AI foundation model capable of accelerating the design of a spacecraft thruster nozzle.

Han Park, vice president of artificial intelligence integration at Northrop Grumman Space Systems, said in the release the new model marked the first step on the road to routinely using physics AI models.

"Physics AI is the next level of complexity in AI, and Northrop Grum-

man said in a statement, while declining to elaborate further.

PhysicsNeMO is a machine learning architecture that rapidly combs large datasets to help create models trained on data relevant to specific designs. NVIDIA did not respond to a request for comment on its role in the collaboration with Northrop Grumman and Luminary.

Alonso confirmed that no hardware as of yet has resulted from Luminary's collaboration with Northrop Grumman, but said Luminary is currently working with as many as six other defense industry firms. He declined to name them.

"You can imagine who they are — underwater vehicle makers, [collaborative combat aircraft] participants, including smaller companies or new entrants," he said.

Luminary's end-to-end process for creating its SHIFT models begins with generating large amounts of data relevant to a particular design, such as a swept aircraft wing. Engineer-



man is bringing this technology to our design engineers to dramatically speed up hardware development," Park said. "Using AI to make something small, like a spacecraft thruster, puts us on a path to do much bigger things, like using AI to design larger components or even an entire spacecraft."

Northrop Grumman views physics AI as an "important niche in the broader AI landscape, and that's the reason the company is focused on options that leverage NVIDIA's PhysicsNeMo, as Luminary Cloud's offering does," a company spokes-

ing and experimental design data are sourced from a client, he said.

Luminary's software runs simulations of that data to create datasets that can have "thousands to hundreds of thousands of simulations," Alonso explained, adding that the SHIFT platforms "can run a single simulation 100 times faster" than the legacy simulation tools many in industry use for design.

With datasets created, curated and prepared, machine learning architectures including PhysicsNeMo can be used to train the model, he said.

“Once you have a model that’s fully trained, you deploy it for what people call ‘inference,’ which means now you have a model of the physical world that is way faster than simulation and very, very accurate,” Alonso said.

With the SHIFT model completed, design engineers can query it to ask, “If I had another wing configuration or another thruster or another geometry or operating conditions, what is the outcome? Give me the answer very quickly,” Alonso added.

Luminary’s SHIFT models achieve accuracy within one percent depending on the quantity and quality of data they ingest, Alonso said.

Because the models are accessible via a secure cloud, an “engineer doing a dynamic database to develop flight control laws, for example, could have their laptop, not a supercomputer, connect directly to Luminary’s product and derive all the aerodynamic loads for development of the control laws,” Alonso said. “So, it’s easily integrated into existing workflows. The laptop

accelerating design processes.

“If you’re trying to ideate designs quickly and go through more of an open-ended creative process, I think these are really helpful and have come a long way,” he said.

The use of physics AI models in design workflows is still at an early stage. At this point, physics AI models work best when the data they ingest is extensive for a particular design space, Turner said.

“They can work well typically for a problem that is very close to the training data that went into it — say a winglet design, for example. Aerospace companies are likely to have decades of data on different winglet designs, so a physics AI model could probably produce a very high-fidelity simulation of a new design or variation,” he explained.

“I think the real test is when you branch away from the domain that your training data comes from, and you look at a new scenario or something that wasn’t included in the data you have,” Turner said. “That’s where

ARTIFICIAL INTELLIGENCE

tion, for humans, she said.

“It’s still computationally extensive, but if we’re clever about it — and that’s what some of our research is about — our AI scientists can go and do high-fidelity simulations in a way that is more computationally efficient,” Briscoe said. “That would allow us to explore wider design spaces than a human team could possibly do.”

Asked if physics AI modeling could help engineers assess design options much more quickly than traditional tools, thereby accelerating the fielding of military platforms, Briscoe responded: “That’s the dream.”

“I think design for more simple parts using physics AI models is more likely to be feasible in the near term as opposed to complex systems with kinetics and control systems, etc.,” she said.

Briscoe added there are a number of “hard problems” when using physics AI modeling for the creation of



is just an interface to the cloud.”

SHIFT models will also be made available this spring for on-premise use by clients wishing to employ them in very sensitive or classified design workflows, he noted.

Dan Turner, lead for Sandia National Laboratories’ Artificial Intelligence for Nuclear Deterrence Initiative, said researchers there are working on a project called Tungsten Rain with the aim of designing a “flight test body” using AI design tools.

Turner said emerging physics AI models offer promise for

something like a four percent error rate would be astounding. How far from your original paradigm are you when you’re looking at the error?”

Erica Briscoe, program manager in the Defense Advanced Research Projects Agency’s Information Innovation Office, leads DARPA’s efforts to harness artificial intelligence to make leaps — not incremental improvements — in design efficiency.

The promise of using AI in design processes is that it can automate a lot of the time-intensive work, known as design space explora-

comprehensive designs such as a submarine or an aircraft carrier.

“Say your AI system can come up with brand new designs,” she said. “If you’re talking about anywhere near a complex system, the number of designs you can come up with is near infinite, especially when you’re talking about 3D printing parts with all of the degrees of freedom that you have.”

“The more degrees of freedom you bring in, the more your design space explodes,” Briscoe noted. “Then it gets really hairy to make any claims about optimization there.” **ND**




*National
DEFENSE*

INDO-PACIFIC

Training Ties

Modeling and Simulation Could
Strengthen Indo-Pacific Partnerships

BY LAURA HECKMANN



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RLANDO, Florida — The vast region of the Indo-Pacific creates a complicated landscape for training

among partners and allies, but modeling and simulation could be the connective tissue to help stitch together an increasingly collaborative presence.

Air Force Brig. Gen. Richard Goodman, director of joint training and exercises (J7), U.S. Indo-Pacific Command, characterized the region from a training perspective as “increasingly joint,” “increasingly connected” and “increasingly combined with partners.”

Warfighters in the first and second island chains “depend on these capabilities that you’re developing and providing for their training, for the exercises, demonstrations and rehearsals that are occurring,” Goodman said during a panel at the National Training and Simulation Association’s recent Interservice/Industry Training, Simulation and Education Conference. “And they matter to the security of the Indo-Pacific.”

As important as collaborative training is to the Indo-Pacific, further complicating its geography is its politics.

“Every piece of terrain in the Indo-Pacific is part of a sovereign country that [has its] own sovereign requirements,” said Brig. Damian Hill, director general of the Joint Collective Training Branch at Australia’s Joint Operations Command.

“So, how do we bring them into our environment to enable us to train together ... so that we don’t make the mistakes when we have to do it for real,” Hill said — mistakes made “real early on that we could have fixed if we had trained together, and [modeling and simulation] is a really powerful way to solve some of those interoperability issues, those language barriers, because some of the tools we have can translate much better than I can.”

Modeling and simulation is an opportunity that needs applications that can be shared with Indo-Pacific partners to “boost them up while still protecting the relationships we have bilaterally and [in] other ways,” he said.

Running training opportunities across different areas of the Indo-Pacific could provide a similar effect,

A Japanese helicopter destroyer, a U.S. Arleigh Burke-class destroyer, an Indian frigate and an Australian frigate participate in Exercise Malabar 25.

U.S. Indo-Pacific Command photo

Hill said. Countries such as Papua New Guinea, Indonesia, Singapore, Malaysia and Brunei “have very powerful, sovereign national focus, but want to ... exercise with” Australia.

But working closely with allies is about more than cultivating relationships — it requires both human and procedural interoperability, Hill said.

While “human to human” experiences cannot be replaced, procedures are “increasingly” important because “our technologies will not always seamlessly connect,” Hill explained. Tactics, techniques and standard operating procedures become important fusion points between personnel and technology.

The two play into each other, he said. “They’re all very important for us to understand how they operate.”

U.S. Army Col. Timothy Rustad, division chief for the Joint Technology and Simulation Division, Joint Staff J7, Deputy Directorate Joint Training and Exercises, said interoperability across real-world systems is “difficult in itself, yet people want to wash that away when we do modeling and simulation training,” expecting that networks and modeling and simulation can be compatible and interoperable from the start.

“We can break some of that. I think some of the acquisition reform that is going on should help with that,” he said.

One major initiative coming out of the U.S. Joint Staff is the Joint Live Virtual Constructive Modernization — a project to update and unify military training simulations within a single, secure environment. The initiative is a federation of 34 service and agency tools, integrated by the Office of the Secretary of Defense and Joint Staff governance.

Its goal is to have a “reliable, realistic, relevant, repeatable and recordable” training environment for warfighters to execute various operations plans by 2027, according to a Joint Staff statement.

“I’m really excited about the Army’s efforts and the next-gen constructive capability that will be initially embedded and integrated directly into JLVC,” Rustad said. “And when that occurs, that allows all the services to have their authoritative collective training models within the Joint Live Virtual Constructive federation. And it will absolutely help with our partners and allies.”

The modernization effort includes a “fully informed simulation environment” that would allow the

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Joint Staff to tie together varying levels of classified exercises that can “be felt all the way down to a releasable level,” Rustad said.

Making sensitive information releasable and shareable is one of the challenges complicating international training environments and global integration events like multi-combatant command exercises.

In 2025, one event pulled together as many as seven combatant commands, Rustad said.

“This next year, it’s all 11 combatant commands and partners and allies, along with some of our government partners,” he noted.

The “biggest challenge” that comes with events of this scale is releasability, he said. “And that’s why that fully informed simulation environment ... can’t come fast enough.”

The JLVC Modernization project began laying the framework for a secure training network “before we even got policy decisions” to design

“I tell them to prove it, because I’ve been told ‘yes’ many times, and then it has been proven that’s not the case.”

If the answer is ‘no,’ “then you need to be able to work hard to do it,” he added. “It’s not on me to do that. I’m the demanding customer. You need to demonstrate that to us, because if you can’t, I can’t work with our allies and partners straight away. So, that’s really important.”

When participating in joint training events, different countries bring different gear, Hill explained — “our own pieces of kit that are important that we’ve made sovereign decisions around.”

The key, he said, is when they come together, “can we share that data, that instrumentation data, and then can we collate that data and put it into a constructive simulation to provide the visualization for our commanders so they can make decisions?”

Merging data is the hardest part, he said. “Because you’re then feeding it into joint data networks to stimulate [command-and-control] systems.”

When juggling multiple data standards, “asking the right questions is really important when you’re making decisions on acquisition,” always thinking back to: “Who will I use this with in the future?” Hill said.

In addition to the Joint Live Virtual Constructive Modernization effort, U.S. Indo-Pacific Command is also operating the Pacific Multi-Domain Training and Experimentation Capability,

an initiative started in 2022 to link distributed live and virtual training ranges across the Indo-Pacific.

The initiative is “critically important” to the Indo-Pacific Command training mission and the region’s partners, Goodman said. Today, there are around 23 joint exercises, compared to 14 four years ago.

The need and the curve in training capabilities for partner nations is “significant,” he said. But there is positive traction and momentum building “in the areas that we

most need them to be building.”

The experimentation is part of that, Goodman said. Nearly four years old, the initiative is funded by Indo-Pacific Command under the Pacific Deterrence Initiative.

“It goes into places where services and partners either won’t or can’t” to enhance and enable joint coalition interoperability across the Indo-Pacific, Goodman said.

The world is changing, he said. The adversary is changing, but so is the training audience — the units the exercises are intended to enhance.

“If our exercise mechanisms are not keeping pace” with whatever the training audience is, Goodman said, “then we are not providing that qualitative training experience for the training audience.”

To do this requires speed, cross-domain fusion and seamless integration — “a lot of things all at once,” Goodman said. A federation of systems like the JLVC will “reduce the manual operation, enhance the speed, enhance the integration that we’ve already talked about.”

“It is solutions that connect across simulations,” he continued. “This is the federation of systems, a common plug or interface based on common data standards. ... And finally, it’s scalable.”

When considering speed, “as we look to catch up and run fast,” partners and allies need to consider each others’ capabilities, he noted.

“There are many partners in the Pacific who are very interested and willing and should be considered by all of you in this space as well,” Goodman said, “so that we are at pace with each other running forward.”

Hill said it is important to remember that training together means “you have to fight your threat, not yourself.”

“Some of those [threats] aren’t humans and capability,” he added. “Sometimes it’s the environment and the geography.”

While battling “tyranny of distance” and “immutable” geography is nothing new for Indo-Pacific countries, Hill emphasized that the nations’ relationships to geography can and have changed “a lot” since 1942.

As a result, “we must work much more closely with our neighbors in the region than, frankly, we have in the past,” he said. “I see modeling and simulation as an entry point into that relationship.” **ND**



Marine Raiders participate in Exercise Talisman Sabre 25 in Sydney, Australia.

a fully informed simulation environment, Rustad said.

While the capability “probably won’t be resonant across the globe” for a few years, he said, “we’re starting small and establishing a top secret training network, which will allow us to at least get after some of that exquisite capability in these bigger exercises.”

When considering modeling and simulation tools, Hill said the first thing he asks every company is: “Can you operate on that classified environment?” If the company says ‘yes,’

Dual-Use Tech

Defense, Civil Aviation Cooperation Needed to Boost Indo-Pacific

Air Mobility **BY ALLYSON PARK**

SINGAPORE — An overarching theme at the Singapore Airshow was the need for more interagency and international partnerships in the Indo-Pacific region to capitalize on dual-use air mobility technology.

Discussions at the airshow called for the defense sector to collaborate more with government agencies and the civil aviation world, particularly through developing technology useful to both the civilian and military worlds.

Industry leaders at the airshow said designing versatile air platforms for both civilian and military purposes is crucial to boosting air mobility, which from a military perspective refers to the rapid movement of personnel or supplies from, to or within a theater via air.

However, dual-use technology can present a host of challenges to sufficiently meet the needs of both defense and civil users.

The biggest challenge is the difference between defense and civil requirements and how to integrate them properly, said Teong Soo Soon, senior vice president and head of unmanned air systems for commercial aerospace at Singaporean company ST Engineering.

“When we design for defense, the requirements are usually very clear; the user knows what they want,” he said during a panel discussion at the airshow. “But when you encounter non-defense customers, sometimes they are still not sure how they are thinking about it.”

When companies are trying to develop an aircraft that can function efficiently in both the defense and civil markets, there is simultaneously a lot of overlap and a lot

of unique differences. What makes integration challenging is the fact that they are just “inherently different systems,” James Dorris, chief



The Airbus C295 tactical airlifter was designed for military use, but it also has civil certification.

executive officer of California-based Odys Aviation, said during the panel.

Mark Emerton, robotics and autonomous systems lead at Frazer-Nash Consultancy in the United Kingdom, added that even if the same capability is required, the standards and requirements will be written in slightly different ways on the civil side versus the defense side.

“They will be tested for slightly different levels, and the supplier ecosystems usually don’t serve both at the same time very often,” he said. “Even right down to aircraft certification, there’s usually — in most nations — two different regulatory bodies that work with roughly the same standards, but it’s still expensive to

approach both, and you can’t typically certify a platform at the same time.”

In order to get after these requirements challenges and avoid fragmentation, more companies need to consider and prioritize integration in the early engineering stages, which is vitally important for aircraft certification, Emerton said.

“It’s not something you do at the end, you have to start it right at the beginning. Again, the supply chains that defense customers are going to ask for and demand and the quality processes used in some of your software that you might be

developing are going to be different and more stringent,” he said.

For example, things like cybersecurity, supply chain assurance and conflict control are different for military customers, “so if you’re deciding to go strategically for dual use, try to do so as early as possible, and try and get your head around the probably more complex military requirements as early as possible as well,” he added.

Additionally, communication between government agencies and civil and defense aviation entities should be transparent and frequent, which is especially crucial in a logistically challenging region like the Indo-Pacific.

For example, Middle East civil aviation authorities “work

very closely” with their defense agencies, Dorris said.

“It’s not entirely separate airworthiness processes, and you can cross between the two quite, quite easily,” he said. “And more than that, there’s actually real communication that happens between the two on a regular basis.”

A “whole ecosystem” approach is crucial to communication and seamless integration, he said. In addition to working with government agencies and civil aviation administrations, aircraft companies must cooperate with end users and the beneficiaries of that aircraft service, such as oil and gas companies that want to purchase and operate aircraft.

“We bring them all together, and rather than building a plan to go in and bring an aircraft and do some circles for a week or two and pack it up and move on to the next, we deploy multiple aircraft for multiple months,” Dorris said.

Odys Aviation’s “deep understanding” of customer requirements has allowed the company to build sample missions that reflect different customer use cases, he said, and over a three-month period, “we’ll be demonstrating these operations, again, both for civil customers as well as for defense customers.”

“Not necessarily the same exact routes — we can’t do some of the defense missions where we would do the civil missions and vice versa — but the framework is the same, the airworthiness approach is the same, establishing safety very much overlaps,” Dorris said.

Communication encourages successful dual-use integration — as opposed to in the United States, where all its work with the Defense Department is military focused. On the civil side, aviation regulations are “very much in their own world” with the Federal Aviation Administration, Dorris said.

“Historically, there’s good transitioning between the two, but that’s really for established aircraft types and processes, and there has been not very good cross boundaries between

new generation aircraft, advanced air mobility aircraft,” he said. “So, I think the key ingredient here is really civil aviation authorities and [ministries of defense] and DoD working relatively closely from a common basis of safety and establishing safe operations.”

Emerton also pointed out that there are some cases, particularly with smaller UAS, where the defense sector actually may offer “an easier market”



Odys Aviation’s dual-use aircraft, Laila (left) and Alta (right)

regarding regulations, and military customers might be “more willing to experiment and more tolerant of risk.”

“Obviously, there are two very different cultures and often completely different requirements,” he said. “Nailing both at the same time early in your engineering design lifecycle is quite hard.”

Prioritizing modularity while designing and developing aircraft is also key and must be considered early in the engineering process, Dorris said.

“With enough foresight — building the aircraft in as modular a way as possible, building your software architecture in as modular a way as possible — these are things that make that integration challenge at least a little bit easier,” he said. “It’s still always going to be a challenge, but I think really thinking about things in a very modular approach is a critical element.”

The interesting thing about dual-use aviation technology is the workforce “doesn’t disappear,” Emerton said.

“If there’s some reason to use it, [workers] can put on a uniform, and then they can be contracted and be a military capability that everyone can rely on,” he said. “You need to contract differently, you need to prioritize the long-term stability over very short-term explosive growth and short-term problems.”

Solving these challenges is particularly timely, as many dual-use aircraft such as drones can be used

for logistics in contested environments — a prevalent issue in the Indo-Pacific, Dorris said.

“How do I get goods to teams that are traditionally inaccessible in a way where I’m not having to worry about the number of humans I might need on my traditional helicopter?” Dorris said. “I can send the UAV and take a [much] different risk posture.”

Singapore’s position as a maritime, logistics and defense hub presents unique dual-use opportunities in the aviation space, particularly in innovation, Teong said. “I think, relatively speaking, the Singapore government is still quite well known for being efficient, and interagency collaboration is pretty good, so we do have [a] good bal-

ance of use cases, as well as trying to get the government support to allow us to carry out those use cases,” he said.

For example, transportation is already “highly efficient” in Singapore, so air mobility solutions like drones don’t actually present a less expensive solution, he said.

“However, that pushes us to think, how else can we create more value in an already efficient environment?” Teong asked.

Teong said ST Engineering uses a “significantly high percentage of AI to reduce the manpower as far as automation, so that we actually can control one to many zones.”

“For the AI part, we would actually give information to our customers automatically, without them reviewing all the data that we have collected,” Teong said. “So, it really forces us to see, how can we overcome the higher cost of drones by providing more value?”

Dual-use air mobility technologies will depend on defense systems pivoting to the civil sector, as opposed to the inverse, which is more typical, Emerton said.

“I think most people in the [advanced air mobility] world are looking for civilian-developed products,” he said. “They’re looking for pivots and diversification of revenue, so they’re now turning to dual use. But actually, there’s a world of defense products out there that maybe could be pivoting back towards civil.” **ND**

Semi-Submersibles

Military Puts Low-Profile Vessels To Work for Logistics **BY HOPE HODGE SECK**

In a much-anticipated Force Design update published in October, the Marine Corps signaled its commitment to a new piece of technology — the Autonomous Low-Profile Vessel — an unmanned narco-sub like logistics platform that has been tested in the Pacific Ocean for more than a year.

“This unmanned surface craft is transitioning to a program of record to provide autonomous long-range logistics distribution,” the document stated in a terse — but significant — announcement.

While the Marine Corps has so far fielded just three of the test vessels, the program-of-record designation indicates plans to buy many more. Senior staff with manufacturer Leidos say they expect follow-on orders in the “hundreds,” if not more.

The concept of a waterborne resupply method that both avoids enemy attention and minimizes risk to human operators is a choice fit for the Pacific, where the Marine Corps envisions itself fighting in dispersed, minimally supported units on islands and in coastal regions.

The concept of autonomous logistics subs began for the Marine Corps in the rank and file, said Brig. Gen. Christopher Haar, one of the planners who spoke to *National Defense* about Force Design plans in late 2025.

“That was an idea that a gunner at 4th Marine Regiment came up with,” Haar said, using the Marine Corps’ term for a senior warrant officer specializing in weapons. The gunner wrote a paper proposing a vessel similar to a “narco-sub” as a solution to the service’s supply challenges.

“He pushed that paper up ... to the Marine Corps Warfighting Lab,” which said, “Hey, you’re right. There’s something there,” Haar said.

While Haar didn’t name the author, the concept has reverberated around the Navy and Marine Corps. In 2020, a Marine infantry officer, a naval aviator and a Navy foreign area officer co-wrote an article for *War on the*

Rocks titled “Cocaine Logistics’ for the Marine Corps” that made a case for using the semi-submersibles most commonly affiliated with South American drug runners for covert resupply.

“If semi-submersible, low-profile vessels can work for delivering cocaine, they can work for delivering warfighting materiel,” the authors wrote. “While these platforms would not solve all of the service’s challenges, they could prove to be an affordable and effective platform to support expeditionary logistics, even in the most fiercely contested areas.”

The Marine Corps Warfighting Lab enlisted Leidos as an industry partner to make the vision for an autonomous narco-sub style logistics vessel a reality.

Jeff Bowles, chief engineering officer for Leidos Gibbs and Cox, said in an interview that a division of the lab had reached out to the company in 2022 to prototype a low-observable logistics vessel.

“They wanted it fast, and they wanted it to be cheap,” Bowles said. “We allowed our capabilities to shine there with our rapid prototyping experience and capability to deliver good, capable systems to

the warfighters in rapid time.”

He called the comparison to narco-subs a “chicken-or-egg thing,” stressing that the semi-submersibles the company designed bore little resemblance — apart from the low-observable form — to the drug-running vessels.

“Those things are dangerous, because they’re manned craft,” Bowles said, “where ours is an engineered piece of equipment that’s designed to be reliable, although perhaps [over] a short lifespan.”

The first prototype, designed at a “blistering pace,” was delivered to the Pacific-based 12th Marine Littoral Regiment for experiments within nine months, he said.

The resulting vessel, which Leidos calls “Sea Specter,” is roughly 65 feet long, can travel about 11.5 miles per hour and has a range of about 2,000 nautical miles, he said. The central payload bay can carry up to 10,000 pounds and is “completely reconfigurable.”

“It’s a big square shoebox that the user can fill up with what they want,” he added.

The vessel uses a “basic autonomy package” that includes waypoint following and collision avoidance that Bowles said can easily be upgraded or swapped based on customer requirements.

The company has made some

Marines conduct a simulated resupply with goods from an Autonomous Low-Profile Vessel during unmanned surface vessel training operations at White Beach Naval Facility, Okinawa, Japan.



Marines operate an Autonomous Low-Profile Vessel during testing on Marine Corps Base Camp Pendleton, California.



improvements to the Sea Specter design, he said. The prototype vessels were made of wood with an external layer of fiberglass, but as the company transitions to a program of record, it's investing in a more durable composite material. It also added a lift fitting to the third prototype, allowing it to be pulled from the water via crane and easily repositioned.

The final Marine Corps specifications for the fielded model will determine the unit cost for these semi-submersibles, Bowles said.

Bowles estimated the cost of the boat without added technology and payloads at \$150,000. The price could go up depending on the specific requirements for different missions, he added.

While the Marine Corps has moved to field a semi-submersible for logistics, the Navy has also made forays into experimenting with the same technology.

At Naval Surface Warfare Center Carderock in Maryland, a study kicked off in spring 2025 in partnership with the University of Michigan to assess the parameters of the narco-sub profile and learn how to make the form more resilient and reusable.

"Obviously, the inspiration for these low-profile vessels originally were drug-running boats, and as such, there has been little formal study on them and what their properties are," Matthew Collette, a professor at the University of Michigan with a specialty in marine design, said in an interview.

"More importantly, what are the design trade-offs?" Collette said.

"Does the deck shape make a big difference? What are we looking for, for mass distribution? How low can you go with the low profile before you start to run into seakeeping problems? We really don't know."

For the study, Collette and his team built a two-meter-long model of a semi-submersible, at about a one-to-six scale of the actual Autonomous Low-Profile Vessel. They modeled it after photographs of South American drug boats, he said, although it's not an exact replica of any design. Then they tested it in a tank, subjecting it to a range of sea conditions from calm waters to choppy, irregular ocean waves. Unsurprisingly, the vessel was more challenged by higher sea states.

"It was noticeable that you would

probably need significantly more power in certain sea conditions," Collette said. "A big part of our project that we are hoping to deliver to the Navy as we work on the final reports is validation data for their more complicated seakeeping models ... so they have more confidence in being able to design this type of vessel in the future."

In the meantime, members of the joint force have been able to inspect and interact with the Autonomous Low-Profile Vessel as it continues conducting test logistics runs within the III Marine Expeditionary Force.

The vessels — which are shared among multiple units within the command element — began arriving in June 2024 as part of the joint exercise Valiant Shield. Marines based in Okinawa, Japan, were thrilled to get the tech and try it out, Maj. Austin Duke, operations officer for 12th Littoral Logistics Battalion, said in an interview.

"We started doing local patrols ... anywhere between 40- and 100-mile local adventures from White Beach down to Naha Military Port, and really just refining that, getting good at getting our feet wet," Duke said.

The first patrols began with an empty vessel to familiarize Marines with the controls and make them comfortable with the autonomy. Then, they started loading it up with supply payloads to support exercises and training, he said.

The unit is still working to understand — with the help of the Marine Corps Warfighting Lab — key parameters such as how long and under what sea conditions the vessel can stay watertight. It's also building familiarity with regional partners and navigating permissions to allow the semi-submersibles to transit in places with very few U.S. troops, said Lt. Col. Matthew Kendrick, commanding officer of the 12th Littoral Logistics Battalion.

"Seems like every time we put this

thing in the water, there's something new," Kendrick said. "We either learn some quirk about the vessel itself, or we run into some other snag in the bureaucracy ... a lot of the learning occurs there."

In one instance, the unit sent a vessel on a 364-nautical mile transit to the island of Tokunoshima and on to White Beach, navigating the challenge of informing partners about the strange drone narco-sub as the mission progressed.

"We've kind of had to try to educate not only ourselves, but others, of like, 'Hey, when you receive [this], this is what you're receiving — not a manned vessel as is traditionally known,'" Duke said.

The Marines have also made inroads in developing a training course for operating and working with the vessels, laying the groundwork for what may be a dedicated "boat operators" military occupational specialty, modeled after the current coxswain job specialty. *(For more on efforts to develop the new military occupational specialty, see page 37.)*

At Leidos, Bowles confirmed that other entities have expressed interest in the Sea Specter, although he couldn't specify who. As users build familiarity with the platform, he believes its utility could far exceed supply logistics, including roles like persistent intelligence, surveillance and reconnaissance; electronic warfare; and even harbor defense with a kinetic effector and extended station-keeping capabilities.

The 12th Littoral Logistics Battalion Marines are also enthusiastic about the future roles the vessel could fill.

"As long as we keep the eye on the prize — that is, to support the joint force and our allied partners — it could be" a Swiss Army knife that "sits within our formation, for the joint force and our allied partners," Duke said. **ND**

WATERCRAFT

Marines to Field New Recon Boats For Littoral Missions

BY HOPE HODGE SECK

The Marine Corps' Force Design update released in October adds a new capability to the service's light armored reconnaissance battalions: a "maritime reconnaissance company" equipped with new tactical boats, to aid the battalions' planned transformation into agile mobile reconnaissance battalions.

With that new unit and new boat — the multi-mission reconnaissance craft — will likely come a new slate of training and even a tailor-made job specialty, said Brig. Gen. Christopher Haar, assistant deputy commandant for Marine Corps Combat Development and Integration.

The addition of boat-borne maritime reconnaissance companies further supported the goal of small Marine Corps units operating in coastal regions, as the Force Design strategy envisions, Haar said in a recent interview.

"Because we operate primarily in the littoral regions, having additional small craft that we can move around in is pretty important."

The small craft are part of an evolution that began when light armored infantry battalions were converted to more agile recon battalions in the mid-1990s, he said.

Meanwhile, "how do we employ the Marines and the skill sets that they've gained using these combat vehicles ashore to be able to do similar actions in the littorals?" he said. "We're going through and trying to figure out what exactly are all the requirements that

we need in these crafts."

The boats themselves will be based on those made by Australia-based company The Whiskey Project Group. The 30 or 40-foot open-water boat models boast a rugged hull, integrated ballistic protection, shock-mitigating seats, low-profile fenders and a side cutout for ease of ingress and egress. They're intended to operate in open-ocean conditions as well as coastal shallows, according to the Marine Corps.

Officials have previously said they want up to 18 of the boats, largely fielded to the three active-duty reconnaissance battalions.

The full set of features and specifications is still to be determined, Haar added.

"We're going through and trying to figure out what exactly are all the requirements that we need in these

crafts. And then once we've settled on that, it will be over to our Marine Corps Systems Command, or [Program Executive Officer] Land Systems, to acquire the specific crafts," he said.

With the acquisition process will come the development of new doctrine for how to employ the boats, Haar said.

While the Marine Corps has long maintained some small boats for special operations and reconnaissance — including the rigid-hull inflatable boat and the combat rubber raiding craft, typically called Zodiacs — the multi-mission reconnaissance craft will be larger and have different operating parameters.

"There will be, obviously, new training, which means that there will probably be a new [military occupational specialty] at the

minimum — an additional MOS that someone will have to go to school to get trained in," Haar said.

Some training may be repurposed. The coxswain's course currently used for Zodiac operators may, he suggested, be adapted for the new maritime reconnaissance companies.

"There will be maintainers that have to be trained on how to maintain the boats. There will be some facility impacts, because we'll have to build additional boat lockers and boat maintenance facilities, boat storage facilities," he said.

Changes to regulations around training ranges will also be evaluated to ensure the Marines can use the boats as they're intended.

"If I'm going to start operating boats off of Southern California, making sure that both those areas in the water that are designated for training now — do they have to be expanded, or are they good enough?" Haar said. "That's the full ... analysis that we go through to make sure that we're ready for those craft."

He did not immediately have information to share on when acquisition of the boats is formally expected to begin, or when the evolution of the new battalions to mobile reconnaissance battalions is expected to be complete.

The plan to convert the battalions was announced in a 2022 Force Design update that built on a 2021 briefing that "identified the likely utility of multi-domain Mobile Reconnaissance units possessing [organic precision fires for infantry], light-weight vehicles, unmanned air and surface systems, boats and other capabilities necessary to succeed in a contested information environment," according to the 2021 update. **ND**



Marines conduct high-speed, open water tests using a multi-mission reconnaissance craft.

Bio-Tech

Wearable Patches Could Monitor Troops' Health, Sense Danger **BY HOPE HODGE SECK**



During the 2023 edition of the Talisman Sabre exercise held in the Indo-Pacific region, U.S. troops from across the joint force were outfitted with small, body-worn patches that could measure their physiological state.

Researchers during the 2023 event cited ambitious goals for the wearable devices, even suggesting that they could — if affixed to paratroopers — alert medics to a jump injury as soon as a servicemember wearing the patch hit the ground.

Since the conclusion of that exercise, little has been published about the results of the experiment or how they've informed ongoing work.

However, according to officials with the Defense Department's Capability Program Executive for Chemical, Biological, Radiological and Nuclear Defense, that work has not only continued but expanded, leading to a device researchers say can track biometric signals, sense environmental hazards and even detect blast overpressure that could cause traumatic brain injuries.

While wearable technology has become something of a buzzword within the Defense Department in recent years, research into tech within the Chemical and Biological Defense Program goes back much further, said Lorenzo Hankla, wearables program officer for the capability program executive.

"We have been looking at wearables for, oh boy, going on around a decade," he told *National Defense*. "It's kind of going back to when Fitbits were the size of your thumb, and then all they did was track steps."

In its earliest stages, interest in the technology focused on biodefense uses for wearables to prevent bad actors from using environmental agents as weapons, he said.

"As technology has evolved and Fitbits ... or things like that have moved

from being just simply step counters to what they are today ... we've still been focused on our mission, but the additional data that the devices collect really gives us more insight on what's going on with the body," Hankla said. "So, it's just really helped us fine-tune how everything works."

The 2023 Talisman Sabre exercise presented a choice opportunity to test the capabilities of these wearable devices on a broad scale.

It was the culminating event of a broader pilot effort that the Office of the Secretary of Defense had assigned to the Chemical and Biological Defense Program, Hankla said. The effort partnered the department with "dozens upon dozens of stakeholders" from other agencies who saw potential for the devices to optimize performance by identifying injury signals, monitoring fatigue and alerting for heat strain, among other uses.

"We had warfighters equipped in all domains, across all services. There were people on ships wearing devices, people in dismounted Army formations. ... It was a huge learning opportunity for us to understand what could or should broader integration look like," Hankla said.

The device of choice was a lightweight and adhesive hypoallergenic patch, called the Ascent Platform, made by medical technology manufacturer LifeLens.

First demonstrated for the Army at a spring 2021 Army Expeditionary Warrior Experiment at Fort Benning, Georgia, the patches contain wearable physiological sensors that pull data from soldiers and can wirelessly transmit that data to a receiving device for monitoring.

According to LifeLens, the first test had "zero field failures" and showed the patches could harvest over 60 data metrics per soldier.

Program officials settled on the device as they considered the needs of special operators in particular,

said Dave Williamson, deputy joint product lead at the chem-bio capability program executive office.

"The first question that we were trying to solve was, what kind of wearable will this very highly trained elite military unit wear the majority of the time? They have a lot of input on what they wear; they only wear what doesn't impact their mission," Williamson said.

They tried a lot of different form factors — from watches to rings to armbands to shirts with sensors ingrained in them. The special operators said LifeLens was the most comfortable sensor.

"Most people said that they forgot they had it on," he said.

On top of that, testers discovered they could use the platform as a sensor fusion hub, laying different kinds of data collectors on top of each other without weighing the operator down with additional devices, he added.

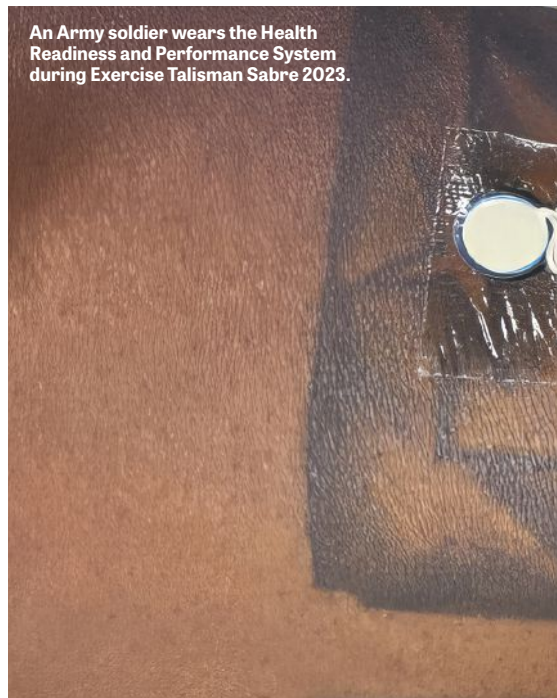
"Actually not only is it providing the physiological data, but we're also connecting all of those other sensors — those radiation sensors, oxygen sensors — to the LifeLens, and then pushing that into the radio network," he said.

Feedback from the exercise was candid — but even the failures were valuable. For example, one key capability they wanted to demonstrate in the test was personnel tracking in a GPS-denied environment using the patches.

We "didn't really know how we were going to get after it and threw our best shot at the wall," Williamson said. "And to be honest with you, [we] pretty abysmally failed with what we thought our

Stock Illustration

An Army soldier wears the Health Readiness and Performance System during Exercise Talisman Sabre 2023.



concept would look like. But again, that testing early and often allowed us to come back within 60 days and go from basically a complete and utter failure to about 99 percent accuracy.”

The device now accomplishes that through ultra-wideband radio in a key fob-like receiver-transmitter device called the Gateway that allows connectivity beyond line of sight, he said.

Hankla said with operational security remaining a paramount need, development efforts have emphasized network encryption in transmitting data and even an “airplane mode” feature that allows users to toggle off sending any information when they can’t safely emit a signal.

Williamson said users were pleased with the device’s performance and even looked for ways to integrate it further in their life and work. “So, that was great feedback to have.”

An article published in September in the journal *Military Medicine* further confirmed users’ generally positive experience with the wearable patch. Following up on the Talisman Sabre experiment and noting that the exercise only provided “limited information” on the device’s usability and comfort, the recent paper followed 47 medical students participating in an intensive five-day surgical training exercise while wearing LifeLens patches.

While most users entered the experiment with high expectations, they generally came away with a positive opinion of the patch, even finding it more comfortable than they were expecting.

“These results indicate that partici-

pants had favorable initial opinions of the LifeLens device, perceiving the system as highly usable after use in a realistic training setting,” the authors concluded.

While the patch — in addition to measuring biometrics — can assess if a servicemember is upright or prone — further enabling proprietary algorithms to identify warning signs of illness or injury — the capability program executive office has continued to pursue research with a particular focus on chemical and biological threats in the Pacific.

“If you look at the [Indo-Pacific Command] theater, it’s such a huge, enormous space that covers everything from the Arctic to the jungle and everything in between,” Hankla said.

“And we very much think that wearables will help our mission space, the CBRN readiness piece, tremendously, because you might have people literally scattered all across the Pacific Ocean and doing remote monitoring,” he added.

Being able to predict or monitor who is exposed to potential chemical, biological, radiological or nuclear threats will be “huge,” he added, “because you might not have a CBRN expert on the ground wherever an operation might be occurring. That expert might be the next island away. So, we view this as being a critical piece within our CBRN readiness toolkit across the next couple years.”

That’s the vision behind the current Wearable All-hazard Remote-monitoring Program, or WARP, which was initiated as a rapid acquisition effort in January 2024. It uses LifeLens patches

equipped with sensors detecting chemical agents, gases and radiation, as well as the biometric monitoring functions that can catch the subtle signs of a chem-bio attack like changes in breathing and perspiration.

Initial fielding of the devices began in late 2025 to elements of the special operations community, and WARP is set to become a program of record in fiscal year 2027, said Williamson, who also serves as its program manager.

Deployed for test purposes at the 2025 Army Best Ranger Squad Competition, one of the patches demonstrated its potential by flagging to a commander a soldier’s vital signs, which showed increasing stress levels even after he took a break to rest. Follow-on medical evaluation led to a diagnosis of early-stage rhabdomyolysis, a breakdown of muscle tissue caused by over-exertion that can cause kidney failure.

Program officials said in a news release that if left undetected, the condition could have ended the war-fighter’s career.

While WARP is focused initially on special operations, testing and conversations continue to take place across the services to demonstrate the value of broader fielding of the devices, and to clarify the individual services’ requirements.

Since the diagnostic power of the devices is based on algorithms that can assess deviation from baseline through all the basic biometrics the patches monitor, adding new capabilities could be as straightforward as pushing out a new firmware update, Williamson said.

Later this year, the Army’s Project Convergence Capstone 26 and several Air Force test events will provide opportunities for commanders to further familiarize themselves with the technology, define capability needs and understand how wearables might feature within the Army’s strategies for next-generation command and control and networking.

“There has been some demand signal from the joint force end users in assessing WARP as a potential solution to some of their gaps,” Williamson said. “So, that’s an ideal scenario in our mind, is that this goes from a rapid acquisition effort to a formal program of record that gets spread across the services.” **ND**

Army photo



More Investment Needed to Revitalize U.S. Shipbuilding

At its core, the United States is a maritime nation with a proud history of shipbuilding that has evolved across this nation's 250-year history.

From the first frigates, Civil War ironclads and the shipbuilding boom of World War II, the U.S. maritime industrial base has consistently provided the vessels necessary to build America's naval supremacy. Due to the efforts of this industry, the Navy was the most dominant in the world by the end of 1945, with more than 6,000 active ships.

Today's Navy remains the most dominant maritime force in the world, but it is facing a looming problem. The current battle force is in the range of just below 300 vessels, and it is retiring more ships from service than it is building.

Compared to the People's Republic of China — which has dramatically increased its capacity in recent years — the United States is being quickly outpaced. The nation outclasses China in ship tonnage and technological capability. But as a two-sea nation, U.S. fleets are stretched thin across the globe. China's maritime strength can concentrate on the Indo-Pacific. If the United States is to keep ahead of its main pacing challenge, then it is of vital importance to address the shortcomings of domestic shipbuilding.

There is no one source that can be pointed to as the reason for the decline in U.S. shipbuilding capacity.

Instead, time and continually shifting priorities over the decades created lapses in upkeep that may not have been necessary at the time but would slowly atrophy shipbuilding capacity until there were only four public shipyards, down from 13.

While there are many more private shipyards, few have the capacity to build and maintain massive projects such as aircraft carriers, submarines and the proposed new battleship

class. To meet the demands of both current and proposed programs, investment in shipyards is vital.

However, shipyard expansion is only one piece of the puzzle. The maintenance and modernization of preexisting shipyards is equally costly, time-consuming and critical to U.S. naval strength.

The Navy's public shipyards were originally built to handle 19th and 20th century vessels, which had fundamentally different needs than modern programs. The Shipyard Infrastructure Optimization Program received \$1.5 billion in the fiscal year 2026 appropriations bill as an attempt to modernize these facilities. While this is an important step towards increasing the current capacity of the public shipyards, more funding and focus should be placed on modernization efforts.

In addition, modernization alone is not enough. The lack of shipyard capacity can only be solved by also investing in the construction of new dry docks and infrastructure.

Infrastructure constraints aren't the only barrier to renewing the maritime



industrial base. Supply chain fragility is also a pervasive threat. Shipbuilders — along with other companies in the defense industrial base and other manufacturing sectors — spread well beyond the military ecosystem, as it relies on an increasingly shrinking number of subcontractors and parts suppliers, with sole-source suppliers and consolidation continually constraining the supply chain.

Furthermore, the reliance on

Chinese sources for critical minerals and materials for electronics and systems aboard the vessels such as radar systems creates a serious vulnerability in fielding the best possible capabilities. Ships require particularly large amounts of materials such as aluminum and iron and are equally susceptible to supply chain weaponization, with detrimental effects on platforms with the scale of ships.

It is vital to the health of U.S. shipbuilding, both as it currently stands and if production is to increase, to secure the supply chains and bolster domestic and partner sources of minerals and materials.

The shipbuilding workforce has also presented an increasingly difficult challenge for domestic shipbuilders. Insufficient compensation, reduced labor pools and other cultural and demographic shifts hamper shipbuilders' ability to recruit, train and retain the workforce they need.

The shipbuilding workforce has notably declined from 218,000 workers in 1981 to 145,000 in 2023 — a 33 percent decrease — leading to critical labor shortages as the Navy aims to increase its fleet size. With an aging workforce population and high attrition rates with young workers, the current workforce methods, including apprenticeship programs, have not been sufficient in building a workforce to meet the demands.

Encouraging skilled trades such as electrical work and welding is going to be vital, and to do so requires investment.

While these issues have their own unique challenges and solutions, one overarching variable for each is cooperation and communication between government and industry.

The circumstances that led to current short-

comings cannot be solved quickly because they did not occur quickly, but from prolonged and systemic gaps in investment. Now is the time to facilitate lasting positive impacts on the U.S. maritime industrial base and invest in shipbuilding capacity, but it can only be done together. **ND**

Alex Pennoyer is a strategy and policy associate at the National Defense Industrial Association.

Critical Mineral Stockpiling Presents Opportunities

As the federal government focuses on securing reliable supplies of critical minerals, stockpiling has emerged as a key policy tool, alongside direct investments in private enterprises, financing support and expanded funding programs for industry.

The National Defense Stockpile, currently serves as the federal strategic reserve of materials needed for national defense, including critical minerals, and the growing policy attention has prompted new proposals and initiatives for upgraded federal stockpiling capabilities that present potential opportunities for contractors.

First created in 1939, the stockpile is a mechanism for the federal government to acquire and maintain reserves of certain “strategic and critical materials.” The intent is to foster the development of domestic sources of these materials and prevent dependence on foreign sources in times of national emergency.

The stockpile is managed by the Defense Logistics Agency and can only serve national defense interests. It may not be used for economic or budgetary purposes.

“Strategic and critical materials” are statutorily defined as materials needed for military, industrial and essential civilian uses during a national emergency that are not domestically produced in sufficient quantities.

The list of materials of interest largely overlaps with the Energy Department’s list of “critical materials,” which in turn incorporates the Interior Department’s “critical minerals” list. The National Defense Stockpile includes, for example, copper, nickel, lithium and antimony, as well as 16 rare earth elements.

Its operations are financed by the National Defense Stockpile Transaction Fund, which holds funds either received from the sale of stockpiled material or appropriated by Congress.

In recent years, Congress has significantly expanded the stockpile’s legal and financial capabilities. The fiscal year 2024 National Defense Authorization Act authorized the stockpile to issue multi-year contracts for the procurement of domestically processed minerals. The One Big Beautiful Bill Act appropriated an additional \$2 billion to the transaction fund.

In 2025, the Defense Department announced its intent to procure up to \$1 billion in stockpile materials and issued numerous requests for information throughout the year seeking sources of specific critical minerals. Many of these RFIs were focused on minerals for which the United States has known deposits but has had insufficient commercial production capacity, such as scandium, tungsten and graphite, as well as the rare earth elements facing particularly acute shortages, such as samarium, dysprosium and terbium.

The Defense Logistics Agency also sought information about rare earth processing and refining technologies, the domestic absence of which remains a major supply chain vulnerability. Several requests for proposals — including those for scandium and indium — advanced to further evaluation of proposals or procurement in the form of sole-source indefinite delivery, indefinite quantity contracts. Recently, the agency issued requests seeking offers for sale of bismuth, vanadium and indium and awarded a contract for fluorspar.

In conjunction with its stockpiling efforts, the agency also invests in the research and development of technologies that can enhance the stability of the critical minerals supply chain.

Critical minerals have consistently been an area of interest in its broad agency announcements, which solicit white papers from industry and academic institutions. Domestic production of rare earth elements was also a focus of the agency’s Small Business Innovation Research and Small Business Technology Transfer programs last year.

According to DLA, it will expand the scope and scale of its critical minerals research and development in coordination with the Energy, Commerce and Interior departments.

The federal government’s critical minerals stockpiling efforts are expected to further accelerate in 2026 and beyond. Stockpiling is one of the core policy tools the administration intends to sustain.

Most recently in Congress, proposals for creating a Strategic Resilience



Reserve for critical minerals have been introduced in both houses with bipartisan support. The proposed mechanism involves an independent government

corporation managing the purchase and storage of the minerals reserve.

The Trump administration also announced a new initiative for a \$12 billion critical minerals stockpile to be made accessible to private industry. As reported, the initial financing will come from both private institutional investors and the U.S. Export-Import Bank.

As a Defense Department sub-agency, the Defense Logistics Agency has also embraced the ongoing efforts to streamline the defense acquisition process and prioritize rapid delivery. DLA leadership noted that — for its supply chain management — the agency will invest in advanced data analytics to improve demand forecasting, scenario analysis and risk mitigation. Contractors that already provide similar capabilities to the Pentagon may be well-served to expand into the critical minerals space.

In sum, companies in the critical minerals space — as well as companies in other sectors with technology that can be leveraged to support critical minerals production or acquisition — would be wise to keep abreast of the government’s rapidly developing priorities.

With billions in new appropriations, the ability to make multi-year arrangements and a stronger appetite for investment in new technologies, the Defense Logistics Agency is poised to continue growing into a receptive customer and funding partner for industry.

Future legislative and policy initiatives for creating reserves beyond the National Defense Stockpile may also provide new avenues for private-public partnership. By closely tracking these developments, companies can position themselves as effective partners for the federal government’s upcoming investments. **ND**

Eunsun Cho is an associate and Peter Terenzio is a special counsel in the Washington, D.C., office of Covington and Burling LLP.

Peter B. Teets Award Goes to Guetlein, Kaufman

The National Defense Industrial Association gave the Honorable Peter B. Teets Award to Space Force Gen. Michael Guetlein and BAE Systems' David Kaufman in a January ceremony held in Los Angeles.

Guetlein was recognized for his “unmatched record of senior leadership excellence” as deputy director of the National Reconnaissance Office, the first commander of Space Systems Command and the second vice chief of space operations. He now leads the nation’s effort to build the Golden Done missile defense architecture.

“His accomplishments have had a lasting impact on our nation’s space capabilities and on enhancing our nation’s and our allies’ security at a time of increasing threats,” the citation stated.

As president of BAE Systems’ space and mission systems sector, David Kaufman “has demonstrated exceptional leadership over the past three decades, delivering critical



Arnie Streland, NDIA Space Division chair (left) and NDIA President and CEO David Norquist (right) present Don Wussler, outgoing Greater Los Angeles Chapter president, the NDIA Gold Medal.

space systems capabilities for the nation,” according to his citation.

He currently oversees a workforce of nearly 5,000 employees. Prior to this role, Kaufman was president of Ball Aerospace, which was acquired by BAE Systems in 2024.

His team was recently selected to build and field the Resilient Missile Warning and Tracking Epoch 2 constellation for the Space Force.

The Honorable Peter B. Teets Award recognizes public or private sector leadership or achievement that results in

significant contributions to the development, introduction, operational contribution or support of space systems.

In addition to the award, Don Wussler, space systems group leader at Systems Planning and Analysis Inc. — and outgoing president of the association’s Greater Los Angeles Chapter — was given the NDIA Gold Medal in recognition of his sustained and exceptional service to the defense space industry, the Space Systems Command community and the Greater Los Angeles Chapter. **ND**

NDIA, Govini Form Strategic Partnership

The National Defense Industrial Association announced a 2026 visionary strategic partnership with defense acquisition software company Govini.

“Streamlining acquisition and compliance processes is essential to delivering capabilities faster and at scale,” said David Norquist, president and chief executive officer of NDIA. “Through its visionary strategic partnership, Govini will help facilitate dialogue on acquisition reform, digital transformation and supply chain resilience in support of NDIA’s mission to sustain a strong and innovative defense industrial base.”

NDIA’s visionary strategic partnerships support the association’s mission to convene leaders across gov-



ernment, industry and academia to address the structural and policy challenges affecting industrial readiness and national security.

Govini’s partnership builds on its continued engagement with NDIA and the broader national security community. Tara Murphy Dougherty, Govini’s CEO and a member of the NDIA board of directors, helps guide

the association’s work to strengthen government-industry collaboration and advance mission outcomes.

“America’s advantage depends on how quickly we can convert intent into capability,” said Murphy Dougherty. “NDIA is where serious operators come together to confront the hard problems behind readiness: industrial capacity, data, budgets and speed. We’re honored to deepen our partnership with NDIA and to keep pushing acquisition into the software era.” **ND**

NDIA **NDIA MEMBERSHIP:** The National Defense Industrial Association (NDIA) is the premier association representing all facets of the defense and technology industrial base and serving all military services. For more information

please email the membership team at membership@ndia.org. NDIA extends complimentary individual membership to federal government employees and active-duty military; sign up online at <https://www.ndia.org/membership/government-membership>.

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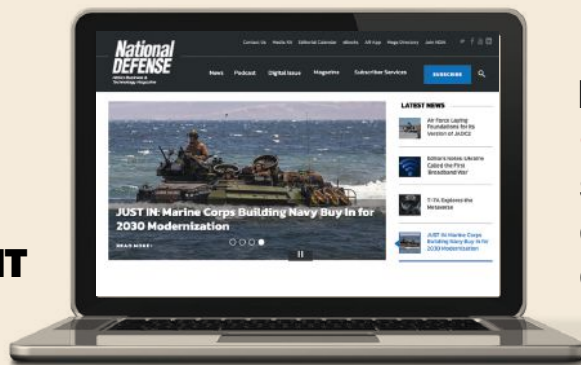
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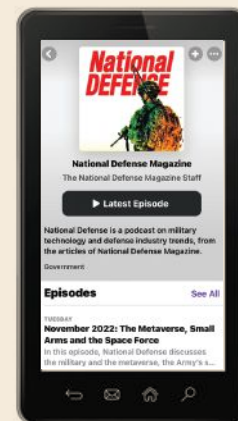
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18-20 2026 Joint NDIA/AIA Spring Industrial Security Conference

Orlando, FL
NDIA.org/events

June

2-3 DLA Supply Chain Alliance Symposium & Exhibition

Columbus, OH
NDIA.org/DLA26

8-10 2026 Future Force Capabilities Conference & Exhibition

Las Vegas, NV
NDIAFFC.org

March

9-12 2026 Pacific Operational Science & Technology (POST) Conference

Honolulu, HI
POSTConference.org

17-18 2026 Human Systems Conference

Arlington, VA
NDIA.org/HS26

17-18 Munitions Executive Summit

Parsippany, NJ
NDIA.org/MES

23-25 Undersea Warfare Spring Conference

San Diego, CA
NDIA.org/USWSpring26

April

14 Space Breakfast

Colorado Springs, CO
NDIA.org/SpaceBKFST26

15-16 Mastering Business Development Workshop

Arlington, VA
NDIA.org/MBDApril

21-22 2026 Missile Defense Conference

Washington, DC
NDIA.org/MDC

22 Simulation & Training Community Forum

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NTSA.org/STCF

2026 Pacific Operational Science & Technology (POST) Conference

NDIA and the U.S. Indo-Pacific Command's POST conference is the premier critical defense technology event for the Pacific, happening at a time when all eyes are focused on INDOPACOM's success. Without fail, groundbreaking discussions are held in this unparalleled forum where innovation happens in real time.

"NDIA's POST Conference provides a critical venue for collaboration and innovation... to address the unique challenges of the Indo-Pacific theater" – The Hon. Heidi Shyu, Former Under Secretary of Defense for Research and Engineering.



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March 9 – 12, 2026 | Honolulu, HI | POSTConference.org



NDIA

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[Learn More!](#)

March 17 – 18, 2026 | Parsippany, NJ | NDIA.org/MES

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Department of the Air Force

Modeling, Simulation & Analytics Summit

CONVERGING HORIZONS

The Department of the Air Force (DAF), Director of Studies and Analysis (SAF/SA), and Chief Modeling and Simulation Officer (CMSO), in partnership with the Space Training and Readiness Command (STARCOM), are hosting the 2026 DAFMSA Summit.

Learn about new MS&A initiatives and techniques, network across military services & with industry experts, and hear our technological leaders' perspectives on how MS&A can transition more training from the real world to digital.

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5 – 8 May 2026 | Colorado Springs, CO | DAFMSS.org

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DLA SUPPLY CHAIN ALLIANCE SYMPOSIUM & EXHIBITION

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[Learn More!](#)

June 2 – 3, 2026 | Columbus, OH | NDIA.org/DLA26



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[Learn More!](#)

June 8 – 10, 2026 | Las Vegas, NV | NDIAFFC.org





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SPECIAL REPORT ON AIR AND MISSILE DEFENSE

Golden Dome

• Shortly after taking office last January, President Donald Trump called for the construction of a next-generation missile defense shield now known as the Golden Dome to protect the U.S. homeland. *National Defense* checks in on the program's progress.

Europe

• As the United States plans its ambitious Golden Dome missile defense system, Europe has been working on a shield of its own for the past several years, known as the European Sky Shield Initiative.



Middle East

• A prominent Middle East aerospace expert looks at the air and missile defense issues the region faces while in a dangerous neighborhood.

Taiwan

• Taiwan sits across a narrow strait from its belligerent neighbor, the People's Republic of China. This poses challenges for the island's air and missile defenses.

Vital Signs 2026

• The National Defense Industrial Association's annual "Vital Signs" report takes its yearly pulse of the U.S. defense industrial base and its capacity to deliver materiel the Defense Department needs to win in any conflict.

Q-Day

• National security space systems will face unique risks and challenges when the transition to post-quantum cryptography begins.

Lockheed Martin photo

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