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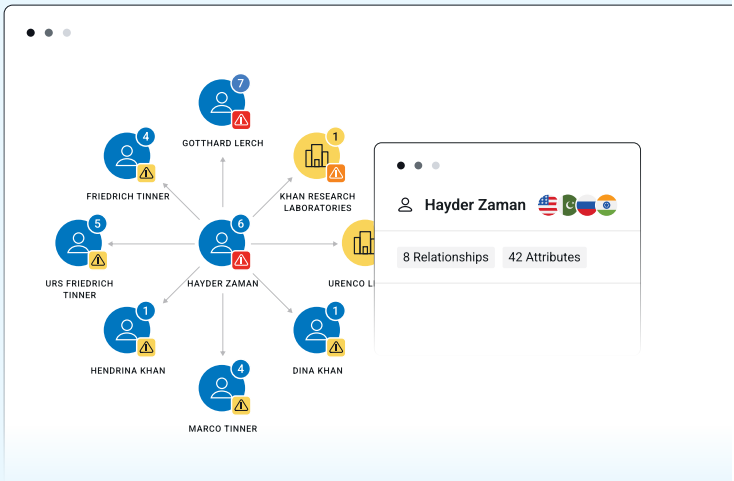
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RISE OF THE MACHINES

Ground Robots to Proliferate on Ukraine Battlefields Following Success of Drones

BY STEW MAGNUSON

WIESBADEN, Germany — Artem Moroz — a representative of Ukraine's Brave1 tech incubator — scrolled through a screen of ground robots at the organization's booth at a recent trade show.

The screen had 20 different models capable of performing a variety of tasks, and the government agency's head of investor relations had four more screens worth, for a total of 100 Ukrainian-made unmanned ground vehicles — all currently available for operations.

"Most of these companies received [Brave1] grants when they were smaller. We helped them early on, and now they are managing to scale up and get government contracts," Moroz said.

The use of first-person drones in Ukraine is well known and has already goaded ground forces throughout the world to rethink their tactics, techniques and procedures. The country's unmanned surface vessels have damaged or scuttled Russian ships on the Black Sea.

However, the employment of ground robots in the Ukraine-Russia war is not as well known. That is about to change.

As the war continues in its fourth year, ground robots are set to proliferate in Ukraine, performing just about all the tasks human soldiers carry out, said Moroz and other sources at the Association of the United States Army's LandEuro conference held in July in Wiesbaden, Germany.

"Last year was the first year that we experimented with the tactics. What are they capable of doing? But this year, we are scaling up. The government is about to procure at least 15,000 systems," Moroz said.

There were no Ukrainian companies involved in the ground robot business at the outset of the 2022 full-scale Russian invasion. There are now more than 100, according to Ukrainian Ministry of Digital Transformation statistics. Moroz put that number closer to 150.

As he scrolled through the myriad models, he ticked off their missions. They ranged from the Cockroach — a small wheeled, disposable robot capable of carrying explosives on kamikaze missions made by Ukrainian nonprofit the Vivakot foundation — to the Ratel H, which is large enough to do casualty evacuations.



Cockroach

Brave1 photos

One robot, the Zmiy, manufactured by Rovertech, had flails to destroy mines. Several other models by other companies were built to lay mines.

Others had weapons mounted on them to carry out suppressive fires. All of them had cameras so they could serve as remote eyes for their operators and gather intelligence.

Cmdr. Robert Brovdi, com-


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mander of Ukraine's unmanned systems forces, said the goal is to build a Great Wall of China-like barrier, which will defend the frontline and will stop anything which is trying to go through it, either from the ground or from the air.

Ground robots are expected to evolve quickly as drones did at the outset of the invasion, Brovdi said.

"It is not the future. It is the routine reality of how we wage our war. We move to the systematic employment of technology. Their rapid expansion is not [an] accident. It is the result of the ability to learn fast, adapt even faster and scale what works," he said through an interpreter during a panel discussion at the conference.

Oleksandr Kubrakov, advisor to Ukraine's minister of defense and cofounder of We Build Ukraine, said the use of ground robots to perform duties normally carried out by soldiers is necessary in the "no man's land" between forces where first-person drones operated by Russian troops make entering these areas especially dangerous.

Last mile delivery of supplies and casualty evacuation have been some of the early applications for ground robots.

"The most risky moment is when you need to deliver something like building materials for fortifications, like food, medicine, etc.," Kubrakov said during a panel discussion at the conference.

Ground robots are being used almost 90 percent of the time to deliver materials to the frontline to reduce the chance of casualties, he said.

The tactic is "significantly decreasing losses at this stage," he said. The upshot of this success is the Ukrainian army looking at the employment of ground robots for other tasks, he added.

Estonia-based Milrem Robotics was an early entrant in Ukraine and served as an example as the Ukrainian robotics companies caught up with unmanned aerial systems manufacturers.

Company officials in June 2024 told *National Defense* that Milrem had sent 15 of its 3,500-pound THeMIS tracked robots to Ukraine primarily for casualty evacuation — but every time they were sent out to collect the wounded, soldiers would load them with food, medicine and ammunition for the frontlines.

The company has since partnered with France's CNIM Systèmes Industriels under a French government contract to integrate a route clearance payload on six THeMIS robots that will be delivered to Ukraine, according to a May press release.


Zmiy


TerMIT


Ratel H

In August, the company announced it had integrated the BURIA remote weapon station grenade launcher—manufactured by Ukraine's Frontline Robotics — onto a THeMIS robot, and successfully fired it 1,200 yards.

Another early success story in the Brave1 catalogue is the TerMIT, which is manufactured by Ukraine's Tencore. The 620-pound tracked robot has been used for resupply with loads up to 660 pounds and can also be outfitted with various combat modules.

It was one of the first ground robots approved for battlefield operations by the Ukrainian Ministry of Defense.

Anatolii Mazarchuk, a Ukrainian Fulbright scholar and AI researcher at Stevens Institute of Technology, said in an email interview that "with UGVs emerging as the next disruptive element, Ukraine is proving that robotic ground systems are not just support tools — they are becoming indispensable battlefield assets."

Following aerial systems, "Ukraine is now leading a second revolution: the mass introduction and adaptation of unmanned ground vehicles for frontline operations," he said.

"We foresee a future in which this [logistics] function becomes entirely robotic. The current demand suggests a need for hundreds of thousands of such systems. The widespread integration of ground drones also paves the way for advanced modules, including those for minelaying, demining and direct fire support when paired with turret-based weapon systems," he said.

One key feature of robotic systems is autonomy. However, Moroz noted that the vast majority of the 100 ground robots in the Brave1 catalogue were teleoperated, meaning at least one soldier had to be controlling the machine from a relatively safe distance.

While remote control keeps ground forces safe, needing at least one operator to guide the machines does not help Ukraine with its manpower shortage.

One critic of that approach was Yaroslav Azhnyuk, CEO and founder of The Fourth Law, a Ukrainian startup that develops autonomy software for drones.

"Once you go from the technology and slides and conceptions to the actual battlefield, that's where you discover the actual problems," Azhnyuk said at the conference. "You know, everyone has got a plan before they get hit in the face."

Ground robots have a little under a mile of connectivity before they start hitting the radio horizon, he noted.

Some of the larger robots such as Milrem's THeMIS have Starlink satellite connectivity.

As far as ground robots — while the use cases sound great — the reality is they need a lot more work, and a lot more iterations, as was the case with aerial drones, Azhnyuk said.

"I believe that they will start working at some point," he added. "They will start finding their useful niches" — there are already a number of examples — but they just won't be employed in the massive quantities that have been seen with drones.

As was the case with unmanned aerial vehicles, data collected from the use of ground robots will be fed into a constant feedback loop.

Giorgi Tskhakaia, advisor to Ukraine's vice prime minister of digital transformation, in a keynote speech at the conference described a tried-and-true system where the robot users grade the weapons systems, give their comments and provide video of tactics, techniques and procedures that do or don't work. That is all fed into a big data analytics system that will tell the ministry what robots are best and the most effective way to use them.

Moroz said not all 100 of the robots

Brave1 photos

in the catalogue will make the cut. Those that don't perform well will inevitably go by the wayside.

Meanwhile — as they have been doing with the unmanned aerial systems revolution happening over Ukrainian and Russian skies — U.S. Army analysts will also be taking notice of how ground robots will be employed.

Lt. Gen. Curtis Buzzard, commander of Security Assistance Group-Ukraine and NATO Security Assistance and Training for Ukraine, said: "I do think this fight is the ultimate battle lab. It's where you prove whether things work or they don't. And I think that all this ... applies globally, specifically the Indo-Pacific and other places around the world."

"You're seeing a lot of these unmanned systems as marsupial systems. They carry other systems, and then just all the data associated with all these systems too. And I think one challenge we all have ... is how you integrate this new technology with legacy systems," Buzzard said during a panel discussion at the conference.

First Lt. Francesco La Torre, director of robotics and autonomous systems on the 173rd Airborne Infantry Brigade's Bayonet Innovation Team, said along with drones, his unit has been looking at how Ukrainian forces are using ground robots.

The team is charged with developing technology internally at the brigade level to solve some of their pressing problems.

The 173rd Airborne Infantry Brigade has already used ground robots for resupply missions. Next, it will take some lessons learned from Ukraine to use expendable robots for breaching operations, La Torre told *National Defense* on the sidelines of the conference.

There are a number of different obstacles that they can breach, he said, referring to case studies coming out of Ukraine.

"Most of those expendable vehicles can carry up to 15 pounds of payload. So, they can completely carry a suite of explosives that you would traditionally find in a blast demo kit," he added.

"If we can reduce soldier presence at a breach, we can cut back on casualties and increase survivability and reduce risk to the force and risk to mission," he said.

Expendable ground robots can also be used for surveillance as the cameras mounted on them are relatively inexpensive, he noted.

As for casualty evacuation, that application for the Army is premature. It is a sensitive mission that requires a lot of training, La Torre said.

Buzzard said: "I admire Ukraine for its will, its endurance and its adaptability, and I think those three things are lessons in and of themselves. When you think about the scale of this conflict, how long they've been fighting and how they've adapted, and they exemplify that idea that we talk about — adapt or die. They live that every day." ***ND***

U.S. 'Way Behind' Using Autonomy, Robotics for Logistics

BY ALLYSON PARK

The United States must utilize robotics and autonomy for logistics to help warfighters operate more efficiently in contested environments, former Marine Corps Commandant retired Gen. David Berger said Aug. 21.

"We're way behind in logistics, in using robotics and autonomy in logistics. Because if you can't communicate and you can't support yourself, you can have the best systems and the best trained force in the world, [and] you're not going to last very long," Berger said at an event hosted by the Brookings Institute. "Logistics is a much more difficult thing to think about. It's not as fun to think about as killing stuff. But frankly, if you run out of stuff, it doesn't matter how good your munitions are."

Autonomy and artificial intelligence can improve logistics missions and overall operational efficiency, specifically through predictive logistics and planning, Berger said.

"Do I need a human to drive that truck or fly that aircraft or whatever, or can we actually do it better, faster, 24/7, with systems rather than [a] human-operated machine?" he said. "The answer is, yeah, we absolutely could."

Robots can also serve as decoys to deceive an adversary during logistics operations. When operating in an increasingly complex and contested environment with a lot of differing factors and sensors to consider, warfighters have to "generate stuff" to throw off the adversary, and that capability lies in numbers, Berger said.

"Rather than one car driving the actor from Hollywood to the restaurant and everybody knows where you're going, 17 cars leave at the same time," he said. "We don't need a human to do that. If the system is talking the way that they describe, it can divert itself to where the higher priority is — for fuel, for munitions, for water, for whatever. We have a long way to go."

In addition to logistics, the United States must also focus on using swarms of robots in domains other than the air, and "we are not there yet either," Berger said.

"How do you swarm in other domains to do different things? [How] do you get different domains worth of autonomous robotic vehicles to work together?" he said. "Between surface and air, between air and subsurface, where those membranes go away completely, and the communication is not something you think about ... it will definitely be challenged to communicate back and forth. But we've got to get out of the same type of environment between robotic systems and autonomous systems and move to different domains talking to each other." ***ND***



A Multi-Mission, Utility, Logistics & Expedition drone prepares to launch during Project Convergence-Capstone 5 in March 2025.

Army photo

Munitions

Army Falls Short of 155mm Production Goal

BY JOSH LUCKENBAUGH



Army cannon crew members conduct a night live-fire range using an M777 towed 155mm howitzer at Yakima Training Center, Washington.

Army National Guard photo

The Army — in response to diminishing stockpiles as it supported Ukraine's defense against Russia — set a goal to produce 100,000 155mm artillery rounds per month by this October.

The service opened a number of new facilities to support this endeavor — and as one Army official stated, "We haven't seen this level of investment in our industrial base since World War II."

However, the Army is going to fall short of its goal. Service spokesperson Steve Warren told reporters in July that the Army is not expecting to produce 100,000 155mm rounds per month until mid-2026.

The service is currently producing 40,000 rounds per month, Warren said — the same amount it was producing as of September 2024, according to a Defense Department release.

There are a "whole host of reasons" behind the stagnation in 155mm production, said Maj. Gen. John Reim, joint program executive officer for armaments and ammunition and commanding general of Picatinny Arsenal.

One challenge has been the supply chain for production equipment, Reim said in an interview.

"For a lot of this equipment that we need to rapidly expand capacity, it's not sitting on a shelf somewhere," and the Army has had to depend on international suppliers, he said. "We've [been] experiencing longer than expected lead times with some of that capability, and that has a cascading effect."

It has also taken time for some of the service's industry partners to ramp production up to the desired rates. The Army recently issued a cure notice to General Dynamics Ordnance and Tactical Systems due to poor performance at a modular metal parts facility in Mesquite, Texas, Reim said.

General Dynamics declined to comment for this story.

The language in the cure notice "is intentionally harsh, and it describes potential options, to include ... termination," Reim said. The service's role is to hold "our industry partner accountable — we owe that to our taxpayers — and where we're at in terms of our 155 ramp, this is on the critical path, and so we want to ensure they're successful."

The Army had just received General Dynamics' response to the cure notice when *National Defense* spoke to Reim in mid-July. The Army intends to continue working with the company and "understand the risks and what a realistic schedule looks like, and if there [are] things that we can do to help mitigate the risk to ensure that we get this up and running," he said.

The service and its industry partners have "realized some risk" bringing in "new and novel 21st-century technologies that really haven't proven to be able to produce 155," Reim noted.

At the Mesquite facility, the Army and General Dynamics have brought in capabilities such as flow-forming technology — which uses rollers to shape a round's metal parts — that have never been used for 155mm production, Reim said. "While all that equipment is installed, now we're in the process" of ensuring those systems produce parts that conform to the service's requirements.

"If we don't have a conforming round, then that can be catastrophic to the equipment and potentially the crew," he said. "So, it's something that's kind of no-fail for us."

Other companies in the 155mm supply chain are modernizing their production capabilities.

Andy Davis, vice president of engineering and strategy at Nammo Defense Systems, said the company is incorporating new automated manufacturing technologies at its Mesa, Arizona, facility, where it produces 155mm projectiles and base bleed grains.

"Although the technology of the 155mm base bleed round relies on legacy propellant formulation," with these new technologies, Nammo is creating an "efficient, high-volume propellant grain production capability that minimizes touch labor and improves quality," Davis said in an email.

John McGuinness, president of munitions and government at Day & Zimmermann, said in an email the company has significantly expanded its use of robotics, data-driven process controls and digital quality assurance systems.

Day & Zimmermann in March

reached an all-time production high, turning out nearly 45,000 M795 155mm rounds — "a milestone that reflects both our workforce's dedication and the effectiveness of our ongoing modernization efforts," McGuinness said.

While 155mm production isn't currently at the desired rate, the Army has experienced successes during the ramp-up, Reim said.

A metal parts production facility in Ingersoll, Canada, managed by IMT Group experienced a labor strike during its build and commissioning phase, but the plant is now producing 3,000 shell bodies a month, he said.

"We're ramping to 10,000 later this summer," with the goal to eventually produce 15,000 shell bodies per month at the facility, he added.

The Army in October 2024 held ribbon-cutting ceremonies at a pair of facilities in Marion, Illinois, and Perry, Florida, that will produce M119A2 red bag propelling charges for 155mm rounds, opening those plants two months ahead of schedule, he said.

In November, the Army awarded a $435 million contract to Repkon USA to establish a production facility in Graham, Kentucky, for TNT — the primary explosive fill for 155mm shells.

"We stopped making TNT in the U.S. in 1986, and we were buying from the Russians. We were buying from the Ukrainians," Reim said. "Obviously, the Russians aren't a source anymore," while a Ukrainian production facility was destroyed early on in the war.

The Army is dependent today on Polish TNT and has also sourced it from Australia, South America and Asia, he said. "So, we're excited ... to bring that back to the U.S."

Additionally, the service and General Dynamics Ordnance and Tactical Systems in April opened a new 155mm load, assemble and pack facility in Camden, Arkansas, that will produce completed high-explosive projectiles at a rate of 50,000 per month when fully operational, an Army release stated.

"So, it's not all bad news," Reim said.

However, the Army's struggle to ramp up 155mm production "raises questions about our ability to surge production in an emergency," said Mark Cancian, a senior adviser in the defense and security department at the Center for Strategic and International Studies.

While production ramp-ups like this are "always complicated ... if it turns out to be much more difficult than we had thought, then that makes a surge strategy more difficult" in the event of crisis or conflict, Cancian said in an interview.

Jerry McGinn, director of CSIS's Center for the Industrial Base, said in an email that the Army's struggles to meet its 155mm production goals are linked to the state of the industrial base before the Russian invasion of Ukraine.

"The industrial base builds capacity to the terms of existing and expected future contracts, and there was no demand signal for a potential production ramp-up prior to Russia's invasion of Ukraine," McGinn said. "The industrial base has responded to the production ramp-up, but that took time."

Reim noted that prior to the invasion, the service was producing 14,000 155mm rounds per month — "that was, frankly, optimized for what we shoot during the course of the year in support of training operations for the Army and the Marine Corps."

When the Army "looked at what it was going to take to surge, we quickly realized it wasn't just production capacity, it was supply chain," he said. "And when we looked, there [were] a number of single points of failure that didn't have surge capacity to meet the rapid requirements."

Cancian said: "The closer we are towards a production capability, the higher confidence we can have in surge. And by that I mean if we have machinery that is in the back room in a state of preservation, that gives us some level of confidence. If we have a production line that is next to the primary production line, and we use it two weeks a year just to make sure it works, that gives us even more confidence.

"But if all you have is a bunch of drawings in the back room and some notion that you're going to build a new building and institute a new production facility — which is where we were — that gives you much less confidence," he said.



M795 High Explosive Projectile 155mm rounds

Army photo

However, maintaining that capacity is expensive, especially in peacetime when you don't need to surge production, and doing so could appear wasteful, Cancian said. The Army will "have to have a comeback to that and be willing to argue for maintaining these surge capabilities."

Reim said one way the Army is looking to keep its 155mm production capacity active going forward is through foreign military sales.

"Our European partners are right behind us in terms of their" 155mm production ramp-up, "and I think they're going to experience a lot of the same challenges we have experienced," he said. "I think our capacity could help satisfy some of their near-term requirements."

Meanwhile, the Ukrainian Defense Industry Joint Stock Company and Florida-based ammunition and primer manufacturer D&M Holding Company Inc. in July announced a joint venture to produce propellant for artillery ammunition, including 155mm shells, at a new U.S.-based facility.

Oleh Huliak, director general of the Ukrainian Defense Industry Joint Stock Company, said in a press release: "We have to gradually move from large-scale procurement to our own production to meet our immediate needs. It is equally important that the company will operate in a safe area."

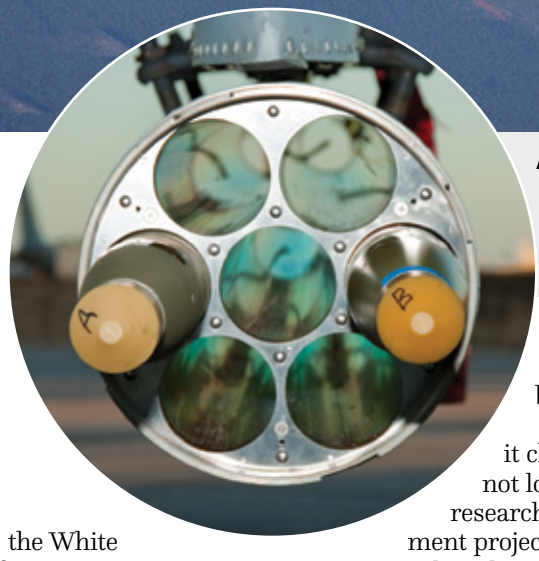
D&M Holding Company Inc. President and CEO Dan Powers and Executive Vice President James Jones said in an email that production will begin at the new facility in mid-2026, and the propellant will be available to other 155mm producers.

While the Army failed to meet its initial timeline for its 155mm production ramp-up, producing 100,000 rounds per month is still the goal, Reim said.

"We've got the resourcing. We've got a lot of the authorities that have enabled us to get money and execution," he said.

It has taken a "whole-of-government approach to get after this," and "we're working hard with our industry partners, and we're going to hold them accountable when they're not meeting their contract requirements," he said. ***ND***





An F-16, above, fires an M151 warhead integrated with the Advanced Precision Kill Weapon System II, left, during a test mission.

Low-Cost Bombs, Rockets Enjoy New Vogue as Drone Warfare Ramps Up

BY HOPE HODGE SECK

In March, the United States launched a successful brute-force campaign called Operation Rough Rider against Iranian-backed Houthi rebels in Yemen, targeting key military targets and taking down hundreds of one-way attack drones over a two-month campaign.

A key weapon of choice for the Air Force F-15 Strike Eagle and F-16 Fighting Falcon jets shooting down drones was the laser-guided Advanced Precision Kill Weapon System, a 13-year-old munition most notable for its low price tag: under $25,000 per shot.

In testimony before the House Armed Services Committee in June, then-commander of U.S. Central Command Army Gen. Michael "Erik" Kurilla said about 40 percent of drone kills were executed with the rockets.

"That's a $25,000 munition going against a roughly $50,000 or $100,000 drone," he added, emphasizing the need to develop and mature even less expensive means to take out unmanned systems.

The concept of spending less per shot is by no means new. In the late 1990s, the Air Force partnered with Lockheed Martin to develop the Low Cost Autonomous Attack System, a loitering cruise missile set to cost about $30,000 per unit that wouldn't look out of place in today's battles, but was ultimately canceled due to ethical concerns.

In recent years, as the war in Ukraine has underscored the high burn rate of a peer conflict, the White House and Defense Department have repeatedly emphasized the need for munitions that are less expensive and faster to produce. The urgent demands of drone warfare, in which the systems the United States is shooting down can cost as little as a few thousand dollars and come in swarms, requiring many munitions to counter, have further clarified the need and prompted fresh investment in technology development.

Meanwhile, new manufacturing and production methods have made it possible for new forms of less expensive and effective munitions to come to market. For experts watching the space, an important question remains: Will military commanders get comfortable employing low-cost weapons?

The reconciliation bill passed by Congress in early July, which included $156 billion in funding for national defense, contained further evidence of commitment to investing in inexpensive munitions. Some $16 billion, about 10 percent of the total, was set aside "to expedite innovation to the warfighter," including increasing "scale production of innovative low-cost and next-generation weapons like drones, counter-drone tech, low-cost munitions and artificial intelligence," according to a statement from Sen. Roger Wicker, R-Miss., chairman of the Senate Armed Services Committee.

Bryan Clark, a senior fellow at the Hudson Institute, called the low-cost weapons funding in the reconciliation bill "a sign of hope."

Congress made it clear that it's not looking for long research and development projects. It's "we want you to go buy things, and that will jump-start the production, the industrial base, if you will," Clark said.

"So, this bill puts a bunch of money in the procurement accounts to be able to then create that demand signal ... so they will get these big orders for systems, and then they can capitalize their production lines and start to build them," he said. "You're putting in an injection of funding and procurement into these companies so they are incentivized to build out their production capacity."

In March, just as Operation Rough Rider was getting underway, Clark and Hudson Institute co-authors Dan Patt and Nadia Schadlow published a 72-page report, "Ending Self-Imposed Scarcity: Exploiting America's Commercial Strengths to Mobilize Weapons Production," which was all about employing modularity and flexibility in acquisition to build up U.S. weapons stockpiles.

Pointing to the Houthi rebels' success with attack drones and the pace of innovation, the pressure is on, the authors wrote, to eschew exquisite methods and narrow supply chains in favor of munitions that can be assembled and shipped on demand.

"The DoD does not have time to field new technologies only as part of major programs, especially as the number of major programs shrinks in response to defense budget constraints and continued cost overruns," the report stated.

Air Force photos

"It will need to incorporate new technologies into U.S. forces faster and at the level of sensors, weapons, uncrewed vehicles or electromagnetic warfare systems rather than only through major multi-mission platform programs."

While analysts emphasize that low-cost munitions are not always synonymous with rapidly producible ones, emerging players in the defense space are successfully finding overlap between the categories.

Colorado-based propulsion company Ursa Major is one such contender. Leveraging additive manufacturing to develop components quickly and cheaply, the company has landed key defense contracts.

Notably, Ursa Major was tasked by the Navy last year to design a new motor for the Mk 104 rocket that powers the service's arsenal of standard missiles. The company also landed a contract with the Air Force this year to flight test its Draper engine for prospective use with hypersonic missiles. Ursa Major has proposed the same engine, which the company says is 80 percent 3D printed, to support the White House's proposed Golden Dome missile defense system.

"Right now, we're proving the art of the possible on a lot of these types of technologies, including hypersonics and 3D and additive manufacturing and rapid development times. And we're looking forward to continuing to do that," said Ursa Major CEO Dan Jablonsky. "And I think that the ecosystem needs that type of innovation and energy now."

Thanks to the company's manufacturing methods, he said, Ursa Major's test vehicle iteration and testing has cost four to 10 times less than comparative programs. It's also much faster: on solid rocket motor development, thanks to 3D printing, "we've gone from clean, white page design to hot fire testing in 29 days on three different programs," he said.

California-based Anduril Industries — perhaps the most prominent name in affordable munitions — is also observing the increased momentum behind and investment in the technology and "scaling ahead of the need," said Steve Milano, the company's senior director of advanced effects.

Anduril's Arsenal-1 hyperscale manufacturing facility in Columbus, Ohio, is under construction and set for completion next year. It is billed as a first-of-its-kind factory that uses the same tools, machines and processes for every autonomous vehicle the company makes.

Its Barracuda-100M is an autonomous air vehicle completing flight testing for the Army's High Speed Maneuverable Missile program, while the Barracuda-500 was one of four designs selected for development in the Air Force's Enterprise Test Vehicle program, focused on developing cheap and rapidly producible air vehicles for long-range cruise missiles.

Both Barracuda variants are based on a system that costs about $150,000 at baseline, Milano said. That's compared with around $1.5 million for the legacy AGM-158 Joint Air-to-Surface Standoff Missile, which has been in service since 2003.

The speed with which the Barracuda-500 went from contract award in 2024 to down-select in 2025, with a mandate to produce a production variant "capable of rapidly scalable manufacture" next year is "a good indication, one, that there is a pivot to this type of rapid development of production," Milano said, "and also this willingness to expend funds and expend resources to be able to actually see it come to fruition."

Even as lower-cost munitions systems enter production, they're likely to complement, rather than replace, more exquisite systems. The Barracuda-500, for example, has a payload capacity of around 100 pounds, compared to the joint stand-off missile, which carries a 1,000-pound warhead.

Cost and capacity tradeoffs will be part of the decision calculus for military commanders ordering strikes, and growing comfortable opting for a lower-cost munition with more conservative effects may come with a learning curve, said Michael Bohnert, a licensed engineer at the RAND Corp.

"For missions that are less consequential, [commanders are] going to use what they're less confident in, and for things that they want to get the outcome, they're going to use the more exquisite. And that really has not changed in thousands of years," Bohnert said.

The best way to develop a comfort level with affordable munitions, he said, is for the military to see them in action, whether in U.S. conflicts or employed elsewhere in the world. In Ukraine, the success of autonomous weapons has supercharged global interest in the technology.

But even further back, the same trend can be seen. Bohnert cited the early necessity-borne use of laser-guided bombs in Operation Desert Storm in the early 1990s. Likewise, he said, GPS-guided bombs proved their value in the air war over Kosovo and Serbia at the end of that decade.

"There were a lot of dumb bombs used at first; then the GPS bombs started working," Bohnert said. "Confidence grows pretty quickly in a fight."

Today, though, new training tools may ease the learning curve by accelerating familiarization, Bohnert noted. Realistic virtual environments, augmented reality and simulators can give troops opportunities to employ different weapons for effect before they ever reach a real-world decision point.

"I think that's a reasonable expectation, that having that virtual reality environment where you get to see the effects is really critical," he said.

Milano said Anduril would like to see a more integrated approach to exercises that allows for a wider range of scenarios and more feedback to show both the company and the warfighters what does and doesn't work in the fight.

"We can't rely on these monolithic exercises to demonstrate, OK, this actually works for our forces. You want to know to some degree of certainty that this concept works, these iterations are working," he said.

"I think that there are existing demonstrations, exercises that actually give us opportunities," he said. "But there should be more permutations of it leading up to those exercises that allow us some input and feedback so that we can change our approach, and the services can change their approach based off of novel inputs."

Anduril is looking ahead to a future in which autonomy will play a much greater role in selecting target-appropriate strike packages, he added.

"One of the use cases that immediately comes to mind is the idea of [a] fighter jet pilot in a cockpit having to hit the pickle button on a single munition to achieve a specific mission objective. And that's kind of a well-worn path," Milano said. "Flash forward to Anduril's vision and what we're actually implementing today, where you potentially have 25 to 50 assets in the air being launched by a pilot that has no control over the assets ... bringing autonomy, particularly mission autonomy, to the forefront, has been a huge enabler for us." ***ND***

Saab Introduces Purpose-Built Munition Designed to Kill Drones BY STEW MAGNUSON

LONDON — Sweden's Saab has introduced a munition built specifically to take down small unmanned aerial systems.

The Nimbrix counter-UAS missile is a fire-and-forget system designed with affordability in mind, Mats-Olof Rydberg, head of product unit for ground-based air defense at the company, told National Defense Sept. 9 on the sidelines of the DSEI UK conference and exhibition in London.

Many of the off-the-shelf solutions that have been adapted for the counter-drone mission are "soft kill" systems, he noted. "What we were looking for is more of a high precision and hard kill" missile, he said.

Legacy interceptors and drones used to take down other drones don't have the necessary speed, he said, especially in the future when they are expected to use more powerful engines.

The company improved the guidance and control system to make it faster and more maneuverable, and since the employment of drones as weapons is rapidly evolving, the software can be rewritten as needed.

"This is not a five-year development. It's continuous rapid development and upgradable," he said.

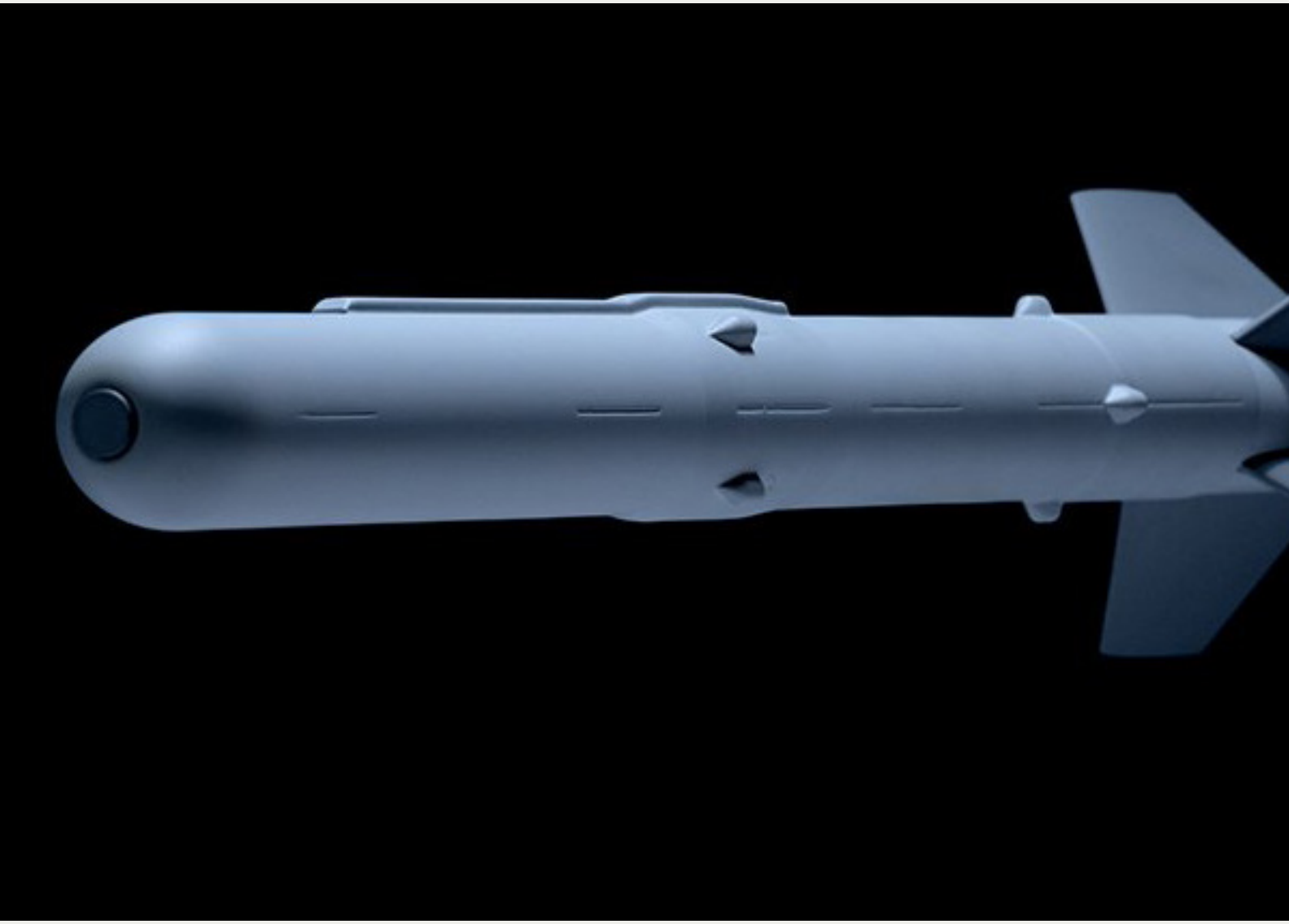
Increased range of two to five kilometers was also a requirement, he added.

The missile can be fired from a variety of ground-based platforms with a cassette that can be integrated into different firing systems, he said. Or the cassette can be placed on a tripod for a more simple system, he added.

Crucial was getting the price point down, Rydberg said. Nimbrix uses some off-the-shelf systems, including the seeker and the warhead to keep the price down to where it can be deployed in swarming scenarios. He declined to state the per unit cost.

Nimbrix is one part of Saab's larger counter-UAS system that includes a sensor suite, data-sharing and different weapons to find, fix and finish drones, said Angelica Persson, senior business development director at the company.

Saab is always looking for new products developed on its own or by other companies that can be integrated to improve its counter-UAS system, she said. ***ND***



SAAB rendering

Instability in Munitions Budgeting Harms Readiness

The U.S. munitions industrial base is crucial to winning any future fight and must be empowered to produce both high-end, exquisite systems and attritable, scalable munitions.

However, munitions are often near the bottom of policymakers' list of budget priorities, particularly when compared to more expensive items such as planes, ships or submarines. The military services can prioritize either cost, schedule or performance. As a result, the munitions industry has faced years of underinvestment — and perhaps more dangerously — instability in funding, imperiling surge capacity and innovation.

This fiscal year, munitions have taken center stage on unfunded priorities lists. For example, the Air Force's list, by dollar amount, is 37 percent munitions. For the Navy, this number is even higher at 40 percent. Combined across just these two services, over $6 billion for munitions spending and investment in the munitions industrial base went unfunded.

When examined at the line item level, the lack of stable funding becomes particularly concerning.

For the AIM-120 AMRAAM, the Navy requested an additional $694 million in funding through its unfunded priorities list — 10 times what was funded in the base budget put forward by the Defense Department. The Air Force — which recently deployed the Massive Ordnance Penetrator in Operation Midnight Hammer — requested $123 million for the bunker buster, dwarfing the $6.8 million it requested in the base budget.

However, prior lists did not include munitions funding at such a high level. This is not due to a recent lack of funding, but a longstanding budget practice using munitions as a bill-payer for other priorities. Retired Rear Adm. Mark Montgomery acknowledged this practice in a 2023 hearing before the House Armed Services Committee, stating that "every service puts in 100 percent of the munitions they need at the beginning of the budget cycle, and it is the bill-payer every budget cycle."

Stable, predictable and on-time budgets are the foremost building blocks of a healthy U.S. defense industrial base. Unfortunately, the demand signals for munitions are far from stable. National Defense Industrial Association analysis suggests that while there is a correlation between topline spending and munitions spending, there is no correlation in the rate of change between topline and munitions.



When defense topline spending goes up, munitions spending tends to increase — as well as the opposite. However, the amount of change in topline spending has no statistical bearing on the increase or decrease in munitions spending. This suggests that there is a "rising tide" effect and that munitions are thus a bill-payer for other priorities. In essence, when the Pentagon can afford munitions due to a larger topline, it will invest in them, but when budgets are leaner, munitions are the first to face deep cuts.

Despite the overall instability, there is one overarching pattern that emerges when analyzing munitions spending across multiple years: it surges during conflicts and quickly returns to relatively lower levels in times of relative peace. Operation Inherent Resolve — the mission to counter ISIS — and the provision of munitions to Ukraine in its defense against Russia's invasion are two prime examples in recent memory.

During Operation Inherent Resolve, the department scaled up purchases of munitions, particularly precision-guided munitions, which were widely deployed in Iraq and Syria. From 2015 to 2019, munitions procurement across all military departments steadily increased from $12 billion to over $18 billion.

Following the raid that killed ISIS leader Abu Bakr al-Baghdadi in October 2019 and the territorial defeat of the group in March of that year, munitions spending quickly began a downward trend. By 2022, munitions spending had fallen to $13.7 billion, which is lower than spending in 2015 when accounting for inflation.

Russia's invasion of Ukraine also created a surge in demand for munitions, including, perhaps most famously, 155mm artillery shells. While the 2023 base budget did include an increase in munitions spending, the supplemental funding bill for Ukraine provided an additional boost, raising the share of munitions in the overall procurement budget from under 10 percent in 2022 to nearly 14 percent in 2023. Unfortunately, it does not appear that this surge is here to stay.

These examples, in addition to the regular budget instability, affect industry's ability to effectively produce and deliver munitions at the quantity and on the timetables warfighters need. Uncertain levels of funding hamper a contractor's ability to secure the necessary suppliers, expand facilities to meet new demand and hire, train and retain the skilled workers they need.



AIM-120 AMRAAM

In addition, due to these budgetary practices over the last three decades, industry has shifted to rely on just-in-time supply chains and adversarial or competitor nations for critical industrial inputs. Unstable budgets and underinvestment disincentivize any investment in these supply chains and do not provide the predictable stability necessary for wise investments in factory capacity or workforce.

The confidence required to deter — and the capabilities required to win — a possible conflict with a near-peer competitor relies on a munitions industrial base that can scale and surge production.

By fortifying budgets, supporting supply chains and eliminating overly stringent regulations, the Pentagon can catalyze a renaissance in the munitions industrial base and close the production gap with competitors. ***ND***

Jack Little is a strategy and policy associate at NDIA.

RTX photo

EMERGING TECHNOLOGY HORIZONS BY ANNA KIM

Accelerating Drone Munition Innovation



The evolution of drone warfare, from the first deployment of Predator drones at the turn of the century to current-day usage of commercial first-person view drones in Ukraine, represents a significant paradigm shift in how defense industries and institutions approach unmanned systems.

With this shift has arrived a raft of advancements to make drones less jammable, more precise and longer range, and alongside this work is the opportunity to innovate new and better munitions for these systems to carry.

To do so, the Defense Department should double down on approaches to prototyping and experimentation that incentivize emulation of innovation in Ukraine, where real-life experiences allow industry and the warfighter to upgrade munitions and drones rapidly.

In his April memo to Pentagon leadership, Secretary of Defense Pete Hegseth underscored priorities that included unmanned systems, munitions and advanced manufacturing. Service modernization strategies reflect this. For example, the Army is pursuing complementary modernization efforts for under 20-pound Group 1 and 21- to 55-pound Group 2 drones, which can deliver correspondingly sized explosive payloads.



A Skydio X10 drone armed with a M67 grenade

Army photo

These systems — which encompass both drone-dropped and loitering munitions — offer superior agility, flexibility and affordability compared to traditional air strikes and reduced risk to soldiers.

Recent tests validate this shift. In June, the Army dropped a grenade using a Skydio X10D drone equipped with an explosives dropper developed by the service's Combat Capabilities Development Command. It illustrated how small drones can deliver lethal payloads accurately over urban and battlefield targets.

Such capability, in addition to exhibiting 3D printable dropper devices that could be used by U.S. troops in combat, underscores a broader push toward equipping small drones with live ordnance.

The Ukrainian defense industrial base has generated an incredible and rapid modernization of drone munitions. Private firms and volunteer organizations have mass-produced first-person view loitering munitions, delivering anti-tank grenades at under $500 per unit at a rate of 1,000 units monthly. Ukraine's rapid prototyping and deployment model — where prototypes are field-tested within weeks and iterated upon based on feedback — offers an exemplar of speed and adaptability.

Recent report findings by the Emerging Technologies Institute support these conclusions, highlighting the importance of using best practices in prototyping and experimentation to speed the process of defense system modernization.

ETI's February study on defense prototyping found that iterative prototyping enabled by digital acquisition and engineering as well as simple, open standard designs throughout the technology life cycle are critical to rapid technology development.

In the report's survey of the defense industry, respondents' priorities aligned with the notion of prototyping toward a goal of functional technology production. When asked how they would define success, the predominant answers were that the prototype worked and was either integrated into an existing system or transitioned to a program of record.

A promising opportunity to view this premise in action for drone munitions is the Army Rapid Capabilities and Critical Technologies Office's recent launch of an initiative to develop a common, optionally manned launcher capable of firing allied munitions.

It plans to develop a first prototype within 18 months and a second within 24 months, each with a separate family of munitions.

Similarly, ETI's November 2024 paper on joint experimentation underscored the importance of taking a "problem-first" approach, where operators and technologists refine concepts through iteration, discover unexpected interactions between systems and understand where assumed requirements need revision based on actual operational use.

Compared to traditional large-scale exercises such as Indo-Pacific Command's Valiant Shield, smaller experimentation events allow for more targeted activities that address key operational gaps and help combatant commanders think through how a new capability might fit into or alter existing concepts of operations.

While prototyping and experimentation programs are an attempt to substitute for real-world operational data, they can be expensive, time-consuming and use up limited test range resources.

To help mitigate this, ETI's findings note that advanced modeling and simulation and virtual, constructive tools are integral to experimentation, and that better use of digital engineering for prototyping can reduce costs and timeframes as well.

In pursuing accelerated timelines for new technologies such as drone munitions, the government may be well served by allowing the commercial sector to drive the technology component, while the Defense Department focuses on developing prototyping, testing and modeling capabilities that exclusively serve defense missions.

The war in Ukraine has shown that small drones can serve as an asymmetric equalizer when paired with rapid innovation cycles and field testing. Military innovation is often shaped by constraints — whether budgetary, logistical or industrial — which should compel the Pentagon to adopt new technology development practices that enable speed, scale and modularity. ***ND***

Anna Kim is an associate research fellow at the National Defense Industrial Association's Emerging Technologies Institute.

The Norge Forge

Norway Defense Industry Part of Trend To Boost European Capacity

BY STEW MAGNUSON



RAUFOSS, Norway — "It's an odd place to build an arms factory," Nammo spokesman Fredrik Tangeraas admitted while driving around the arms manufacturer's facility in an industrial park near the small city of Raufoss, Norway.

Like most of the nation's factories back in the 1800s, the nascent arms industry was initially located in the capital, Oslo. But as Norway sought to break away from Sweden and the winds of war were blowing, it was all moved here where a mountain chain and large lake provided some natural protection against an attack, Tangerass explained.

Back past the company's buildings where munitions have been manufactured for over a century, Tangerass drove to a spot where the company is carving out a new industrial site out of the side of a mountain — for there is little flat space in this part of the country.

Nammo — like defense companies throughout Europe — is expanding its capacity in the wake of Russia's invasion of Ukraine.

There are two centers of gravity for the Norwegian arms industry: one is here, about a two-hour train ride north of Oslo, and the second is in Kongsberg, which hosts the company of the same name an hour's drive southwest of the capital.

Norway isn't famous for any particular platform. While Finland is renown for its 8x8 armored vehicles and Sweden has the Gripen jet fighter, neither Nammo nor Kongsberg Defense and Aerospace are in the platform business. However, their fingerprints are all over a host of Western defense systems.

Kongsberg, for example, has the contract to supply sections of the F-35 fuselage and makes the National Advanced Surface-to-Air Missile System. Nammo is a global munitions company and manufactures ammunition for everything from squad rifles to 155mm shells.



Norwegian F-35A

Topography explains a lot about the Norwegian defense industry, Kongsberg Defense and Aerospace President Eirik Lie told *National Defense* in an interview in Oslo.

The ability to track and shoot down missiles in a mountainous environment meant it had to invest in "fire-and-forget" interceptors, he said.

That led to the National Advanced Surface-to-Air Missile System, developed in partnership with Raytheon, now known as RTX.

Norway was the first one to introduce this fire-and-forget system. "And if you look at the fjords, they're extremely complex and narrow. You need a strike missile capacity, which has very high accuracy, to position itself and be extremely low sea skim, so it's undetectable," he said.

That led to the company's Naval Strike Missile and a version of it being adapted for the F-35 Joint Strike Fighter — the Joint Strike Missile. Australia, Japan, Germany and the United States are procuring the missile, which is stored internally in the aircraft's weapons bay.

Norway also has dual-use technologies for the maritime domain it has developed for its fishing, undersea mining, oil and gas industries, Lie noted. Kongsberg Maritime is actually a larger business than the defense division.

"We also have a long water frontline with Russia," he added.

"Norway is a small country when it comes to the number of people," he continued. "The hierarchy is kind of short. We have short lines of communication between industry, defense and the government. And that creates an atmosphere for quick innovation."

That has led to the nation's success as an exporter of military goods. Like many European countries, Norway could not depend on the domestic market alone and had to branch out, Lie said.

In the early 2000s, it only exported

iStock illustration, Norwegian Armed Forces photo

about 10 percent of its defense products. Today, that stands at 90 percent, he said.

In October, the Norwegian government announced a roadmap to further support its defense industrial base with several initiatives, along with significant funding to back it up.

The country's defense and trade ministries together will seek to increase access to capital, reduce regulatory challenges, bolster supply chains and assure the nation has the expertise to move its defense industry forward, the roadmap stated.

Norway will also focus on research and development, targeting defense-related R&D funding towards cutting-edge technologies such as quantum technology and artificial intelligence in order to increase national expertise and capacity, it said.

Along with the roadmap, the Norwegian government announced it had earmarked around $96 million to assist small and medium-sized companies who want to work with Ukrainian forces; create a new production line for rocket motors; and expand production of explosive material.

Norway selected the F-35 in 2008 and flies 52 of the aircraft's A models. For the country, joining the program has been an ongoing boon. It became the first international partner to fulfil its program of record in April. Kongsberg supplies rudders, vertical leading edges and main landing gear closeout panels to prime contractor Lockheed Martin for the global fleet.

Kongsberg Aviation Maintenance Services in March signed a deal to build a new F-35 maintenance depot.

That follows a previously established depot for the maintenance and upgrade of F-135 engines for the aircraft. This means routine F-35 maintenance, upgrades, modification and enhancements will no longer be outsourced to Italy.

During a tour of Kongsberg's facilities in the city of the same name, *National Defense* was taken through the painstaking process the company goes through to manufacture the composite material that goes into making the aircraft's panels.

Meanwhile, Lie highlighted Norway's roots in the U.S. defense market. He pointed out that the U.S. Army in an 1892 competition chose Kongsberg's Krag-Jorgensen rifle as its weapon of choice and licensed production to Springfield Armory for a decade.

Today, Kongsberg's U.S. subsidiary has a long-established factory in Johnstown, Pennsylvania, where remote weapon stations and remote turrets are made.

In 2024, the U.S. subsidiary announced it is establishing a new factory near Williamsburg, Virginia, where it will make the Joint Strike and Naval Strike missiles. The company's overall investment in the state of Virginia alone will come to $100 million, a Kongsberg statement said.

Nammo also has long-established factories in the United States and is expanding. Its primary facility is in Mesa, Arizona, where it produces shoulder-fired systems, rocket motors, commercial ammunition and propellant powder.

It also opened a new 155mm production factory in Perry, Florida, in 2024. It is expected to produce 33,000 M119A2 propelling charges monthly, according to a statement by the U.S. Army's Joint Program Executive Office Armaments and Ammunition.

Nammo is 50 percent owned by the Norwegian Ministry of Trade, Industries and Fisheries and 50 percent owned by Finland's Patria, which itself is 50.1 percent owned by the Finnish government and 49.9 percent owned by Kongsberg Defense and Aerospace.



Nammo's 155mm high-explosive extended range ammunition

With this pan-Scandinavian ownership scheme, and factories in Sweden, Finland and Denmark, Nammo is well poised to participate in the newly formed Nordic Defense Cooperation, which consists of Denmark, Finland, Iceland, Norway and Sweden. The overall purpose of the minister-level organization "is to strengthen the participants' national defense, explore common synergies and facilitate efficient common solutions," its website stated.

First up in this new era of defense industry cooperation might be the joint acquisition of a new CV90 combat vehicle. In June, Finland, Sweden, Norway, Lithuania, Estonia and the Netherlands signed a statement of intent to jointly procure new versions of the Swedish-made platform.

Bård Stenberg, Nammo's vice president of international sales and marketing, said Sweden and Finland joining Norway and Denmark as NATO members will also strengthen cooperation, where before the nations' defense industries were rivals.

"I won't say it's been done overnight, but at least there's a clear intention now, when Norway, Sweden, Finland and Denmark all are joined together in NATO, so then you see a clear, much stronger cooperation than you've seen in many, many years," Stenberg said.

As for the need to expand defense industrial capacity across Europe, he said this is a consequence of Russia's second invasion of Ukraine more than the Trump administration's drive for NATO members to spend 5 percent of GDP on defense.

After demand for weapon systems and munitions skyrocketed, the need to expand capacity became acute, Stenberg said.

"Suddenly the politicians in many European countries realized that they didn't have anything to give, because basically the countries didn't have very much stock. So, then this was then internal discussion in the countries, and then everybody, all the countries, basically have come to the conclusion that, 'OK, this is fact. We now have a different Europe or a world situation with an actual war in Europe,' which 10 years ago was unthinkable," he said.

The main problem now is while companies such as Kongsberg and Nammo are expanding their capacity domestically and overseas, the governments are not following through with orders, he said.

"I think that in many countries, the orders are now kind of, let's say in the books. The ones that have not really been placing the orders needed [are] typically the big countries — the smaller countries have already taken action and have ordered at least some of what they have defined as war stock," he said.

The chemical companies in Europe that provide the explosive material are also attempting to ramp up their production, but haven't reached their goals yet, which is slowing orders down, he noted.

"As a consequence, some of the countries have been a little bit reluctant to place the big orders," he said.

"So, it's coming, but it has taken way longer than many anticipated," he added. ***ND***

Nammo illustration

ARMAMENTS

Army Looks for Help to Boost Paladin Lethality

BY SCOTT R. GOURLEY

When the Army accepted delivery of the first low-rate initial production M109A7 Paladin howitzer from BAE Systems in April 2015, service representatives highlighted improved performance features and logistics commonality with the Bradley Fighting Vehicle.

One characteristic that was not highlighted was increased range.

A significant contributor to field artillery range involves the length of the cannon, with longer tubes allowing greater expansion of propellant gases, making for longer ranges.

Tube length is expressed as a "caliber" multiple of the bore diameter. The M109A7, for example, featured the same 39-caliber length 155mm tube as its predecessor, the M109A6.

The 39-caliber barrel length 155mm tube was first introduced on the M109A1.

While the Army explored an impressive 58-caliber length tube for its separate Extended Range Cannon Artillery program, other industry efforts focused on the potential of placing a 52-caliber length tube on the M109A7. That focus led to the development of a prototype platform designated by BAE Systems as the M109-52.

In June, the company announced a Cooperative Research and Development Agreement partnership with the Army Combat Capabilities Development Command Armaments Center to further advance the M109-52 prototype design.

"The M109-52 is a lethality upgrade to the M109A7," Dan Furber, product line director for artillery programs at BAE Systems, said in an interview.

"Essentially, we've taken the proven M109A7 that's in production today and integrated the 52-caliber Rheinmetall L52 cannon. It's still a 155mm cannon, but at that 52-caliber size, it almost doubles the [maximum] range of the 39-caliber M109A7 with a non-precision munition and more than doubles the range of the M109A7 when it comes to precision fires," he said.

The company has been working on the concept "for several years" and has invested "several million dollars" in the design work to date, he added.

"The Army has stated that they have a need for increased range," he said. "That was the goal [of] the Extended Range Cannon Artillery program. We came in thinking about it from a more direct support armored brigade combat team kind of approach in parallel with ERCA. This provides an incremental increase in capability that both satisfies the armored brigade combat team needs for increased range and helps the division artillery formations with increased range for the deep fight."

Furber emphasized that the Rheinmetall L52 cannon design was selected after extensive analysis.

"The L52 cannon is on several platforms today throughout the world, with many of our allies using the L52. We sorted through almost 20 different cannons in our analysis of alternatives, and the L52 rose to the top. It's very mature. It's very well refined. And it works very well with how we've integrated it into the M109A7," he said.

Asked about the possibilities of using a 52-caliber cannon from the Army's inventory at Watervliet Arsenal in New York, Furber quickly acknowledged the government-owned facility's specialty in producing cannons for Army and other service needs.

"Over the last several years, they've been really hard at work supporting the U.S. Army and also producing cannons for Ukraine, for both the M777s [towed 155mm howitzers] as well as the older M109s that have been provided to Ukraine," he said.

"That's not to say that they don't produce developmental cannons, but we were really looking for something that's mature and available for quick integration. Today, we are working with the U.S. government to figure out how we could 'onshore' production of the L52 cannon and put that as part of the Watervliet menu of items that they can build. That's still in the works, but I suspect one day we could see an L52 being produced out of Watervliet," he added.



The M109-52 howitzer

BAE Systems image

While the technology development effort has been focused on the M109A7 howitzer, Furber described some parallel systems engineering efforts, such as the supporting M992A3 Carrier Ammunition Tracked vehicle, formerly the Field Artillery Ammunition Support Vehicle.

"Our model-based systems engineering approach has looked at concepts to increase the rate of fire on the M109-52 to get to eight or nine rounds a minute," he said. "We're working on concepts for that, and we're sharing those concepts with the U.S. Army."

BAE is also working through concepts of how to increase the cannon's rate of fire and how to increase the rate of ammunition resupply off the M992A3, he added.

The company will mature the design over the next couple of years as the Army further develops its requirements, he said.

"We hope to get the M109-52 into a soldier touchpoint, potentially next year, to get soldier feedback on our system," he added. "And that will then come back into that design iteration to help us refine that design a bit more." ***ND***

SMALL ARMS

Next-Gen Squad Weapon Clears Fume Problems to Reach Army Milestone

BY LAURA HECKMANN

The Next Generation Squad Weapon program recently achieved a classification milestone that confirms the system meets Army standards for operational performance, safety and sustainment, having overcome toxic fume challenges that plagued the program's early stages.

The designation, called Type Classification - Standard, was awarded in May to the M7 rifle and M250 belt-fed automatic rifle, the Army announced. The M7 is the M4A1 carbine replacement, and the M250 will replace the M249 squad automatic weapon.

The Next Generation Squad Weapon program consists of the rifle and automatic rifle that utilize a common 6.8mm ammunition. The M7 is a modular, piston-driven, select-fire magazine-fed rifle, and the M250 is a lightweight, belt-fed select-fire light machine gun.

The program is intended to "significantly" increase lethality and probability of hit at the squad level, an Army description said. The 6.8mm ammunition will "outperform even the most modern 5.56mm and 7.62mm ammunition" and is intended to deliver capability improvements in accuracy, range and signature management.

The Army called the designation a "major program milestone" in a journey that has given both the service and the program's contractor, Sig Sauer, a few kinks to work out.

Sig Sauer was awarded a 10-year production contract in April 2022 to produce the M7 and M250 rifles, with early testing challenges emerging related to accuracy and toxic fumes, the Army reported. The issues were enough to delay the projected fielding from fiscal year 2023 to March 2024.

The Office of the Director of Operational Test and Evaluation in its fiscal year 2024 annual report noted the program office had made several technical improvements to the weapons to address deficiences identified during an October 2023 operational demonstration, and recommended the Army continue with a redesign of the suppressor to reduce heat signature and burn risk and the effort to reduce the systems' noxious off-gassing.

Phil Strader, vice president for consumer affairs at Sig Sauer, told *National Defense* in an email that the company's involvement with the reduction of toxic fumes in suppressed firearms goes back nearly a decade, starting with Special Operations Command's Suppressed Upper Receiver Group, or SURG, program in 2016.

Lessons learned from the SURG program informed improvements to the Next Generation Squad Weapon, including the development with Special Operations Command of a "Tox Box" to evaluate toxic fumes, he said.

"To the best of our knowledge, this was the first true evaluation criteria for suppressor toxic fumes," Strader said. Up until that point, "splatter" evaluation was used, placing white paper by the ejection port to evaluate oil and carbon particulate density by subjective opinion, he said.

The Tox Box evaluated carbon monoxide emissions and correlated them to gasses such as ammonia, hydrogen cyanide and sulphur dioxide to understand the toxic fume blowback performance. Lessons learned from the Tox Box were incorporated into Sig Sauer's SLX suppressor line that was utilized for its Next Generation Squad Weapon submission, Strader said.

He did not comment on specific timelines in relation to the program's toxic fume problems, but said the Army developed a new toxic fume testing protocol and device called the MOUT Box — a container with a weapon fixture, multiple tubes placed in various positions around the weapon system and a Fourier transform infrared spectrometer to detect harmful gasses.

Sig Sauer invested in its own version of the box to ensure it had the same equipment for testing, Strader said.

Ultimately, the Army sets the conditions for the type classification milestone, and it is a reflection of "numerous conditions being met," Strader said. "Sig Sauer's input in that process is to provide confidence in production risk and production readiness."

The company has submitted improvements to the Army's Next Generation Squad Weapon program office for a shorter, lighter and more efficient suppressor design for acceptance, Strader said. The new design reduces toxic fumes "even further." **ND**



A soldier tests the Next Generation Squad Weapon M250 light machine gun at Fort Campbell, Kentucky.

Army photo



HIMARS delivered to the 25th Infantry Division

Army Indo-Pacific Division Replacing Howitzers with HIMARS

BY LAURA HECKMANN

The Army as part of its recent transformation initiative is bringing in 16 High Mobility Artillery Rocket System launchers to its 25th Infantry Division at Schofield Barracks in Hawaii to replace 14 howitzer artillery weapons in an effort to support readiness in the Indo-Pacific region.

The service said the new launchers will enhance the division's long-range precision fires capability and strengthen its lethality and warfighting readiness to support campaigning efforts across the region. The transition will replace eight 105mm howitzers and six 155mm howitzers with the 16 HIMARS.

Col. Jonathan Harvey, director of the theater fires element for U.S. Army Pacific, said the introduction of HIMARS is a "visual signal" to allies and partners that "we are committed and that we will bring the best capability to bear. We will bring it in mass, quantity and volume, and we will put it in our best units to experiment with, test with, and be ready to employ as the need comes."

What this means for the 25th Infantry Division is "that we are integrating in long-range fires that increases the ability to extend our operational reach," Maj. Gen. Marcus Evans, commanding general of the 25th Infantry Division and senior commander of U.S. Army Hawaii, said during a media roundtable July 15.

The launchers also provide a platform that "we can better protect ourselves with," Evans said. "Because we can shoot and then we can rapidly displace or move to an area that affords us better protection."

HIMARS in the Indo-Pacific are not necessarily new across the Army, he said. The capability has been incorporated into previous training events, such as in the Philippines over the past two years and at the Joint Pacific Multinational Readiness Center at Schofield Barracks.

What is different about the integration into the 25th Infantry Division is "now this capability will be organic to the division artillery brigade," he said.

Supporting the transition will include personnel and a training effort that will require soldiers who were "one day, shooting a cannon" to "drive and shoot a rocket," Evans said.

As part of the integration, a transition training course has gone into effect, and "as of yesterday, we started receiving this long-range fires capability, and then we will continue building that over the course of about the next six weeks or so," he said.

The training course takes soldiers back through regional training institutes for three weeks, Evans said. The course supports the transition from the towed artillery pieces to the HIMARS, after which soldiers will return to the unit and begin a training regimen to prepare for a benchmark validation exercise in the fall. The exercise will employ and evaluate the launchers' concept of employment, he said.

While the HIMARS are replacing 14 howitzers, the division will still maintain cannon capability in the formation, said Col. Daniel Von Benken, 25th Infantry Division artillery brigade commander.

"We transformed and consolidated our cannon artillery systems into a ... single cannon battalion" that consists of two batteries of 105mm howitzers and one battery of 155mm howitzers, Von Benken said. "So, yes, we will still retain cannon capability in the formation."

Combined with the cannon capability, the addition of HIMARS makes the formation "more ready and more lethal," Von Benken said. "It's clear the HIMARS weapon systems will make us more lethal at the end of the day. It extends the range to long-range precision fires while still retaining the capability to win in the close fight with ... the cannon artillery."

"This is a campaign of learning that is focused on one thing," Evans said, "and that is warfighting readiness. And it works best in terms of innovation when this new technology is given to soldiers at the lowest level and allow them to iterate on it, work on it in a field environment and then provide bottom-up feedback."

Sgt. Maj. Shaun Curry, command sergeant major of the 25th Infantry Division, said the division is charged with protecting the island regions and "getting ourselves 1 percent better for our American people. ... In less than 12 hours, we got, I would say, 4 percent better, or 3 percent better, as the three HIMARS came off of the airplanes yesterday." ***ND***

Army photo



An M10 Booker conducts a live fire demonstration.

Canceled Army Assault Vehicle M10 Booker Outgrew Its Worth

BY JOSH LUCKENBAUGH

The M10 Booker armored vehicle is among the programs the Army has put on the chopping block as part of its new transformation initiative.

Although the effects of "requirements creep" rendered it unable to perform the desired mission set, the service still has a critical need for a mobile, protected firepower platform, one Army observer said.

The Booker was the result of the Army's Mobile Protected Firepower program, which sought to provide Infantry Brigade Combat Teams a direct offensive fire capability they do not currently have. Program Executive Officer Ground Combat Systems Maj. Gen. Glenn Dean told reporters in 2023 the system would support Army units "by suppressing and destroying fortifications, gun systems, entrenchments and secondarily then providing protection against enemy armored vehicles."

However, the vehicle the Army ultimately asked for and received from manufacturer General Dynamics Land Systems was a far cry from what the service originally wanted, said Carlton Haelig, a fellow in the Center for a New American Security's defense program.

"Back in 2013, 2014 when the requirements were being written ... it was supposed to be something that could be transportable on a C-130," which is "the backbone tactical airlift capability of the Joint Force," Haelig said in an interview. "The idea was that this was going to be something that would be going alongside the early entry, forcible entry operation units ... that don't have organic heavy fire support."

Such a platform "sounded great on paper, but as the system progressed through the development process, it became something that, well, maybe we can only get it on a C-17," he said. Then the requirements changed again "to, well, it doesn't need to be airdroppable," which "kind of negates" the original purpose of the platform.

"If it's not airdroppable, how is it going to be going in alongside ... the airdroppable forces themselves?" Haelig said. "So, requirements creep is obviously a problem."

General Dynamics declined to comment for this story. The Army did not respond to an interview request, but issued a press release June 11 confirming it was ceasing procurement of the M10 Booker.

During testimony to the House Appropriations Committee's defense subcommittee in May, Army Secretary Dan Driscoll said the service must "own" the fact that it got the Booker wrong, "but what we are trying to do is not fall prey to [the] sunk cost fallacy where because we have invested all of these dollars into this machine that turned out to be inadequate we're going to keep purchasing it."

"The risk is much greater ... keeping the status quo" and sending soldiers into combat with inadequate systems, Driscoll said.

Haelig said he is "very much in support of" the effort to correct Army procurement mistakes such as the Booker, "so long as we can continue to say that this is an operational capability that needs to be fulfilled in the future."

"The Booker program was trying to fill a critical gap," he noted. "This isn't necessarily the Army saying that this gap is no longer something that we need to be worried about — specifically a light, transportable, expeditionarily capable protected firepower platform."

The Army has tried several stopgap solutions to meet this need, such as putting larger guns on Strykers or changing wheeled vehicles into tracked platforms, but those types of systems would not fare well in a high-intensity conflict with a near-peer adversary, Haelig said. The service "should be focusing on delivering that kind of next-generation capability, rather than putting ourselves in a pretty bad situation with stopgap measures that simply are not survivable."

The bottom line is, "if you're going to make a light tank, make a light tank," he said. "Don't make something that slowly becomes a medium tank, or slowly becomes something lighter like a Paladin. ... Make the light tank."

As for the 80 or so Bookers the Army already has in its inventory, Haelig said there could be a potential market for selling them to foreign partners, but "anybody who takes these vehicles on is going to face very similar constraints in terms of" handling maintenance and logistics.

The Army is likely "going to wait a little bit" before deciding what to do with them, he said.

"I don't think we're necessarily going to hear a deal tomorrow that these are being sold to" an ally overseas. "I don't think that they'll try and integrate these into the force. ... So, it's really yet to be seen," he said. ***ND***

Army photo

INTEGRATED PRECISION WARFARE

Chem-Bio Defense Plugging into Joint Command, Control Architecture

BY JOSH LUCKENBAUGH

BALTIMORE — The Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense is working to integrate its early warning systems into the Defense Department's Combined Joint All-Domain Command and Control architecture, with a key experiment planned for 2026, officials said at a recent industry conference.

The command-and-control initiative, known as CJADC2, seeks to link U.S. and allied sensors and shooters across every warfighting domain through a unified, AI-enabled network. Each military department is pursuing its own contribution to the architecture, including the Army's Project Convergence, the Navy's Project Overmatch and the Air Force's Advanced Battle Management System.

Drew Murphy, joint product lead for CBRN integrated early warning at the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense, said the office is working with the U.S. military services and mission partners overseas to plug into the architecture, noting its requirements are "aligned" with the CJADC2 capstone software initial capabilities document.

JPEO-CBRND reports to the assistant secretary of the Army for acquisition, logistics and technology, and its headquarters are at the service's Aberdeen Proving Ground in Maryland.

"Being situated where we are geographically," it has engaged closely with the teams developing the Army's Next Generation Command and Control architecture, which was tested at the service's Project Convergence Capstone 5 experiment earlier this year, Murphy said during a panel at the National Defense Industrial Association's recent CBRN Defense Conference.

His team is planning to participate in the Project Convergence experiment series for the first time at the 2026 edition, Murphy said in an interview following the panel.

"We're working that right now," he said. "We're going through the process. There's a series of two risk reduction events, but they do have tailored vignettes for [the] force protection, CBRN space."

It will take time to see "how that progresses, how the Army looks at it, how they're building out the capability and the capacity," but having the service's Program Executive Office Command, Control, Communications and Network and the Army Combat Capabilities Development Command C5ISR Center also headquartered at Aberdeen Proving Ground "is a benefit," he added.

"We're understanding how their networks are coming together, how data is moving from an Army perspective, to drive at, all right, this is where I need to have this data in order to fuse it with another element to give a whole picture ... and understand that chain of events and that sequence of events to then adjust our posture," he said. "How do we build? How do we react? How do we change our operating paradigm because something happened that we didn't plan for?"

JPEO-CBRND is also working with the Navy on its Maritime Tactical Command and Control program, as well as the National Guard, Murphy said.

"At the end of the day, we're leveraging each service network and their contribution to CJADC2 ... to get that CBRN [data] up to that strategic-level echelon in order to make decisions," he said.

In addition to partnering with the U.S. military services, the office is working with NATO to ensure "that we can transmit ... CBRN warning messaging across all of our partners there, making sure that standard stays robust and adapts as technologies change," he said.

The same goes for partners in the Indo-Pacific, Murphy said. "All of those things are being worked out right now, but it's really centered around availability of data at different echelons — making sure it's available for those tactical decision-makers, but yet, as it moves up, is sifted through to the valuable information to make those operational, strategic decisions."

Tim Tharp, joint project manager for chemical, biological, radiological and nuclear sensors at the joint program office, said the CBRN enterprise needs to "change how we think about sensors."

"We are not in the CBRN business — we are in the information business," Tharp said during the panel. "We use sensors to collect information so commanders can make decisions. The information they collect has to be decision quality, and it has to be able to inform decisions."

Whether it's telling an individual operator to take their mask on or off, or "it may be a decision to say, 'Hey, there's something out there no one's ever seen before,' ... everything's about decisions, the decision quality of data and information," he said. ***ND***



A warfighter uses an Aerosol Vapor Chemical Agent Detector.

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COMMENTARY

Changes Needed to Spur Private Sector Innovation for CJADC2



BY MATT JONES

Small and medium-sized businesses are driving innovation in the defense and intelligence spaces. Still, it's often nearly impossible for them to get a seat at the table with federal buyers.

The catch-22 here is that for the Defense Department to remain dominant on the international stage, it will need the technology those agile, inspired smaller companies are creating.

Combined Joint All-Domain Command and Control, or CJADC2, serves as an instructive ongoing use case for this challenge. The concept aspires to create the connected fighting force needed to defend against increasingly sophisticated threat actors. However, it will take a shift in culture, contracting and bureaucracy to make it a reality.

Right now, every component has its own ecosystem and operates within its own environment with its own rules, including how, when and why it can pursue new technology. Those barriers to buying will hinder the Pentagon's ability to unite the services through data sharing and improve decision-making in the most critical circumstances.



Thankfully, the Trump administration has begun to reform some Pentagon acquisition regulations by issuing an April executive order, "Modernizing Defense Acquisitions and Spurring Innovation in the Defense Industrial Base." It asks the Pentagon to utilize existing authorities to expedite acquisitions throughout the department. This includes a first preference for commercial solutions and a general preference for pathways to promote streamlined acquisitions under the Adaptive Acquisition Framework.

This move shows the White House's commitment to spurring the innovation the department will need to dominate the battlefield of the future. However, to truly overcome the above-mentioned obstacles, the Pentagon must rely on small and medium-sized companies that can quickly create and iterate battle-ready software that delivers on the vision for CJADC2.

Small and medium businesses have been fighting to bring new, cutting-edge capabilities to the Defense Department. However, too often, those companies are locked out by proprietary technology developed by large prime contractors with the primary purpose of protecting shareholder value. This marginalizes true innovation and leaves the warfighter with suboptimal tools to take on some of the world's most challenging missions.

The large primes recognize that these agile, adaptable businesses threaten their stranglehold on lucrative defense contracts and have done everything they can to stifle progress and freeze out smaller competitors. One of their primary tactics is to create closed-loop proprietary systems. There are hundreds of use cases where this is true, including those around CJADC2.

There are a few ways to address this challenge. One approach is to require or incentivize modular contracting strategies to prevent massive contracts that only major primes can bid on.

Another strategy is ensuring that small and medium-sized businesses are performing meaningful work, rather than acting as pass-through for large primes.

Additionally, allowing more flexible interpretations of relevant past performance can help small and medium-sized businesses qualify for work.

Wholesale change in the Defense Federal Acquisition Regulation Supplement is not needed to achieve better outcomes for the most innovative small and medium-sized businesses. They need some adjustments that give them a seat at the table.

Retired Marine Corps Lt. Gen. Dennis Crall — the architect of CJADC2 — called on defense technology contractors to meet the customers where they are. Large primes can't do that.

Often, their solution is to sell more hardware rather than truly enabling the ability to connect existing yet divergent systems. This will take a modular open source platform utilizing commercially available, off-the-shelf technology that delivers new capabilities to the warfighter at the speed of relevance.

The military services silo their systems, so these platforms need to be versatile enough to work with any hardware and receive data over any transport topology. Deploying a foundational architecture that allows applications and data to move seamlessly between the cloud, forward positions and edge locations will enable processing and decision-making in a dynamic mission environment.

To take advantage of this approach, the military must accelerate the pace at which software can be designed, tested and deployed, allowing the warfighter to update and deploy software anywhere in the world as fast as someone can develop an application.

The rules of acquisition make this kind of flexibility incredibly difficult. Even if a contractor builds and demos an app in a few days, it could still take nine months to get the finished app out to the field.

To allow for the military to accelerate the pace at which software can be designed, tested and deployed, the Pentagon can take steps like requiring open source architecture to eliminate vendor lock and allow interoperability across systems, adopting agile and DevSecOps methodologies at scale and using secure, cloud-based development environments.

The vision of "sense, make sense and act" that CJADC2 promises will be most effectively addressed through a public-private partnership that delivers new capabilities through leading-edge technology that connects disparate systems across all branches of the military and joint forces.

The April executive order is the first step in creating an environment where the military can adapt quickly to solve complex problems. It will take changes to both culture and contracting to achieve the level of interconnectedness outlined in CJADC2.

Steps must be taken now to start shifting mindsets and making innovation easier for the department and the private sector companies that want to support those vital missions across the world. ***ND***

Matt Jones is CEO of Sigma Defense.

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