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4

The Role of Logistics, Sustainment in Integrated Deterrence

Commentary by Assistant Secretary of Defense for Sustainment Christopher Lowman

6

Navy Going Digital to Increase Energy Efficiency

By Josh Luckenbaugh

8

Navy to Accelerate Delivery of Unmanned Tanker

By Jan Tegler

10

Air Force to Replace Aging Bomb Loader

By Josh Luckenbaugh

11

Air Force Acquisition Strategy for KC-135 Replacement in Limbo

By Jan Tegler

13

Army to Live off Land in Contested Environments

By Allyson Park

15

How One Army Plant Modernized to Support Ukraine

By Lt. Col. Frank Musisi

16

Securing Directed Energy Supply Chains

By Mark Niece and Rebecca Wostenberg

18

Pentagon Harnessing Data for Predictive Logistics Planning

By Laura Heckmann

20

Transcom's 'Game Changer' Management System Moves Forward

By Laura Heckmann

21

Defense Industrial Base Needs to Secure Trusted Supply of More than Just Chips

Commentary by David Schild, executive director of the Printed Circuit Board Association

22

New Manufacturing Process Boosts Military Semiconductor Efficiency

By Allyson Park

23

On Defense Electronics, U.S. Just Past Square One

Opinion by Chris Mitchell, vice president of government relations at IPC

25

Enabling Logistics in Contested Environments

Viewpoint By Alan R. Shaffer and Wilson Miles



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The Role of Logistics, Sustainment in Integrated Deterrence

BY CHRISTOPHER LOWMAN



In my first year as the assistant secretary of defense for sustainment, I have observed the contested, dynamic and distributed nature of the new strategic environment.

Peer competitors increasingly hold our defense ecosystem at risk. The future of war will be fast, mobile and lethal and requires the Defense Department to think about sustainment through the lens of integrated deterrence, which is a holistic and coordinated approach that integrates all elements of national power to address and respond to a wide range of threats and challenges.

Realizing the benefits of integrated deterrence from a sustainment perspective hinges on our ability to: prevail in a contested logistics environment; modernize the industrial base across the network of organic, domestic and international partners; establish data-informed sustainment; and find and fix operations and support cost drivers.

In recent decades, U.S. forces have operated without much strategic risk to logistics. We operated from secure bases and became comfortable with uncontested and unchallenged movement throughout the theater of operations. During that time, the capabilities we have fielded — like the F-35 Joint Strike Fighter and other enduring platforms — have utilized sustainment strategies that assume a more permissive strategic environment.

Today, the strategic environment is defined by challenges to logistics agility, flexibility and survivability through kinetic and non-kinetic disruptions. To navigate and prevail through a contested logistics environment means ensuring that logistics, supply chain operations and transportation capabilities are resilient and can operate effectively in hostile environments.

Therefore, I've launched a campaign of tabletop exercises to stress the life cycle sustainment strategies for existing capabilities, given the realities of a contested logistics environment, to

better inform current sustainment gap mitigation efforts and future sustainment strategy design. To secure enduring military advantage, the Defense Department must ensure that the combatant commands are postured with sufficient resources such as munitions, fuel and spare parts. They must also have the capabilities to perform maintenance, manufacturing at echelon, storage and transportation and withstand and recover quickly from disruptions.

The future calls for resilient sustainment strategies that are more distributed, flexible and responsive to changing operational and strategic conditions.

One example of reducing risk within a contested environment is the need to mitigate demand for ocean lift capabilities by employing strategies that satisfy demand closer to the point of need.

Advanced manufacturing, which includes 3D printing, provides an opportunity for manufacturing parts on demand, which can be useful in situations where supply chains are disrupted or contested. By integrating advanced manufacturing at different levels, the joint force can produce crucial parts in contested environments in a distributed manner, increasing an adversary's dilemma and ultimately U.S. integrated deterrence posture.

To enable full implementation, the office of the assistant secretary of defense for sustainment is working to ensure secure transmission of intellectual property and accurate accounting of its use to ensure appropriate compensation to the IP owner, as well as assessing our department's approach to modernizing intellectual property licensing rights or fee strategies, which requires close collaboration with our industry partners to identify the appropriate changes in policy and process.

The office of the assistant secretary of defense for sustainment is charged with providing advice and assistance to the undersecretary of defense for acquisition and sustainment, deputy secretary of defense and secretary

of defense on sustainment functions including logistics, material readiness and product support. In addition, the office is responsible for budgetary, policy and management oversight for sustainment functions in the Pentagon.

At the enterprise-level strategy, the department is looking 15 years down the road at sustainment capabilities within the organic base and developing pathways to better share our future vision throughout the defense industrial base and its commercial partners. My goal is to create a more collaborative, transparent environment that ensures capital investments, whether government or commercial, result in more integrated support for the industry of the future.

We've developed goals to ensure strategic alignment across the service modernization efforts and are applying a results-oriented management framework to define an optimum investment approach. This will not only ensure the industrial base is able to keep pace with the rapidly evolving technological landscape but will facilitate smoother integration of these advanced systems into the defense infrastructure.

Today, the services are working to modernize depot maintenance organizations, operations and technologies. They are improving processes, deploying interoperable maintenance repair, overhauling information technology systems and retaining world-class capabilities properly sized to workload requirements. The objective is to meet materiel readiness goals with modernized, efficient and resilient infrastructure at the service and enterprise levels.

Instrumental to the success of the sustainment modernization effort is striking a balance between the organic industrial base and the commercial industrial base.

We must maintain the right balance of capabilities between it and industry, both domestic and international, to ensure resiliency, economic viability and the overall health of all partners. The goal is to create a more complementary defense industrial base that minimizes the duplication of capacity and capability, balancing organic and commercial industry repair capabilities and capacity. The Defense Department is committed to being as transparent as possible when outlining government investments in the organic industrial base, focusing on how it plans to have capabilities complement

rather than compete with industry.

To achieve this balance, we are adopting increasingly transparent approaches to foster a more collaborative relationship between the industrial base partners, ultimately driving efficiency and effectiveness in our modernization efforts.

One initiative that should be the subject of future sustainment strategies is being resilient and flexible with commercial partners that emphasize a regional sustainment concept, which would utilize existing allied and partner maintenance, repair and overhaul capabilities and U.S. industrial base capital investments to provide sustainment support service using allied and partner national and/or commercial capabilities partnered with U.S. industry within the various theaters of operation.

Building upon and working collaboratively with industry and allied nations would minimize disruptions, optimize supply chains, maximize availability in theater, minimize reliance on long over-ocean transportation routes and further distribute the maintenance, repair and overhaul capabilities regionally to increase resilience and survivability. Building a regional sustainment concept would foster new and innovative supply chain resiliency, improve our ability to identify and respond to future challenges and aid in integrated deterrence.

Given the rapid pace of technological advancements, the department must harness new capabilities and workforce competencies to effectively sustain the force both now and in the future.

For instance, we have only just started tapping into the potential of machine learning and artificial intelligence to address sustainment challenges. As part of this effort, we are developing new capabilities that utilize data and analytics to enhance sustainment-related decision-making at all echelons both within the operational and strategic levels and throughout the weapon system life cycle.

The distributed nature of the battlefield necessitates greater precision in our inventory requirements, increased visibility of our joint transportation needs and capabilities and a better understanding of failure probabilities to efficiently deploy our maintenance resources.

I've challenged the services to operationalize conditions-based maintenance-plus at echelon to shift maintenance from an unscheduled,

reactive approach to a deliberate, predictive approach. It facilitates performing maintenance based on evidence of need, when it optimally supports operations, as opposed to providing maintenance at failure, which can negatively impact unit readiness.

Taking advantage of the sensor platforms the department has invested in over the last 20 years by implementing conditions-based maintenance-plus decision support tools at echelon helps provide a better understanding of system performance, including associated cost drivers and support options, while also enabling more precise inventory management of critical items.

Consequently, we are concentrating on the creation of business intelligence tools that enable decision-making at each echelon to ensure the battlefield logisticians have the information they need to make actionable decisions that maximize availability and readiness. By pursuing programs in supply, transportation and maintenance functional areas, we strive to leverage data and analytics to further improve sustainment-related decisions across all levels of the department.

As we face the emerging challenges of today's strategic landscape, we are adopting transformative solutions to drive down operating and support costs while enhancing operational availability across the services. The goal is to incentivize the services and defense agencies to collaborate, align efforts both horizontally and cross-functionally and to ensure we are delivering the highest materiel readiness return on investment.

Key to this endeavor are efforts like the Rapid Sustainment Improvement Program, which is a cornerstone of our strategy designed to address cross-service cost drivers that do not rise above the individual service prioritization levels but collectively account for significant sustainment cost across the department. Through this program, the department can prioritize and resource commercially available sustainment technologies that demonstrate positive returns on investment and can be scaled quickly to improve availability and lower operations and sustainment costs.

Implemented beginning in fiscal year 2024, the department has identified and funded a full range of projects and identified proposed projects for 2025, which include key enablers such as conditions-based maintenance-plus business intelligence tools at echelon,

and has started on the effort to solicit industry input for 2026 projects.

This decentralized decision-making process fosters a more agile and responsive structure, ultimately securing our ability to deliver combat power at the point of need. Through this approach, the department can better allocate resources, prioritize efforts, field existing solutions more rapidly and adapt quickly to evolving challenges, ensuring that our military remains prepared and effective in an ever-changing landscape.

The dynamic and contested nature of the strategic environment demands a new approach to logistics and sustainment. Integrated deterrence, as an element of the current National Defense Strategy, offers a comprehensive framework to address emerging challenges and ensure military advantage. Key areas of focus include prevailing in a contested logistics environment, modernizing the industrial base, leveraging data and analytics for sustainment decision-making and finding and fixing operations and sustainment cost drivers.



The current era offers a unique opportunity for collaboration and knowledge exchange between the Defense Department, international partners and industry stakeholders, setting the stage for development of effective regional sustainment strategies that meet the demands of modern warfare.

By adapting to the changing strategic environment and embracing an approach that uses integrated deterrence to combine our strengths to maximum effect, the department can ensure the United States and its allies maintain a decisive edge in an increasingly competitive and challenging world. **ND**

Christopher Lowman is the assistant secretary of defense for sustainment.

Fueling the Fleet

Navy Going Digital to Increase Energy Efficiency

BY JOSH LUCKENBAUGH



Refueling Navy ships while at sea — particularly larger vessels like destroyers — takes a lot of time and effort, requiring a supply ship to come fill up the tank.

While this may not be such a daunting task in peacetime, in a potential Indo-Pacific conflict an underway replenishment could become an easy target for an adversary. The Navy is going to need to make the most of every tank and spend as little time as possible at the pump, experts have said.

The service's Global Energy Information System, or GENISYS, could play a key role in improving decision-making and fuel efficiency across the fleet. Its goal is "to accurately and consistently track surface ship energy usage to improve operational readiness," a Navy spokesperson said in an email.

GENISYS consists of three applications: two ship-based applications called eLogBook and the Shipboard Energy Assessment System and an ashore, cloud-based component called the Fleet Energy Conservation Dashboard, the spokesperson said. The system achieved initial operational capability in 2023 "after GENISYS validated its ability to automatically

transfer data from the ship-based applications on an Arleigh Burke-class destroyer to the Fuel Energy Conservation Dashboard application live on the government cloud," the spokesperson said. As of the end of fiscal year 2023, GENISYS has been installed on 12 destroyers.

The Navy leveraged Small Business Innovation Research funding to create GENISYS, with Beacon Interactive Systems and Frontier Technology Inc. serving as the developers and ManTech International Corp. as the software integrator, the spokesperson said.

Beacon CEO ML Mackey said through the SBIR program, the company has been able to take its experience in the commercial sector "to bring to bear on DoD problems and deliver capabilities into the hands of the warfighter."

The company's first SBIR program was focused on "the question of how do you decrease the cost of keeping our ships mission-ready by addressing the big cost driver, which was the people doing the work?" Mackey said in an interview. "And the proposers on our topic proposed a lot of the mainstream kind of stuff that was being suggested across the DoD. We were outside the DoD, [and] we said, 'Well, you'd figure out how to make it easier for them to

An Arleigh Burke-class guided-missile destroyer and a supply ship conduct an underway replenishment during a training exercise.

get their work done,' which is what we had done for" private companies such as Olympus, MetLife and IBM.

A major time-consuming task for sailors is logging activity on a ship — and in the Navy, "every single thing that happens on a ship gets logged," Mackey said.

Beacon president and chief technology officer Mike MacEwen said the logs include everything from orders given on the bridge, to when equipment is turned on and off or valves are changed out in the engine room, to personnel, sea state and environmental data — "they do one where it's trying to figure out how much fuel and water are in [the] tanks, and they do it manually" — to combat system orders, to "what happens when you enter a harbor. So, it's all this very minutiae data about everything happening on a ship."

Before GENISYS — which is still the case for the majority of the fleet that has not received the system — all the ship logs were, or are, done on paper, Mackey said. Beyond taking a lot of time to do, the handwritten logs are messy and hard to read, causing problems such as information getting missed, she and MacEwen said.

In contrast, eLogBook digitizes the ship's records for engineering, deck and daily fuel and water, reducing the burden on sailors to record the information and the time required to access the logs, the Navy spokesperson said.

"It's much more accurate to click a button than to handwrite scrawl — and if you've ever seen a written log book ... I mean, you can't read them. It's insane," MacEwen said.

And now that "all this digital information on the ship" is in one place using eLogBook, that data can be fed into algorithms that tell the sailors whether they are operating efficiently with the energy that they have, Mackey said — and that's where the Shipboard Energy Assessment System, or SEAS, comes into play.

SEAS consolidates information into decision aids to inform the ship's operators on energy utilization, helping ship operators conduct missions as efficiently as possible, the Navy spokesperson said.

Having a system like SEAS continuously running operational energy calculations to determine whether the ship is "operating at peak energy efficiency — and if you're not, what should we do about it?" — will help the Navy increase a ship's time "on station," meaning increasing the time between refuelings, as well as allowing the service to make "informed decisions at the edge," Mackey said.

This could prove useful if and when a ship must conduct contested logistics — a scenario where "I have to figure out how to get something from here to there in a difficult situation," MacEwen said. "Since I have a limited resource — fuel — [and] I don't have a lot of gas stations, [and] I need to go do something, if I can figure out my operating parameters around that and have it with confidence," knowing exactly "what I have and what I can perform and what I can do" rather than a rough estimate, that can save the ship from having to refuel unnecessarily.

Underway replenishment is a risky mission in contested waters as the supply ship has to come up next to the vessel receiving fuel. "So, I spend an hour in my [destroyer] next to 10 million gallons of fuel driving in a straight line," MacEwen said. "If you're talking contested logistics, that's a really dangerous moment. So for the Navy, it can help them either extend the duration of that ship before they need to do a replenishment, or I can change my route. I can go pick up some gas and

then go, or from a battle group perspective, I can send a different ship to do a thing because they have more gas. So from a planning perspective, operations, safety, it kind of hits all those."

The system can also do "what-if analysis" and send out alerts, he said. For example, if "the captain says, 'All ahead full,'" — meaning to operate the engines at full speed — "but if engineering doesn't make a change on an engine to go all ahead full, you want to know that. You want to know that pretty quickly." And "because it's digital instead of paper," the system can send out an alert that notifies the sailors, "Hey, something happened here."

On shore, the Fleet Energy Conservation Dashboard "consolidates energy information across ships to inform naval planners and engineers on how energy is used across multiple ships," giving the Navy "better data analytics to optimize the energy efficiency of ship modernization and new ship designs," the service spokesperson said.

In its entirety, the GENISYS suite will help the Navy conduct and plan for distributed maritime operations — the service's new warfighting concept in which the fleet is dispersed in small detachments across a large area — the spokesperson said.

"Distributed maritime operations stress fuel logistics and supply lines," the Navy spokesperson said. "Information from GENISYS enables reduced energy demand of forward-deployed assets and provides logistics planners with higher fidelity energy data sets tied to specific mission profiles to more accurately forecast near-term energy needs."

Following the successful deployment of GENISYS on the Arleigh Burke-class ships, the Navy plans to install the system on its San Antonio-class amphibious transport docks in 2024, a service release stated. The Navy spokesperson said that while the Arleigh Burke-class and San Antonio-class ships are the only planned deployments of the system, expansion onto other platforms is possible in the future.

"GENISYS can be deployed on any platform with the proper tailoring to that platform's unique require-

ments," the spokesperson said.

In its fiscal year 2024 budget request, the Navy asked for \$9.6 million for energy management or measurement software and systems, which includes funding for GENISYS.

The investment would help fund the system's fielding and sustainment to support the Navy's digital transformation, enable distributed maritime operations and fulfill the Navy's operational energy management system requirement, according to Defense Department budget documents. The funding would also support GENISYS' transition out of the research-and-development phase, which includes shipboard installations, user training events, critical or routine maintenance requirements such as cybersecurity, and periodic updates.

So far, sailor feedback regarding GENISYS has been "generally positive, although more time and training is needed to fully understand and utilize the capability," the Navy spokesper-



USS Arleigh Burke guided-missile destroyer

son said. Mackey and MacEwen said Beacon is actively participating in the installation of GENISYS in the fleet, as well as providing training.

"The whole goal of this is there's all this data on a ship. Let's use it, let's make it really, really valuable," MacEwen said. "Put it together, run a calculation, give you some knowledge. ... It's helping that [commanding officer] know what to do, when."

Mackey lauded the Navy's "Herculean effort" to get the SBIR-funded GENISYS "accredited and part of a program of record that is right now doing energy calculations and could be a basis for additional operational algorithms.

"It was non-trivial this path getting here, for them as well as for us," she said. **ND**



MQ-25 Stingray

MQ-25 Stingray

Despite Delays, Navy to Accelerate Delivery of Unmanned Tanker

BY JAN TEGLER

The Navy announced in April 2023 a second delay in the debut of its carrier-based unmanned aerial refueling aircraft, the Boeing MQ-25A Stingray.

Initial operational capability slipped from 2025 to late 2026 for the drone the Navy has called the “pathfinder” for future carrier air wings that could be 60 percent unmanned by 2040.

Rear Adm. Stephen Tedford, the Navy’s program executive officer for unmanned aviation and strike weapons, attributed the delay to difficulties faced by Boeing in establishing a mature production line. The company in 2018 won an \$805 million contract to build the first four Stingrays, with the Navy exercising an \$84.7 million option to purchase three additional aircraft in 2020.

Then in late November, the Defense Department’s Office of the Inspector General released an audit of the service’s management of the program. It found that “the Navy planned to make crucial production deci-

sions before conducting tests and evaluations to ensure the program meets operational requirements.”

Originally planned to be in-service by 2024, the MQ-25 is designed to take over the aerial refueling duties now performed by F/A-18 Super Hornets in carrier air wings and perform additional future missions including intelligence, surveillance and reconnaissance as well as joint all-domain functions including advanced communications.

The service’s decision to proceed without sufficient testing added to the risk that the MQ-25 program “will not meet its operational capability requirements, which could require costly and time-consuming engineering changes and may delay the MQ-25A’s deployment,” the audit stated.

The inspector general’s audit recommended the service either delay the initial production and initial operating capability decisions until sufficient tests are conducted or ensure the program’s risk management documentation is updated to identify, assess and mitigate the impacts of making these decisions before conducting developmental test and evaluation and initial operational test and evaluation.

Capt. Daniel Fucito, who leads PMA-268, the unmanned carrier aviation office responsible for the MQ-25, said the Navy’s decision to delay initial operating capability prior to the release of the report will allow the service and Boeing sufficient time to complete and test the seven flight-worthy engineering and manufacturing development, or EMD, aircraft being built ahead of production and adequately train pilots and maintainers.

“This will also provide increased opportunity for the correction of deficiencies discovered in tests,” Fucito noted. The Navy is adjusting the current plan for MQ-25 development, test and production toward a more traditional acquisition strategy, he added.

A production decision for the Stingray and a low-rate initial production contract award previously proposed for 2023 will be postponed for now, Fucito said.

Troy Rutherford, Boeing MQ-25 program vice president, said the company expects low-rate production to begin late this year or early in 2025.

An unresolved question is what the MQ-25 will cost. The most recent Selected Acquisition Report on the Stingray is from December 2022. The report put the total cost of the MQ-25 program at \$16.5 billion. The Navy’s fiscal year 2024 budget estimates list the cost of each MQ-25 at \$136.2 million, however the report noted an increase in average procurement unit cost.

Despite setbacks for the MQ-25 effort, the service and the Sting-

ray's maker contend it is still on a rapid path to deployment.

"The Navy and Boeing took aggressive risk on cost, schedule and testing and we expect to see benefits from that early learning in the program long-term," Fucito said. "Our intent is to accelerate the delivery of these aircraft to the fleet as soon as possible."

Rutherford compared MQ-25's gestation to typical time from contract award to initial operating capability across the Defense Department, which averages 14 years, he said.

"When we look at IOC in 2026, it shows how lean-forward both the Navy and Boeing were in saying we're going to rapidly develop this faster than any other production program out there. We're still in front of that average," he said.

Boeing currently has five Stingrays in production at its St. Louis facility, Rutherford said. With a contract award for low-rate initial production aircraft, the company will transition production to a newly built site, he noted.

Boeing invested \$200 million on a new production facility at Mid-America Airport attached to Scott Air Force Base in Missouri. It will complete final assembly there for the current airplanes and conduct flight tests there, he said.

Rutherford added that Boeing's production line problems have mostly been resolved. Post-COVID challenges, including issues with the quality of coatings applied to Stingray's metal components and drilling holes in the components during the fabrication process, a practice known as "full size determinant assembly," were the result of work done by "sub-tier processing facilities."

Boeing now has checks in place to ensure proper execution of manufacturing processes, Rutherford said. Manufacturing delays also came down to "the length of time it took for the supply base and even our own manufacturing to stand up in a post-COVID world where we had to train new employees and gather a new employee base," he explained.

While Boeing is responsible for the air vehicle, the Navy is responsible for the Unmanned Carrier Aviation Mission Control System, or UMCS, the means by which pilots will command and control Stingrays. Known as "air vehicle pilots," they will fly MQ-25s from a ground control station within unmanned warfare center installations aboard aircraft carriers.

Fucito said that the USS George H.W. Bush is being modified with control system updates and a ground control station. Carriers USS Carl Vinson and USS Theodore Roosevelt will receive the same modifications in fiscal year 2025.

The Navy "is making great progress with ongoing lab integration events to demonstrate the capabilities of the UMCS" in coordination with Boeing and Lockheed Martin, the builder/developer of the MD-5 ground control station, he said.

The Navy has no current timeline for fielding future Stingray capabilities. Fucito said capabilities beyond refueling and deployment phases for them are still being determined.

J.J. Gertler, senior defense analyst for the Teal Group, observed that the delays for the MQ-25 program are concerning, particularly as the aircraft will serve as the foundation for future carrier air wings and have roles beyond refueling.

"MQ-25 is not being treated as a program," he said. "It's being treated as an experiment. The difference is if you do an experiment with an [unmanned combat air vehicle] and it works out, you've got [an unmanned combat aerial vehicle]. But if you only do an experiment with a tanker and it works out, you've got a tanker and you've still got to develop a UCAV."

While the Navy hasn't outlined exactly what aircraft types future air wings will consist of, service leaders have mentioned a combination that includes MQ-25, collaborative combat aircraft — also called robotic wingmen — and the service's sixth generation fighter, known as F/A-XX.

"At some point they have to make MQ-25 and F/A-XX work together," Gertler added. "But we haven't seen a plan that I know of for that."

Fucito responded: "MQ-25 will play a key role in the air wing of the future and as such has been assessed alongside all current naval platforms for capability; what exactly that entails and details for future platforms are still being determined."

Tim Walton, senior fellow at the Hudson Institute's Center for Defense Concepts and Technology, said the

Navy hasn't said much about the possibility that MQ-25s could receive gas as well as refuel aircraft.

"That would be a really important capability, because if you could do that, it gives the MQ-25 very long range," he noted. "Sure, it could refuel other aircraft in other locations, but you could use it for forward [intelligence, surveillance and reconnaissance] and targeting."

"There's absolute potential there," Boeing's Rutherford said. Current Navy requirements call for the unmanned tanker to be capable of offloading at least 14,000 pounds of fuel up to 500 nautical miles away from the carrier.

"The next phase of autonomy is for MQ-25 to be able to shuttle tank off a KC-46 or receive fuel from another MQ-25. That's definitely in the Navy's roadmap and our roadmap," Rutherford maintained.

Training is underway for the personnel who will fly the MQ-25. The first eight MQ-25 warrant officer pilots finished undergraduate training, earning their wings of gold in May 2023, according to Fucito. The eight pilots have now become part of Unmanned Carrier-Launched Multi-Role Squadron VUQ-10 at Naval Air Station Patuxent River, Maryland.

There, they join multiple naval aviators with previous manned flight experience who will later perform instructor duties at VUQ-10 and operate the MQ-25 in support of the Integrated Test Team.

Twenty-two MQ-25s are to be in-service by 2028, according to the Navy. But concerns raised by the inspector general and other government reports introduce doubt to the Navy's contention that the "pathfinder" Stingrays will be in service in meaningful numbers before 2030.

Walton said the service will have to accelerate delivery of the Stingray and fund the program appropriately to ensure carrier air wings can fight effectively in contested environments against China.

"I would say that it's even more important that the Navy invests in the suite of capabilities related to autonomy and command, control and communications that will allow MQ-25 to conduct operations in contested environments," he said.

"Otherwise, what we'll find is that regardless of what the number is in the 2028 timeframe, that 22 number, you might not be able to use those as effectively as you want," he added. **ND**



AIR FORCE TO REPLACE AGING BOMB LOADER

BY JOSH LUCKENBAUGH

The Air Force recently awarded Colorado-based company Stratom a contract to develop its Small Agile Lift Truck prototype — an all-electric, autonomy-ready platform to replace the service’s aging MJ-1 vehicle.

The MJ-1 — commonly referred to as a “jammer” — has been the Air Force’s bomb load vehicle of choice since the 1950s. While the vehicle’s longevity is a symbol of its reliability, technological advancements and the rapidly evolving security landscape have made an upgrade necessary for the Air Force, Stratom executives said.

The company’s Small Agile Lift Truck, or SALT, “is benefitting from 70 years of technology advancements, which is huge,” Jesse Weifenbach, Stratom’s lead vehicle systems engineer, said in an interview. “We spent some time examining the original vehicle, and ... it has a lot of good attributes, and that’s part of the reason they’ve used it for 70 years. So, we kind of examined

what we thought were the good attributes and held on to those” and then upgraded aspects of the MJ-1 that are more “dated.”

While SALT has the same lift capacity as the MJ-1, the former is more compatible with modern fifth-generation fighters and can be operated by wired remote, reducing the crew required to load and unload munitions and aerial stores, a Stratom release stated. The company estimates SALT is three times more maneuverable than the MJ-1.

The MJ-1 requires someone in the driver’s seat operating the vehicle, “and then you have several other airmen around the vehicle performing various operations,” Weifenbach said. SALT “is a little bit more flexible, in that the guy who’s driving it can also walk around the vehicle to the point of concern and look directly at what he needs to when maneuvering the store into place. So, our vehicle potentially can cut down upon the amount of manpower required to load these aircraft.”

Stratom president and CEO Mark Gordon said the flexibility SALT provides fits right in with the Air Force’s fifth operational imperative of resilient basing and the service’s Agile Combat Employment strategy, in which forces would be dispersed across a wide area of operating locations.

In a potential Indo-Pacific conflict, the Air Force will be operating in “more austere environments,” making the upgrade from MJ-1 to SALT “extremely important,” Gordon said. The MJ-1 is more “tarmac-based,” meaning it has to “work on more improved surfaces,” whereas SALT is designed to “work in a little bit more of an austere environment,” such as off-road or on a hasty, dirt airfield — “one that’s not as improved as what may be in a standard, traditional airbase.”

SALT can also be rapidly deployed in less than five minutes “when it gets to where it’s going” and will take up less space in a cargo plane than an MJ-1, allowing the Air Force to bring more supplies, Weifenbach added.

SALT also supports the Air Force’s electrification goals. In its October 2022 Climate Action Plan, one of

the service’s stated objectives was to pursue alternative energy sources. SALT is powered by lithium batteries and is thus “extremely quiet,” Weifenbach said.

SALT is “designed to complete a full day’s work on batteries alone,” he said. “This vehicle actually has chargers built into it, so all you need is a wall outlet to charge it. ... It helps them be more flexible. So, they can plug it in in a hangar, they can have a dedicated building or it can be out in the field just charging off of any generator.”

And while the vehicle is autonomy ready, “there were some specific requirements with this vehicle that it was wire-controlled, no radios and no active sensing,” he said. “It uses the same basic control system as our other autonomous vehicles, but we eliminated some features at the request of the Air Force to keep it more of a closed system.” Future designs could include additional sensors and computers to provide alignment assist and autonomous loading, the Stratom release said.

Stratom plans to deliver the initial working prototype of SALT in early 2024 to the Air Force for evaluation, Gordon said. **ND**



MJ-1C bomb load vehicle

Air Force photo

Aerial Refueling

Air Force Acquisition Strategy for KC-135 Replacement in Limbo **BY JAN TEGLER**



Omega carried out further work with fighters in October and November, refueling A-10s and F-16s respectively.

“Overall, short-term to mid-term tanker capacity is not a concern for the Air Force,” said service spokesperson Ann Stefanek. But she added that the Air Force is exploring how it could potentially leverage commercial aerial refueling in the future, revealing that the service’s transition from legacy tankers to the KC-46A and the aircraft that will be procured under the tanker recapitalization program does strain capacity.

“As the Air Force retires KC-10 and KC-135 aircraft, there is a short conversion period where aircrews and maintainers are trained on the new KC-46A aircraft,” Stefanek explained. “During each KC-46A unit conversion, there is a reduced availability of day-to-day tanker sorties until airmen in a unit are qualified. The Air Force does experience periodic day-to-day limitations on availability of tanker aircraft and crews as global demand shifts.”

Late last September, the Air Force issued a formal request to industry for information on tanker recapitalization with an approved requirement for up to 140 aircraft. At the end of October, Lockheed Martin, which had teamed with Airbus to offer a special version of the European maker’s A330 multi-role tanker transport, or MRTT, for the recapitalization program, unexpectedly announced its withdrawal from the partnership.

Lockheed’s only public statements to date regarding its decision explained that the firm would redirect its focus to new opportunities, including developing solutions for the Next-Generation Air-Refueling System. Asked how quickly it might be able to take a design from concept to reality, the company declined to answer.

The Air Force announced an accelerated schedule for the program last year. Andrew Hunter, the service’s assistant secretary for acquisition, technology and logistics, said, “We are looking at what is going to get us to NGAS. We think we will need about five years of tanker production from the current end of deliveries of KC-46 to get to increment one.”

The current procurement rate of 15 KC-46As annually would amount to 75 tankers for the recapitalization program, roughly half of what had been expected, Hunter said at

The Air Force has yet to determine a strategy for buying new aerial refueling aircraft that will replace much of its aged KC-135 fleet.

And as 2024 gets underway, the service still hasn’t stated whether it will proceed with a competition for its KC-135 Tanker Recapitalization Program or negotiate a sole source agreement with KC-46A Pegasus maker Boeing.

Brian Brackens, spokesman for the service’s Mobility and Training Aircraft Directorate, said: “We anticipate having an approved strategy later in 2024, but are unable to confirm with any precision when a [request for proposals] and contract award would follow.”

That lack of clarity gives rise to questions including how soon the recapitalization effort can produce operational replacements for retiring KC-135s and the almost-retired 59-jet KC-10 fleet once currently programmed deliveries of KC-46As end in 2029. All KC-10s will be retired by September.

Also in question is whether the number of aircraft purchased as part of the tanker recapitalization program will provide sufficient capacity until

the service’s Next-Generation Air-Refueling System program, known as NGAS, becomes operational.

Congress expressed its concerns about refueling capacity in mid-December with the release of the compromise National Defense Authorization Act for fiscal year 2024. Signed into law by the president just before Christmas, the bill prohibits the Air Force’s use of 2024 funding to retire a number of KC-135s within the service’s reserve components.

According to Air Mobility Command, the prohibition shouldn’t impact the command’s 2024 KC-135 planning.

“AMC plans to maintain the congressionally mandated air refueling inventory of 466 aircraft,” command spokesman 1st Lt. Peyton Craven said. “AMC will meter KC-135 retirements accordingly to maintain this number. Future [Air Force] acquisition decisions will drive the exact number of KC-135s planned to remain in service.”

Last summer, the Air Force conducted two proof-of-concept and compatibility demonstrations using contract aerial refueling services from Washington, D.C.-based Metrea and Alexandria, Virginia-based Omega Air Refueling Services. Metrea and



A KC-10 performs its final mission in 2020.

the Air & Space Forces Association's Warfare Symposium in March 2023.

The smaller buy is one of several reasons Lockheed Martin may have opted to bow out, according to Richard Aboulafia, managing director for AeroDynamic Advisory.

"You've got a competition that's always been a price shootout," he said. "You're up against a hot [KC-46A] pro-

"These aircraft are expected to have capabilities similar to a KC-46A with Block 1 installed and potentially a digital backbone capable of Advanced Battle Management System/Joint All-Domain Command and Control integration," Stefaneck said.

The Air Force awarded Boeing a \$184 million contract for Block 1 upgrades, including line-of-sight

date and to further deliveries while simultaneously building upgraded versions of the tanker if chosen for the recapitalization program, Hafer said: "We do the retrofits at another location. I think we're looking at Cecil Field near Jacksonville, so it doesn't impact the production line."

If chosen, Boeing would prefer to deliver recapitalization tankers in

blocks, he said. "Don't do a wholesale swap over of buying the next super tanker that has loads of requirements in it. Let's do it incrementally then cut that into the production line — just keep building the block upgrades to get you where you need to be."

With the Air Force's acquisition

strategy still undetermined, Stefaneck didn't comment on the idea of block deliveries. She said the service will "examine the best path forward in terms of meeting continuous, uninterrupted tanker recapitalization, and industry's ability to deliver new aircraft with specific capabilities."

Like Aboulafia, Tim Walton, a senior fellow with the Hudson Institute's Center for Defense Concepts and Technology, suggested that it will be hard for Airbus to offer a cost-competitive solution for the tanker recapitalization program.

"To provide stability for the industrial base and cost savings to the government, the Air Force should reach a sole-source agreement with Boeing to procure additional KC-46s as soon as possible, and well before the end of the KC-46A contract," he recommended.

"Assuming NGAS will be ready for procurement by 2034, a buy of 75 aircraft would ensure KC-46 could be delivered until NGAS is ready for procurement," Walton said.

The ability to procure up to 140 tankers provides the Air Force with a hedge in case NGAS takes longer to develop than desired. KC-46 procurement should continue until that aircraft is ready so that the size of the Air Force's tanker fleet can remain stable and grow, he added. **ND**



duction line. You've got the need to create a large new assembly facility here in the United States, and you're selling a more expensive plane. Oh, and you've got to satisfy the profitability requirements for two different contractors. How could you possibly come up with a competitive bid that wins?"

In the wake of Lockheed Martin's withdrawal, Airbus announced that it would respond to the KC-135 recapitalization request with a U.S. version of the A330 MRTT. But Airbus has been tight-lipped since then, declining to comment about whether it might base its offering on an upgraded version of the A330 known as the A330neo or if the tanker could include the Auto'Mate autonomous refueling system the company is developing.

Boeing, the only other firm that responded to the Air Force's request, will offer a version of the KC-46 with enhanced communications and airborne battle management systems as well as upgraded protection systems to improve aircraft survivability and "boom operator in-the-loop autonomous air refueling," according to Mike Hafer, the company's KC-46 business development director.

That aligns with Air Force requirements calling for an air-refuelable tanker derived from a commercial aircraft with minimal development.

and beyond-line-of-sight communications with anti-jamming and encryption features last March.

Hafer said that Boeing's hot KC-46 production line and its ability to quickly transition to building upgraded Pegasus tankers for recapitalization offers "the most economically beneficial solution for the U.S. Air Force."

"We'll emphasize that it's very important to keep production rolling if the Air Force decides to go with the KC-46," he said. "When the last KC-X program aircraft delivers then we want to roll right into the 135 replacement airplane."

Boeing's argument for choosing the KC-46 seems to dovetail with previous statements from Air Force leaders — including Air Force secretary Frank Kendall and Hunter — who previously suggested the service could skip a competition for the KC-135 Tanker Recapitalization Program and buy improved KC-46s.

By the end of December, Boeing had delivered 79 Pegasus tankers to the Air Force. But the KC-46 still suffers from six category 1 deficiencies including its flawed remote vision system, or RVS. Hafer confirmed that Boeing's improved RVS 2.0 is still on track for "a late 2025 delivery."

Asked how Boeing might retrofit RVS 2.0 to the KC-46s delivered to



Out of Their Element

Army to Live Off the Land in Contested Environments **BY ALLYSON PARK**

After two decades of counterterrorism and counterinsurgency operations in permissive theaters, the Army is pivoting to the Indo-Pacific, where a near-peer adversary and an expansive maritime theater present immense challenges for logistics and sustainment in a conflict.

That's why the Army and the defense industry are investing in environmental research and technology to help the service and the Joint Force conduct and sustain operations in contested and distributed environments.

While a potential conflict in the Indo-Pacific would be fought largely in the air and sea, the Army would still play a critical role providing long-

range fires and other effects for the Joint Force. Preparing for that is a key focus for the Army of 2030, Maj. Gen. Kimberly Colloton, deputy commanding general for military and international operations for the Army Corps of Engineers, said at the Association of the United States Army's annual meeting and exposition.

"To maintain a military advantage over our adversaries, we must [better] leverage and exploit faster new technologies across all domains," she said. "We know that forward-positioned ground forces, those able to converge effects from land, air, sea, space and cyberspace, can complicate our adversaries' decision-making, disrupt their actions and assure

our allies and partners."

Supplying and sustaining those forward-deployed forces will require new technologies, tactics and thinking, which is why the Army in March created the Contested Logistics Cross-Functional Team based in Huntsville, Alabama, in partnership with Army Materiel Command, as announced by Gen. James Rainey, commander of Army Futures Command.

Given the distances involved in the Indo-Pacific theater, the Army is looking to reduce what it needs to carry and increase what it can extract or rely on from the environment, which is why the Defense Department and Army are investing in research and development for alternative energy sources, water purification and geospatial data gathering.

While the service already has capabilities to identify water sources in complex environments and to purify that water to sustain warfighters, this process can be streamlined further, said Dr. Martin Page, materials engineer at the Cold Regions Research and Engineering Laboratory.

"Water supply is one of the top demand signatures on the battlefield for resupply," he said. "And as we think about moving forward toward contested logistics environments, with an increased focus on mobility and dispersion at large unit scales, we need to think about how we can reduce that [logis-

tics] tail further and give our commanders options for technologies that can increase freedom of action, operational reach and endurance."

Reducing demand and increasing production at the point of need are two key pillars of achieving a more sustainable water supply process, meaning that the Army is focusing on using each drop of water "as efficiently as possible" and on being able to produce water on the move, untethered from a water source.

"We found that water recycling or water reuse, specifically of graywater, can have a big impact in those types of environments, reducing demands by up to 50 percent in some cases," Page said. "When we think about mobile

operations, we're thinking about looking at less showering and less laundry support in those environments in our planning. And so, we need to increase our focus on being able to produce water at the point of need."

The Army, the Cold Regions Research and Engineering Laboratory and the Army Combat Capabilities Development Command Ground Vehicle Systems Center are developing the Advanced Low Logistics H₂O, or ALL-H₂O, system, a wheeled system that is focused on hygiene support, demand reduction and increasing production at the point of need through the lens of hygiene support.

"It's basically a system that can provide shower and laundry support, but it also has an onboard water recycling capability that can recover 75 percent of the water as clean water that can go back into the shower and laundry systems," he said.

The All-H₂O system was featured at Project Convergence in November 2022, and it underwent additional testing at Fort Leonard Wood in Missouri this summer, working toward reaching technology readiness level six milestones.

"We are working on the system; we're continuing to do research on increasing that water recovery beyond 75 percent. But what we're finding is that for various reasons, we're not going to ever get to 100 percent recovery," Page said. "There's always going to be some need for either resupply or point in the production, no matter how hard we try on that."

Another critical challenge in contested environments is providing power, and the Army Corps of Engineers — in collaboration with the Department of Energy, Army labs and other services and agencies — is researching fuel cells and hydrogen for alternative energy generation and storage.

Hydrogen can be used as an alternative energy storage medium, both in stationary and mobile applications. The Army has invested in a research project called H₂Rescue, a hydrogen fuel cell and battery hybrid emergency vehicle that can immediately begin exporting 25 kilowatts worth of power in an emergency.

"It replaces having to pull in additional generators," Nicholas Josefik, engineer at the Army Engineer Research and Development Center's Construction Engineering Research Laboratory, said. "This vehicle can drive about 1,500 miles on a

single tank of fuel and can immediately begin powering, just plugging in whatever items you have."

H₂Rescue can be integrated into many different vehicle platforms, and the fuel cell can even produce some usable water, he added.

The Army, in partnership with the DEVCOM Ground Vehicle Systems Center Laboratory in Michigan, is developing this fuel cell-powered system that is for both tracked and wheeled vehicles, capable of exporting power and delivering hydrogen in the field.

"It's another way to dispense hydrogen, to create power in the field and just give us different opportunities for types of energy generation," he said.

Along with H₂Rescue, the Army Corps of Engineers is also looking to generate hydrogen fuels in the field via a distributed low-energy wastewater treatment system that can harvest two different types of usable fuels, Josefik said.

"We're able to harvest methane and hydrogen, along with treating the water and having usable water," he said.

"Our researchers are leading the way and looking at, instead of spending all that energy and time just to treat our wastewater,

[harvesting] that into usable fuels and increasing our energy security, our resiliency and reducing our logistical burdens of bringing fuel in the field."

In addition to water and power solutions, the Army is exploring technology to improve overall management of logistics in contested environments. The Army, along with the Army Geospatial Center, is investing in a project called the Geocentric Environment for Analysis and Reasoning, or GEAR, to help warfighters operate more efficiently.

GEAR is a tool that provides location-based information and data, and depending on that data, it determines how certain tasks should be prioritized, said Heather Speight, physical scientist at the Army Geospatial Center.

"If you have something that's important to you, maybe three objectives that really matter, [we] put them on a

map together and then see if there's an area that seems to be the area that we want to focus on," she said.

The Army Geospatial Center is currently working with U.S. European Command to develop GEAR, she said. The service mainly utilizes GEAR to gather data on airports, seaports and large cities, as well as the larger transit network.

GEAR can also factor in climate variables, Speight said.

"When we come to climate change considerations, a climate-informed assessment may need to include flooding, it may need to include climate migration, it may [need] to include sea level rise," she said.

GEAR's ability to collect and interpret relevant climate data and its effect on future Army operations, as well as its varying effects on different domains, is absolutely crucial, Speight said.

"Environmental issues and water



issues fall into Army challenges," she said. "One of our jobs here is to come up with ways that we are going to help [the Army] wrap its arms around those requirements and really help them understand those environmental challenges in a manageable and meaningful way."

GEAR will allow the Army to integrate new information into existing workflows, which is key especially as climate change continues to alter existing environments, she said.

"The thing with GEAR is we're allowing you to take the work you already do and conduct an analysis and then add a few more variables and see if the analysis changes," she said. "In that way, we're helping to really see whether or not climate is going to change things, or if really climate didn't make that big of a difference, and we just continue with operations as normal." **ND**

VIEWPOINT

How One Army Plant Modernized To Support Ukraine

BY LT. COL. FRANK MUSISI

The Army recognizes the urgent need to increase artillery production and expedite the modernization of the organic defense industrial base.

Before Russia's invasion of Ukraine, the U.S. Army's focus was its capability to function in a multi-domain operational environment. This focus included funding efforts related to the development of a 155 mm high-explosive, extended-range cannon artillery projectile with a range of 70 kilometers.

The Army also planned a decrease in the production of the legacy M795



projectile — 22-kilometer maximum range — and replacement with the M1128 projectile, which has a 30-kilometer maximum range, for war reserve, while retaining the M795 projectile for training purposes.

The Scranton Army Ammunition Plant has been the leading source of U.S. joint large-caliber artillery metal parts for more than 60 years. Artillery shells are produced there, then shipped to another government facility in Iowa for explosive filling before being brought into the Army inventory.

The plant is a government-owned, contractor-operated facility currently run by General Dynamics Ordnance and Tactical Systems.

The Army's strategy was to modernize the Scranton facility infrastructure and production capabilities by capitalizing on state-of-the-art manufacturing equipment and technologies while maintaining the same level of hardware production.

The Russian invasion of Ukraine completely changed the dynamics of the 155 mm high-explosive munitions production strategy at the plant and its modernization pace.

The demands of the Ukrainian battlefield generated an urgent need for increasing production and accelerating modernization efforts in Scranton. The urgent need to support

the Ukrainian defense strategy with U.S. munitions forced the Army to develop rapid production strategies to increase capacity at the plant and leverage the commercial industrial base for additional sources of supply.

The primary goal was to increase capacity production for 155 mm HE, especially the M795 metal parts projectile. The M795's success in the war has made the Scranton Army Ammunition Plant one of the most important organic industrial facilities.

The urgent need to provide Ukraine with ready, reliable and lethal artillery ammunition brought an increased demand to accelerate the plant's modernization efforts along with the expansion of production capacity. But it had challenges of degraded infrastructure and legacy production equipment that had exceeded their useful life. This equipment had to be replaced by capitalizing on state-of-the-art manufacturing equipment and technologies while expanding capacity and production.

To support this, the Army was able to expedite funding to support modernization and capacity expansion. To this effect, the Army Ammunition Plant Modernization Plan was increased by 86 percent to meet the rapid modernization efforts and current war demand for fiscal years 2023 through 2029.



155 mm casings go through the heat treating process at Scranton Army Ammunition Plant, Pennsylvania.

Before the Russia-Ukraine war, the Scranton plant was producing an average of 7,000 artillery shells per month. The Army's goal is for it to produce 35,000 artillery shells per month by 2027.

Support to Ukraine has also accelerated funding and contracting. The Army is leveraging the undefinitized contract action process to expedite the procurement of equipment contract awards to support both facility modernization and rapid production capacity expansion for artillery shells.

Under this process, the Army can award 50 percent to the contractor before the contract is definitized or finalized. Under the fiscal year 2023 National Defense Authorization Act, the Army can award up to 100 percent of the contract funding for undefinitized contract actions that support Ukraine. Project Director Joint Services has leveraged this authority to fund the Scranton plant's contract actions up to 75 percent to purchase critical production equipment and urgently needed facility modernization repairs.

According to the project director, as of May 3, 2023, the Army awarded more than \$243 million to procure equipment for Scranton's production capacity increase and facility modernization in fiscal years 2022 and 2023 through Ukraine supplemental appropriations.

The equipment includes new production lines for the M1128, XM1113/XM1210 — new rocket-assisted projectiles for increased range — and for M795 capacity expansion to 35,000 artillery shells per month. The Army is also leveraging multi-year production contract awards at the facility to mitigate inflation costs in raw materials for a seamless supply chain to avoid artillery production shortfalls.

The Scranton Army Ammunition Plant's rapid capacity expansion challenge must be in sync with the total munitions requirement. Despite the need to support Ukraine's defense, senior Army leaders and Army planners must balance replenishment requirements and rapid capacity expansion to minimize high maintenance costs of unused production capacity.

The current expansion strategy is primarily driven by the urgent need to support Ukraine's war efforts and with limited consideration of replenishment requirements.

Project Manager Combat Ammunition Systems is also expanding the capacity of metal parts artillery production at the General Dynamics facility in Wilkes-Barre, Pennsylvania, which is contractor-owned and operated.

In addition, the Army has leveraged other sources of metal parts supplies from IMT Canada and authorized General Dynamics to purchase the REPKON flow forming metal parts production technology from Turkey and set up new production lines in Mesquite, Texas. These expansion activities will enable the Army's goal for a production capacity of greater than 85,000 shells per month by 2027 to be met.

The combined artillery shells monthly throughput capacity may also raise challenges when the war ends. However, capacity expansion requirement forecasts are to support the war and replenish the depleted inventory. Once the war ends, the Army will have an excess inventory on hand and excessive production capacity.

The new contracts have the flexibility to accommodate both war surge requirements and peacetime downturns with a clearly defined minimum sustainment rate. Determining that minimum sustainment rate is going to involve all major stakeholders.

The Russian invasion of Ukraine has completely changed the dynamics of government-owned, contractor-operated, and industry's rapid modernization and 155 mm high-explosive artillery production increases. The rapid production expansion strategy of the M795 and extended-range projectiles is crucial to provide freedom of action to Ukraine's commanders as they face off with the Russians.

The M795 projectiles are essential to the survival of Ukraine in the near term and will likely have a high demand among other allied countries.

Army contracts must be flexible, robust and postured for a minimum sustainment rate in peacetime. This mitigation will ensure artillery production is effectively postured for both wartime and peacetime. **ND**

Army Lt. Col. Frank Musisi is the assistant project director at Project Director Joint Services within the Joint Program Executive Office Armaments and Ammunition, Picatinny, New Jersey.

VIEWPOINT
BY MARK NEICE AND
REBECCA WOSTENBERG

Securing Directed Energy Weapon Supply Chains

Directed energy weapons have emerged as potentially transformative technology on the modern battlefield.

Recent advancements have made high-energy lasers and high-power microwaves more capable than ever, with many systems possessing the power and range necessary to engage a wide variety of threats more affordably than current systems.

At the same time, the current conflicts in Ukraine and Israel have shown the importance of affordable munitions capacity and the need to counter different kinetic threats, specifically the proliferation of armed unmanned aerial systems.

Given their tremendous potential, the Defense Department should work to transition these weapons from the laboratory into the hands of warfighters. However, a critical component to doing so is ensuring secure, healthy and resilient supply chains to support their deployment at scale.

As such, the National Defense Industrial Association's Emerging Technologies Institute undertook a study to assess the state of directed energy weapon supply chains and provide policy recommendations for their development, health and resilience. The final report was published Jan. 23.

The study concluded that current directed energy weapon supply chains, including critical raw materials, the manufacturing base and workforce, and testing infrastructure are incapable of supporting the technology's deployment at scale. Current supply chains are only able to produce small quantities of systems with long lead times.

While addressing supply chain vulnerabilities is a formidable task, it is not insurmountable. A series of concrete steps by government, industry and academia is necessary to fortify these supply chains and fulfill the potential of these cutting-edge technologies.

The most important step the

Pentagon can take to secure directed energy weapon supply chains for the future is to clearly articulate their strategic goals, transition appropriate weapon systems to programs of record and use multi-year contracts to send an extended demand signal. Without a clear and sustained demand signal from the military — and therefore a return on investment — industry is hesitant to make the investments necessary to have secure, healthy and resilient directed energy supply chains.

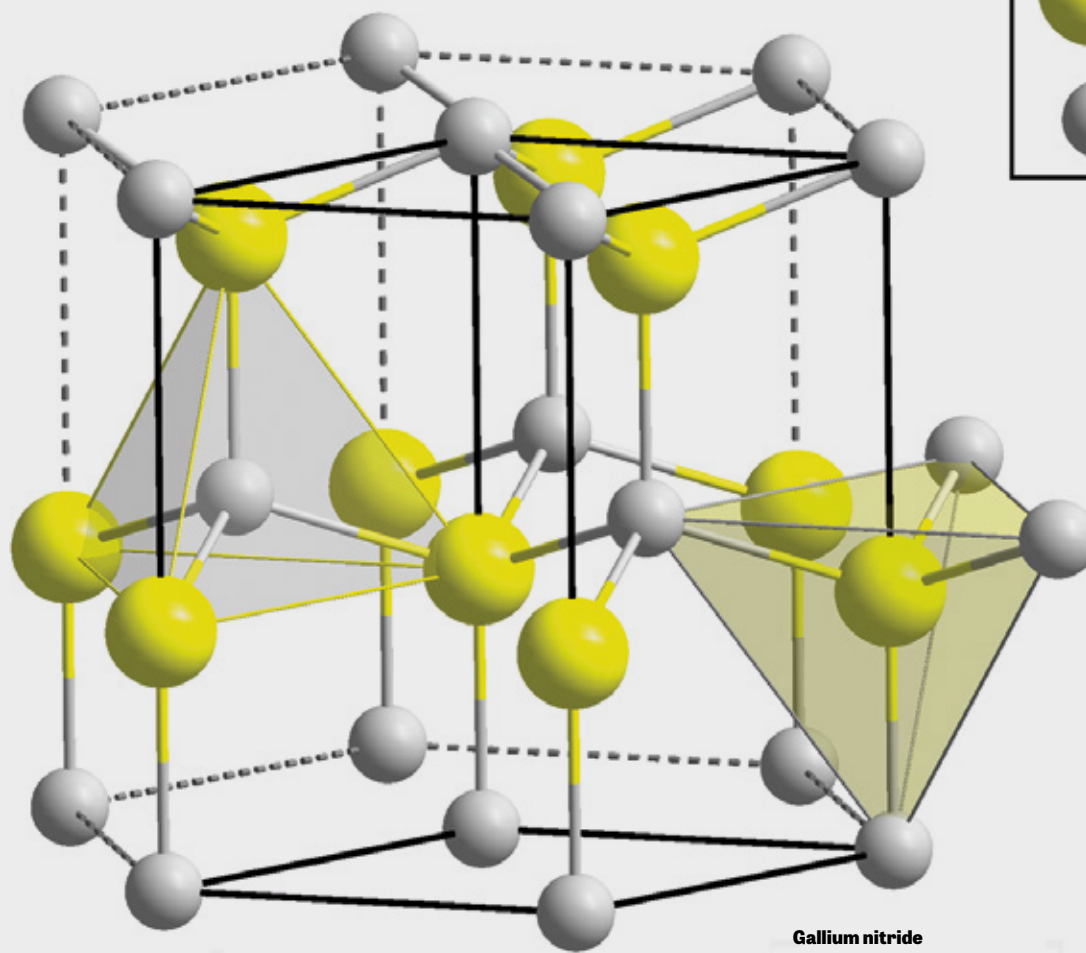
Current supply chains have several vulnerabilities when it comes to critical raw materials and goods, notably the supply of germanium, gallium and rare earth elements — all of which are largely dominated by China.

To address these vulnerabilities, the report outlines several recommendations, including adding gallium to the National Defense Stockpile, developing domestic gallium nitride production capabilities and Defense Department investment in synthetic alternatives to the most vulnerable materials needed for the technology.

As noted earlier, the current directed energy manufacturing base can only produce small numbers of systems with long lead times. Efforts to scale up production would quickly encounter issues, including producing optical components, beam directors, batteries and the regulatory regime governing above-the-horizon testing.

Key recommendations to address these issues include establishing directed energy programs of record that provide clarity on future demand, standardizing and defining requirements for the systems, components and testing and harnessing commercial technology whenever possible.

The current directed energy workforce is insufficient to support scaling up production. Interviewees highlighted optical coatings, high-power optics and energy production and storage as three specific areas facing the greatest shortages. As such, the department should expand existing workforce development efforts by establishing a Directed Energy University Consortium with the specific goal of creating a strong



workforce to meet future needs.

The directed energy supply chains face several key security issues and vulnerabilities. While the overall financial health of directed energy companies is relatively stable, the failure of even a single company could have severe repercussions. Limited suppliers exist throughout the supply chains but especially in beam directors, adaptive optics, optical coatings, specialty optical fibers, beam dumps, ceramic laser materials and fused silica.

To mitigate these risks, the Defense Department should consider using artificial intelligence to anticipate potential supply chain failure points, the development and prioritization of overlapping components for directed energy weapon systems between different programs and conducting regular, in-depth analysis of the financial stability and security risks of companies involved in the supply chain.

International partnerships and allied nearshoring present potential avenues for diversifying directed energy critical material sources and enhancing testing capabilities. However, barriers including overclassification and restrictive export controls often impede international collaboration.

As such, Pentagon leaders should designate the Joint Directed Energy Transition Office as the office of primary responsibility for international collaboration on the technology. At the same time, the Defense Department should work with Australia — which has existing directed energy testing infrastructure — to help increase U.S. testing capabilities.

Finally, given Israel's Iron Beam program, the United States should work with the Israeli Ministry of Defense to identify opportunities where the two nations can combine demand for key directed energy subsystems and components, while ensuring security measures to protect sensitive information.

If implemented, the recommendations in this report could help enhance the resilience, health and security of directed energy supply chains in the years to come. Directed energy weapons have long been considered the "weapon of tomorrow" and will remain so unless action begins today. **ND**

Mark Neice is the director emeritus of the Directed Energy Professional Society. Rebecca Wostenberg is a research fellow at NDIA's Emerging Technologies Institute.



An Air Force staff sergeant logs data in a cargo movement operations system.

Crystal Ball

Pentagon Harnessing Data for Predictive Logistics Planning **BY LAURA HECKMANN**

O KLAHOMA CITY — “Logistics wins wars” is an age-old adage, but its application has evolved from logbooks and spreadsheets to data streams and analytics. The Defense Department now wants to harness these new practices to predict the future.

Christopher Lowman, assistant secretary of defense for sustainment, described predictive logistics as a method of utilizing data generated across various platforms — something the Defense Department has no shortage of — to better understand what tools need to be employed to turn data into actionable logistics decisions.

“It’s all about regenerating readiness and pushing the capability to satisfy demand closer to the point of need within the theaters of operation,” Lowman said at the National Defense Industrial Association’s recent National Logistics Forum.

Army Gen. Charles Hamilton, commanding general of Army Materiel Command, said precision and predictive sustainment means “not only knowing when, where and how much a unit is using something like ammo [or] water or maybe certain parts, it also means knowing precisely where and when, and how much of a commodity that you will need in the future.

And the key is getting out in front.”

The ability to predict is also the ability to stay steps ahead of an adversary — one that requires “that we go into the next fight” with a “data-informed decision-making process,” Hamilton said.

The “crystal ball” of data analytics is taking all of the data gathered across the government and industry and analyzing and interpreting meaningful patterns. Hot button solutions like artificial intelligence and machine learning are tools that can help but need to be recognized as such — tools, and not the ultimate salvation, participants at a forum panel discussion suggested. The fundamental input is the data they rely on.

Kevin Gaudette, a retired Air Force colonel and senior vice president of integrated analytics and support at LinQuest, said AI and machine learning are, just like optimization and simulation, “tools — and they’re reliant on data. We throw these buzzwords out, everybody gets excited ... and starts asking for things that they don’t even know what they’re asking.”

The question needs to be, “What is it that you’re trying to do?” he said. “Let’s start with your understanding of what it is. Because [AI and ML] may not be the answer. In a lot of cases, it’s not.”

But sometimes it is.

Marine Corps Maj. Gen. Keith Reventlow, commander of Marine Corps Logistics Command, called artificial intelligence and ChatGPT “awesome tools.” While they may be associated with cheating on term papers, the concept of “going through every source that’s on the internet on [a] subject, comparing it all and giving you an answer” could be revolutionary for logistics, he said.

“What if we could do something similar when we think of sustainment, and understanding our weapons systems, understanding predictability of conditions-based maintenance,” he said, such as predicting time between failures, “and give the commander the option of changing it out before it actually breaks. I think there are all kinds of opportunities we are working on to try to understand how we are going to leverage data using those tools.”

AI and machine learning are just a few tools across a broad spectrum of projects and research underway across the Defense Department to better understand how to leverage data.

One such effort is the Defense Logistics Agency’s Joint Additive Manufacturing Model Exchange, or JAMMEX — a tool that consolidates technical data packages and allows users to

download and print models from multiple sources through a single system.

Adarryl Roberts, chief information officer for the Defense Logistics Agency's information operations, highlighted a program building on JAMMEX called the Digital Sustainment Platform, "to not just be able to take the technical data packages, but also create a single platform where all our engineers ... and digital twins can reside department-wide in order to get that efficiency" across combatant commands and the services.

Other DLA efforts include Digital-Business Transformation and a Warehouse Modernization Project, Roberts said. These efforts are buying down on what he called 20 years of technical debt, saying the department "got left behind in terms of ... our ability to be flexible and have agility to move with technology."

The Army last year stood up its Contested Logistics Cross-Functional Team, which Hamilton said "will never go away because it's integrated with everything else that we're doing." Part of the team's "very narrow problem set" is precision and predictive sustainment, he said.

Air Force Materiel Command launched its Digital Materiel Management initiative last year — an effort to integrate and employ digital methods across the entire capability lifecycle, from invention to retirement, leveraging digital tools, structured data and security.

Jim Sutton, senior director of strategy at Shipcom Wireless, said a recent kickoff event for the initiative involved conversations about the "idea of creating organizational constructs and aggregating data and identifying all the risks and setting up teams to reduce the risks," but a near-complete absence of conversations around zero trust.

Zero trust is a Defense Department security framework that assumes a "never trust, always verify" mindset. Trust around data sharing is a well-documented hesitation between government and industry, and another speed bump on the way to effectively harnessing data analytics.

While there are many "underlying uncertainties" with data sharing as industry and government intersect on the delivery of capabilities, Sutton said the primary point

of entry from a service leadership standpoint should be to press the implementation of the White House's 2022 zero trust memorandum, which requires agencies to meet specific cybersecurity standards by the end of fiscal year 2024.

"If that were in place, essentially 90 percent of all of the discussion around risk evaporates," he said. "And as a result of that, we would then focus on places where risks really matter in terms of getting to that actionable, decision-worthy information at the point of use."

Aaron Jaffe, head of supply chain and logistics at Palantir Technologies, said data linkages between industry and the Defense Department need to be thought of in the broader community of the industrial base "as inputs that are limiting factors to how the DoD can operate as well as being able to integrate and work with our allies and partners in any decision that we're making."

The question becomes how to better understand the gaps and the seams, and the technology that will protect security while enabling seamless interoperability "across that much larger community than what we would historically look at," he said.

The gaps present "tremendous challenges," but not unprecedented ones, he said. The COVID-19 vaccine accelerator Operation Warp Speed and support to Ukraine are examples of industry and government collaborating on rapid timelines and "moving at the pace of conflict."

A core enabler across those efforts — and one that industry needs now — is a clear sense of mission, he suggested — "a clear purpose and objective ... is incredibly helpful and enabling for both us as an individual company but also for how we work with others and build on that approach that's open and interoperable. You can leverage existing programs and new technologies that can help increase the pace of change across the DoD."

While trusted data is crucial, the Defense Department also needs to get comfortable with dirty data, one industry representative said.

Justin Woulfe, chief technology

officer at Systecon, said achieving perfect data is likely impossible, and while a noble and necessary pursuit, the department needs to accept some risk as well.

"What we really need to do is actually just start doing analytics," he said. The idea of dirty data is "fascinating," but not a hindrance, he added, suggesting no major acquisition program has perfect data, but can still use "data as dirty as it is today" to predict mission capable and full mission capable rates within 3 percent of what it set out to achieve.

Pristine data is ideal, but "it's not an excuse to not do analysis," Woulfe said. "So, the idea that we can't start doing anything until we get perfect data is nonsense. When we think about contested logistics, we're planning for things that are unknown. ... So why do we expect to need to have a perfect viewpoint of our maintenance data or supply transaction history?"

Fuzziness is a certainty, he said, "but I think there's this analysis paralysis that happens where the idea of, 'We must know everything before we can start' needs to be tossed to the side and just use the analysis, use the process of analytics, to learn more about our systems ... and [accept] that [there are] some things that we don't know perfectly and then move on from there and apply the risk and understand the risk and make decisions."

Gaudette said for the first time "in a long time, we've got integrated strategy documents, and we've got integrated architectures, we just still don't do data — it ends up going in a million different directions. So we have lots of pockets of excellence, but not an integrated solution still to this day."

The ultimate solution may not exist, but the Pentagon is looking, and Sutton said that is the most important thing: "get started."

Utilizing data to make informed, predictive decisions means putting tools in the hands of operators, he said, and "the more you do it, the better you are at it. ... And the more we encourage our people to try using it in a space that is useful to their job, the more ubiquitous it will become — the easier it will be to adopt." **ND**





Transcom's 'Game-Changer' Management System Moves Forward

BY LAURA HECKMANN

O KLAHOMA CITY — Transportation Command's Joint Transportation Management System — a visionary concept conceived nearly a decade ago to unify hundreds of fragmented transportation and financial systems across the Defense Department — will move to a request for proposal later this year, Army Lt. Gen. John Sullivan, Transcom deputy commander, said at the National Defense Industrial Association's National Logistics Forum recently.

The Joint Transportation Management System, or JTMS, program officially began in 2022 after years of gap analysis, and the effort is taking "a veritable smorgasbord of systems — some transportation, some financial, most of which don't talk to each other — and bringing this universe together," he said. There are currently 280 systems being

used for various transportation purposes throughout the department.

Typically, conversation around optimization has assumed it comes at the expense of effectiveness, Sullivan said. "I believe now that's a false choice. I think you can optimize for efficiency, and thereby, effectiveness. And that's what we're attempting to do with the Joint Transportation Management System."

The system will also improve auditability, something "many in the department continue to struggle with — to be able to trace a requirement from origin to payment, and to have complete visibility at each segment of the transportation network, and what somebody is spending — we're not there, but that's what we're trying to get at," he said.

The past year has been heavy with grunt work such as process mapping, documentation and

systems architecture, work he said is "well along," he added.

Transcom delivered the system's acquisition strategy to the Defense Department in early February, and expects "solicitation in the relatively near future, this year." The program is eyeing a 10-year, single-award indefinite delivery, indefinite quantity contract, and a planned award date within the second quarter of 2025, he said.

The program has "a lot of steam behind it," across all services, the Defense Logistics Agency and "multiple organizations throughout the department," he said.

"I don't want to oversell it, but it is a game-changer," Sullivan said. "We're on the right path right now and looking forward to moving to an RFP ... a little later this year."

A procurement forecast placed the system's projected value range between \$25 million and \$49 million. **ND**

COMMENTARY

Defense Industrial Base Needs to Secure Trusted Supply of More Than Chips BY DAVID SCHILD

Every industry that makes modern life possible relies on a microelectronic stack consisting of computer chips, substrates and printed circuit boards, or PCBs.

Nowhere is this more prevalent than in the defense industrial base. Everything, from night-vision goggles to F-35s, relies on multiple microelectronics.

Most of the manufacturing and know-how for PCBs and substrates left U.S. shores many years ago and migrated to countries with low-cost labor and significant government subsidies.

While this may have been a good financial strategy for the short term, the long-term consequences have been grave. U.S. national defense and economic security are at risk because the nation relies so heavily on adversaries and geopolitical competitors for the technologies that buttress military systems.

Congress recognized this issue with semiconductors and last year — after almost five years of deliberation — passed the CHIPS and Science Act. Lawmakers raised the alarm because the U.S. share of the world's supply of chips had fallen to just 13 percent.

What was lost in the legislative process was the rest of the microelectronics stack: substrates connect a computer chip to a printed circuit board, which in turn connects to an electronic device. Chips don't function without those two components. And if we thought 13 percent was an alarming statistic, the numbers for PCBs are even scarier. We now make only 4 percent of the world supply of PCBs and less than 1 percent of the substrates.

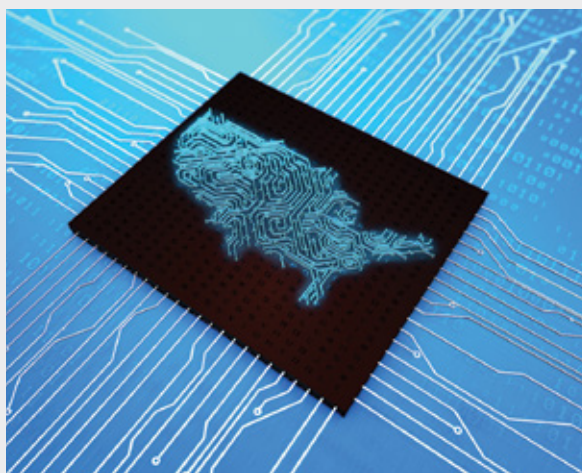
What this means is that most of the new U.S. chip fabrication facilities being built with CHIPS Act funding



and the private investments that followed will produce chips that will be shipped to Asia to be packaged with substrates and printed circuit boards.

Without creating a more robust manufacturing capability for PCBs and substrates, the CHIPS Act is not improving the security and resiliency of our supply chain.

Beyond the logistical challenges of shipping microelectronics back and forth across the Pacific is the matter of security. The microelectronics that power national security systems and critical infrastructure must be trusted and secure. With 90 percent of the world's PCBs being made in Asia — 56 percent in China and 13 percent in Taiwan — along with almost 100 percent of the substrates, there is risk of bad actors adding unwanted “phone home” and “kill switch” capabilities that would allow them to interfere with the most sensitive national defense and infrastructure systems.



Not all microelectronics require such rigorous vetting and trust. Having a long supply chain works for garage door openers and toasters, but it is unacceptable for national defense systems and critical infrastructure.

Fortunately, many of the most sensi-

tive microelectronics for the defense industry are made in America, but most of the second- and third-tier suppliers of commercial-off-the-shelf components come from Asia, and more than half come from China alone.

That latter point is addressed in the National Defense Authorization Act. By 2027, Congress will require the Pentagon to have a plan to remove microelectronic components made in China, Russia, Iran and North Korea. The year 2027 may sound like a long way off, but accomplishing what Congress is mandating will be a significant pivot for many large original equipment manufacturers.

In addition to sticks, there are also important carrots in play. The Defense Department has begun distributing funding through the Defense Production Act. Several companies have announced plans to invest in additional capacity. But more is needed.

It will take years for the domestic microelectronics industry to scale up to decrease reliance on other nations. That is why the Printed Circuit Board Association of America has been advocating for H.R. 3249, the Protecting Circuit Boards and Substrates Act, which would provide \$3 billion for research and development, facilities and workforce development and a 25 percent tax incentive for companies buying American-made printed circuit boards and substrates.

The association also promotes a healthy Defense Production Act budget to address increasing domestically sourced microelectronics. Just as the CHIPS Act funding attracted private investment, the Protecting Circuit Boards and Substrates Act would likewise energize an industry that has shrunk to its current unacceptable state.

National Defense Industrial Association member companies and suppliers have a major stake in this industry, and we hope they will join the Printed Circuit Board Association of America in supporting legislation and policies that bring the microelectronics ecosystem back in balance.

The United States needs reliable, secure and trusted sources for the microelectronics ecosystem to protect national and economic security. **ND**

David Schild is the executive director of the Printed Circuit Board Association of America.



New Manufacturing Process Boosts Military Semiconductor Efficiency

BY ALLYSON PARK

Northrop Grumman's Space Park foundry

BALTIMORE – Northrop Grumman is utilizing a new patented transistor technology to improve the speed and efficiency of designing and manufacturing semiconductors for its military customers.

Super-lattice castellated field effect transistors are a circuit technology that use gallium nitride to boost performance levels of semiconductors by implementing “filters, switches and components that are inside of a multi-function sensor” and have very low insertion loss and a smaller footprint, Vern Boyle, vice president of Northrop Grumman’s Microelectronics Center, Mission Systems, said during a recent media event.

The transistors allow future systems to operate equally efficiently with a significant reduction in insertion loss — or the loss of a transmission signal — meaning fewer chips are needed, less data is lost and higher frequency abilities are enabled because of those features, according to the company website.

Using this transistor technology “allows us to get the size, the weight, the power and get the performance [of our] semiconductors up,” Boyle said. “This is a computing wafer, so we are building a lot of new technol-

ogy around superconducting electronics — that is, electronics that [operate] at near zero-degree temperature, very special materials.”

About half of the wafers — or thin slices of semiconductor — that Northrop Grumman processes in its Baltimore, Maryland, facility are designed for multi-function sensing, and the other half are designed for computing. Using the new transistor device improves the efficiency and lowers the overall footprint of manufacturing multi-function semiconductors while maximizing performance and lowering their size and weight, Boyle said.

Northrop Grumman has two internal semiconductor foundries, one in Redondo Beach, California, and the one in Maryland. Each location is focused on different materials and applications: the California foundry mostly manufactures chips for space applications, and the Maryland foundry focuses mainly on airborne applications and advanced computing technology.

The Maryland foundry uses a “low volume, high mix” approach to chip manufacturing. Commercial microchip fabrication plants, or fabs, make “millions of chips,” Boyle said.

“We need lower volume, purpose-

built chips. ... The high mix refers to the variety of materials that we work with,” he said. “A commercial fab might make one or two products. We make 90 products across our fabs. They might work with a small mix of materials. We work with a high mix because we’re driving those 90 products into over 60 different programs and systems across Northrop Grumman.”

When it comes to designing and manufacturing products for the military — especially electronics — the government’s unique and specific requirements must be addressed all the way down to the semiconductor level, Boyle said.

One application is for radars with wide bandwidths and high frequencies, he said. “When you look at the front end of a tactical fighter, there’s not a lot of space, so size, weight and power become really important. And how we build and design those custom chips

drives the performance of the mission systems that they go into.”

Northrop Grumman is using digital tools and spurring a digital transformation on the semiconductor level through the design process and product lines, Boyle said.

The company uses digital modeling and twins to “design the chip, understand how it integrates up to the next packaging level up onto the board level, up into the chassis level, so that when [we] make these custom build parts, we can get it right the first time, and that reduces the cost and reduces the schedule,” he said.

On the production side, the company integrates product data into a digital thread and uses automation and robots to ensure improved assembly line efficiency.

“All the data and all the information that tracks that [chip], from the wafer to the aircraft, is all part of that digital transformation thread,” Boyle said. “[If] you’re running a test, and you find something isn’t working, and it’s isolated down into the electronics, we can trace it all the way back to the process that was used — the day, the hour it was manufactured. ... We can do that very fast because all that data is integrated as part of the digital thread.” **ND**

COMMENTARY

On Defense Electronics, U.S. Just Past Square One

BY CHRIS MITCHELL



The good news is that U.S. government leaders are taking the important first steps in rebuilding America's electronics industrial base.

The tougher news to swallow is that the United States — having laced up its shoes and selected a new route — continues to waiver on whether it's committed to the long journey ahead. The commitment of \$52 billion to the semiconductor industry without any meaningful plan to build up the broader electronics industry exemplifies the schizophrenic approach to promoting innovation and manufacturing.

Without greater resolution across government to strengthen the domestic electronics manufacturing base, the nation is likely to find itself building the most cutting-edge chips but not the most cutting-edge systems. Having the capability to build these systems is central to long-term innovation, economic competitiveness and national security. This fact is well-understood by countries racing ahead even as the United States continues tying its laces.

The U.S. electronics manufacturing industry is no longer the leader it once was. Global competitors have outpaced the United States in expanding their capacities and capabilities. The erosion in the U.S. industry has transpired over two-plus decades and in full view of policymakers who have been flatfooted in their response.

Much has been written about the strategic significance of the CHIPS for America program and for good reason. It holds the potential to catalyze U.S. chip fabrication and packaging, ensuring that the nation is just as good at manufacturing semiconductor components as designing them. Achieving this goal will be far more difficult than merely handing out government awards. After all, the United States is seeking to cultivate an industrial ecosystem for the manufacture of the latest chip technologies; but some elements of that ecosystem — such as integrated circuit substrate

fabrication — have never been done in the United States.

It makes sense that policymakers are deliberative on how best to allocate CHIPS funding, but progress is being made. To cite a few examples, the Department of Commerce is weighing applications for incentive grants; the National Semiconductor Technology Center is being stood up to oversee R&D; a national vision for “advanced packaging” has been released; and the CHIPS Research and Development Office has issued a pair of notices that it plans to invest at least \$500 million in R&D in the electronics ecosystem.

But just as we shouldn't understate the strategic importance of the CHIPS Act, we should not overstate it. The act is best understood as the first response in policy triage. Government leaders belatedly assessed the risk of a degraded electronics manufacturing base to future U.S. leadership in global tech innovation. They decided that bolstering the semiconductor industry was the most important and immediate strategic priority.

Prioritizing chip manufacturing was a defensible call given the global race for semiconductor leadership. Less defensible is the lack of any real plan to bolster the rest of the electronics manufacturing ecosystem. Semiconductor chips don't work on their own; they only gain functionality by being interconnected with other components on printed circuit boards.

But electronic interconnection is a capability that has been marginalized in the United States, which helps explain why U.S. semiconductor advanced packaging capabilities are so weak and why it is difficult to source a domestically manufactured printed circuit board for the most cutting-edge semiconductor chips.

Going forward, industry and government must follow through on what is becoming their most ambitious collaboration ever — revitalizing U.S. electronics manufacturing. Achieving this ambitious goal is far more difficult than bolstering one segment of

the industry, but it's highly meaningful in furthering U.S. strategic interests.

At IPC — the global electronics trade association — we refer to this approach as “silicon to systems.” It's not enough to manufacture semiconductor components; the U.S. must also be able to manufacture intermediate systems and end systems. An end system, after all, is what the customer buys.

Yet, decades of offshoring resulted in a mass migration of both bare printed circuit board manufacturing and electronics assembly to Asia. In the 1990s, for example, more than 2,000 U.S. printed circuit board manufacturers commanded more than 30 percent of global production. But today, there are fewer than 150 of such manufacturers, and their collective share of global production is just 4 percent.

As the Defense Department allowed its expertise and engagement in the electronics industry to atrophy, the smaller defense budgets of the 1990s and the exploding, cutthroat global electronics marketplace placed severe cost pressures on electronics manufacturers, launching an outsourcing trend. Defense contractors began outsourcing work they had done internally, and the department dropped many military-specific standards, adopting the reliability inherent in commercial electronics when possible.

The rise of “original design manufacturers,” which take product specifications from companies and then design and build product at lowest cost, also accelerated the offshoring of electronics manufacturing.

The shrinkage of market share and profit margins undercut the domestic industry's ability to innovate. And defense decision makers became cut off from electronics manufacturers, who were increasingly managed through defense primes and second-tier suppliers.

The 25-year history of Defense Department disengagement with the electronics industry is especially worrisome today as global conflicts and tensions threaten another upset of the global economy. The United States and its allies are working to prevent wider wars in Ukraine and the Middle East and to avoid the escalation of hostilities in East Asia. Just imagine the situation that would have arisen if any of these military conflicts had erupted in 2021, when the United States had only a few weeks' worth of electronics on hand.

Fortunately, there are glimmers of

progress apart from the CHIPS for America program and its success in stimulating investment in domestic semiconductor fabs. In the spring of 2023, President Joe Biden issued a formal determination that printed circuit boards are essential to national security, and he called for using Defense Production Act authority to stimulate investments in advanced production. Over the last year, Commerce Secretary Gina Raimondo repeatedly expressed the need to invest in more than just chips, including circuit boards and more. The CHIPS program's guiding documents envision future investments in related sectors of the electronics ecosystem.

Within recent months, the Defense Department has awarded more than \$80 million to domestic printed circuit board companies that are moving into producing advanced integrated circuit substrates and related capabilities.

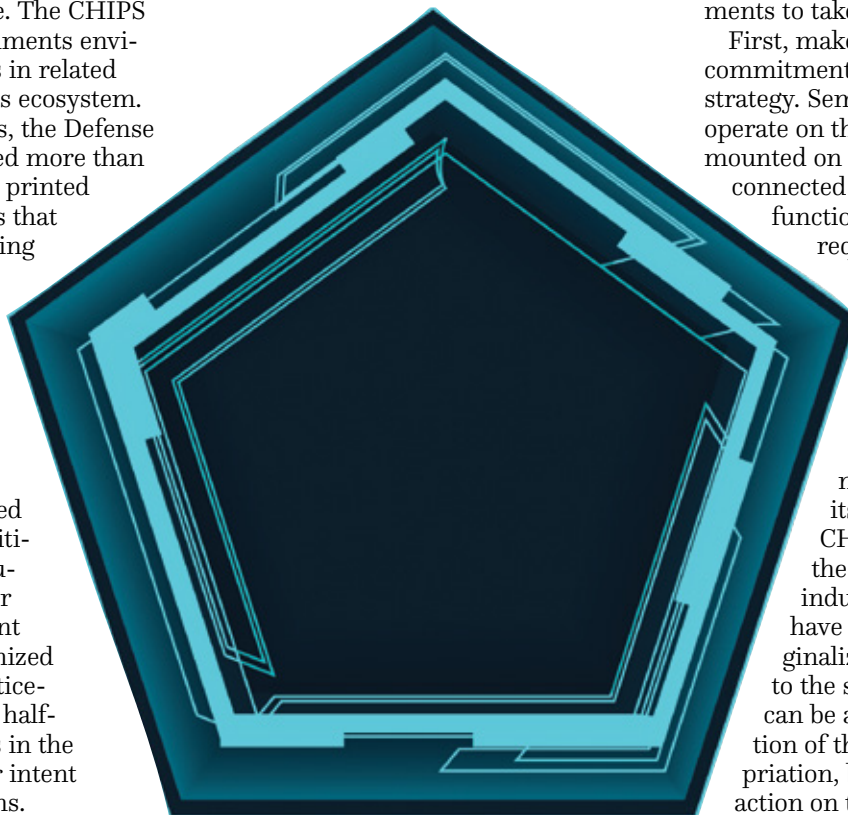
Meanwhile, the electronics industry is also expanding its workforce education and credentialing programs because the skilled workforce is another critical element of the manufacturing ecosystem. For example, the Department of Labor recently recognized IPC's "National Apprenticeships Standards," and a half-dozen major companies in the field have signaled their intent to expand such programs.

The House of Representatives is considering two bills — H.R. 6655 and H.R. 6858 — that seek to bridge the skills gap by providing more funding for adults and dislocated workers for skills development, including allowing Pell Grants to be used for training that leads to industry credentialing. Members of Congress on both sides of the aisle have offered an array of additional ideas including allowing the use of 529 savings accounts to pay for industry-backed credentials.

Across the pond, the European institutions also are acting, having last spring enacted the European Union Chips Act and last fall established a public/private body to manage an array of research, development and innovation projects at the EU level. The European Commission's Directorate General for Internal Market, Industry, Entrepreneurship and SMEs

has been responsive to our call for a strong silicon-to-systems approach.

All that progress is welcomed and needed. And yet the United States remains highly dependent on foreign suppliers of circuit boards, substrates and advanced packaging — even more dependent than it is on foreign sources of semiconductors. There needs to be a silicon-to-systems approach in long-term reality, not just in plans.



For example, there is not yet a clear plan for implementing President Biden's directive on printed circuit boards, and Congress last year hit the brakes on Defense Production Act appropriations citing significant backlogs of unobligated funds.

However, in the months since then, the Manufacturing Capability Expansion and Investment Prioritization directorate has successfully awarded hundreds of millions of dollars in projects. In 2023, the Defense Department made 22 awards valued at more than \$714 million through the Defense Production Act. Two of those awards were for printed circuit boards and substrates, totaling roughly \$85 million.

With prior year funding all but exhausted, the department is now in a "hurry-up-and-wait" holding pattern until appropriations are enacted.

Unless the United States and its allies act quickly and make a clear commitment to the "ecosystem" approach to electronics, the growing supply of advanced silicon chips made in government-funded fabs in North America and Europe will still need to be shipped to Asia, where several nations have built robust ecosystems for packaging and electronics assembly.

To overcome these risks, the electronics industry is calling on the United States and allied governments to take the following actions.

First, make a clear, unambiguous commitment to a silicon-to-systems strategy. Semiconductor chips don't operate on their own; they must be mounted on circuit boards and interconnected with other components to function. More advanced chips require more advanced components and assemblies, and the West has only limited capabilities and capacities today.

Second, the CHIPS Program Office at the Commerce Department should make clear its intentions about using CHIPS funding to support the printed circuit board industry. Mixed messages have served to further marginalize an industry that is key to the success of the act. Much can be achieved with a fraction of the total CHIPS appropriation, but it requires affirmative action on the part of Commerce.

Next, Congress needs to provide robust funding for Defense Production Act accounts to stimulate investments in production. The Defense Department needs to leverage these funds broadly to support circuit board manufacturers.

Finally, building a "semiconductor" workforce is an inherently flawed notion. We need a robust workforce from silicon to systems.

Governments should support industry efforts to build career pathways with stackable, portable and industry recognized credential programs. Workers in our industry have shared knowledge and seek portability not just from one company to another but from one industry segment to another, an option that strengthens resiliency. **ND**

Chris Mitchell is vice president of global government relations at IPC.

Enabling Logistics in Contested Environments

The Defense Department has enjoyed decades of military supremacy. Because adversaries lacked the capability to target U.S. and allied forces and supplies in transit to a theater of operation, the military has conducted unobstructed deployment and resupply activities. Today, China has been identified as the “pacing threat,” ending the era of uncontested logistics.

The Joint Chiefs of Staff recognized the need for the department and each military service to modernize to meet this new challenge, leading to the creation of the Joint Warfighting Concept — a threat-informed operational document detailing how the Joint Force will operate and fight cohesively across all domains.

Contested logistics — a key tenet of the concept — describes a problem set, including increased threats to supply chains, reduced mobility and the need to operate in a resource-constrained environment.

To contribute to the conversation, the National Defense Industrial Association’s Emerging Technologies Institute recently released “Enabling the Joint Warfight.” The report is based on several panel discussions hosted by ETI that focused on the capabilities and technologies necessary to address the operational challenges that the concept describes. The panels focused on building flexibility in logistics, plans and operations to ensure that the warfighter remains sufficiently supported during a future conflict.

To increase resiliency, the Defense Department must address key technical challenges. Tangible benefits will arise by improved data management, shortening the decision cycle time and building resiliency into command and control.

To plan for and adapt to logistics failures, data will need to be collectively visible to the Joint Force. Service stovepipes inhibit data management, which affects how the services coordinate delivering supplies such as replacement parts. There are several initiatives by the Joint Staff Logistics Functional Capabilities Board to understand how the services are gathering their data.

While there is some improvement in coordinating needs such as fuel, trans-



parency and data-sharing between the services remains an uncomfortable but necessary step for supply chain visibility, interoperability and the development of artificial intelligence solutions for data management.

Better data management will also enhance the department’s ability to embrace digital engineering. Models, structured data and infrastructure are key to revolutionizing how the services approach the acquisition materiel life-cycle. In fact, ETI is working with the Air Force and Army on adopting digital materiel management capabilities to help facilitate collaboration between industry and government. For logistics, these processes will enable automated, data-driven decision-making, which will help proactively address issues, including diminishing manufacturing sources and materiel shortages.

The Defense Department’s ability to automate — or otherwise speed up — decision-making will be a key enabler of resilient logistics. This would allow commanders to make faster threat assessments and ensure logisticians can provide multiple materiel options in real-time. Machine learning tools can help support decisionmakers with analysis, namely network modeling, decision optimization and advanced pattern recognition — all of which will help the military respond more dynamically to a fast-paced battlespace.

The cyber and space domains play an integral role in the department’s ability to command and control, where increasing resiliency will be accomplished vis-à-vis distributed control.

The Joint Requirements Oversight Council is working to identify capabilities through experiments like live exercises, wargames and tabletop exercises. Operating successfully in a contested environment entails using different nodes, routes and distribution platforms.

However, combat is becoming so complex that it has begun to render live exercises insufficient for making informed decisions. Among the greatest needs is to invest in modeling and simulation experimentation tools to support the development, integration and transition of next-generation contested logistics solutions such as autonomous systems and additive manufacturing.

Lastly, the Defense Department will need to continue to enhance intra-agency, commercial and international relationships to create new ways of delivering fuel and supplies to the front lines. Access is key in a future conflict in the Indo-Pacific. By partnering with commercial industry, it can leverage shipping lanes and ports to build resiliency in its logistics operations.

At NDIA’s Emerging Technologies Conference in August, Defense Logistics Agency representatives noted their inventory managers are working with industry to support surge capacity and increase supply chain resiliency. The Defense Department is also seeking to establish agreements with international allies and partners in the region for needs such as airfields or distribution networks on the ground.

The department has identified last mile delivery as a current shortfall. Ultimately, harnessing commercial and international partner logistics capabilities will be crucial to solving infrastructure, force posture and delivery gaps.

While the Joint Warfighting Concept was created to prepare for a potential conflict in the Indo-Pacific, the modernization changes it calls for will lead to benefits that are applicable to every combatant command. Capabilities such as faster decision-making loops and route optimization will give the Defense Department the agility to succeed in any 21st century fight. With these kinds of sustained investments, it can ensure it will operate effectively in contested environments by using its personnel and equipment as efficiently as possible. **ND**

Alan R. Shaffer served as deputy undersecretary of defense for acquisition and sustainment. Wilson Miles is an associate research fellow at NDIA’s Emerging Technologies Institute.