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Army's Newest Truck Hits the Road

AI Systems Vulnerable to Attack

ROBO-SHIPS

The Navy's Grand Ambitions for Unmanned Vessels

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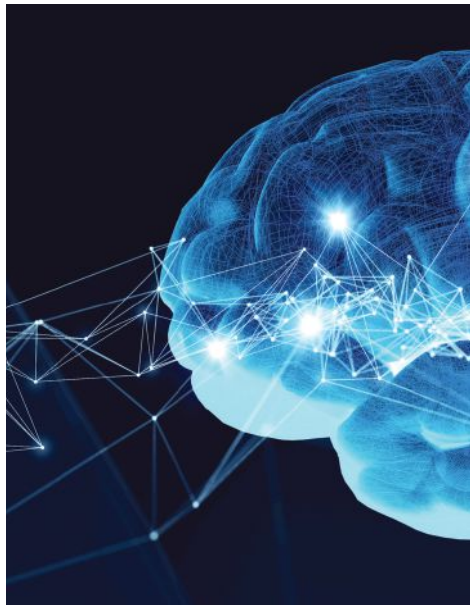
Cover Story 26

The Navy wants to develop and deploy large numbers of unmanned surface and underwater vessels. But there are more questions than answers, and critics of the service's plans abound. **Cover: Leidos photo**

Army Vehicles 24

The Army's newest truck — the Infantry Squad Vehicle — is on an accelerated pace for fielding. The GM Defense-produced platform will be put through its paces this year.



Artificial Intelligence 38

Strategists are beginning to grasp that AI can be attacked, manipulated or spoofed and must be protected — just like many other weapons systems.

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DEFENSE

The Biggest Risk Is Not Taking Risk

"The perfect is the enemy of the good enough." Fortunately, a close friend imparted this wisdom when the Air Force selected me for promotion to major.

Her assertion gave me the confidence to take risks, to innovate, to lead boldly without worrying about making mistakes or needing to achieve a perfect outcome. It helped me stomp on impostor syndrome, the self-doubt and sense of fraudulence that can overcome feelings of accomplishment, when accomplishment appears to fall short of ideal.

Her advice encouraged me to volunteer to lead big projects and gave me confidence to succeed. As we embark on Women's History month, I'm honored to highlight a Women In Defense volunteer leader who embraced this ethos in 2020, generating positive professional impacts for herself and other women.

Like many of us, Josephine Lewis spent 2020 prioritizing between her job and family in ways she never anticipated. She enjoys working for Raytheon Technologies and she loves her five-year-old twins; however, she never expected to simultaneously work from home recruiting talented individuals and leading kindergarten for smart, energetic kids.

Many women would feel they had enough on their plate with work, family and a pandemic. But Lewis also serves as volunteer leader for WID, and in 2020 she accepted a significant additional workload to organize and execute a virtual event, "Taking More Risk."

Josephine Lewis

She stepped up to this leadership challenge because she wanted to help other women achieve their professional objectives by reframing their mindsets to view risk not as a potential danger, but instead as an opportunity.

WID depends on volunteer leader passion and initiative to achieve its twofold mission of helping women within the national security enterprise achieve their personal objectives and encouraging talented young women to choose the field as a career.

This means volunteer leaders enjoy wide latitude to work on projects and events they choose based on interest, significance and professional impact.

Lewis volunteers for two reasons: because she wants to participate in a community that makes a difference in people's lives, and she seeks professional development opportunities in human resources. She specifically volunteers for WID because she knows many women, like herself, struggle with taking the next steps in their careers; they don't know how or where to start.

She recognizes challenges exist along everyone's career path, including fear of failure, fear of embarrassment, or fear of inadequacy. She finds WID volunteer leadership a critical tool to overcome these challenges, because connecting with other women facing similar challenges helps create shared confidence.

Lewis's background and motivation made her the perfect project leader for the WID Greater Boston Chapter's "Taking More Risk" event, which encouraged women to embrace risk by pursuing leadership opportunities in their careers and life. Anchored by a panel featuring speakers from industry and government, 217 participants tackled common challenges from different perspectives.

After the panel, attendees could access virtual networking booths to engage with a cross-section of women working in defense in the Boston area, and engage one-on-one with panelists and each other to share information and advice about taking risk in pursuit of career objectives.

Lewis received positive feedback after the event, with one participant focused on the idea, "you miss 100 percent of the shots you don't take." This aligned with her takeaway: "the biggest risk is not taking any risk."

That sentiment resonates with Lewis because she did find it hard to carve out time for the event, given other demands on her schedule. However, she wanted to participate in an event designed to encourage women to take more risks and she recognized someone needed to take the initiative to make the event a reality.

She volunteered believing she would enjoy a significant return on her investment of time, talent and energy.

Lewis led "Taking More Risk" because she felt the event would provide her with practical tools to help her attain her professional goals. It can be very difficult to manage personal priorities with professional priorities, and some women hesitate to take on additional tasks fearing they won't execute the additional tasks perfectly.

An unrealistic standard of perfection can prevent women from volunteering to lead a professional development event, a classic case of the perfect as the enemy of the good enough.

I'm sure Lewis faced challenges in organizing and executing the event, but attendees didn't notice. What they noticed, and what they commented upon, was the value they derived from panelist stories and advice.

Lewis understands she does not know from where her next professional opportunity will emerge. But she knows it's out there. Volunteer leadership strengthens her network and enhances her knowledge, skills and abilities, increasing her access to opportunities and preparing her to identify and seize them.

So, take the risk! Joining WID will build your network, foster your well-being, and provide you with learning experiences in leading and supporting projects to benefit your career.

Additionally, leading these events allows you to influence others' lives, in ways you cannot imagine. It won't always be perfect, but it will likely be good enough, for you and the many other women your leadership will impact. ND

Josephine Lewis is talent acquisition at Raytheon Missiles and Defense and Rachel McCaffrey is executive director of Women In Defense.

Raytheon Missiles and Defense photo

When Hondo Talks, People Should Listen

■ The change in the administration in January meant a change in leadership at the Defense Department.

Departing the Pentagon were three executives who we in the press were going to miss sorely: Undersecretary of Defense for Acquisition and Sustainment Ellen Lord; Air Force chief weapons buyer, Will Roper; and his counterpart at the Navy, James "Hondo" Geurts.

All had a great, mutually beneficial working relationship with the press — which isn't always the case with senior leaders. But most importantly, they almost always had something interesting to say. The marching orders here at the magazine were: when these three talked, we wanted to pass on what they said to our readers.

Fortunately, Geurts did not resign from the senior executive service and just before we went to press was named as the person "performing the duties of" the undersecretary of the Navy.

We have been listening to Geurts since his days as an acquisition executive at Special Operations Command. He was there for a decade — forging a reputation as someone with innovative ideas who could deliver new technology quickly and affordably — before being hired by the Navy to be the assistant secretary for research, development and acquisition.

He admits that the hire three years ago was a bit of a head-scratcher. He was a former Air Force acquisition officer, then SOCOM, and now Navy?

"I think there was a little bit of anxiety on my part — how do I contribute to a team here?" he said in what would be his final talk as assistant secretary during the Surface Navy Association's annual conference.

Hondo earned a reputation as an acquisition guru — someone who thinks deeply about how to get the best technology in the hands of the warfighters as soon as possible.

Here are a few of Hondo's thoughts he shared before stepping down as assistant secretary:

On dealing with COVID-19…

"We delivered $140 billion of contracts. That's about 21 percent more than we did last year, almost twice what we did two years ago, we did it with 10 percent less contract action. So we did it more efficiently. …

"It takes us all working together, identifying opportunities, leveraging those opportunities by doing so with an output in mind, not an input in mind. … We proved ourselves as a good partner in government. We put a lot of things in play that helped our industry partners [and gave] them stability."

On his constant discontent…

"We need to continue to work at scale and at speed. We are making improvements. We are seeing better outcomes. That's the positive in me. The discontent is we've got to do more and we've got to do it faster and we've got to do it at larger scale."

On pivoting quickly…

"How fast can we adapt? How fast can we learn? And what I've come to realize over time is pivot speed really relies on a strong foundation, right? You can't pivot effectively if you don't have a strong foundation on that fulcrum to pivot from."

On readiness verses modernization…

"We've got to get away from a false situation where it's either we're ready or we're modern. … We have got to be ready and we need to continue to modernize. We can't either just be ready or just modernize. The only way we're going to do that is us continuing to find those opportunities to drive costs out of the equation. And I'm not talking drive profit or margins out. I'm talking drive fundamental costs out. …

"There are things we do that drive fundamental costs that don't add value to a product. They just add costs. Lots of work to go there."

On developing talent…

"…That's developing talent across the board: talent in industry, talent in our labs, talent on our waterfront, and really focusing on creating that environment where folks want to belong.

"There is no better job in the world than supporting the military and our international security from my perspective. And there's lots of awesome ways to do that. And they don't all have to be in uniform. ...

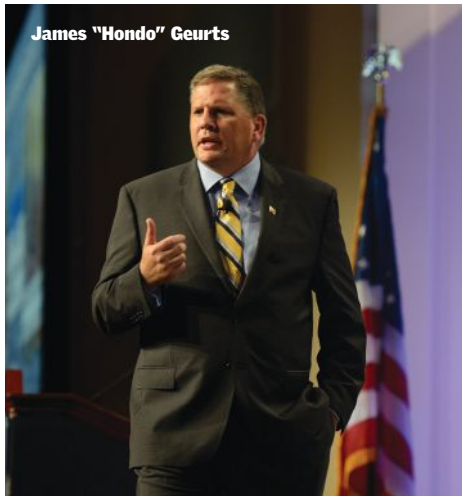
"I go back to this COVID example, the patriots in the shipyard — keeping the ships sailing in the middle of COVID — there is no greater example that I can think of, at least in the modern era, where we have seen that. ...

"As long as we have the courage to really leverage the diverse inputs and experiences and backgrounds and get past: 'Are you a uniform person or an industry person? Or a female or a male?' We need to get past all of that and get into: 'What do you bring to the team?'"

On innovation…

"If we can close down the distance between the fleet operator and the acquisition person and the technology person, that inherently allows us to find opportunities and go after them faster. … We should never do a fleet exercise where we aren't experimenting with anything, and we should never have an experimental exercise and not have fleet operators trying things."

As for the trio of Lord, Roper and Geurts, the marching orders will remain the same — whether they are inside the Pentagon or out — we will be listening to what they have to say. **ND**



James "Hondo" Geurts

"Hondo earned a reputation as an acquisition guru ..."

Navy photo by Richard Rodgers

UP FRONT COMPILED BY STEW MAGNUSON

It's Like Amazon Delivery, But With Bullets Flying

■ Marine Corps Commandant **Gen. David Berger** wishes his service's logistics was a lot more like Amazon and other private sector delivery services.

"They build in resilience, resiliency and redundancy. Assuming that any one of those connecting fibers is gone because of weather, because of whatever … they immediately shift to plan B," he said at a recent NDIA conference.

The Marines are stuck with a hub-and-spoke model, where something is delivered to a central point, then it waits for someone to take it where it needs to go. If there's a problem, the item just sits there.

Of course, the Corps has to deal with a lot more than the weather, especially when enemies are attacking supply lines, he noted.

"We need that idea, but it needs to be able to survive in a contested environment where an adversary is trying to cut every fiber in that [network] to make sure we can't resupply ourselves," he said.

Air Force Looking at Commercial Tanking Services

■ The Air Force wants to analyze the feasibility and affordability of leveraging contractor-owned platforms for aerial refueling services during training exercises.

"The idea of contract air refueling was to enhance the readiness of the force by offloading the standard administrative refueling that we do here in the [continental United States] to prepare our combat air forces … for the joint fight," Air Mobility Command Commander **Gen. Jacqueline Van Ovost** recently told reporters.


Van Ovost

The air staff asked AMC to do a full business case analysis "as we look at government-owned, lease back to a contractor, or contractor-owned [tankers], and working with the FAA on the certification and oversight requirement for all of these options," she said.

The business case analysis "is going to take some time," she added. "We are back in the throes of framing the study and awarding that study so that we can move forward on this larger analysis."

Solving Technical Problems Can Be an 'Art'

■ **James "Hondo" Geurts**, currently performing the duties of the undersecretary of the Navy, is known for his out-of-the-box thinking. He once brought in a pair of comic book artists to help a team solve a difficult challenge.

The artists listened in on the discussion of the problem, then translated it into graphic novel format to make it easier for everyone to grasp.

"If I can give you the problem — or at least what I think the problem is — you can give me solutions that I didn't know I needed, or you may give me a different way to think about a problem," he said at a recent conference.

The graphic artists put the story up on the wall and suddenly the group of very technically and operationally experienced personnel grasped what was needed.

"There's this value of bringing diverse teams together to solve common problems," Geurts said.

For more on Geurts, see page 5.

AFRL Fights Against Human Nature


Pringle

■ **Brig. Gen. Heather Pringle**, Air Force Research Laboratory commander, said failure is an option when it comes to research and development, but facing criticism is never easy.

"That's a real human tendency, right? To retreat to the safety when you are a little bit under threat and to reduce the risk that you would face," she said at a Mitchell Institute talk.

"We learn more from our failures and knowing what went wrong than we do from what went right," she added.

"We still move the needle and we move the ball down the court."

— Reporting by Jon Harper and Stew Magnuson

FURTHER READING

Department of Defense Additive Manufacturing Strategy
By the Department of Defense

■ Co-produced by the Joint Defense Manufacturing Council, the office of the deputy director for strategic technology protection and exploitation, and the office of the undersecretary of defense for research and engineering, this overlooked document released the day after the inauguration didn't receive a lot of attention, but should have.

The list spelling out the potential benefits for the military of adapting what is also called 3D printing is impressive.

For example, innovative designs brought on by new manufacturing methods can lead to greater operational performance of weapon systems. It will help transform the engineering process from design-build-test to model-analyze-build.

The capability enables rapid prototype production, reducing development timelines. It can expand the industrial base by employing alternative manufacturers and lead to the fabrication of parts at the time and point of need.

It can help solve the problem of parts that become obsolete. And it can reduce the complexity of replacing components when a piece of machinery that previously had a dozen sperate components welded together is reduced to one item, thus reducing supply chain complexity, weight and manufacturing costs.

However, the Defense Department and its industrial base aren't there yet. The document details five strategies that will help clear a path for additive manufacturing.

For one, the Pentagon through policy, guidelines and implementation plans will encourage 3D printing use inside the department and industry.

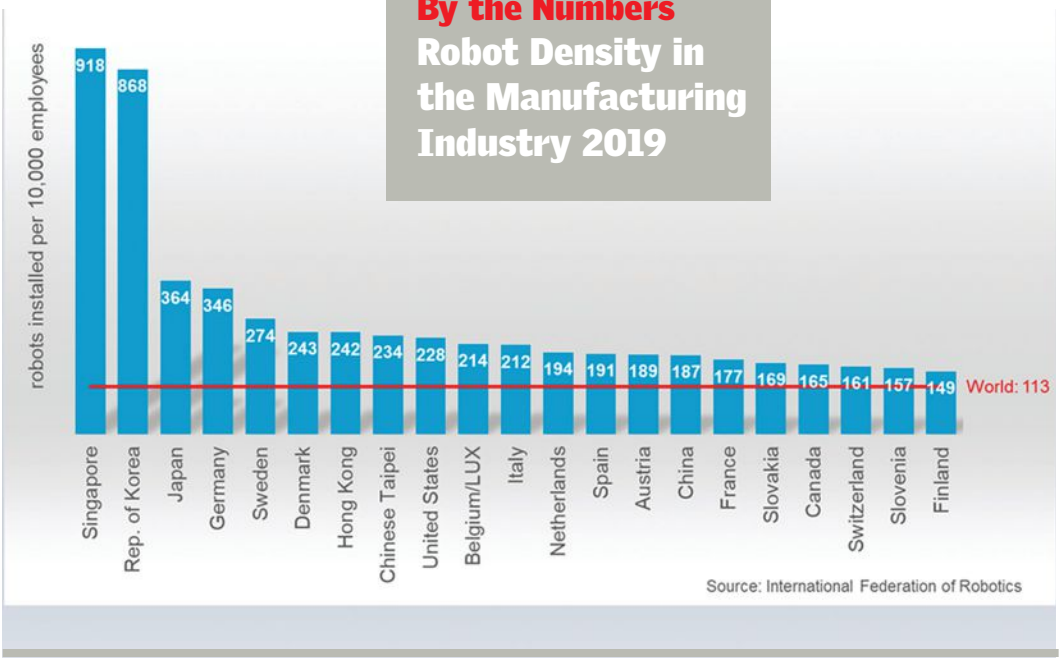
It will also educate and train the technical and business workforce to integrate and use the capability.

"Additive manufacturing is a powerful tool to enable innovation and modernization of defense systems, support readiness and enhance warfighter readiness," the strategy said.

— Stew Magnuson

Defense Dept. photos

By the Numbers
Robot Density in the Manufacturing Industry 2019



Hello, Goodbye

■ NDIA welcomes **Dr. Mark Lewis** as the director of the Emerging Technologies Institute, the association's recently established think tank. For more about Lewis and the institute, see page 20.

Ellen Lord, former undersecretary of defense for acquisition and sustainment, and former NDIA vice chairman, has landed at the Chertoff Group as a senior advisor.


Lord

The Center for a New American Security launched a new Indo-Pacific Security Program with **Lisa Curtis**, former National Security Council senior director for South and Central Asia, as its new director. Also joining the program as adjunct senior fellows are **Rich Verma**, former U.S. Ambassador to India; **David Feith**, former deputy assistant secretary of state for East Asian and Pacific Affairs; and **John Park**, director of the Korea Project at the Harvard Kennedy School's Belfer Center.

Raytheon Technologies named **Michael Dumais** as its chief of transformation. He was previously executive vice president of operations and strategy at United Technologies Corp. prior to the two companies' merger last year.

IBM appointed **Steve LaFleche** as general manager for the U.S. public and federal market. He previously had a similar role for IBM in the state of New York.

Brig. Gen. Edmond M. Brown, formerly deputy director/chief of staff of the Futures and Concepts Center at Army Futures Command, will take over as commanding general of Combat Capabilities Development Command, Aberdeen Proving Ground, Maryland. **Brig. Gen. Guy M. Jones**, who served as a deputy commanding general with the Eighth Army in South Korea, takes over Brown's spot at the Futures and Concepts Center.

Brig. Gen. Jeth B. Rey, director, J-6, Central Command, was named director of the Network Cross-Functional Team at Aberdeen.

Unmanned aircraft system manufacturer AeroVironment agreed to acquire Arcturus UAV in a cash-and-stock transaction valued at approximately $405 million as part of efforts to expand into adjacent segments and broaden its portfolio and customer footprint.

The Petaluma, California-based Arcturus UAV employs 270 workers, builds Group 2 and 3 drones and offers contractor-owned, contractor-operated services to Special Operations and the Army. ND

Defense Dept. photo

COMING SOON

■ The magazine will be virtually covering parts of NDIA's Pacific Operational Science & Technology conference March 8-11. We're also looking forward to the association's first National Security AI Conference and Exhibition, which was going to be held in December, but got pushed back to March 23-25.

We're beginning to receive notifications from other conference organizers that they are proceeding with in-person meetings in the late spring, early summer time frame — no matter what! We won't list them as we have heard that before, and don't want to jinx them. We're cautiously optimistic. ND

BUDGET MATTERS

BY JON HARPER

Biden to Restrict 'Buy American' Waivers

President Joe Biden recently issued a new "Executive Order on Ensuring the Future Is Made in All of America by All of America's Workers." The directive will put waivers to "Buy American" laws in government contracting under additional scrutiny, although it's unclear how impactful it will be when fully implemented, experts say.

"With this order, President Biden is ensuring that when the federal government spends taxpayer dollars they are spent on American-made goods by American workers and with American-made component parts," said a White House fact sheet.

The directive increases oversight of potential waivers to domestic preference laws including through the creation of a centralized review agency. The move is aimed at "fulfilling the president's commitment to crack down on unnecessary waivers," the fact sheet said.

Biden tasked the director of the Office of Management and Budget to create a new Made in America Office. Any procuring agency that seeks to grant a waiver to a Buy American law must provide a detailed justification to the office's director, who will then make a written determination as to whether the waiver will be granted.

"By centralizing the waiver process at OMB, requiring that the granting agency investigate the why and how of the cost advantage, and separating the request from the self-interest of the contracting activity, likely the result will be a reduction in the number of waivers issued," attorneys at Venable LLP wrote in a recent report, "Biden Strengthens Buy American Provisions — Executive Order Details Preferences for U.S. Workers and Companies."

"Going forward, the ease or difficulty of obtaining waivers will be subject to the policy directives of the incumbent administration and far more visible than individualized decisions made at the contracting level," they said.

Agency heads are instructed to consider suspending, revising, or rescinding agency actions that are inconsistent with Biden's Buy American policy, the Venable report noted.

"The EO arguably permits agencies to cancel or modify existing waivers to conform with domestic preference requirements," it said. "It is unclear whether agencies will do so, and, if they do, what notice will be provided to those companies currently relying on such waivers and whether such waivers may be grandfathered or extended."

Additionally, the order directs the General Services Administration to create a website where all proposed waivers will be publicly posted.

Venable attorneys said key unanswered questions include: Will a domestic manufacturer be able to contest the grant of a waiver? What happens if a waiver is granted and an American company is able to provide those items, services, or materials?

"Interested companies and practitioners are advised to track how this added transparency and information may be utilized, particularly with regard to bid protests," they wrote.

Notably, only 3.1 percent of contract dollars awarded by the Defense Department in fiscal year 2019 were for items purchased from "foreign entities," with a total value of about $12 billion.

Services, petroleum, construction and subsistence items accounted for about 68 percent of those purchases; defense equipment 17 percent; and "a variety of categories" 15 percent, according to the Pentagon's "Report to Congress on Department of Defense Fiscal Year 2019 Purchases from Foreign Entities."

Of the $381 billion in total Pentagon contracts obligations in 2019, the total dollar value for items in which the Buy American Act was not applied due to inapplicability, waivers and authorized exceptions, was $6.7 billion, the report said.

"All of this focus on strengthening Buy American from both political parties would lead one to believe that an enormous amount of government funds must be going towards purchases from foreign countries. The reality is far different," said a recent report from The New Center think tank, "Why Buy American Usually Doesn't Buy Us Much."

Biden said waivers can still be issued in situations where there is an "overwhelming national security, humanitarian, or emergency need."

Jeff Belkin, partner in Alston & Bird's government contracts group, said the executive order "may not be as dramatic as some have suggested."

"Between exemptions for certain products and the broad definition of what constitutes 'manufacturing' in the U.S., the net effect on American manufacturing may not be perceptible for some time, even after rule changes are finalized," he said.

(For more on Biden's executive order see article on page 42) ND

iStock illustration

Analysts Call for Adjusting Missile Defense Funding

■ The Biden administration should rethink the nation's investments in missile defense, according to analysts.

The Congressional Budget Office in a new report, "Costs of Implementing Recommendations of the 2019 Missile Defense Review," estimates that the 10-year price tag of the Pentagon's missile defense plans for the 2020s would be about $176 billion, based on the Trump administration's 2020 budget request.

Of the $176 billion total, "about 35 percent of the total is for systems that are primarily for homeland ballistic missile defense, … about 40 percent is for systems that are primarily for regional ballistic missile defense, and the remaining 25 percent is for cruise missile defense," according to the study.

However, the new administration is expected to conduct a new missile defense review which could result in a significant shift in priorities.

"I think that the Biden administration really wants to be thoughtful and not chase every threat" with expensive defensive systems, said Laura Grego, senior scientist with the Union of Concerned Scientists' Global Security Program. "It wants to do really hard-nose cost-benefit analyses."

The United States needs to avoid getting into a "tail chase" trying to keep up with growth in adversaries' intercontinental missile arsenals, she said during a recent panel. To that end, she suggested "slimming down" the mandate for the Ground-based Midcourse Defense, or GMD, system with the goal of protecting the homeland against limited strikes. Greater focus should be on investing in systems that are dedicated to regional missile defense, she added.

A Standard Missile-3 Block IIA test launch

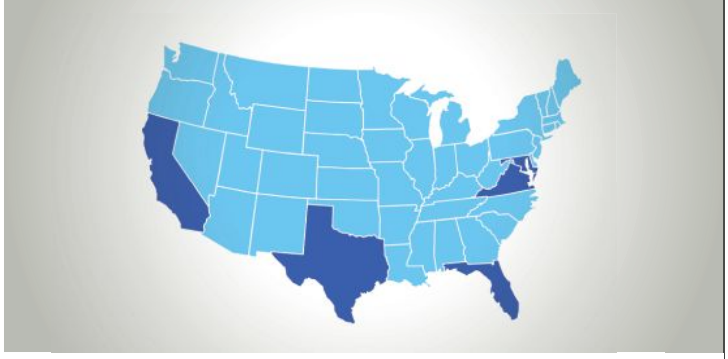
Other ideas that have been bandied about, such as building systems that could have a global reach like space-based interceptors, would be "wildly expensive" and should be discarded, Grego said.

Tom Karako, director of the Missile Defense Project at the Center for Strategic and International Studies, said topline funding levels for missile defense should be maintained, but some of that money should be shifted toward programs focused on defeating non-ballistic missile threats such as cruise missiles, drones and hypersonics.

"We could be doing something significantly different than what we're doing now while staying within basically the same budget profile," he said. "We're going to need to stay within that budget profile" due to budget constraints.

"This is an opportunity to really double down on regional and theater air-and-missile defense … for all the other aspects of forward [deployed] forces in particular, so that we can support our broad deterrence and defense goals," he added. ND

Army photo by Ryan Keith, iStock illustration



Small Number of States Dominate Defense Spending

■ A huge portion of U.S. defense spending is going to contractors and military personnel based in just a handful of states, according to data recently released by the Pentagon.

Defense Department contract obligations and payroll spending in the 50 states and the District of Columbia totaled $550.9 billion in fiscal year 2019. Of those outlays, 73 percent was spent on contracts for products and services, while the remaining 27 percent paid the salaries of department personnel, according to the Office of Local Defense Community Cooperation's latest report on defense spending by state.

"California, Virginia and Texas topped the list of recipients for overall defense spending," said a press release accompanying the study. They received $181.3 billion, about one-third of the total allotted to all 50 states plus D.C.

The top five, which also included Florida and Maryland, received about 43 percent of the total, while the top 10 received approximately 59 percent, according to the data.

The top 10 states were: California, $66.2 billion; Virginia, $60.3 billion; Texas, $54.8 billion; Florida, $29.8 billion; Maryland, $26.1 billion; Connecticut, $19.7 billion; Pennsylvania, $18.1 billion; Washington, $17.8 billion; Alabama, $16 billion; and Massachusetts, $15.8 billion. That adds up to a whopping $324.7 billion.

The 10 states whose economies are most dependent on military outlays — measured by defense spending as a percentage of their GDP — were: Virginia, 10.6; Hawaii, 7.7; Alabama, 6.9; Connecticut, 6.8; Alaska, 6.4; Maryland, 6; Maine, 5.8; Kentucky, 5.7; New Mexico, 5.7; and Mississippi, 5.3.

"Some states received substantial funds for both contract and personnel spending, while other states received relatively high amounts in only one," the report noted.

The top 10 states for defense contract spending were: California, $50.2 billion; Texas, $43.4 billion; Virginia, $41.6 billion; Florida, $22.3 billion; Connecticut, $19 billion; Maryland, $18.4 billion; Pennsylvania, $15.3 billion; Massachusetts, $14.7 billion; Missouri, $13.4 billion; and Arizona, $12.9 billion. That adds up to $251.3 billion, more than 60 percent of the total value of defense contract obligations across the nation.

Patrick O'Brien, director of the Office of Local Defense Community Cooperation, said: "State and local officials need to use this information to better understand the essential continuum of investments across people, equipment, weapons systems, real estate and services required to maintain our national defense. Across these areas, they should determine if there are opportunities to further develop workforce skills, enhance and improve innovativeness and buying power, and partner to strengthen the resilience of our installations and industrial base." ND

NEWS BRIEFS

COMPILED BY MANDY MAYFIELD

Navy to Fully Integrate Laser Into Aegis Combat System

Artist's rendering of HELIOS system

Lockheed Martin illustration

The Navy this year will be firing a high-energy laser weapon that is fully integrated with one of its destroyers, which proponents say is a major step toward fielding directed energy technology.

Joe Ottaviano, Lockheed Martin business development director for advanced product solutions, said he has heard the adage that battlefield lasers always seem to be "one year away" from fielding, but asserted that this time is different.

The High Energy Laser with Integrated Optical-dazzler and Surveillance, or HELIOS, this year is slated to be permanently deployed aboard a Flight IIA DDG Arleigh Burke destroyer and integrated with its Aegis combat system.

"We're delivering a full-end system that actually brings defense capabilities to an area where there currently isn't any and exceeds the capability I think we all had in our mind going forward," Ottaviano said in a press briefing.

HELIOS is a 60-kilowatt solid-state laser capable of scalable effects, which can "dazzle" and blind sensors, but at high power it can "put a hole" through unmanned aerial vehicles, low flying aircraft, and in some cases, missiles, Ottaviano said.

Jason Wrigley, Lockheed's business development director for naval combat and missile defense systems, said: "People have been talking about the promise and the possibility of laser weapon systems for decades. So it's really exciting for us to finally have reached this milestone, delivering an integrated laser weapons system into the hands of sailors and as part of the Aegis weapon system."

Lockheed Martin went under contract to deliver the integrated system in 2018. It spent 2020 carrying out a critical design review and factory qualification tests.

After decades of company research and development surrounding solid-state lasers, the system was primed to be delivered in such a short time, Ottaviano said. The Navy contributed much of the software needed to integrate the system into Aegis, he added.

A bonus for the Navy is the high-powered optical tracker that comes with the system and can double as an intelligence, reconnaissance and surveillance sensor when the laser isn't being fired, the Lockheed executives said.

"It will be the most accurate [electro-optical] sensor on the ship," Ottaviano added.

As for firepower, directed energy weapons feature an almost unlimited magazine.

Ottaviano said: "As long as the ship has got power, the system can fire. You don't run out of bullets. You don't run out of lasers. You just keep going. … I'll call it a transformational capability."

Rear Adm. Seiko Okano, the Navy's program executive officer for integrated warfare systems, said integrating HELIOS into Aegis is "a pretty big deal."

Tests carried out in 2020 on land at Lockheed Martin's Morristown, New Jersey, facility, surprised her.

"We've realized over time that the capability that we're giving to the fleet is actually more capable than what we initially had thought," she said at the Surface Navy Association's annual conference.

Ottaviano said the Navy is looking at possibly integrating HELIOS into other platforms, particularly aircraft carriers. A larger footprint could result in higher powers capable of taking out larger targets.

Okano said: "I think certainly we can build a bigger laser, but it is how does that work, and how do we integrate that into the ship, and what other [tradeoffs] do we have to think about?"

As for the laser taking down hypersonic missiles traveling at speeds above Mach 5, that is still a ways off. Sensors will have to improve, she said. **- STEW MAGNUSON**

U.S. Military Experiments With Remote Digital Air Traffic Control

■ A military airbase in Florida is testing a remote digital tower that allows air traffic control to take place hundreds, or even thousands of miles, away from runways.

A systems operational verification test took place at Homestead Air Reserve Base over the course of one week in late 2020. Testing was done using real-world scenarios and the airbase's daily operations. An early operational assessment began in late 2020 and will be completed mid-2021, said Jay Balakirsky, Frequentis USA vice president of business development and sales.

In this phase, operators will actively control aircraft using the system. The airfield's tower will serve as a backup, he explained.

"Remote Digital Tower has the ability to support contingency operations, improve the situational awareness of air traffic controllers, and facilitate the control of several airfields from a central location," he said in an email.

Vienna, Austria-based Frequentis AG has been selling the technology to public sector aviation agencies in regions such as Scandinavia, where some airfields are infrequently used, and operating them remotely makes economic sense. For militaries, the system can be set up rapidly and can keep air traffic controllers out of harm's way, Balakirsky said.

"This brings great benefit to the warfighter in today's complex environments," he added.

The system includes augmentation features such as data tags, bounding boxes and visual overlays. It is also the first time that a remote digital tower has been integrated with the Standard Terminal Automation Replacement System allowing controllers to see pertinent radar display data overlaid on the panoramic out-the-window view, the company said in a statement.

Frequentis & Defense Dept. photo, Oshkosh Defense photo

Naval Information Warfare Center Atlantic — with the support of the Air Force, Navy and Marine Corps — is sponsoring the test under an other transaction authority agreement. The company has a history with the Navy as it has supported air traffic control for aircraft carriers and landing helicopter dock ships over the last seven years.

Once the latest assessment is complete, the agreement calls for Frequentis to move to another Air Force base where a mobile solution will be demonstrated and tested, Balakirsky said.

Frequentis has remote tower installations and trials ongoing with several military customers in South America, the Middle East and Europe.

"Interest in our RDT technology/implementations remains high," Balakirsky said. **- STEW MAGNUSON**

Army Approaches JLTV Trailer Milestone

■ Approximately two years after the Army's first unit equipped milestone for the Joint Light Tactical Vehicle, and after service exploration of available alternatives, the broader program is preparing to begin fielding of the program's trailer.

The JLTV-Trailer will be capable of carrying a 5,100 pound payload with similar mobility characteristics as that tow vehicle, according to Michael Sprang, program manager of the JLTV Joint Program Office.

Operational testing demonstrated that the current Light Tactical Trailer designed for the Humvee was not compatible with the JLTV when operating at mission profile speeds, Sprang said in an interview. "The JLTV truck off-road mobility capability is significantly higher than the Humvee it is replacing. As a result of this, the capabilities of the JLTV are limited to the safe towing speeds of the LTT to limit equipment damage."

This is "the only trailer solution available that allows the JLTV to maintain this critical capability while towing a trailer," he added.

The trailer design features a bolted steel frame rail and cross-member design with an independent trailing arm and air spring suspension. This allows for a mobility profile to match that of the JLTV, and reduced height for transport-loading procedures. Additionally, tires and rims are common with the JLTV. Other features include an onboard stowage box for the removable sidewalls and tailgate as well as attachment of the cargo deck to the chassis through ISO locks, providing a quick removal capability.

Significantly, the lock interface allows the trailer chassis to be a baseline for any future requirements that will need to be pulled behind the vehicle.

Sprang acknowledged that the trailer has been a part of previous acquisition and development phases of the family of vehicles, which included several variants of the truck, kits and companion trailer. In fact, the production contract source selection following the engineering manufacturing and development phase, which was awarded to Oshkosh Defense, included scope for the JLTV-T production.

However, at the Milestone C Defense Acquisition Board, the Army position was to leverage the investment in LTT with JLTV and not resource the procurement of the companion trailer. As a result, initial production quantities were limited to test assets.

However, in June 2019, an Army Requirements Oversight Council decision was made to consider and field the JLTV and trailer as a system — rather than a mixed fleet — setting the stage for establishing a JLTV-T distribution plan and funding profile for additional procurement. The council also approved fielding the JLTV with the use of the LTT — and a reduced mission profile — until the JLTV-T program was established.

JLTV-T full unit equipped is currently planned for 2nd Stryker Brigade Combat Team, 4th Infantry Division, Fort Carson, Colorado, in the third quarter of fiscal year 2021. Subsequent fieldings will continue afterwards to match that of the JLTV. **- SCOTT GOURLEY**

U.S., U.K. Navies Establish London Tech Bridge

■ The United Kingdom's Royal Navy is teaming with the U.S. Navy in a new international Tech Bridge partnership in London in hopes of accelerating the adoption of innovative ideas and technologies.

The newly established London Tech Bridge will serve as a command post for innovation for the two navies as they work toward interchangeability in everything from technology development to deployment and operations.

Military, industry and academia can meet, share ideas and collaborate to produce capabilities that will be beneficial to both the military and civilian sectors.

"The Tech Bridge facilitates navigation of the innovation pipeline for stakeholders," said U.S. Navy Cmdr. Albert Arnold IV, director of the London Tech Bridge. "The offices aim to accelerate delivery of capability to the sailor and Marine by developing strategic partnerships that allow rapid flow through the pipeline."

The official partership was announced in December.

The U.S. Naval Agility Office, or NavalX, has successfully leveraged a number of Tech Bridges across the United States over the past year. The London office is its first overseas location among its 13 outposts.

The Tech Bridge expansion is the next logical step for NavalX, Arnold said in an email.

"The U.S. Navy and Royal Navy have long recognized the very special and critical relationship that we have, and its importance to global security," he said. "As threat vectors continue to evolve, our two navies have realized that just being interoperable isn't enough to effectively and efficiently stay ahead of those threats."

In October, the two navies also signed the Statement of Intent for Future Integrated Warfighting, which outlines a shift in the way the two forces work together, going from interoperable, to interchangeable, Arnold said.

"To achieve the interchangeability, we need to work at it from all angles, including development of capabilities and technology," he said. "The Tech Bridge is one tool and one of the first tangible actions following the [statement of intent] that solidifies both countries' commitment to this new idea."

Initial focus areas for the effort include unmanned systems, autonomy, AI, biotechnology, directed energy, lasers and space capabilities, Arnold said.

The London Tech Bridge will be facilitating a joint U.K.-U.S. test and evaluation symposium in late 2021 to assess new capabilities. **- MANDY MAYFIELD**

Marine Corps Awards OTA For Long-Range Sea Drone

■ The Marine Corps has selected shipbuilding company Metal Shark to develop a long-range unmanned surface vessel.

The service awarded the Louisiana-based company an other transaction authority agreement in January to design, build and test the vessels. Metal Shark will also work with the Marine Corps to integrate autonomy and an advanced command-and-control software suite into the systems.

Immediate next steps for the company include "development of a low-rate production fleet, a series of early crafts that will be incorporated into the Marine Corps [fleet] and used to develop, test and demonstrate the technology, which is intended in the early winter of 2023," Metal Shark CEO Chris Allard said in an interview.

The system will be tiered and scalable, providing the service with the ability to track and destroy targets at range, Allard noted.

"We are designing the platform for long-term scalability [and] integration of different payloads, whether that be submarine detection, hydrographic survey, surveillance [or] mine hunting," he said. "We are going to be incorporating future opportunities for growth into the craft."

The long-range unmanned surface vessel will be fully autonomous with the option of being manned. The system can carry multiple payloads, which it can retrieve or launch.

Metal Shark is working with autonomous technology developer Spatial Integrated Systems — which was recently acquired by Huntington Ingalls Industries — to provide the autonomy capabilities for the platform, according to the company.

In addition to the autonomous unmanned system, Metal Shark will also produce manned support vessels for the LRUSV system utilizing its "40 Defiant" military patrol craft,

Concept of LRUSV system being developed by Metal Shark

Metal Shark concept

which the company is currently producing as part of a Navy patrol boat effort.

As a number of new unmanned systems programs are being launched throughout the Defense Department and other government agencies, Metal Shark is eyeing new opportunities in the autonomous system market.

"There are a couple of other unmanned systems programs coming out of both the Navy and [the Department of Homeland Security] that we're excited to be a part of," Allard said. *(For more on Navy unmanned systems see story on page 26)* **- MANDY MAYFIELD**

Spending on Quantum Tech on the Upswing

■ Investments in quantum technology — which use the manipulation of neutrons, photons, electrons and protons to perform tasks — are increasing worldwide and will reach $10 billion by 2024, according to an expert.

"The security implications of quantum technologies, as well as the expected advantage in computing and sensing have caught the interest of the world's governments," said Gabe Lenetsky, business development engineer at Keysight Technologies.

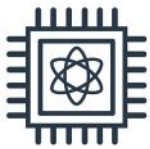
China has poured billions of dollars into its quantum programs, he said during a January webinar hosted by BrightTALK. Other countries accelerating their investments include Germany, the Netherlands, Canada, and several Asia-Pacific nations including Japan.

Just last year, India began a $1 billion investment into quantum technologies, he added.

Meanwhile, the United States previously lagged in spending until 2018 when Congress passed the National Quantum Initiative Act "to garner leadership in the areas of quantum technologies and computing," Lenetsky said.

There are three main areas of quantum research including computing, sensing and communications, he noted.

Quantum computers — which utilize basic units known as qubits rather than 1s and 0s like traditional computers — will play an important role in data encryption including the optimization of computational algorithms for modeling systems, big data and artificial intelligence, he said.



Quantum sensors offer extreme sensitivity for applications of precision timing and navigation through methods like electromagnetic sensing, he said.

Quantum communications will enable secure data pipelines, he noted.

These technologies will have a big impact on the aerospace and defense sectors, Lenetsky predicted. For example, a sensing application called quantum illumination can play a large role in the development of new radar systems "to get to higher range and sensitivity of stealth objects," he said.

Quantum technology could also enable a secure communication system known as "quantum key distribution," or QKD.

"QKD is promising for satellite applications or satellite-to-ground communications," he said. However, distance is the No. 1 challenge for space applications, he noted.

"The main reason is that the longer the distance, the more chance the qubits will be absorbed or scattered," Lenetsky explained. "This has implications on whether the repeaters and nodes along the way are trusted or untrusted. As such, we typically see the need to have a repeater every 100 kilometers or so to maintain reasonable bit rates. This may be over optical fibers or over satellite mediums."

Quantum key distribution could enable a quantum internet, Lenetsky noted. This would be a "virtually unhackable" system that would make it substantially harder for a person to eavesdrop on the transmission of encrypted data, he said.

The U.S. government is making investments in a quantum internet. Last year the Department of Energy's Argonne National Laboratory and the University of Chicago announced they had completed successful tests on what they called a "quantum loop," which could serve as a precursor for a future national quantum internet.

Quantum will also help drive the development of AI platforms, experts say.

In a draft final report, the National Security Commission on Artificial Intelligence — which was tasked by Congress to research ways to advance the development of AI for national security and defense purposes — said quantum technology is poised to enable new growth in artificial intelligence.

"As semiconductor manufacturers reach the physical limits of microchip design, leadership in the next-generation computing hardware will be essential to leadership in AI," said Commissioner Gilman Louie during a public meeting of the group in January. The government should "prioritize quantum computing use cases to create a market for such services and to incentivize the domestic fabrication of quantum computing components."

While traditional computers will likely remain the most economical way of performing computational tasks, quantum computers "have the potential to outperform their classical counterparts on certain classes of problems related to machine learning and optimization, the simulation of physical systems, and the collection and transfer of sensitive information," commissioners said in the draft report. A final report was slated to be released in March.

Quantum computers could more efficiently optimize military logistics operations or help discover new materials for weapon platforms, the study noted.

Commissioners recommended the government transition quantum computing basic research to national security applications as well as incentivize domestic quantum fabrication.

"The United States is a global leader in research of quantum computers, but it risks losing its edge in real-world applications," the report said. "It must continue investing in development of national security use cases, recognizing that advances in quantum may drive future advances in AI."

Additionally, commissioners recommended the government offer access to quantum computers through the National AI Research Resource.

"Publicly announcing specific government use cases of quantum computers will signal that a market exists for national security applications and encourage further investment by the private sector," the group members said. "Incentivizing the domestic design and manufacturing of quantum computers via tax credits for relevant expenditures, loan guarantees and equity financing would help to avoid the situation in which the U.S. government currently finds itself regarding access to trusted and secure microelectronics."

Microelectronics are a foundational element of key technologies such as AI, but the United States is reliant on foreign sources of production which leaves its supply chain vulnerable to disruption, the report noted. **ND**

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NASA's Mentoring Program Can Benefit Defense

■ Since 1958, NASA has been at the forefront of exploration. Its achievements in science and engineering helped America win the Cold War and provide the foundation of today's connected society. Today, its mentor-protégé program is showing similar innovation.

The program's intent is to "incentivize NASA prime contractors to assist small, disadvantaged business concerns, historically Black colleges and universities, minority institutions, and women-owned small business."

Last year, the Boeing Co., a major NASA prime contractor, and Southern University and A&M College at Baton Rouge, Louisiana, signed an 18-month mentor-protégé partnership to work together on NASA's Space Launch System. Boeing is one of the largest primes to participate in NASA's mentor-protégé program.

"Ask professionals across trade industries about the benefits of allying veteran, large companies with energetic startups, and they're likely to praise the marriage of proven business acumen, fresh perspectives and bleeding-edge technological capabilities," says Lee Mohon, of ASRC Federal, an aerospace and defense company. According to NASA, it is the only federal agency with a mentor-protégé program targeted at historically Black colleges and universities.

These partnerships aim to solve some of America's most significant national security issues.

"America is at a crossroads," said retired Air Force Gen. Hawk Carlisle, president and CEO of the National Defense Industrial Association. "The industrial base is facing multiple headwinds," he noted. "Skilled, cleared workforce shortages remain a challenge," and "increased regulatory burdens and barriers to new entrants continues to be a barrier," he said.

The supply chain is one example of a security concern since some niche components needed for space flight are no longer manufactured domestically. This is especially concerning in the new age of great power competition, where supply chains are becoming an emerging area of concern.

Ellen Lord, the former undersecretary of defense for acquisition and sustainment, said the "silver lining" of the COVID-19 pandemic is that it encouraged U.S. businesses to bring their supply chains back to the United States. Many of America's supply chain vulnerabilities are due to its dependence on foreign nations — China in particular. The pandemic highlighted just how much even something like the spread of a virus touches the defense industry.

The Pentagon's industrial policy office suggested in the "2020 Industrial Capabilities Report" that qualifying new suppliers and investing in new technology to acquire domestic sources is a national priority. However, a possible model for the solution has already presented itself — mentor-protégé programs — which in addition to NASA, is also a tool for the Defense Department.

For some, NASA seemingly has nothing to do with national security. However, one cannot fully understand the story of the development of the Space Shuttle until "the national defense context in which it was conceived, developed and initially deployed" is considered, wrote the editors of *Wings in Orbit: Scientific and Engineering Legacies of the Space Shuttle.*

Southern University and NASA have enjoyed a long relationship and show just how initiatives like the mentor-protégé program can and have helped push the United States forward. Morgan Watson — a Southern University engineering faculty member and a former NASA engineer — is proof of that. After graduating in 1964, Watson helped integrate the Marshall Space Flight Center. He went on to become a part of the mission that sent the first man to the Moon.

Patrick Mensah, associate dean of research and graduate programs in Southern University's College of Sciences and Engineering, said it was opportunities like this that led to Southern being the first historically Black college or university to enter into an agreement with Boeing as a member of NASA's mentor-protégé program.

While national security is not the primary focus of NASA's mentor-protégé program or Boeing's agreement with Southern University, the ramifications of making such programs a part of national security can be far-reaching.

By exposing smaller institutions and businesses, accompanied by the motivated people molded and produced by them, to opportunities like the ones provided by the mentorship program, U.S. national security acquisition programs could be both revolutionized and revitalized tapping into all our talent pools and domestic resources.

NASA-sponsored mentor-protégé partnerships between entities such as Boeing and Southern University could be one solution to sourcing and mobilizing the workforce needed to develop the next generation of hardware, software and services required by the U.S. military.

They could also provide an opportunity to wean the United States from its dependence on international supply chains — strengthening national security while boosting support for small businesses and the American workforce. **ND**

Shaliza Tolliver is a junior fellow at NDIA.

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The Price of Success vs. the Cost of Failure

"Uneasy is the head that wears the crown."

Shakespeare most likely did not appreciate the timeless relevance when he wrote that line for his play *Henry IV, Part 2*. When applied to business, the clairvoyance cannot be overstated.

Successful companies achieved their standing by being competitive in their respective markets. A recognized measure of business success is having the company become a part of the Dow Jones Industrial Average. In 2021, there are no original companies left on the index, and many of these original companies haven't been part of it for many years now.

There are several reasons for that. Some unfortunately failed to adopt disruptive technologies that would have maintained, and perhaps strengthened, their leadership position. One of the lessons to be learned here is that companies can get left behind if they fail to innovate, leaving themselves vulnerable to more agile competitors who keep a pulse on disruptive technologies. This is an everyday reality in the tech industry. Companies must innovate or succumb to the competition.

The defense industry is now facing a disruptive technology moment and looking directly at Silicon Valley for inspiration. Within the Defense Department, the digital revolution is in full swing, with multiple new programs signifying a push for widespread adoption of commercial processes by defense contractors. The department is signaling that it is ready to push the envelope with commercial best practices and will no longer tolerate the "never enough time and money to do it right, but enough time and money to do it over" acquisition process.

The Defense Department is now demanding better, faster and cheaper. And as it studies successful commercial companies who regularly produce must-have, sophisticated, quality products on a "can't miss Christmas" schedule with a firm fixed-price budget, it's clear that there is a better way.

With this push for commercial processes, one might hear phrases such as "emulate before you fabricate" and "digital twinning" within the halls of program offices, even as some wonder if these are fads that will eventually pass.

In reality, much can be learned from Silicon Valley. Tech companies have hard deadlines, such as the holiday shopping season or key trade shows, for hardware/software systems. In the commercial world, companies usually have only one shot to get it right.

Over a period of years, elements of the development process have changed. Prior to the growth and proliferation of cloud computing, development tools basically had to be purchased at the beginning of a project for its duration. Additionally, computing resources, in terms of workstations and servers, had to be acquired for the full project duration.

Today, the development of hardware and software can be done securely in the cloud — whether it's a hybrid environment or a fully cloud-based environment — allowing development teams to scale resources as needed. For example, in the weeks and months leading up to a tapeout of a custom chip, or before the next release of complex software, the amount of hardware verification and software testing has to scale to a much higher capacity than during the rest of the development process.

In contrast to all these improvements in the commercial, consumer-facing world, development of complex hardware and software systems in the defense industry looks quite grim today. Current acquisition programs that have massive budget overruns and significant schedule delays are producing systems that are neither affordably sustainable nor modernizable.

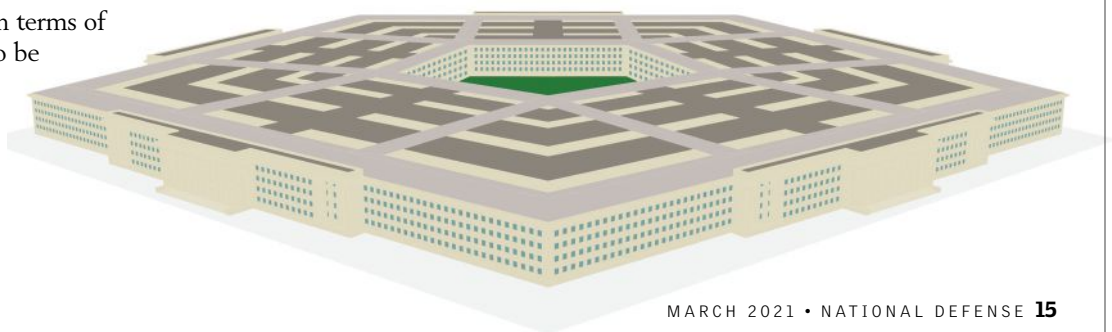
That said, it doesn't necessarily have to be this way. A digital revolution, as it has been experienced in the commercial world, seems unavoidable in the coming decades. Some of it can already be witnessed in the rise of nontraditional space companies and the government's future aircraft programs.

The solution for the defense industry to keep up with the changes in development can be seen as a two-fold methodology that requires both an investment and a growth mindset. The investment of money is obvious, but companies also need to change how they view their role in the process. The defense industry must operate with the mindset that they are in a highly competitive market where rapid and meaningful innovation determines whether they sink or swim.

This isn't the first time defense contractors have been encouraged to operate as if they have free-market competition. Some who are reading this article may even say, "We tried that before." In the late 1980s, there was a push to implement the well-intended, but ultimately ineffective, Total Quality Management system. The idea was that acquisition program cost overruns and schedule delays were the result of companies having to adhere to military standards. Some believed that the required adherence to these standards discouraged innovation. Essentially, if companies were given the freedom to determine their best way to meet system requirements, the result would be better products developed at a reduced cost and in less time.

It has now been proven that only when operating in highly competitive, free markets, do such practices yield the desired results.

Because Defense Department investments funded the creation of many cutting edge technologies used to develop systems to give the military an advantage, there seems to be a



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prevailing belief within the defense industry that the price of entry into the defense market by a nontraditional company is too high. However, that belief has proven to be a myth. In fact, defense-related technologies are now the foundation of our country's economic engine.

Entrepreneurs have used these defense technologies to develop highly profitable, innovative products that created new commercial markets. These new markets become highly competitive, thus fueling the desire to consistently introduce new products that delight the customer.

Some may argue that the defense industry has the same goals. To this point, one must acknowledge a significant difference between the defense industry and commercial product development. In the defense industry, product development is almost entirely funded by the Pentagon. This means companies have little incentive to avoid cost overruns and schedule delays.

On the flip side, commercial product development is funded internally, and missing a product launch cycle during a major buying season or introducing a poor-quality product can prove catastrophic to a company.

In the highly competitive commercial electronics systems market, high levels of internal research-and-development investment have resulted in tools and processes that are used to consistently produce affordable, high-quality, sustainable and modernizable products.

In recent years, defense officials have acknowledged the benefits of nontraditional commercial companies competing in the defense marketplace. The most visible example is the growth of commercial space contractors who are profitably selling systems to national security agencies and NASA that are priced lower and are more reliable than those produced by the government-subsidized incumbents.

The push for commercial space systems, along with other well-covered programs, indicates that the government is now taking action to own their acquisition destiny. As these actions continue to show significant benefits, more will be taken.

The overall reaction by the defense industry to these events has been interesting, with little indication of large-scale changes. Some still view this as a passing fad. In fact, they seem to be doubling down on working to maintain the status quo. But if we know anything from history, it's that labeling innovation as a passing fad can be problematic. A visit to Syracuse, New York, once dubbed the "Typewriter Capital of the World," could make that pretty clear. Ask a millennial now what a typewriter is, and they would likely need to Google it on their smartphone.

When companies encounter a disruptive technology for their market, many make the determination that the price to continue to compete is too high. However, not doing so can leave them at a competitive disadvantage. The list of companies that have learned the hard way that there is no such thing as "too big to fail" or "too important to fail" is incredibly long.

Looking toward the future, we can hope that entities within the defense ecosystem take a close look at the commercial sector as a model for best practices to evolve in order to meet the new needs of an educated, aware defense customer. **ND**

Steve Carlson is director of aerospace and defense solutions, James S.B. Chew is senior group director and Frank Schirrmeister is senior group director of solutions marketing at Cadence Design Systems. Chew also serves as chair of the National Defense Industrial Association's Science and Engineering Technology Division.

Viewpoint BY FRANK GAGLIARDI AND MATTHEW SLOANE

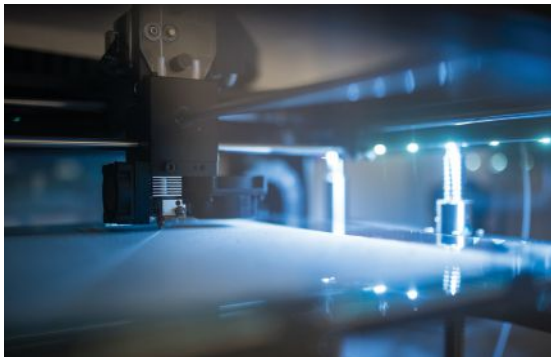
Changing Acquisitions with Advanced Manufacturing

In 2019, the secretary of the Army released a memorandum with the subject line "Army Advanced Manufacturing Directive of 2019-29: Enabling Readiness and Modernization through Advanced Manufacturing." The directive "establishes policy and assigns responsibilities for the employment of advanced manufacturing methods and materials in all capability areas."

It is apparent that the genesis of this directive stems from the realization that industry is evolving into the "digital era" of manufacturing. Digitization is the prime mover of advanced manufacturing, and data the fuel for its models, code and automata.

One of the most prominent areas readily associated with this promising manufacturing revolution is additive manufacturing, colloquially known as "3D printing." Despite its ubiquitous presence within the dictates of the Army directive, the use of additive manufacturing remains a conundrum for our acquisition personnel. The pressing question continues to be: when exactly is it appropriate and sensible to implement additive manufacturing in lieu of traditional manufacturing processes already in place?

Presently, on the surface, additively manufactured solutions and their usage seem destined to remain in the realm of prototyping. Their functional uses are often deemed unproven and cost prohibitive. However, to alleviate natural hesitancies with the unknown and subpar economic returns, the Army directive provides a jump-off point to propel its manufacturing into the future by taking a disciplined approach to selecting and designing parts for additive manufacturing.



The Army approach recognizes and affords the latitude to take its cues from industry and implement a multi-staged business case analysis for part selection. The essentials of the analysis may be comprised of four main areas that collectively address the benefits to the part, materiel system, and manufacturing process. These areas are strategic/performance drivers, technical considerations, activity-based cost assessments, and scheduling considerations.

The first step to any successful implementation of additive manufacturing lies with evaluating influential performance factors or strategic drivers. It is imperative that acquisition professionals resist the temptation to plug additive manufacturing machines into their existing manufacturing processes if they hope to reap all the potential benefits of the new technologies. The Advanced Manufacturing Directive of 2019-29 aids in pointing the acquisition professionals in the right direction by encouraging them to consider the potential improvements in their ability to design, produce, deliver and sustain materiel capabilities.

It is prudent for any industrial manufacturer contributing products to their supply chain as the Army considers theirs, to realize the benefits of product improvements by re-thinking and re-designing with additive manufacturing in mind.

Questions should be: "Have we optimized our design and accounted for the freedom of increased geometric complexity that additive manufacturing provides?"

"Are we considering advanced materials, or are we simply 3D printing with traditional materials for which we already have a traditional source available?" Alternatively, "are we additively manufacturing parts for manufacturing lines that have become obsolete or whose supply line has dramatically decreased?"

Program managers must first adopt — and engineering support staff must encourage — this type of thinking before the technical, cost and scheduling aspects of additive manufacturing are even considered or evaluated.

Once the acquisition community deems that additive manufacturing can provide a strategic benefit to the part design or the supply chain, they should juxtapose its assessment with a more traditional manufacturing process. These comparative assessments will incorporate technical analyses, cost evaluations and scheduling estimates.

The technical analyses must make considerations for both the additive manufacturing process and the additively manufactured end item, as they do for the traditional sources. Cost evaluations will bifurcate into direct and indirect breakdowns — with additive manufacturing-specific distinctions incorporated.

And, finally, scheduling estimates must account for supply chain variations due to the impact of additive manufacturing on sourcing, manufacturing, shipping and receiving — such as just-in-time manufacturing — and distribution.

These three stages of evaluation will provide program managers with a complete and nuanced view of the role of additive manufacturing in shifting the engineering and business landscape toward advanced manufacturing.

Additive manufacturing is not the sole panacea for production, but it does have the ability to change the way many items are "designed, made, bought and delivered."

Without this realization, a commensurate strategic approach and a nuanced view of the impact of additive manufacturing on the current engineering and business landscape, organizations will never realize the full benefits of this technology. ND

Frank Gagliardi, Ph.D. and Matthew Sloane, Ph.D. are the principal investigators for the Advanced Manufacturing Cell of the Quality Engineering and System Assurance Directorate at the U.S. Army Combat Capabilities Development Command - Armaments Center.

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Viewpoint BY GENE MORAN

Spinning SBIR Grants Into 'Gold' Requires Midas Touch

■ It's not uncommon for a company new to the federal marketplace to be elated with their award of a phase 1 Small Business Innovation Research (SBIR) contract.

If it's the first time breaking through, it should be cause for celebration for the awardee. In particular, the Defense Department and other government agencies can appear like a challenging labyrinth that requires understanding unique conditions and language to navigate.

A $50,000 or $100,000 award for a company that has been toiling with a new concept or technology may be the critical first step to the big leagues of sustained federal sales.

But let's put it into perspective. It is the essential first step of a very long road. The SBIR program is a time-tested way for the government to seed funding for new ideas. Some of those ideas are good, even great. Some will prove not so useful. It's OK for ideas not to pan out. The SBIR award will have achieved a success by mitigating government risk and avoiding a big bet that ultimately fails.

The Discovery Channel has a program called "Gold Rush," which has aired for many seasons and has since rolled out spinoffs. The storylines follow several family-run mining operations, primarily in Alaska and the Yukon area of Canada. Specifically, these miners run strip mines where acres and acres of dirt are excavated and then mechanically sifted to reveal very tiny specks of gold. During a months-long mining season, each mine might produce anywhere from 15 ounces to 2,500 ounces of gold that can be processed and subsequently sold. That's right — ounces of gold.

Depending on gold's market price, the season can prove wildly profitable, merely break-even, or bust. The themes of the show often revolve around wrenching decisions related to return on investment. Will it cost more to set up and run a strip-mining operation than the value of gold to be mined? If they dig for the pay dirt, will they capitalize on the dig before the harsh winter rolls in again? Revenue before costs can range from $27,000 to $4.5 million dollars. After the cost of operations, that's a challenging profit profile to sustain.

With SBIRs, return on investment for the government is more often a secondary consideration to solving the government need. Said differently, if the new capability significantly advances the warfighter's demand, the investment decision becomes a relativity discussion. Investment returns for the SBIR awardee may look like a more straightforward calculation. Getting that first phase 1 contract typically does not require extraordinary effort.

Companies using SBIR contracts are participating in Gold Rush-style mining. But they aren't the miner; they are the specks of gold.

In the best of circumstances, the technology or capability will be nurtured to maturity and maybe even a sizeable contract funded through a program of record. But those odds are long. The award mitigates government risk. So, yes they are in the Gold Rush, but do they know where they are in that relationship?

SBIRs stimulate small business participation in research and development that support critical priorities. They serve a noble purpose, and the government's desire to seed federal funding is well-intended. However, landing a SBIR contract does not mean a company has struck gold. It may have secured a phase 1 contract for $50,000 or $100,000. Compared to the maybe zero corporate dollars they had in the bank, yes, this is real money. But they are a speck of gold in a front loader of pay dirt until they are mature enough to connect to programs of record.

Company owners have toiled from one phase 1 SBIR award to the next for nearly 20 years, never having advanced to solve a need validated by a funded requirement. It shouldn't be the case.

A few years ago, while attending a professional seminar session led by the then-chief of naval research, he asked a hotel ballroom filled with 1,000 attendees to raise their hands if they had recently won a phase 1 contract. Many hands went up, well over half in the room. Next, he asked, "Raise your hand if you have received a phase 2 SBIR contract." A lot of hands went up, but not nearly as many as with phase 1. He continued, "Raise your hand if you have received a phase 3 SBIR contract." Fewer than 10 hands went up.

That was a dramatic decrease. That ballroom session of a professional conference was not an outlier; the condition revealed in the dramatic narrowing from phase 1 to phase 3 is the norm.

Why does that happen? There are myriad reasons. Failure of the technology to develop, government need changes, inability to integrate the emerging capability with technical specifications, and the customer-contractor relationship can play a role.

Failure to satisfy a need is perhaps the most damning and often not understood by contractors. SBIRs exist to promote small business opportunities while potentially allowing exciting capabilities to quickly breakthrough and solve a validated need.

SBIR funding is a tool. It is a way for the government to mitigate risk, encourage participation, and avoid chasing too

iStock photo

many shiny objects that cost a lot of money before the shiny thing is ready for prime time.

The SBIR budget across the Defense Department is approximately $2 billion, representing two-thirds of the government total for this type of contract. In fiscal year 2019, there were over 3,000 awards of SBIR contracts, with many companies receiving multiple awards. Just doing some quick math, it's clear that most awards are well below $1 million. Few lines of the president's budget proposal record numbers smaller than $1 million, although contract awards of less value are numerous.

It can be a useful exercise to learn where SBIR dollars appear in the budget.

All government agencies publish budget data by fiscal year in searchable formats online. The defense budget documents are exemplary compared to other agencies and are fertile ground to learn and increase understanding of how and why some decisions get made.

A company awarded tens of thousands of SBIR dollars to help share the development costs for a capability should feel great. Still, it does not necessarily advance a company to the larger funding and the real opportunity to solve even bigger government needs.

Getting into the actual budget as part of a program of record is the real Gold Rush in which they want to participate. Those same companies nurtured through SBIR can grow their customer relationships and solve need into the tens of millions of dollars per year. Sound capitalistic? It is. That's OK.

The acquisition system encourages participation by all, to the degree that it can, but as described above, the competitive odds are far from even. Despite SBIR initiatives, much of defense spending still goes to fewer than 100 companies. Bloomberg Government's report, "The BGOV200, FY19 Federal Industry Leaders," identifies only 69 companies that had total contracts exceeding $1 billion, for a total of $310 billion. That's close to half of annual defense spending going to fewer than 100 contractors.

There are hundreds of defense companies, and thousands of suppliers with revenues below $1 billion are competing for those remaining dollars. Some have a full-time presence in Washington, D.C. Some use a coterie of professional support in general consulting, business development and lobbying.

The SBIR awardee must be aware that those competitors are participating in different mining activities. Their more sophisticated mining operations have mapped out the gold a bit differently. They take position near a gold vein, and their specialized capability fits. Further, they communicate with their customer network with intent, learning about needs, obstacles and opportunities. They have likely mapped contacts and aligned funded requirements to their company specialties across multiple fiscal years of demand.

Many states have additional small business incentives that can complement an initial foray into government sales via SBIR. Such incentives include tailored loan programs, grants, tax credits and employee skills training opportunities. When thoughtfully coordinated, perhaps with a Procurement Technical Assistance Center counsel, these myriad programs can strengthen the federal sales tapestry of small businesses new to the federal customer.

For companies with SBIR contracts who also supply larger prime contractors, don't overlook the need to communicate with that large prime. Many subcontractors have insufficient contacts with their prime customer; they know too few people and speak too infrequently about the wrong things. A large prime customer must understand when a supplier is working on a SBIR. They can help with efforts to extend the work while simultaneously helping expand a network.

If an awardee's primary contact at the prime customer is a contracting official or purchasing agent, that should be a red flag of an insufficient array of communications with the prime. Many smaller companies new to the federal market hold back for fear of upsetting their prime and potentially inhibiting future business. It's an ill-placed fear. Ideally, they should want multiple people working at the prime to know everything about the capabilities, ongoing work, and desire to solve more issues.

A SBIR contract gives a subcontractor something positive to share with its prime that signals government interest in what they do. Work to connect those dots that may seem disbursed at the outset.

Those who have been supporting government needs and requirements understand the differences and subtleties described above. They know the programs and how to follow the funding. The SBIR award is a terrific tool. An awardee must appreciate that the contract vehicle is just that — a tool that provides an entry point. From that entry point, the real prospecting can begin. **ND**

Gene Moran is president of Capitol Integration, specializes in government affairs and is the author of "Pitching the Big Top: How to Master the 3-Ring Circus of Federal Sales."

Q&A with Dr. Mark Lewis, Director of NDIA's Emerging Technologies Institute

Dr. Mark J. Lewis in January took the helm of the National Defense Industrial Association's new Emerging Technologies Institute after serving dual roles in the Pentagon as the acting deputy undersecretary of defense for research and engineering and director of defense research and engineering for modernization.

One of the nation's foremost experts in hypersonics, he has also held positions as chief scientist of the Air Force, the founder of both the Center for Hypersonics Education and Research and the NASA-Air Force Constellation University Institutes Project, and the director of the Institute for Defense Analyses' Science and Technology Policy Institute.

He recently shared his thoughts with *National Defense* magazine Editor in Chief Stew Magnuson on the role of the new institute and some of the advanced technologies it will be following.

Can you tell us about the new institute and what you hope to accomplish as its first leader?

The Emerging Technologies Institute (ETI) is NDIA's new think tank, devoted to accelerating the development and implementation of technologies that will be essential to the future defense of our nation. Our nation's defense is at a critical point; the technological superiority that our military has come to depend upon is being challenged across the board by peer competitors and emerging threats. Make no mistake, we are in a race, and it is one with the most serious of implications.

If the United States is to retain its military advantage, we need to double down on the full range of modernization technologies, including artificial intelligence and autonomy, biotechnology, cyber, quantum science, microelectronics, networked systems and communications, directed energy, space and hypersonics.

To that end, ETI is being stood up as a source of trusted information and thought leadership on defense research and engineering. Very importantly, we're not just here to advocate for more total spending on research and engineering, but rather to present credible and reliable analyses on where those investments should be made, in order to maximize their value and minimize the time to delivery.

Do you see it playing a role in influencing the Defense Department's advanced technology goals? If so, how will you do that?

I absolutely do expect ETI to play a role in setting the department's goals, as well as impacting how those goals are realized.

Ultimately, we want to not only contribute to the national debate, but actually frame that debate in order to encourage actions that will accelerate the delivery of modern capabilities into the hands of our warfighters.

We'll do that in several ways. ETI will pull together teams of members who will work with appropriate government officials and other essential partners, to research and convene discussions on a carefully chosen set of technology issues. Remember that NDIA's approximately 1,700 corporate members and more than 63,000 individual members represent an incredible pool of talent that includes expertise on just about any technology topic we might touch upon. That's a strength that is truly unrivaled by any comparable organization.

We are committed to producing research products that are of the highest quality, building a reputation for objectivity and independence, and drawing on the incredible resources of NDIA as well as the unrivaled access we have to industrial and government leadership.

We are also building strong partnerships with academia so that we can leverage the best and the brightest that our universities have to offer. Further, we will take full advantage of NDIA's incredible convening authority to address audiences across the executive branch and on Capitol Hill, as well as industry, academia and the broader research community.

I heard you say about two years ago that the technological challenges developing hypersonics were tough but by no means insurmountable. Are the services developing the technology making progress? What are some of the harder challenges that lie ahead?

I have spent the majority of my research career in hypersonics, and it's an area that I believe is absolutely essential to national defense. The simple answer is yes, we have made remarkable progress in developing this technology and getting it closer to fielded systems.

Unfortunately, so have our competitors, who are ahead of us in a number of key aspects. We can always improve the technology, but at this point I honestly believe our remaining challenges are more policy and infrastructure than technical.

We know hypersonic systems work. Now it's just a matter of being able to design, test and deploy these systems in a timely and efficient manner.

In many ways, that means relearning how we used to do things in the past and insisting on moving beyond prototypes to deliver real capabilities at a useful scale.

What do you see as the main benefits of AI in the military? How do you assess the services' efforts to integrate artificial intelligence into their day-to-day operations?

Al is often called a game-changer, a term that is overused, but in this case is absolutely appropriate. But we also have to be careful, because the term AI is misused quite a bit, thrown about with some abandon.

There are too many folks who think they can solve technological roadblocks by merely invoking AI, but we're not there yet. True AI brings several important attributes — including the ability to rapidly incorporate information from multiple sources, and to speed up decision-making cycles. AI can help us relieve humans of tedious tasks so that people can do what they do best. We have also learned that AI-powered systems are willing to take risks to themselves that humans would be unwilling

NDIA photo

to take.

The services are indeed all stepping up to the plate in AI. I would also note that beyond the services we have activities across the enterprise, including the Defense Advanced Research Projects Agency, the Joint Artificial Intelligence Center, as well other Defense Department organizations such as the Office of the Director of Operational Test & Evaluation, which is taking an early lead in thinking through how we will effectively test AI systems.

Having said that, I would warn that we are still in the early stages of learning how AI can be used best, including when and where it can buy its way into future systems. To that end, I would argue that our goal has to be establishing AI as a systems engineering discipline and coordinating R&E efforts across the board.

There are many alarmists who warn against the dangers of AI being applied to weapon systems. What's your take on the controversy?

The Department of Defense has been very clear on establishing ethical guidelines for the use of AI. I actually think AI can lead to weapons that are used more responsibly. For example, an AI system that helps us refine and pinpoint a target could reduce the chances of collateral damage or targeting errors; and an AI system that removes a human operator from harm's way is clearly one that I would prefer.

This is an issue in which ETI, and NDIA as a whole, will have a very credible voice.

I do worry about how our peer competitors will use AI, and that is one of the reasons I want the United States to develop these capabilities first.

There is an adage that laser weapons on the battlefield are always just a year away from becoming a reality. The year may be up as the Navy is integrating a solid-state laser into an Aegis Weapon System aboard a destroyer later this year. (See story on page 10)

Do you think this will be a niche capability, or open the floodgates to more applications if the program is successful?

We are definitely seeing the dawn of directed energy as another arrow in our defense quiver.

This is being driven by two developments. The first is the practical realization of lasers that operate at useful power levels. It isn't just about power of course, other aspects of the technology are also important, including beam control, though we have seen significant advances there as well.

Another development is a refined understanding of how we would use directed energy. We have come to understand that a laser that simply duplicates the effects of a kinetic weapon really doesn't buy its way onto a platform unless it can do so at significantly reduced cost; and a laser that brings some new capability — say defense against a hitherto unstoppable threat — really brings value.

The Navy application is especially exciting — think of a directed energy weapon that could give a ship a near-infinite magazine depth.

Base defense, particularly against low-cost unmanned craft, is also a very attractive application, from both a capabilities standpoint as well as a cost tradeoff.

Biotechnology is a field that the military obviously has an interest in developing. What are some potential applications for biotech in the military?

Until recently, many in the DoD viewed biotechnology as promising, but not something that was directly relevant to their mission. That has changed significantly since the pandemic began, in part because much of the success of the various COVID vaccines was built on investments that the Department of Defense made years ago.

But biotechnology is about much more than medicine or human performance. In fact, it opens up new opportunities for manufacturing and can enhance the industrial supply base, not only giving us new materials but also alternate, less vulnerable, production pathways.

Biotechnology, for example, can offer new ways to manufacture structural materials — think of repairing a runway crater by spraying microorganisms into it — or even in-situ manufacturing of jet fuel. That makes biotech one of the most exciting disciplines of this century.

What concerns you most about the technological competition between the U.S. and its allies vs. China and its ambitions?

Earlier I referenced peer competitors who are breathing down our necks, and have in some cases exceeded our capabilities. China is the country that concerns me the most. They are making significant advances in a number of the critical technology areas, including hypersonics and AI, and they have done so in large measure by wholesale theft of American intellectual property.

But what I worry about most is the somewhat minimal likelihood that China will apply the same ethical standards to those technology areas as we will. For example, consider the dangers of biotechnology if misused; will China abide by ethical standards? There are about 12 million Uyghurs who would tell you no. What about the application of AI? Just look at what the Chinese are doing in establishing and manipulating social ratings of their own population.

Even in the hypersonics arena, we see China and Russia both blurring the lines between conventional and nuclear systems in ways that we will not. So bottom line, this is a technology race we dare not lose. And that is why the ETI is so important at this time.

Finally, if you could do one thing to boost the number of U.S. students pursuing careers in science, technology, engineering and math, what would you do?

I actually don't think it's a matter of attracting more students into the STEM disciplines, as there isn't much evidence of an overall STEM shortage. What I would like to do instead is attract students already interested in STEM to work on problems in national defense. And the way to do that is to give scientists and engineers exciting and meaningful things to work on that will contribute to the growth and security of our country. **ND**

SOCOM Shows Interest in Hybrid, AI-Enabled Vehicles

BY YASMIN TADJDEH

Special Operations Command is experimenting with emerging technologies as it works to bolster its ground vehicle fleet with new capabilities.

The command's family of vehicles — which features 3,000 platforms — includes the Ground Mobility Vehicle 1.1, light tactical all-terrain vehicles, non-standard commercial vehicles and mine-resistant ambush protected platforms, said Navy Cmdr. Tim Hawkins, a SOCOM spokesman.

Special Operations Command is currently investing its research, development, testing and evaluation dollars for vehicles in lightweight armor, hybrid-electric systems, advanced situational awareness and autonomy/semi-autonomy, Hawkins said in an email to *National Defense*. It is seeking technology that maximizes mobility, payload and protection.

Last year, the organization and its industry partner finished production of the Ground Mobility Vehicle 1.1, a highly mobile platform that supports both lethal and non-lethal special ops missions.

The vehicle — which is manufactured by General Dynamics Ordnance and Tactical Systems — is "becoming a mainstay of our capabilities throughout the force," said Col. Joel Babbitt, program executive officer for SOF Warrior, which oversees the command's vehicle portfolio.

The system offers SOCOM increased mobility including internal CH-47 Chinook transportability, he noted during the 2020 Virtual Special Operations Forces Industry Conference hosted by the National Defense Industrial Association.

Key capability areas of interest for the GMV include lightweight armor material, improved payloads, storage capacity, vehicle weight reduction, terrain-specific tire alternatives as well as command, control, communications, computers, intelligence, surveillance, and reconnaissance integration cost reductions, according to Babbitt's slides.

Additionally, the command is currently building two GMV 1.1 hybrid prototypes to explore the usefulness of hybrid-electric technology, Hawkins said.

"We expect to conduct performance testing and gather SOF operator feedback this summer," he said. "The results will help inform future decisions on whether to invest in outfitting the existing GMV 1.1 fleet with the technology."

A spokesperson for General Dynamics said the company is not involved in the hybrid-electric prototype effort.

The command also plans to purchase hybrid-electric prototypes of its light tactical all-terrain vehicle in the coming fiscal year, Hawkins added. "The LTATV prototypes will be evaluated by the program office and SOF operators to help inform any future requirements and possible procurement of the technology," he said.

The LTATV is a Special Operations Command-modified, commercial-off-the-shelf lightweight platform that can be internally transported via V-22s, H-53s and H-47s, according to Babbitt's slides. There are two variants including a two-seat and a four-seat platform. The vehicle is intended to perform a variety of missions including reconnaissance and medical evacuation.

Last year the General Services Administration awarded a multi-year contract in support of the command for the lifecycle replacement of its LTATV fleet to Polaris with a value of up to $109 million.

Polaris offered SOCOM its MRZR Alpha platform, a lightweight vehicle with off-road capabilities that was purpose-built for the command.

Mark Schmidt, manager of defense programs at Polaris Government and Defense, said the company would be providing SOCOM with a hybrid-electric variant of the LTATV in year three of the program.

"We're really excited to test and field a vehicle like this with Special Operations Forces as it will open up even more operational use cases with a high level of export power and even quieter operational modes," he said in an email.

The company leveraged work from its commercial product lines as it developed the new vehicle, said Shane Novotny, director of engineering at Polaris Government and Defense.

"The MRZR Alpha is engineered and designed to meet specifications and requirements that greatly expanded on the durability, payload and performance of the current LTATV, the MRZR Diesel," he said.

The platform has a durable chassis, powerful drivetrain and modular vehicle design, he noted. It features an expanded exportable power system and can carry more payload.

"We've also increased the size of the cargo area by 60 percent and added greater functionality through the incorporation of a flatbed design that includes cargo tie-down rails for added adaptability," he said. "For example, with the tailgate installed and flat, two litters can be secured without any modifications to the second row or its seating capacity."

The vehicle is powered by an 8-speed automotive transmission and a 4-stroke, 118 horsepower turbo-diesel engine, according to the company. That provides 200 foot-pounds of torque. Additionally, the four-seat version includes 2,000 pounds of payload, run-flat tires and can reach top speeds over 60 miles per hour.

Earlier this year the company wrapped up the critical design review phase of the program, Schmidt said.

"Our rigorous testing and extensive off-road mission profile field evaluation miles … [have] proven the MRZR Alpha's performance and durability at extreme heat, in the cold chamber and when operating on desert sand dunes or rocky terrain at elevation," he said.

Production of the platform will be followed by government durability and user testing, as well as air transportation certifications, he said.

Because the effort is an indefinite-delivery/indefinite-quantity contract, the number of vehicles is not specified. However, Schmidt said the company could produce 1,500 MRZR Alphas per

Polaris photo

year on its current production line.

Nick Francis, director of Polaris Defense, said the contract was structured in a way that did not limit the vendor from expanding on the vehicle's capabilities, which allowed the company to exceed requirements in some areas.

"This was a great approach, because it doesn't put a limit on a very qualified industry base," he said.

Previous MRZRs have been outfitted with a variety of payloads including counter-drone systems, direct-fire weapons, ISR systems and autonomy packages. Schmidt noted that with the Alpha's increased payload capacity, exportable power and physical space, it is easier to incorporate a variety of payloads.

In year two of the program, testing and delivery will focus on an Arctic mobility package, Schmidt said.

This "includes a full cab enclosure and tracks," he said. "This will greatly expand the terrain and environments the MRZR Alpha can operate [in], to include snow and ice."

Planning is also ongoing to outfit the LTATV with autonomous capabilities, Hawkins said. The command is considering purchasing a few autonomous platforms in the coming fiscal year.

"We will then test the prototypes and conduct user evaluations to help determine the usefulness of the technology, which will also help inform any possible future requirements for integrating autonomy into any portion of our fleet," he said.

Other artificial intelligence efforts include a data-logger system that collects vehicle operational parameters to help advise maintenance efforts, Hawkins said.

"Machine learning is used in this logger to help project managers and logisticians determine when a vehicle will reach the end of its economical usefulness," he said. "This a key factor when making informed decisions on whether vehicles should be replaced or receive lifecycle extensions."

Meanwhile, one new vehicle Special Operations Command has indicated it may be interested in pursuing is the Joint Armored Ground Mobility System, or JAGMS.

Currently, no formal acquisition process is planned, Hawkins noted. However, last year the command conducted a market analysis of the industrial base for vendors that could produce such a platform. That report is under review,

Ground Mobility Vehicle 1.1

Defense Dept. photo

he said.

In a request for information released last year, Special Operations Command said it was seeking industry input about an armored ground tactical vehicle that could transport nine to 11 passengers as well as be internally transported in a C-130 aircraft.

"The government is primarily focused on understanding the marketplace for commercial and non-developmental items and/or commercial items easily modified," the solicitation said.

Mark Cancian, senior adviser at the Center for Strategic and International Studies' International Security Program, said many of SOCOM's vehicle programs are well suited for counterterrorism and counterinsurgency operations, which the command has become known for in the past two decades. However, with the Pentagon emphasizing great power competition with advanced adversaries such as Russia and China, those types of platforms are not as ideal.

The other services are moving "toward armored vehicles because of the higher level of threat," he said. "SOCOM would have to at least balance its vehicle inventory with some sort of armored vehicle that could operate in a higher threat environment."

A heavily armored vehicle such as JAGMS could be particularly useful in great power competition, Cancian said.

Meanwhile, Special Operations Command is maintaining its fleet of mine resistant, ambush-protected vehicles, which consist primarily of SOF-modified MRAP all-terrain vehicles and RG-33-A1 platforms.

MRAPs gained fame during the wars in Iraq and Afghanistan after being rushed into the field to protect troops from roadside bombs.

"We are actively resetting those at this point in time and managing the obsolescence of them," Babbitt said.

Areas of interest for the command include active reset operations, obsolescence management and sustainment cost reductions, according to his slides.

One of the largest vehicle programs for the military writ large has been the Army and Marine Corps' acquisition of Oshkosh Defense's joint light tactical vehicle. Special Operations Command does not plan to purchase purpose-built JLTVs, Hawkins said, but is currently collaborating with the JLTV Joint Program Office and its user community "to determine the potential configuration and cost of a future JLTV 'SOF-kit.'"

Babbitt noted that the JLTV will be brought into the SOF fold via the services.

"This is a service-provided solution from the Army, Navy, Air Force, Marines to their components within USSOCOM," he said. "It's a great capability and will certainly be a mainstay of our capabilities into the future."

A potential future acquisition opportunity is a lifecycle replacement for the non-standard commercial vehicle fleet in the coming years, Hawkins said.

SOCOM uses the platform — which resembles regular trucks found on highways all over the United States — when they want to blend in with local populations overseas, Babbitt said.

"If you want to look like just another jingle truck, this is what you're driving, except ours are armored, ... much better maintained and can go a lot of places that some of the local vehicles may or may not be able to," he said.

Capabilities of interest for the current fleet include lightweight armor materials, lightweight vehicle components, C4ISR cost reductions and suspension technology, according to Babbitt's slides. **ND**

Army Putting New Infantry Squad Vehicle Through Paces

BY MANDY MAYFIELD

The Army is testing its new transport vehicle less than a year after it awarded a contract to GM Defense for the program.

Developmental testing of the Infantry Squad Vehicle, or ISV, began in November and will culminate in an initial operational test in August, said Steve Herrick, product lead for ground mobility vehicles at the program executive office for combat support and combat service support.

The Army received the first batch of its new ISVs in October from GM Defense 120 days after awarding the company a contract. The initial delivery of the vehicles is part of the Army's effort to fast-track the acquisition of an all-terrain, highly transportable platform intended to provide ground mobility capabilities for infantry brigade combat teams.

The ISV is an all-terrain troop carrier for nine infantry squad soldiers and their associated equipment. The vehicle has a payload requirement of 3,200 pounds and a maximum weight of 5,000 pounds. It is also required to be transportable on a CH-47 Chinook helicopter and airdropped by C-17 and C-130 aircraft, according to the Army.

GM Defense was awarded a $214 million contract for the program in June to manufacture 649 ISVs. The company will support the production of up to 2,065 vehicles with additional authorization over eight years.

Following the award, the company has since delivered all nine test assets to proving grounds and continues to produce vehicles per the contract requirements, the company's Chief Engineer Mark Dickens said in an interview.

The Army's product lead for ground mobility vehicles office, in coordination with Army Test and Evaluation Command, has already executed key safety and performance tests, Herrick said in an email.

Testing for reliability, availability and maintainability was slated to take place at Yuma Proving Ground, Arizona, and Aberdeen Proving Ground, Maryland, in February, he said.

The vehicle has already completed successful tests in the static drops category for low velocity airdrop. Low velocity airdrop is the delivery of a platform or other asset out of an aircraft involving parachutes that are designed to slow the speed of descent as much as possible so it impacts the ground with minimal force.

Infantry Squad Vehicle

See the ISV in action

Starting in March, the service will begin live drops with soldiers executing missions after the drop, Herrick said.

Following the airdrop testing, initial operational test and evaluation exercises will begin at Fort Bragg, North Carolina, in August, Herrick said.

"The program management team is executing an aggressive acquisition strategy to field the first unit equipped," which is slated to be the 1st Brigade Combat Team, 82nd Airborne Division, at Fort Bragg within the third quarter of this fiscal year, he said.

The ISV is based off General Motors' Chevrolet Colorado ZR2 mid-size truck. The majority of the offering is crafted from commercial-off-the-shelf parts.

Some 90 percent of the vehicle is made from COTS components, which has enabled fast-paced deliveries, lowered costs and simplified parts sustainment, Dickens said.

The ISV program is the first major award for GM Defense since the subsidiary was re-established by its parent company in 2017. The company returned to the defense market in 2017 after a long hiatus that began when a previous iteration of GM Defense was sold to General Dynamics in 2003.

Tom Spoehr, director of the Heritage Foundation's Center for National Defense, commended the Army for the speed of the program, noting that the service has refrained from burdening the effort by adding unnecessary requirements.

"The program is moving at a decent rate of pace. It has not been slowed down. It hasn't had any delays, protests, setbacks," he said. "They've taken a very hard line in terms of just keeping this program very simple."

The high percentage of commercial equipment in the program makes it well suited for a more rapid acquisition strategy, Spoehr said.

The Army "probably looked to what [the] defense industry had out there, and maybe even tailored their requirements in that direction," he said.

The Pentagon's effort to embrace commercial capabilities that meet its requirements is a step in the right direction, Spoehr said.

"You don't want the military to be completely oblivious to what industry has to offer, so I think this is a good marriage of both," he added.

GM Defense is teaming with Ricardo Defense on the ISV program. Ricardo will handle integrated product support, including technical manual development, new equipment training, provisioning, total package fielding and field service support.

During the ISV competition, the Army selected GM Defense, an Oshkosh Defense-Flyer Defense team and an SAIC-Polaris partnership to build two prototypes each. The teams were awarded a $1 million other transaction authority agreement to build the vehicles. OTAs are a contracting mechanism that allow for more rapid prototyping efforts than traditional contracting methods.

Army Test and Evaluation Command conducted developmental testing of all three vendors' prototype ISVs from

GM Defense photo

December 2019 through January 2020, according to a recently released report from the Defense Department's chief weapons tester. Following those examinations, the ISV program office conducted two soldier "touchpoint" tests in January 2020.

According to the report from the Pentagon's former Director of Operational Test and Evaluation Robert Behler — which was released this January — the vehicles were constricting for soldiers.

"All vendors' ISVs are cramped and soldiers cannot reach, stow and secure equipment as needed, degrading and slowing mission operations," the report said. During the tests, "soldiers on all ISVs could not readily access items in their rucksacks without stopping the movement, dismounting and removing their rucksacks from the vehicle."

Despite these findings, Herrick said the ISV still meets all of the requirements created for the program.

"The Army's assessment is that the ISV requirement and solution set are in alignment," he said.

"Soldiers who evaluated the ISV prototypes in both soldier touchpoints were able to carry their rucksacks, helmets, vests, individual weapons and night-vision goggles for missions," he said. "There are no recommendations for change at this time that have not already been implemented."

When asked about the report, Dickens said the soldier feedback GM Defense received from the touchpoints was favorable, noting the company found a unique seating configuration for its offering given the small footprint laid out in the Army's requirements.

Spoehr also noted that although the DOT&E finding was valid, a vehicle with strict requirements such as carrying nine soldiers and having the ability to fit inside a CH-47 Chinook aircraft is going to be a cramped ride.

"The parameters that the Army specified — the weight, the height, all those kinds of things — it was going to be cramped no matter what," he said. "The laws of physics makes this a cramped vehicle, period. To get nine soldiers on it and it has to be this [specific] weight and size — there's no way it is not going to be cramped."

Meanwhile, GM Defense has started renovations to a North Carolina facility where it intends to manufacture the ISVs, Dickens said.

The first group of trucks will be built at General Motors' Milford Proving Ground in Michigan. Later this year, production of the vehicles will move to a Concord, North Carolina, facility, a plan that has long been in place, he noted.

Construction at the 75,000-square-foot facility is expected to continue through early spring 2021, and the production line there will begin delivering vehicles in April 2021, according to the company.

"It was a perfect footprint for us to transition to what we needed for a manufacturing facility," Dickens said. There have "been modifications to the concrete to facilitate the manufacturing assembly line and the shipping, receiving [and] security. We have made modifications to the grounds for storage of vehicles in a secure manner."

The facility can support the production of up to 2,065 vehicles with additional authorization over eight years.

The company is duplicating its production processes from Milford Proving Ground at the North Carolina plant, Dickens said. Many individuals currently working out of Milford were hired from the North Carolina area and brought to the proving ground to be trained prior to working at the new facility. ND

UNMANNING THE GUNS

Navy Has High Hopes For Robotic Ships

Boeing Illustration

BY JON HARPER

The Navy is keen to integrate large unmanned vessels into the fleet in coming decades. But there remains a great deal of uncertainty about how much of the total force will be robotic as political, budgetary, operational and industrial considerations complicate the calculus.

Chief of Naval Operations Adm. Michael Gilday in his "CNO Navigation Plan" said these types of vessels will play a vital role in the future.

"Successfully integrating unmanned platforms … gives our commanders better options to fight and win in contested spaces," he said in the guidance, which was released in January. "They will expand our intelligence, surveillance and reconnaissance advantage, add depth to our missile magazines, and provide additional means to keep our distributed force provisioned."

They will provide additional "offensive punch" and "affordable solutions" to grow the Navy, he added.

Officials also tout unmanned platforms as a way to keep sailors and Marines out of harm's way.

The sea service's latest 30-year shipbuilding plan, released in December during the final weeks of the Trump administration, laid out a long-term vision for robotic vessels, calling for additional resources to "accelerate fielding the full spectrum of unmanned capabilities, including man-machine teaming ahead of full autonomy."

For the future years defense program in fiscal years 2022-2026, the blueprint calls for about $4.3 billion for 12 large unmanned service vessels (LUSV), one medium unmanned surface vessel (MUSV), and eight extra-large unmanned

LEFT: Boeing's Echo Voyager, which is informing development of the company's Orca XLUUV for the Navy.

ABOVE: Artist's rendering of an MUSV

RIGHT: Sea Hunter USV

L3Harris concept, Leidos photo

underwater vehicles (XLUUV).

The Navy envisions LUSVs being 200 feet to 300 feet in length, with full load displacements of 1,000 tons to 2,000 tons; MUSVs being 45 feet to 190 feet long, with displacements of roughly 500 tons; and XLUUVs having a diameter of more than 84 inches, according to the Congressional Research Service.

The large surface ships are initially intended to operate as missile-launching platforms in support of manned multi-mission platforms; the medium ones as low-cost forward deployed sensors and communications nodes; and the extra large boats as modular platforms capable of delivering multiple payloads at extended ranges.

Beyond the FYDP, a wide range of numbers have been thrown around for how many platforms could be acquired.

See the Sea Hunter in action

The Pentagon's Future Naval Force Study called for procuring 143 to 242 unmanned surface and undersea vessels, including 119 to 166 USVs and 24 to 76 UUVs by the 2040s.

"We're not sure of the exact numbers yet," Chairman of the Joint Chiefs of Staff Gen. Mark Milley said at the U.S. Naval Institute Defense Forum Washington conference. However, at some point in coming decades upwards of 25 percent of the fleet could be sailorless, he said.

However, many details about what the Navy will buy, and when it will buy, have yet to be fleshed out.

"As we learn from land-based testing and as prototypes are matured, specific procurement profiles outside the FYDP will be refined," the shipbuilding plan stated.

Meanwhile, lawmakers are questioning the Navy's vision.

The fiscal year 2021 National Defense Authorization Act cut $205 million from the service's $464 million request for medium and large technology components and prototypes.

The act also put restrictions on the Defense Department's ability to add offensive capabilities to such systems until it could satisfy Congress that the platforms would adhere to the laws of armed conflict and were the most appropriate vessels to meet offensive requirements.

"I want to make sure we get it right," Rep. Rob Wittman, R-Va., ranking member of the House Armed Services seapower and projection forces subcommittee, said at the Surface Navy Association's annual symposium.

"I want to make sure we don't lose time by taking some missteps," he added. "I would rather take a little bit of time to exactly determine how unmanned gets integrated into the fleet, how things get done with the capability there."

Other challenges identified by naval observers include connecting the platforms to the service's broader command, control and communications network, and how problems will be addressed when the vessels have problems at sea with no sailors aboard to fix them.

The ships will need to have a relatively high level of autonomy and not be remotely piloted, noted Brent Sadler, senior fellow for naval warfare and advanced technology at the Heritage Foundation's Center for National Defense.

"It's not going to be like [today's aerial] drones where you have to have constant or near-continuous control or data feeds to control these platforms," he said. That's especially true for underwater robots.

Rep. Joe Courtney, D-Conn., chairman of the HASC seapower subcommittee, said lawmakers aren't fundamentally opposed to relying more heavily on robotic systems.

However, "it's not unreasonable before we make large investments, to really get some of these basic fundamental questions fleshed out," he said.

Eric Labs, senior naval analyst with the Congressional Budget Office, said legislators have generally been supportive of new shipbuilding programs. However, "they are not very supportive when they do not have a clear understanding and vision of what the ship is going to do and how it's going to serve U.S. national interests."

Ronald O'Rourke, a naval specialist at the Congressional Research Service, said lawmakers have a number of factors to consider as they evaluate funding requests going forward.

"The Navy's large UV programs pose a number of oversight issues … including issues relating to the analytical basis for the more distributed fleet architecture; the Navy's accelerated acquisition strategies for these programs; technical, schedule and cost risk in the programs; the proposed annual procurement rates for the programs; the industrial base implications of the programs; potential implications for miscalculation or escalation at sea; the personnel implications of the programs; and whether the Navy has accurately priced the work it is proposing to do," O'Rourke wrote in a recent CRS report, "Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress."

James "Hondo" Geurts, who served as assistant secretary of the Navy for research, development and acquisition prior to the presidential transition, told reporters that robotic platforms are meant to supplement manned ships, not replace them, saying it's not an "either/or" choice. The sea service is planning additional testing events and exercises to demonstrate USV and UUV capabilities and develop concepts of operations to determine how best to integrate them into the larger fleet architecture.

"Do I see a place where we're having large numbers of [ships] running around doing ISR and collection and creating comms nodes across a vast expanses of ocean? Absolutely," said Geurts, who as of press time was performing the duties of undersecretary of the Navy. "Now it's just, how do we do it? And can we do it cost effectively?

"When you get into the lethal end of things, I think we have notions and ideas that we've got to go off and experiment and demonstrate and prototype," he added.

The service has already been experimenting with prototypes such as the Sea Hunter USV, which has successfully sailed from Hawaii to California. Other platforms, such as the Orca extra large UUV, are under development.

Geurts said each new platform will have to prove its capabilities and utility to get integrated into the fleet.

Speaking at the Brookings Institution, Milley said at some point in the future there could be sailorless aircraft carrier battle groups. "I'm not saying it's going to happen, but it's theoretically possible."

However, some missions such as carrier operations are extraordinarily complex, noted Vice Adm. James Kilby, deputy chief of naval operations for warfighting requirements and capabilities.

"Let's stair-step our way into this" introduction of robotic platforms, he told reporters. "Let's think about manned and unmanned teaming. Let's look at complexity of the mission, let's look at duration of the mission. … Let's not drive to the toughest case" in the early stages.

See the Echo Voayer in action

The portion of the fleet that is unmanned will be determined not just by how many robotic vessels are procured in coming years and decades, but how many manned boats are acquired.

Right now, there are currently just shy of 300 manned platforms in the battle force. Under the latest plan, that number would grow to 316 by 2026 and surpass 400 by the mid-2040s.

However, the proposed buildup would come with a hefty price tag — between $27 billion and $36 billion annually over the next 30 years, according to Labs. Many observers have ques-

tioned the plan's affordability.

For comparison, Congress allocated about $24 billion for Navy shipbuilding in 2020.

"To get to this larger fleet is going to require substantially more resources … than what we've seen" in recent years, Labs said.

Also unclear is the extent to which the new U.S. administration will back its predecessor's vision.

President Joe Biden has said the military writ large should emphasize capability over capacity, and he has touted unmanned systems as a key technology for the future.

Biden's nominees for senior Defense Department positions have been noncommittal about the longstanding goal of a 355 manned-ship fleet, but touted the importance of artificial intelligence and autonomy — key enablers of robotic platforms.

Echo Voyager open water test

Boeing photo

The new administration is expected to put forth its first shipbuilding plan this spring. Sadler said it is possible that Biden's team will only make minor adjustments to the existing one.

"They might even actually slam on the gas and say, 'We need more, this is not good enough,'" he said. "But given the strength of the voices of those that want to use DoD ... as a bill payer [for domestic programs], I'm not as optimistic that that's a likely outcome."

Another key factor that will affect the Navy's plans is the state of the industrial base. The service has highlighted the need to bolster industry and the workforce to achieve its vision, and has promised more investments.

Traditional players in the military shipbuilding sector such as Huntington Ingalls Industries will be involved in producing robotic vessels, Sadler said.

In January, HII announced that it had completed the first phase of its new Unmanned Systems Center of Excellence in Hampton, Virginia. It will be used to assemble hull structures for Boeing's Orca XLUUV offering for the Navy, the company said in a press release.

The main facility, sized at 135,000 square-feet, is scheduled to be completed by the end of 2021, and will be used for prototyping, production and testing of new platforms.

"HII has made significant investments in the unmanned systems industry during the last year," said Duane Fotheringham, president of Huntington Ingalls' Technical Solutions unmanned systems business group. "This facility solidifies HII's commitment to advancing development of unmanned systems for our current and future customers."

However, nontraditional players can be expected to expand the industrial base for these types of ships and supporting technologies, Sadler noted.

"There are other … builders out there that we may not be thinking of yet," he said. "There may be more entrants into this market once the money and the contracts start going out and it becomes more real."

However, right now "too many questions are swirling" regarding the budget and other issues to encourage a rush from nontraditional companies to jump into the market, he added.

Down the road, growth in the robotic ships industry — and the jobs it provides — will likely bolster support for these programs in Congress, Sadler noted.

However, any push to shift funding away from manned platforms toward unmanned programs would make lawmakers whose constituents would be negatively impacted "kind of pissed," Sadler cautioned.

"You don't want to mess with that … because from a purely political calculation, you're going to make enemies" on Capitol Hill, Sadler said.

What is the right mix of manned and robotic ships for the future fleet?

"I have not seen or heard of any argument that would make me think that unmanned has no place in the future," Sadler said. "It will have some role. How big it is, is really the question — and how fast" the Navy adopts the technology.

The Future Naval Force Study envisioned the unmanned portion increasing to as high as 35 percent, or more than one-third of the fleet.

"I would certainly start to get skittish if the ratio of unmanned vessels became upwards of 30 percent of the total force," Sadler said. "I would start to worry that we're becoming a little too unbalanced."

Robotic ships pose some disadvantages when it comes to interacting with allies and conducting peacetime operations, he noted.

"You don't have a crew that can go ashore and engage," he said. "You don't have a ship that can exercise with a partner navy or coast guard like a manned ship can. And those are very important missions, especially in the military diplomacy arena, which is very important if you're going to compete with the Chinese in the South China Sea and the East China Sea."

New systems need to demonstrate their reliability and ability to perform their assigned missions before the Navy should even consider reducing its demand for manned vessels, which are more proven platforms, he added.

Support for them will ultimately depend on how well they perform at sea, he noted.

"Congress needs to know that they're going to get a return on investment before they really expand the production," Sadler said, noting that interest in drone aircraft ramped up after they demonstrated their utility in combat zones in places like Afghanistan and Iraq.

"When they started killing bad guys up in the mountains and in the desert, it became, 'Oh wow, this is great! We want it.' Then it was on steroids for many, many years," Sadler said. "The same thing is true for these unmanned [naval] systems as well." ND

Navy Chooses Evolution Over Revolution for Shipbuilding

BY STEW MAGNUSON

Vice Adm. William Galinis, Naval Sea Systems Command commander, points to the Arleigh Burke-class guided missile destroyer program as an example of how the service should acquire more ships.

"If you think about the DDG-51 class and how we have evolved that since the concept first came about back in the 1980s and where we are today … it really is kind of a model program," he said at the Surface Navy Association's annual conference.

The evolutionary type design versus the revolutionary approach has made it combat relevant throughout its life and continues to do so, he said.

Whether it is the current goal of a 355-ship Navy or the even higher 500-plus ship fleet proposed by Mark Esper in the waning days of his tenure as defense secretary, the Navy has a lot of vessels to build over the next couple of decades.

Facing an emerging Chinese navy that is christening new ships at a rate that alarms some experts, the U.S. Navy is feeling the pressure to keep up.

The new shipbuilding plan, which covers 2022 to 2051, was released in December and called for the fleet to grow to 316 manned battle force ships by fiscal year 2026. The service currently has just under 300 battle force ships.

Budget instability, acquisition snafus and capacity at its shipyards are among the possible roadblocks.

"We really have to get the next-generation warships delivered on time and without some of the first-class challenges that we've seen previously on some of our platforms," Galinis said.

The DDG-51's Flight III Combat System that is currently being developed shows that the risk in these programs shouldn't be in the basic elements of the ships, but the subsystems that give them their "teeth," he said.

"As we think about these newer designs, our high-end technical risk should really be the combat capability that you deliver and not so much the platform," Galinis said.

Rigorous engineering in the design process and land-based testing has been key to the Flight III successes so far, he added.

The follow-on to the Littoral Combat Ship, the Constellation-class frigate, serves as another example of this evolutionary approach backed up by rigorous engineering before keels are laid. The light amphibious warship, next-generation destroyers, DDG(X), and the joint Coast Guard-Navy Polar Security Cutter program are other ships still in the early stages of development, he noted.

"The design approach is key to delivering the ships and … these new concepts and new programs that are coming down the way," he added.

Chief of Naval Operations Adm. Michael Gilday said: "In the future, we're really going to have to team closely together to deliver platforms like the Constellation class and the new DDG(X) on time. ... We have to get them right. We cannot afford to have delays. We cannot afford to have big mistakes. We can't afford to have cost overruns. We really have to deliver those on-time, on-budget and with the kind of capabilities that work."

Rear Adm. Casey Moton, program executive officer for unmanned and small combatants, said the new frigate has a great foundation because of all the work that went into the program in the design phase.

Risk was reduced by using a mix of an existing "parent" design for the ship and non-developmental technologies for the subsystems.

"There was a lot of hard work with industry to mature those designs before we ever even put the ship on contract," Moton said.

The Navy has been doing the functional design work on the frigate and has entered the detailed design phase that will be completed by the end of fiscal year 2021. Production begins in fiscal year 2022, he said. Fincantieri Marinette Marine is the lead contractor for the first three ships.

"Preparing for production is our focus," Moton said.

Tom Rivers, executive director for amphibious, auxiliary and sealift in program executive office ships, said the new destroyers "are making tremendous progress, which will improve our lethality and warfighting capability for decades to come."

Other efficiencies can be found through contract vehicles, Rivers said.

Landing platform dock ships 28

Navy photo by MCSN Riley McDowell

Guided-missile destroyer USS Arleigh Burke

through 30 are under construction with LPD-31 now under contract.

The San Antonio-class ships provide the Navy and Marine Corps with sea-based platforms that can ferry troops from ship to shore with aircraft and landing craft. The PEO's "economic order quantity strategy" leverages the authorities and the appropriations given to the Navy this year to maximize cost and schedule benefits, while also providing more stability and production efficiency to suppliers, he said.

That includes the workforce. Without highly skilled shipyard workers, these vessels can't be delivered on schedule.

"We need to send to industry a common, steady demand signal so they can hire, they can train. They can't invest without that. [Or] we can't expect them to be ready when we have a demand," Rivers said.

"That is one of our initiatives — to bring that stability to the workplace for at least the amphibious ship workforce. We're trying to do the same type of strategy with other shipbuilding programs to bring that stability," he added.

At the end of fiscal year 2020, the Navy had 45 ships at various stages of development, which will increase steadily throughout this year as the service awards more contracts, said Rivers.

"We're focused on setting the right conditions with the industrial base, so that we're executing to the plan and delivering ships on schedule," he said.

Rivers' office is also working closely with the requirements community to develop the light amphibious warship — also known as LAW.

Officials have described the vessel as somewhere between 200 to 400 feet long that can carry about 75 Marines and their equipment. It is a new concept and not replacing any legacy ships. Officials have not announced how many of the new amphibs they would like to procure.

The Navy plans to accelerate delivery of the landing craft by adapting commercial vessels and design standards, Rivers said.

These surface ships — along with an aggressive schedule to build new submarines — makes coordinating work at shipyards complex. The Navy has established a shipbuilding industrial base task force led by Matt Evans, which is specifically charged with helping to align ship and submarine construction, maintenance, and matching them with available resources, capability, and capacity requirements, Rivers said.

The Navy also appointed Tina Zimmer as its first futures director to provide expertise and oversight for concept design work, giving the requirements community a single authoritative resource for developing and transitioning with these programs, Rivers said.

"By doing this, we're getting a better understanding of the crosscutting challenges across the industrial base, that in turn allows [us] to develop strategies and better promote the resiliency of the critical business space," he said.

Gilday said: "Our public shipyards, our aviation depots, our global networks of bases are our readiness engines. They are long overdue for restoration and remain a focus of mine."

While the Navy pursues a goal of sailing 355 ships, or possibly more, it must also make tough choices to subtract some platforms from the fleet, Gilday said.

"The composition of the fleet matters to us the most," he said.

"Divestments will also be necessary to build back the naval power America needs. That includes the first experimental [Littoral Combat Ship] hulls, legacy cruisers, dock landing ships and transferring non-core Navy missions like Aegis Ashore [missile defense] to our ground forces. Our sailors put years of exceptional service into these platforms, but pivoting to the future requires tough choices," he said.

Gilday also said unmanned vessels will be a part of the shipbuilding mix.

"We need to pursue unmanned systems, pure and simple. They expand our [intelligence, surveillance and reconnaissance] advantage. They add depth to our magazines and they can operate inside highly contested areas. They will provide affordable solutions to grow our Navy and to provide lethal combat fire," he said. *(For more on unmanned systems see story on page 26)*

As for the other hindrance to getting ships delivered on time — fiscal uncertainty coming from Congress or a change in administrations — that's to be expected, he said.

"There will be fiscal uncertainties in the future. No doubt about that," Gilday said. "There always is, but we have to have our priorities right. … We have to understand what we're expected to contribute to the joint force and that's sea control and power projection, and we can never lose sight of that." ND

Navy Fleshing Out Requirements for Next-Gen Logistics Ship

Military Sealift Command dry cargo and ammunition ship USNS Lewis and Clark

Navy photo by Petty Officer 2nd Class Michael Russell

BY MANDY MAYFIELD

The Navy wants to build a new class of at-sea resupply ships, but it has more work to do to develop requirements and secure adequate funding for the effort.

The service announced in 2020 its Next-Generation Logistics Ship program, or NGLS, which is planned to be a new class of vessels that will enable refueling, rearming and resupply of Navy ships while complementing its existing logistics forces.

The NGLS program is part of the Combat Logistics Force, said Tom Rivers, executive director for amphibious, auxiliary and sealift programs at the program executive office for ships. The Navy's current combat logistics ships include oilers, or T-AOs, dry cargo and ammunition ships, or T-AKEs, and fast combat support ships, or T-AOEs. These ships are all large auxiliary vessels.

"We're looking for something that is smaller than the existing T-AOs, T-AKEs, T-AOEs," Rivers said during a panel discussion at the Surface Navy Association's annual symposium in January.

The new fleet would include an increased number of smaller ships to support a more distributed architecture and enable the Navy to more easily counter adversaries through a concept called Distributed Maritime Operations, or DMO, according to a recent Congressional Research Service report, "Navy Next-Generation Logistics Ship Program: Background and Issues for Congress."

"DMO aims at avoiding a situation in which an adversary could defeat U.S. naval forces by concentrating its attacks on a relatively small number of large, high-value U.S. Navy ships," the study explained.

In December, the Navy released a new long-term shipbuilding plan aimed at boosting the capacity and capability of its fleet. Over the next 30 years, the blueprint calls for procuring a number of new vessels including 80 combat logistics force ships.

"Logistics ships are and have always been an integral part of the Navy's architecture," said Jerry Hendrix, a naval analyst and retired Navy captain. Hendrix recently released a book, *To Provide and Maintain a Navy: Why Naval Primacy Is America's First, Best Strategy*, in which he advocates for a larger logistics fleet.

An auxiliary logistical support fleet is necessary for keeping Navy ships that are spread out across vast theaters resupplied with fuel, spare parts, ammunition and food, he said in an interview.

Having a bigger Navy means there needs to be growth in the logistics fleet "or what you'll end up finding is that you'll be out of balance, you'll have too many combatants and you won't have the logistics force to keep those combatants resupplied at sea," Hendrix said. "It has to be carefully managed from that perspective."

The NGLS program will likely be operated by Military Sealift Command which is currently in charge of the replenishment and military transport ships for the Navy and other services, Rivers noted.

According to the CRS report, the new logistics ships may be built in two different variants to perform specific missions.

The vessels "will enable refueling, rearming and resupply of naval assets — afloat and ashore" in support of Distributed Maritime Operations, littoral operations in contested environments and expeditionary advanced base operations, the report said.

The Navy is also considering converting existing vessels, building new ships, or pursuing both options to acquire the logistics platforms, Rivers said.

Military Sealift Command issued a solicitation in December looking to obtain an existing commercial platform to experiment with for the program, an effort that could help inform requirements, Rivers said.

Rivers said PEO Ships is partnering with Erica Plath, director of strategic mobility and the combat logistics divi-

sion in the office of the chief of naval operations, to help develop requirements for the program. Officials are focused on writing the requirements for the refueling, resupply and rearming portions of the program, he added.

Military Sealift Command hosted an industry day in January where more than 20 companies participated, Rivers said. During the event, program leaders shared initial concepts studies with members of industry. The Navy is planning to release an industry study request for proposals in the first quarter of 2021 with the goal of awarding multiple companies contracts later this year that will help inform requirements for the program.

"We're planning to release an industry study RFP here in this quarter, and … we're looking to get some multiple participants to help us as we kind of inform the requirements decision process," Rivers said.

The Navy hosted its first industry day for the program in June 2020 to gain feedback from attendees and to continue developing program characteristics. One of the challenges the service is facing is underway replenishment, Rivers said. That "is unique to Navy ships, and we're trying to figure out how to best integrate that into a commercial platform, because we want NGLS to be based upon a commercial platform as much as possible," he said.

Underway replenishment is a method of transferring fuel, munitions and other goods from one ship to another during operations at sea.

The contract for designing and constructing, or converting, the first NGLS will be awarded in the second quarter of fiscal year 2023, according to the CRS report. Construction or conversion of additional platforms will follow in fiscal year 2024 and subsequent years.

Building logistics ships won't just help the Navy meet its resupply requirements. It can also build resiliency and redundancy back into the military's overall shipbuilding infrastructure, Hendrix said.

"The one thing that we know is that a strong, robust logistics fleet — and for that matter, a strong, robust merchant fleet — helps to train workers, whether they're welders or pipefitters or electricians that can work on ships," he said. "Those people who are trained to build civilian or combat logistics ships also have skill sets that can contribute to the marketplace for the naval shipyards, so it helps to generate a better trained workforce for us in the long run."

As the Navy grows its combat logistics shipbuilding capability, it likewise bolsters its small parts suppliers, he noted.

This "has a tendency to lower the overall cost of your naval ships — your destroyers, your cruisers — simply because you have more parts suppliers that are in the market of building small parts and components, and then competing for those contracts with the government," Hendrix said. "By adequately managing your logistics force, as well as your military sealift and your merchant fleet, you are actually adding to your naval force as well by growing that resilience and lowering your overall costs."

The Navy requested $30 million in research-and-development funding for the program for fiscal year 2021. However, funding for the NGLS was cut by $6 million in the fiscal year 2021 Defense Department Appropriations Act, according to the CRS report.

Oftentimes, logistics ships are one of the last programs funded by the Navy, Hendrix noted.

A "challenge that we often have is getting the logistics force to rise to the top of the priority list," Hendrix said. "If there's a restricted number of dollars, an argument has to be made that the logistics force is as important to invest in as your naval surface combatant force, and that we need to also invest in those shipyards that are associated with building them."

USNS John Ericsson, left, transfers fuel to the dry cargo and ammunition ship USNS Richard E. Byrd during an underway replenishment.

Navy photo by Stephen Bowen

Rep. Rob Wittman, R-Va., ranking member of the House Armed Services subcommittee on seapower and force projection, recently has been advocating for the logistics fleet, and other Navy vessels that defend that fleet. Near-peer adversaries such as China could target logistics ships and thereby interrupt critical military supply lines.

"More and more people are understanding the critical nature of the Navy in this fight and the critical nature of all the different components … whether it is tankers, or securing tankers or cable ships … as well as a modernized logistics fleet, and then having the ability to make sure that we are protecting the logistics fleets," he said.

Another important aspect of logistics ships, specifically in wartime scenarios, is that they are imperative for supplying not just the Navy, but the other services as well, Hendrix noted. For example, Air Force bases in the Asia-Pacific region rely on Navy resupply vessels for aviation jet fuel.

Wittman shared the same sentiment, noting that soldiers also rely on logistics ships.

The Army "understands in a very strong way that if they are going to be part of that [fight] in the Indo-Pacific, there needs to be a strong Navy," Wittman said. "The Army has got to have a fleet of logistics ships to be able to mobilize and to be able to get there."

Meanwhile, PEO Ships is focused on speedily developing capabilities and delivering vessels on time.

To increase its commitment to the effort, Rivers said a shipbuilding industrial base task force was stood up last year, "which is specifically charged with helping to align ship and submarine, construction, maintenance and modernization with available resources, capability and capacity requirements."

As the service branches into more small programs, the industrial task force will give the Navy better insight into issues members of industry are facing.

"By doing this, we're getting a better understanding of the cross-cutting challenges across the industrial base, that in turn allows us to develop strategies and better … resiliency of the critical business space," Rivers said. **ND**

Coast Guard Ship Modernization Under Full Steam

BY STEW MAGNUSON

As work continues on replacing its fleets of outdated ships, the Coast Guard is kicking off the development of two new programs — a vessel for Arctic operations and a family of boats that will ply inland waterways.

"We have a lot going on. We're doing more acquisitions than we've done since World War II," said Rear Adm. Mike J. Johnston, assistant commandant for acquisition at the service.

Progress continues on the Coast Guard's top shipbuilding priority, the Offshore Patrol Cutter, he said at the Surface Navy Association annual meeting in January.

Hull No. 1 of the planned 25-ship fleet is under construction and on track to be delivered to the Coast Guard in 2022. It will take about 20 years to build out the fleet. The $12 billion program will replace the service's 270-foot and 210-foot medium endurance cutters, which are becoming increasingly expensive to maintain and operate, the Coast Guard has said.

Eastern Shipbuilding Group is the contractor for the first four hulls. In 2018, the company's Panama City, Florida, shipyard suffered heavy damage when struck by Hurricane Michael, which resulted in the Coast Guard having to revise the costs and schedule of the program as the company rebuilt its facilities. The Department of Homeland Security granted the company $659 million in relief, but announced that hulls five through 25 would have to be recompeted.

The Government Accountability Office in a November 2020 report, "Coast Guard Acquisitions: Opportunities Exist to Reduce Risk in the Offshore Patrol Cutter Program," said the revised schedule was risky.

"The Coast Guard authorized the start of construction for the first two OPCs despite not having a stable design, which is inconsistent with shipbuilding best practices," the report said.

"Further, the revised post-hurricane delivery dates for the first four OPCs are optimistic and do not fully incorporate schedule risks, increasing the likelihood that the OPCs will not be delivered when promised," the report said.

Johnston sounded a more optimistic note. Despite the storm damage and the COVID-19 pandemic, the program is back on track, he said.

The second hull will follow in 2023 and funding is in place to buy long-lead time materials for hulls three and four, he said.

The service has yet to name a shipbuilder for hulls five through 25, he said. "We have had a lot of industry study and engagement to ensure that that's a fair and open competition," he added.

The service's second highest priority, the Polar Security Cutter, is also on schedule to begin construction by the end of the year, Johnston said.

"This has been a very unique program because we haven't built a heavy polar ice breaker in the United States in about 40 years," Johnston said.

The joint Coast Guard-Navy program has funding for two hulls so far "and very good support for hull three," Johnston said.

The Coast Guard currently operates only one icebreaker, the aging Polar Star. Coast Guard Commandant Adm. Karl Schultz said at the same conference that the service needs "a minimum" of six.

Johnston said: "That's going to be an incredible asset. And the partnerships and the relationships [with the Navy] that we built out has spread across all of our acquisition programs … and that has paid incredible dividends."

Meanwhile, the Coast Guard is in the pre-acquisition stage of developing a new ship it is calling the Arctic Security Cutter, which will also be designed to operate in cold climates and serve as a medium-sized icebreaker, Johnston said.

"At this point it's a little early to really pull out the strategy, but we will certainly be planning to engage industry as we move forward," he said.

How many Polar Security Cutters are ultimately built will have an impact on the new program and allow the Coast Guard to better refine requirements.

Schultz said he would like to have six icebreakers and three of the smaller Arctic Security Cutters for a total of nine ships.

To ensure there is always icebreakers on hand, the service is considering renting them to meet its needs, Schultz said.

"We're looking at some leasing options as a bridging strategy — not to be in lieu of [buying vessels], but additive — to close some gaps," he added.

Coast Guard photo

"Truly in the high latitudes, it's all about presence. And we are excited to be off to the races on building icebreakers," he added.

One idea that had been considered but appears to be dead now is nuclear-powered icebreakers.

"We have moved off the nuclear-powered" icebreaker, Schultz said. "The ability to operate that in the Coast Guard — that just doesn't exist, and nor could we build out to that with all the demands on our plate."

Meanwhile, the National Security Cutter program continues with the ninth ship recently delivered by the contractor, Huntington Ingalls Industries' Ingalls Shipbuilding of Pascagoula, Mississippi.

The original program of record had eight NSCs in the Coast Guard inventory, but Congress has since authorized funding for three more, plus kicked in $100 million to purchase long-lead time materials for a 12th ship.

Fast Response Cutters, which replace the service's 110-foot cutters, are past the middle of their production run, with 42 of a planned 64 boats now completed.

Capable of sailing at 28-plus knots, Johnston called them "a game-changer." Two of the new vessels will be sailing to Bahrain to replace two legacy ships that have been there since Operation Iraqi Freedom, he said. There will eventually be a total of six stationed there, Schultz added.

The multi-mission Fast Response Cutters are just "one tool," Schultz said. "They complement our 11 National Security Cutters as well as our forthcoming 25 Offshore Patrol Cutters. Add to that [up to] three new Polar Security Cutters, and you have a fleet of 103 highly capable U.S. Coast Guard cutters," he said.

That will add 2,000 more sea-going billets for the service's personnel needs, he noted.

As for the ships, "they're not one-for-one replacements at all," Schultz said. "Each new platform outperforms the legacy hull it replaces. And we haven't yet even fully realized the capabilities or the potential of these platforms. I continue to challenge our cutter community, our cutter commanding officers to deploy these ships in innovative ways and really press the limits of their maximum effectiveness."

Another program in the pre-development stage is the Waterways Commerce Cutter, which will be a family of three platforms intended for rivers, lakes, intracoastal waterways and harbors. Some of the boats this program would replace — inland tenders — have been in the water for 77 years, Johnston said. They maintain and replace navigation buoys that facilitate the safe passage of commercial watercraft.

A request for proposals to replace the 35 legacy tenders should be out in March, Johnston said. The service is looking at three monohull variants.

The Coast Guard plans to acquire 16 river buoy tenders, 11 inland construction tenders and three inland buoy tenders. The new tenders will have greater endurance, speed and larger deck load capacity than their predecessors. The ships will also feature improved habitability and will accommodate mixed-gender crews, according to a service factsheet.

A draft request for proposals was released in July with an anticipated contract award in 2022 and initial operating capability scheduled for 2025.

"The ability to affordably and safely move product across and throughout the nation is vital to American prosperity," Johnston said.

"We are producing the cutters and capability for the operator on schedule and on budget the majority of times, but we are far from perfect," he said.

The service is in the middle of an acquisition study being done by independent consultants that will look at where the Coast Guard can improve.

"We're looking forward to using that as a tool to drive us from good to great," Johnston said.

There is a lot more work to be done to support all these new ships, Schultz said. The Coast Guard is looking for more funding to boost its capacity and capabilities. It is pursuing upgrades to its information technology systems and other assets, as well as looking to bring on more personnel, the commandant said.

"To close the Coast Guard readiness gap, we need sustainable annual budget growth — I would say 3 to 5 percent over the next five years," Schultz said. "We need a booster shot of sorts, about $900 million to $1 billion dollars to address our most pressing needs."

ND

— Additional reporting by Jon Harper

NUMBER OF AUTHORIZED COAST GUARD CUTTERS

Coast Guard images

Navy Optimizing Shipyards With Digital Twin Technology

BY YASMIN TADJDEH

The Navy's public shipyards — which repair the service's submarines and aircraft carriers — are aging and facing obsolescence issues. To revitalize the yards and improve infrastructure, the Navy is in the midst of a multi-billion-dollar optimization overhaul that will employ digital twin technology to map out areas most in need of changes.

The Shipyard Infrastructure Optimization Program, or SIOP, is a 20-year, $21-billion effort to modernize the four public yards in Norfolk, Virginia; Pearl Harbor, Hawaii; Portsmouth, Virginia; and Puget Sound, Washington.

"We've got dry docks that are over 100 years old," said Steve Lagana, program manager for the SIOP office. "We have buildings that are over 100 years old."

Rep. Rob Wittman, R-Va., ranking member of the House Armed Services subcommittee on seapower and projection forces, said the yards are in dire need of an upgrade.

"When you travel to our public shipyards, it is sobering to see the age of the dry docks, … the limited capability of the dry docks, and also the age of the shops that are there," he said during the Surface Navy Association's annual conference in January, which was held virtually due to the COVID-19 pandemic.

This creates substantial efficiency issues, he noted.

"If you go to a place like Norfolk Naval Shipyard, and you're working on a ship in a dry dock and the shop that is producing materials for that ship is thousands of feet away, … it is grossly inefficient to be able to do that," Wittman said.

Over time, the infrastructure "got a little misconfigured for what we're doing," Lagana said in an interview with *National Defense*.

The missions had changed over the years from shipbuilding to maintenance, and then to nuclear-powered ship maintenance, he noted.

"The infrastructure just never evolved with those changes," he said.

The Navy recognized that infrastructure is intrinsically linked to performance and in 2017 began laying the groundwork for the SIOP program, which officially began in the summer of 2018, Lagana said.

"This really is an … industrial manufacturing optimization program with a focus on productivity in the shipyards and how that affects the overall national defense," he said. "How do we get submarines in and out of shipyards as efficiently as possible, so the fleet commanders have the assets they need to do their mission?"

Critical to the effort is a modeling-and-simulation technology known as digital twins which digitally replicates an object, place or building, said Stephanie Douglas, executive director for logistics, maintenance and industrial operations at Naval Sea Systems Command.

"The modeling and simulation is really key as it allows us the opportunity to figure out how to optimize flow, not only within the shops, but around the yards to provide the most efficient and productive layout for operations within the shipyard," she said. "We're already seeing some really exciting things come out of the modeling-and-simulation piece of it in terms of opportunities."

The service reached out to industry to tackle the "massive effort" and chose Siemens Government Technologies to create digital twins for each of the four yards, Lagana said.

"There has never been a digital twin modeling-and-simulation effort of this size and scale ever in the world," he said.

The service completed its first digital twin of Pearl Harbor Naval Shipyard near the end of 2020, he said. Puget Sound recently finished up its baseline model and will soon begin an analysis for its industrial optimization. Meanwhile, data collection recently wrapped up in January at Portsmouth.

"Once we do the validation and verification of that, we will start into that effort," he said.

Norfolk is also moving along well, he added.

Lagana noted that all the yards will have their digital twins up and running this year.

The service is already gleaning a great deal of information from Pearl Harbor's digital twin, he said.

"We're definitely getting some better insight into some potential tweaks in infrastructure," he said. "With any analysis, you kind of want to find that sweet spot, that knee in the curve to where can I get the most efficiencies with the best return on investment."

In some cases, the Navy is finding that some areas are not as bad as they originally thought and applying "lean manufacturing principles" could provide good value, Lagana said.

The Los Angeles-class fast-attack submarine USS Olympia arrives at Puget Sound Naval Shipyard.

However, in other areas they are finding that they may need to construct new buildings to create efficiencies.

For example, some workforce service buildings may need to be moved closer to the waterfront, he said. "That way the workers don't have to travel so far for food or for training or for any type of support," he said.

In April, the office plans to bring together all of Pearl Harbor's facilities engineers, modelers and industrial engi-

neers to sift through the data and outline a new area development plan that will articulate the service's intentions for the shipyard, Lagana said. That will include infrastructure investments that are required to achieve efficiencies and a strategy to execute them.

As the various digital twins come online, the Navy is applying lessons learned to the entire program, he said.

"We're learning as we're ingesting thousands and thousands of lines of data and information into the model," he said. The service is identifying limitations in the software and working through those to make the system more efficient. Those changes will then be incorporated into the other digital twins.

Navy photo

Already the service has found changes at Puget Sound that can be applied to Pearl Harbor.

"The interesting thing is we found out a tidbit of information at Puget Sound that we did not find at Pearl because of a different business line," he said. "It's a constant learning process. We're learning every day with the data, the model and how we interact with the model."

Lagana compared the Navy's digital twin approach to what is known as spiral development of software.

"You let [the first version] run for a little bit, find your bugs, and then you program in the fixes for those bugs," he said. "We can continuously do this with the model. We can manipulate the model with new information, and you can program in different functionality … so we can run different types of analyses."

The digital twins are becoming very robust and flexible tools, he added.

Lagana noted that the service went with a single contractor for all four yards to increase continuity among the digital twins.

"There's different variables at each of the shipyards that we have to consider, … [including] what kind of mission, what kind of fleet assets each shipyard services, inactivation of ships, different types of ships that can pull into different types of dry dock to different yards," he said. "We felt as a risk mitigation tool, we'll use one approach, one methodology at all four sites to get us to a really high confidence level baseline that we can then evolve from."

This approach has facilitated knowledge transfer between the yards and has allowed the service to make progress rapidly, he added.

Lagana noted that so far there have been no delays caused by the COVID-19 pandemic.

"We haven't even seen a delay of one day," he said. "As soon as COVID hit, the team got together, and because a lot of this is digital kind of work and the big boom of Zoom and [Microsoft] Teams and virtual meeting platforms, … it was easy to continue to have those engagements in a virtual environment and continue the dialogue and the data transfers to keep moving."

Lagana noted that digital twin technology could be useful across the Navy, including in private ship repair yards for surface vessels.

Bryan Clark, director of the Center for Defense Concepts and Technology at the Hudson Institute, noted that some private construction shipyards are already employing the technology.

"Doing digital models of your shipyard is very popular in some of the high efficiency shipyards you see overseas. Chinese shipyards, Daewoo in South Korea, German shipyards — all use computer modeling," he said. They "have for a long time been using computer modeling to improve the efficiency of their shipyards and improve their workflow and figure out how to maximize the predictability of the ship construction process."

Digital twins are just now starting to be employed in ship repair yards, he noted. The challenge for them, however, is that they are much smaller than new-construction yards and have less money to invest.

"The returns aren't as significant," he said. "You don't get the big tranche of money that you do with a ship construction project where you can sort of bring your digital twin investment into the construction of a new class of ship."

Digital twinning requires a lot of software and time which can result in a significant investment, he said.

"They may not have that kind of cash lying around," he noted. The Navy could either provide a system to them or help them invest in it themselves by giving them a grant.

However, Wittman has criticized the SIOP program and said it is taking too long to complete.

"We need to cut the SIOP plan in half in order to have any chance of having what's necessary to maintain the ships," he said. "If we're going to build to a 500-ship Navy the only way that we have the full capability of those ships is to make sure that there's not a single maintenance availability that's missed; and making sure, too, that we have necessary practices in order to get change orders through quickly, to make sure we model what to expect."

Vice Adm. William Galinis, commander of Naval Sea Systems Command, noted that the SIOP program "is certainly one of those things that we really need to get after" over the next decade.

However, Douglas said accelerating the program would not be easy.

"Think about it in terms of living in your house while they're doing a wholesale renovation and moving you from room to room to room," she said. "That's the challenge that we will have in trying to accelerate as there's so many dependencies in between everything we do within the shipyards." ND

Pentagon, Rivals to Play 'Cat-and-Mouse Game' with AI

BY JON HARPER

The U.S. military and its foreign adversaries could soon find themselves in an interminable battle to protect their artificial intelligence systems from attack while developing offensive capabilities to go after their enemies' AI capabilities.

Defense officials see great potential for artificial intelligence and machine learning to aid in a variety of missions ranging from support functions to front-line warfighting. But the technology comes with risks.

"Machine learning … offers the allure of reshaping many aspects of national security, from intelligence analysis to weapons systems and more," said a recent report by the Georgetown University Center for Security and Emerging Technology, "Hacking AI: A Primer for Policymakers on Machine Learning Cybersecurity."

However, "machine learning systems — the core of modern AI — are rife with vulnerabilities," noted the study written by CSET Senior Fellow Andrew Lohn.

Adversaries can attack these systems in a number of ways to include: manipulating the integrity of their data and leading them to make errors; prompting them to unveil sensitive information; or causing them to slow down or cease functioning, thereby limiting their availability, according to the report.

Methods such as "data poisoning" and "evasion" are just some techniques that can lead ML platforms to make mistakes.

"In 'data poisoning,' attackers make changes to the training data to embed malicious patterns for the machine to learn. This causes the model to learn the wrong patterns and to tune its parameters in the wrong way," the report explained. "In 'evasion,' attackers discover imperfections in the model — the ways in which its parameters may be poorly tuned — and then exploit these weaknesses in the deployed model with carefully crafted inputs."

For example, an attacker could break into a network and manipulate the data stored within it, compromising the integrity of the data that the software relies on.

However, adversaries don't necessarily have to break into a network or system to thwart it, the report noted. For example, attackers might not need to hack into a military drone to cause it to misidentify its targets — they could simply make educated guesses about the drone's machine learning system model and act to exploit it.

In a so-called "evasion" operation, an attacker can make subtle changes to system inputs to cause a machine to change its assessment of what it is seeing, the study explained.

To illustrate this vulnerability, CSET cyber experts made subtle changes to a picture of Georgetown University's Healy Hall building, a National Historical Landmark, and then fed that into a common image recognition system.

"Human eyes would find the changes difficult to notice, but they were tailored to trick the machine learning system," the report said. "Once all the changes were made … the machine was 99.9 percent sure the picture was of a triceratops" dinosaur.

While the Healy Hall triceratops vignette might be amusing to some readers, it would be no laughing matter if, say, a military drone misidentified a hospital as a weapons depot and bombed it; or, conversely, if enemy tanks were allowed to attack U.S. troops because an adversary was able to trick an ML-equipped surveillance system into misidentifying the platforms as innocuous commercial vehicles.

The aim of another type of counter-AI operation, known as a "confidentiality attack," is not to cause a machine learning system to make errors, but to uncover sensitive data.

To achieve this, adversaries can watch how the system responds to different kinds of inputs.

"From this observation, attackers can learn information about how the model works and about its training data. If the training data is particularly sensitive — such as if the model is trained on classified information — such an attack could reveal highly sensitive information," the study said.

With this level of understanding about how a particular machine learning model works, adversaries could also figure out how it may be compromised, the study noted.

Technology developers and policymakers are confronted with the task of figuring out how to manage the inevitable risks associated with machine learning.

Meanwhile, the Pentagon also has incentives to develop capabilities to go after competitors' platforms.

"The United States is not the only country fielding AI systems, and the opportunity to exploit these vulnerabilities in adversaries' systems may be tempting," the CSET report noted. "There are obvious military benefits of causing an enemy weapon to misidentify its targets or send an adversary's autonomous vehicles off course. There are also the obvious intelligence benefits of stealing adversaries' models and learning about the data they have used."

U.S. defense officials are already thinking through these issues.

The Air Force has been in talks with the Defense Digital Service about holding an AI hacking challenge.

"We want to go into this clear-eyed and understand how to break AI," said Will Roper, who recently served as Assistant Secretary of the Air Force for Acquisition, Technology and Logistics. "There's not a lot of commercial investment [or] commercial research on that. Not nearly as much as there is on making AI."

Roper, a highly respected tech guru who spearheaded a number of artificial intelligence initiatives at the Pentagon, left office in late January during the presidential transition.

More research and probing could help uncover vulnerabilities in AI and ML.

"Whatever we discover, we'll try to fix," Roper told reporters during a Defense Writers Group event. "Then whatever we fix, we'll try to break. And we'll try to break those fixes and fix those breaks. And I guess that goes on forever in what we're calling 'algorithmic warfare.'"

iStock illustration

The Pentagon already has experience leveraging machine learning for intelligence operations such as Project Maven, which used the technology to help human analysts sift through hours and hours of drone footage collected from overseas battlefields.

Future plans call for deploying a variety of unmanned and autonomous systems to include robotic aircraft, combat vehicles and ships. *(For more on unmanned ships see story on page 26)*

Roper said artificial intelligence technologies are ushering in "a new epoch of warfare."

"The algorithms, the AI that we take into the fight, we're going to have to have an instinct for them and they will have weaknesses that are very different than our humans and our traditional systems," Roper said.

The military will need to develop "digital stealth" and other digital countermeasures to thwart enemy efforts to undermine U.S. artificial intelligence and machine learning capabilities, he noted, comparing the concept to how warfighters currently use stealth and electronic warfare to defeat enemy radars and jamming devices.

The Defense Department needs to accelerate its acquisitions so that it doesn't end up fighting "tomorrow's war with yesterday's AI," he added.

The military will have to find the right balance between letting "smart" machines do their thing, and keeping them on a leash with humans exercising oversight.

While officials acknowledge the risks involved in relying on artificial intelligence, the technology is also viewed by many as too useful to pass up.

"When it's having a bad day, when an adversary's potentially messing with it, it's too fragile today for us to hand the reins completely to it," Roper said. "But it's too powerful when it's having a good day for us not to have it there in the first place."

The Defense Department's AI strategy, released in 2019, calls for funding research aimed at making artificial intelligence systems more resilient, including to hacking and spoofing.

Alka Patel, head of the ethics team at the Pentagon's Joint Artificial Intelligence Center, told *National Defense* that the military's AI systems will need to be designed and engineered so they can be disengaged or deactivated if they aren't operating as intended.

In this new era of algorithmic warfare, will the attacker or the defender have the upper hand?

"It is hard to answer this question until the field of machine learning cybersecurity settles on specific offensive and defensive techniques," the CSET report said. "Even then the answer may not be clear, as attackers and defenders engage one another, both sides will discover new techniques."

The study likened the situation to a "rapidly evolving cat-and-mouse game."

Roper noted that it's unclear what the balance of power will be.

An image of Georgetown University's iconic Healy Hall was altered to trick an image recognition system into thinking it was a triceratops dinosaur.

"It could end up being that it's so easy to break that the offensive order of AI … is always so dominant that we don't really have to worry about it. We just have a lot of counter-AI capability and we muddy that water for both sides," he said. "But it could be that it balances pretty well, that the countermeasures and the counter-countermeasures balance well so that as you get into a cat-and-mouse game, if you pick your plan well, you can always have a decided advantage."

Defenders face a number of challenges. For one, traditional cybersecurity techniques don't necessarily apply to machine learning, the CSET report noted.

"Attacks on machine learning systems differ from traditional hacking exploits and therefore require new protections and responses," it said. "For example, machine learning vulnerabilities often cannot be patched the way traditional software can, leaving enduring holes for attackers to exploit."

A subtle change in an attacker's operations can change how effective a particular defense is, the study noted. Additionally, defensive techniques that work well for a less sophisticated machine learning system might not be as effective for a more advanced system, or vice versa.

The CSET report compared AI competition to the arcade game "Whack-a-Mole" where defenders must rapidly bat down new threats that keep popping up.

"New attacks are invented and defenses are developed, and then those defenses are defeated, and so on," the study said.

So how should policymakers and technologists approach this challenge? System-level defenses, according to the CSET study. That includes the use of redundant components and the enablement of human oversight and intervention when possible.

The report used a self-driving car scenario to illustrate how system-level defenses could avert disaster.

"A commonly cited example of an attack involves placing a sticker on a stop sign that makes it appear to autonomous vehicles to be a 45 mph sign," it said. "Although this attack is possible and easy to perform, it only achieves a destructive effect if the car drives into a busy intersection. If the car has many ways to decide to stop, such as by knowing that intersections usually have stop signs, relying on lasers for collision avoidance, observing other cars stopping, or noticing high speed cross-traffic, then the risk of attack can remain low despite the car being made of potentially vulnerable machine learning components."

While traditional cyber attacks won't be going away anytime soon, algorithmic warfare is the future of cyber conflict, said James Lewis, director of the Strategic Technologies Program at the Center for Strategic and International Studies.

Biden administration officials need to continue to think about "how we develop our own tools, how we mess with other countries' tools," Lewis said in an interview. "Our opponents are certainly looking at more sophisticated tools" for attacking AI systems, he warned. **ND**

Gtownsfs photo via Wiki commons

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6 STRATEGIC PRIORITIES

- Promote and Educate Budget Stability
- Foster Small Business Success
- Gain Acquisition Agility and Regulatory Modernization
- Promote Innovation in Technology and Process
- Strengthen the Defense Industrial Base and Workforce
- Expand Security Cooperation and Interoperability

29
DIVISIONS
Provide Functional Focus

19
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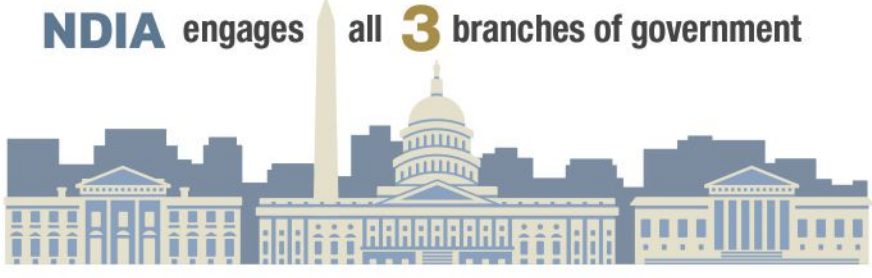

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Justice Guidelines Can Buoy Compliance Programs

■ In June 2020, the Department of Justice criminal division updated its "Evaluation of Corporate Compliance Programs" document.

First published in 2017 and revised in April 2019, this document offers guidance for prosecutors dealing with matters involving corporate wrongdoing. But it also has great value for contractors as an outline of many best practices in designing and improving compliance and ethics programs.

In accordance with the department's "Justice Manual," one of the factors prosecutors must consider when investigating corporations, determining whether to charge them, and negotiating any agreements, is the "adequacy and effectiveness" of the compliance program in place, both at the time of the offense and when a charging decision is made.

The information in the "evaluation" document helps explain to prosecutors what to look for to judge whether the program under review is adequate and effective. For a government contractor or indeed any company looking to create or improve its compliance and ethics program, this document is a rich source of information and it is enhanced with each round of revisions.

The U.S. Federal Sentencing Guidelines for Organizations and the Federal Acquisition Regulation present standards and requirements for compliance and ethics programs, including: the need for a compliance and ethics officer; a "Code of Conduct" and policies and procedures to set behavioral standards; effective periodic training and communications about those standards; a hotline or some other type of communication mechanism to raise concerns about perceived misconduct confidentially or anonymously; and protection from retaliation for those who raise concerns.

It also requires: internal control systems that include monitoring and auditing: enforcement of standards through disciplinary or corrective action; periodic evaluation of the effectiveness of the program; and periodic assessment of the organization's risks with a view toward adjusting the program to address changing risks.

The Justice Department's evaluation document fleshes out those program element bullets with useful insights into how to implement them effectively.

In addition, the program evaluation guidance emphasizes that any organization's compliance program should be appropriate to the company and its particular situation. This is key. The prosecutors' guidance states, "we make a reasonable, individualized determination in each case."

Federal Acquisition Regulation 3.1002 also states that elements of a contractor's ethics and compliance program should be "suitable to the size of the company and extent of its involvement in government contracting." For small- and medium-sized contractors, or niche operators, or anyone who may have resisted starting down the path to implement a compliance program out of concern that it would be too expensive and time-consuming, this should be reassuring.

It is not expected that every company will commit the time, staff and resources to put in place a world-class compliance program that covers every possible base. What is most important is that the contractor assess its own situation and implement a program that enables it to answer "yes" to three fundamental questions cited in the guidelines: Is the corporation's compliance program well-designed?

Is the program being applied earnestly and in good faith? In other words, is the program adequately resourced and empowered to function effectively? And does the corporation's compliance program work in practice?

Stepping back and remembering the big picture, the primary goals of an effective ethics and compliance program are to prevent and detect misconduct and promote an ethical corporate culture.

To start with, every contractor should conduct an ethics and compliance risk assessment. The results of the risk assessment steer the focus of resources to high-risk areas. For example, if the business is a strictly domestic trucking company, compliance with workplace regulations will be among its top priorities, while Foreign Corrupt Practices Act violation risks may be non-existent.

> "The newly revised evaluation document is substantive and comprehensive."

The evaluation document recommends considering things like whether the company is actually appropriately devoting compliance resources to the high-risk areas, whether the risk assessment is being periodically updated and how, and whether adjustments are being made to policies, practices and internal controls as a result of a shifting risk landscape.

It also asks whether the risk assessment is modified over time to take into account lessons learned from compliance failures — either internal or observed at other organizations in the same industry or region.

That lessons learned consideration is one of several updates to the evaluation document that emphasize looking at how the ethics and compliance program evolves over time. These are valuable enhancements, because it's never enough to simply put a code of ethics on the shelf and conduct training once a year. Contractors need to employ a continuous improvement approach for the program to remain effective.

The newly revised evaluation document is substantive and comprehensive. It may appear intimidating for some, but it needn't be. A contractor only needs to focus on its own particular risk profile and design and implement a program that is appropriate for its size and its needs. The document is a useful tool for contractors to help them understand the standards for these programs, whether the business is just setting up a program, or managing and improving a mature program. **ND**

Anne R. Harris is owner and principal of Ethics Works LLC, an ethics and compliance consulting practice with a focus on government contractors. She formerly served as ethics officer for General Dynamics Corp. Contact her at anne.harris@ethicsworks.com.

BY SAMANTHA CLARK, EVAN SHERWOOD AND MICHAEL WAGNER

Biden Issues New Buy American Directive

On Jan. 25, President Joe Biden issued a much-anticipated executive order announcing plans to strengthen the government's preference for domestically-sourced supplies, a move that has major implications for contractors.

Executive Order 14005 on "Ensuring the Future Is Made in All of America by All of America's Workers" is the most ambitious in a line of recent proclamations from the White House aimed at strengthening domestic preference requirements in federal contracting. It calls for an array of changes to existing domestic preference regulations and procedures in order to "maximize" federal purchases of domestic supplies.

The order contemplated changes that generally fall into three principal categories: proposed revisions to substantive Buy American Act, or BAA, standards and requirements; additional procedures for review and approval of waivers from Made in America laws; and detailed tracking and reporting requirements focused on Made in America compliance and use of waivers. This article focuses on the first of these categories.

The order calls for the Federal Acquisition Regulation Council to consider amending Part 25 of the FAR to change the regulatory thresholds and standards that have long-defined the application of the Buy American Act. Historically, an article was considered a "domestic end product" for purposes of the BAA if the article was manufactured in the United States and the cost of domestic components exceeded 50 percent of the cost of all components for the end product. The rule historically applied an upward cost adjustment for foreign products of up to 12 percent when compared to the price of a domestic product.

> "The effect of Biden's directive will depend on the details of its implementation."

On the last full day of the Trump administration, the FAR Council issued a rule that increased the domestic content threshold from 50 percent to 55 percent (and from 50 percent to 95 percent for iron and steel components used in iron and steel end products), and increased the price adjustment for foreign products from a maximum of 12 percent to a maximum of 30 percent.

Biden's new order directs the FAR Council to consider a further increase in these numerical thresholds, although it does not set a specific target.

Of potentially greater significance, however, the order directs the council to consider replacing the BAA's "cost of component test" for evaluating domestic content with a test that considers "the value that is added to the product through U.S.-based production or U.S. job-supporting economic activity." This is a potentially seismic change to the law's regulatory analysis, though substantial questions remain about how the government would identify and quantify the "value" of U.S. production or "job-supporting economic activity."

Under the executive order, the FAR Council will be empowered to again raise the domestic component threshold, a potential change that could have disruptive effects on government contractors with global supply chains.

After decades of managing supply chains to meet the 50 percent cost-of-components threshold, the seemingly modest increase to a 55 percent cost-of-components threshold already has required many contractors to reexamine bills of materials and assess the need to shift sources of supply. The prospect of another increase to this threshold will require further adjustments to sourcing and supply plans and is likely to prompt frustration from some multinationals about a perceived moving target for BAA compliance.

But the executive order's direction to consider replacing the cost-of-components test with a value-based test would constitute an even more fundamental regulatory shift. For nearly 70 years, the cost-of-components standard has been a foundational element of the BAA's country of origin test. The prospect of an alternative standard focusing on the domestic value that is added to the product will create uncertainty and complicate planning for global companies that sell into the federal market.

In addition, replacing the cost-of-components test could raise questions about how this new approach might apply to commercially available off-the-shelf, or COTS, items. At present, federal regulations waive the domestic content test of the BAA for acquisitions of COTS items, but the executive order provides no assurance that the value-added test would not apply to such items. Such an expansion could raise the regulatory hurdle on a wide range of manufacturers who otherwise might not be tracking the sources of components for COTS items.

In the near term, contractors will be keen to have a clearer understanding as to how the government proposes to implement this proposal. Key open questions include: how this value-based standard would be defined and quantified; whether the same domestic content thresholds would apply under the value-based standard; and what constitutes "U.S. job-supporting economic activity" within the meaning of the executive order.

Ultimately, the effect of Biden's directive will depend on the details of its implementation. While it largely avoids prescriptive details, it requires the FAR Council to consider proposing new implementing regulations within 180 days, and the Office of Management and Budget and General Services Administration likewise are directed to establish oversight and reporting mechanisms to ensure BAA compliance.

Contractors would be well-advised to closely track these developments as they unfold. ND

Samantha Clark is special counsel, Evan Sherwood an associate and Michael Wagner a partner at Covington & Burling LLP.

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Hill, Merbaum Named NDIA International Division Leaders

The National Defense Industrial Association announced new leadership appointments for the International Division.

Greg Hill, vice president of global trade compliance at Leonardo DRS, has been named the new chair. Hill will lead the division for the next two years.

Alan Merbaum, senior associate at Booz Allen Hamilton, will support Hill as the newly elected vice chair.

NDIA would like to express its gratitude to Wayne Fujito as he steps down from the division chairmanship but remains actively engaged as a member of the Division Executive Committee.

The committee will soon begin laying out an agenda and the path forward for the division in 2021. Please send ideas for topic or speaker requests to Division Director Britt Sullivan at bsullivan@NDIA.org. ND

Women In Defense Scholarship Applications Now Open

Women In Defense, an affiliate of NDIA, is now accepting applications for academic year 2021-2022 WID scholarships.

Through the WID Scholarship Program, Women In Defense encourages women to pursue careers supporting U.S. national security. Eligible candidates may submit applications for funding to assist them in pursuing education on the path to a career in defense or foreign policy. Applications must be submitted no later than March 12.

For more information and to apply for a WID Scholarship, please visit WomenInDefense.net/WIDScholar.

Please contact Ann Webster at awebster@NDIA.org with any questions. ND

iFEST Organizers Issue Call for Ideas

In collaboration with the National Training and Simulation Association — an affiliate of NDIA — the Advanced Distributed Learning Initiative is pleased to announce iFEST 2021. iFEST is the premier conference on distributed learning, bringing together thought leaders, innovators and senior officials from government, industry and academia to collaborate and share the latest challenges and innovations in the field.

The event is being planned as an online conference with opportunities for some in-person sessions Aug. 30 through Sept. 1.

A call for ideas will close March 15. Ideas may be submitted for six topical areas. Formats include presentations, tutorials, posters and activities. Notification of acceptance will be sent April 16.

Potential speakers may submit ideas at application.ndia.org/abstracts/11d0/. Presenters will be selected based upon the quality and fit of their submissions. Full papers are not required. ND

NDIA CALENDAR

We look forward to bringing together leaders in government, industry, and academia again to solve the most challenging issaues in national security.

To keep our community engaged, NDIA meetings, conferences and events are currently held virtually.

Visit NDIA.org/Coronavirus for event status updates.

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

MARCH

2-30 2021 Human Systems Digital Experience
Virtual conference
NDIA.org/HSDE

4 Tactical Wheeled Vehicles Webinar
Virtual webinar
NDIA.org/TWVMarch

8-11 2021 Pacific Operational Science & Technology (POST) Conference
Virtual conference
NDIA.org/POST

15 NDIA-IPMD: Applying Agile Development and Execution on DoD Projects
Virtual webinar
NDIA.org/IPMDAgileUpdate

23-24 2021 Undersea Warfare Virtual Conference
Virtual conference
NDIA.org/VirtualUSW

23-25 NDIA National Security AI Conference & Exhibition
Virtual conference
NDIA.org/NSAICE

APRIL

6-7 Integrated Precision Warfare Review (IPWR-21)
Virtual conference
NDIA.org/IPWR21

7-8 2021 Insensitive Munitions & Energetic Materials (IMEM) Technology Symposium
Virtual symposium
NDIA.org/IMEM21

8 2021 Joint NDIA/AIA Industrial Security Spring Webinar
Virtual webinar
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*The industry showcase is a separate event to POST 2021 and is hosted exclusively by NDIA. USINDOPACOM does not support or endorse the industry showcase event.

March 8 – 11 | NDIA.org/POST

Next Month

CMMC Update
■ Soon, every defense contractor — big and small — will have to earn Cybersecurity Model Maturity Certification to do business with the Defense Department. A variety of experts give their best advice on how to prepare for this eventuality.

Artificial Intelligence
■ The National Security Commission on Artificial Intelligence — which was tasked by Congress to research ways to advance the development of AI for national security and defense purposes — is on the cusp of releasing its final report. What are the key enablers of AI technology commissioners are homing in on?

Army Helicopters
■ The Army is working to acquire both a future scout helicopter and a Black Hawk replacement aircraft. What strides are being made by the service and industry to meet requirements for the new programs?

Army Aviation Industrial Base
■ The Army aviation industrial base — which manufactures the service's family of helicopters — has been clobbered by the COVID-19 pandemic. Service leaders are working with companies to try and mitigate issues, but concerns about the health of the industrial base remain.

V-22 Upgrades
■ The U.S. military's V-22 — which is employed by the Marine Corps, Navy and Air Force Special Operations Command — is now almost 15 years old. We take a look at the upgrades in store for the tilt-rotor aircraft.

Counter-UAS
■ The Defense Department is investing more into countering unmanned aerial systems. The Pentagon is organizing new programs and strategies to protect troops from the ever-improving technology.

MARCH 2021 Index of Advertisers

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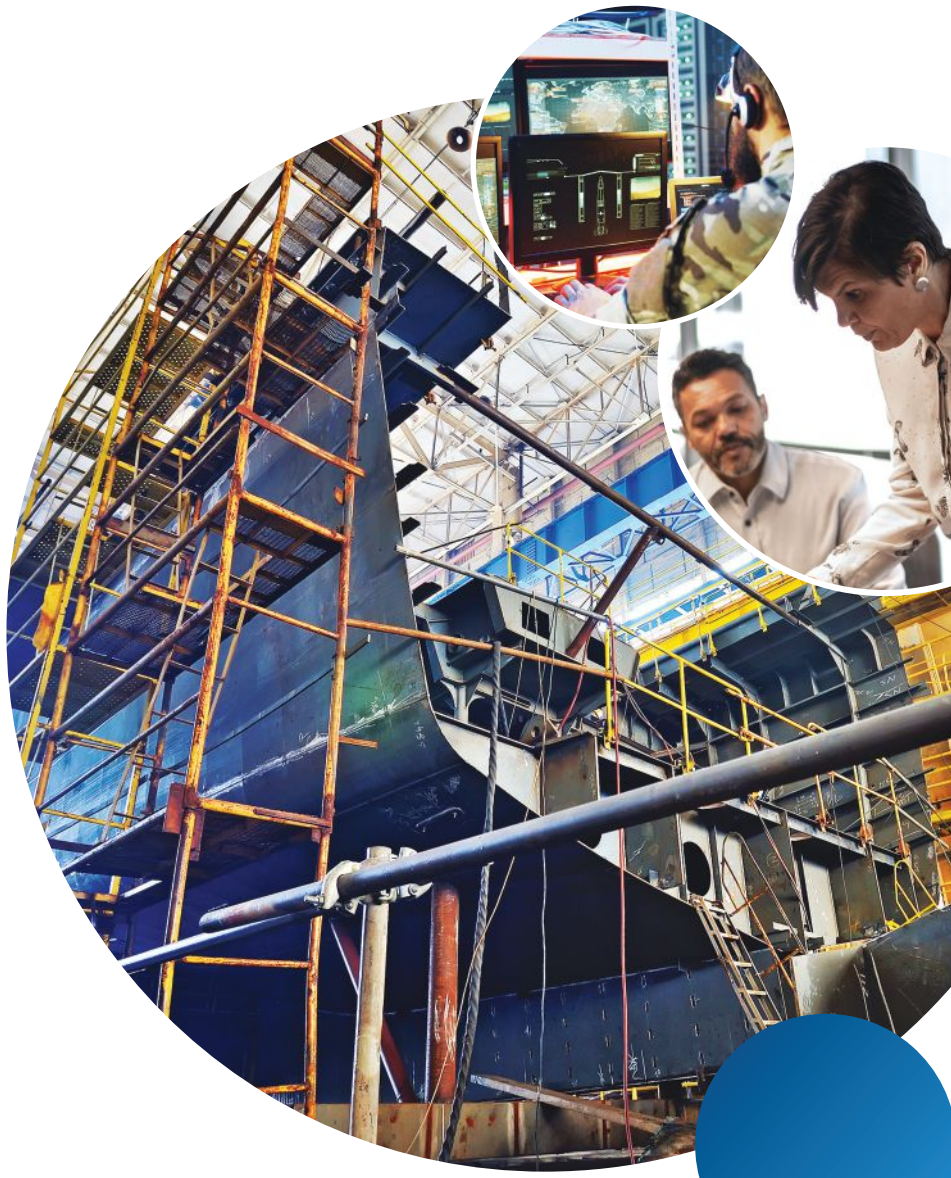

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