National
DEFENSE

Indo-Pacific
Technology
Outlook

AUKUS Reforms Still Have Some Ways to Go

The trilateral security partnership between Australia, the United Kingdom and the United States known as AUKUS is designed to be part of the strategic deterrent to the People's Republic of China's growing military capabilities in the Indo-Pacific region.

Although attention initially focused on the proposed transfer of nuclear propulsion technology to Australia, the plan also has ambitions to develop advanced technologies and other military capabilities expected to deliver decisive advantage in the capabilities defining the modern era of warfare such as hypersonics, cyber, quantum computing and undersea robotics and autonomy.

A focus for the partnership throughout 2024 was the concurrent rulemaking by all three governments on an exemption for defense trade and cooperation among the three countries.

In the United States, this rulemaking process was authorized by the exemption to the International Traffic in Arms Regulations mandated by section 1343 of the fiscal year 2024 National Defense Authorization Act. The State Department released the proposed rule on the AUKUS ITAR exemption in May 2024 and, pursuant to section 1343, issued a determination on Aug. 15 that the Australian and U.K. export control systems are comparable to those of the United States and have implemented a reciprocal export exemption for U.S. entities.

In addition to the ITAR exemption, the State Department also implemented expedited processing of license applications for the export of defense articles and defense services to Australia, the United Kingdom or Canada under ITAR § 126.15, which was required by section 1344 of the 2024 National Defense Authorization Act.

This exemption applies to items or services that are not eligible for transfer under the ITAR exemption and must be to, or within, the physical territory of these countries and between governments or persons of these countries. To the extent practicable, processing times under expedited processing are directed to be within 30 days, if related to a government-to-government agreement, and 45 days for all others. However, it is important to note that the congressional certification period is not included in these timelines.

Although many in industry see the exemption as a positive step forward, this was an important, but incomplete, first step in a larger discussion that needs to occur. The U.S. partners of the AUKUS Advanced Capabilities Industry Forum, which includes the National Defense Industrial Association, the Aerospace Industries Association, the Professional Services Council and the U.S. Chamber of Commerce, conducted a survey on the AUKUS ITAR exemption in November 2024.

The majority of the respondents, 69 percent, viewed the exemption as a positive step, 21 percent viewed it as negative and 9 percent viewed the rule as neutral. When asked if the interim final rule addressed primary concerns from the proposed rule, only 38 percent of respondents said yes, while nearly 29 percent said no and 33 percent were unsure.

Respondents were also asked about the effectiveness of different elements of the rule, and the Excluded Technology List was highlighted as the least effective, with 32 percent of respondents viewing it as negative, 43 percent viewing it as neutral and 25 percent viewing it as positive.

The top concerns cited were: the list was considered too broad, 54 percent; the list includes technology essential to trade with Australia and the United Kingdom, 43 percent; and industry cannot identify the reason behind technologies listed on the list at 39 percent.

Furthermore, companies expressed concern that the Excluded Technology List includes technology that falls under AUKUS Pillar 2 objectives, including electronic warfare as well as hypersonic and counter-hypersonic capabilities.

Nearly four years after the establishment of AUKUS, government and industry need to make progress on a coordinated approach with meaningful efforts within the next 12 months to enable its partners to develop and deliver needed capabilities.

With the structure and frameworks, including the ITAR exemption and expedited licensing processes, largely in place, the next phase of AUKUS is moving toward the testing and evaluation implementation phase.

For the United States, this will necessarily shift the focus of the partnership away from the State Department and to the Defense Department, the military services and Congress to begin identifying designated AUKUS programs with dedicated funding streams and contracting vehicles.

In this vein, the U.S. associations have been working with the government agencies and international AUKUS partners to identify narrowly focused strategic priorities with specific lines of effort that can enable meaningful progress under the agreement, particularly in the near-term.

There is also an opportunity to address the challenges each AUKUS nation is facing with supply chain illumination and supply chain resilience. For the United States, this includes the imperative to move away from relying on China for critical minerals and finding viable supply alternatives. For example, Australia has some of the largest recoverable critical mineral deposits on Earth, including high-quality cobalt, lithium, manganese, rare earth elements, tungsten and vanadium. If utilized wisely, AUKUS could provide a unique opportunity to enable the United States to partner with Australia for the supply of critical minerals that are essential for defense technologies and national security.

A vigorous, comprehensive export control system is essential to preserve U.S. economic security and U.S. national security, including the technological competitive advantage of the military. At the same time, it is equally important to prioritize what requires government controls.

AUKUS has the opportunity to be a pathfinder for a more modern, responsive export control framework that accelerates the delivery and interoperability of critical technologies with the United States' closest allies. Finally, as the United States focuses on increasing defense trade, policymakers should also consider mechanisms to improve defense trade with other U.S. allies. **ND**

Jennifer Stewart is NDIA's executive vice president for strategy and policy.

iStock illustration

Solving Critical Challenges For The Nation's Security and Prosperity

Accelerating Innovation. Advancing National Security.

Parallax Advanced Research and the Ohio Aerospace Institute (OAI) collaborate with the Department of Defense, U.S. Intelligence, and defense agencies to solve the toughest challenges in land, sea, air, space, and cyber domains.

We deliver mission-ready solutions, from AI-driven autonomy to multi-domain command and control, that enhance operational effectiveness and drive technology transition. We work across industry, government, and academia to push the boundaries of innovation in:

- Advanced Aerospace R&D
- Modeling, Simulation & Systems Engineering
- Autonomy & Unmanned Systems

- C5ISR & Human-Machine Teaming
- Prototyping, Testing & Integration
- Space & Spectrum Dominance

Through strategic partnerships and technology acceleration, we strengthen defense capabilities and fuel economic growth.

Let's advance together. Learn more at: parallaxresearch.org | oai.org

AUKUS INNOVATION

U.S., U.K., Australia Still Ironing Out Tech, Info Sharing Kinks BY ALLYSON PARK

Amid a technological pacing threat from China in the Pacific, the trilateral security partnership between Australia, the United Kingdom and the United States known as AUKUS is struggling to overcome barriers to information and technology sharing among allies.

And while pointed efforts have been made to improve and streamline these processes, experts contend more needs to be done, proposing solutions ranging from legislation to a joint cloud system and changes to classification procedures.

AUKUS was formed in 2021 with the mission to "strengthen the ability of each government to support security and defense interests," as well as "promote deeper information sharing and technology sharing and foster deeper integration of security and defense-related science, technology, industrial bases and supply chains," according to the Defense Department.

The partnership is divided into two parts, Pillar 1 and Pillar 2, with the first focused on supporting Australia in building and acquiring nuclear-powered submarines, and the second on the collaborative development and delivery of advanced capabilities.

The list of Pillar 2 technologies includes: undersea capabilities; quantum technologies; artificial intelligence; autonomy; advanced cyber; hypersonic and counter-hypersonic capabilities; and electronic warfare.

For the United States, the sharing of technology-related information often falls under export control regimes such as the International Traffic in Arms Regulations, or ITAR, and the Missile Technology Control Regime, or MTCR, which govern how military technology and information is shared between countries.

In August, the U.S. State Department published an interim final rule amending ITAR, granting an exemption for the AUKUS partnership to "facilitate defense trade and cooperation" among the three countries. The rule went into effect on Sept. 1, adding an expedited licensing process for certain defense articles and defense service exports to Australia, the United Kingdom and Canada, according to the Federal Register.
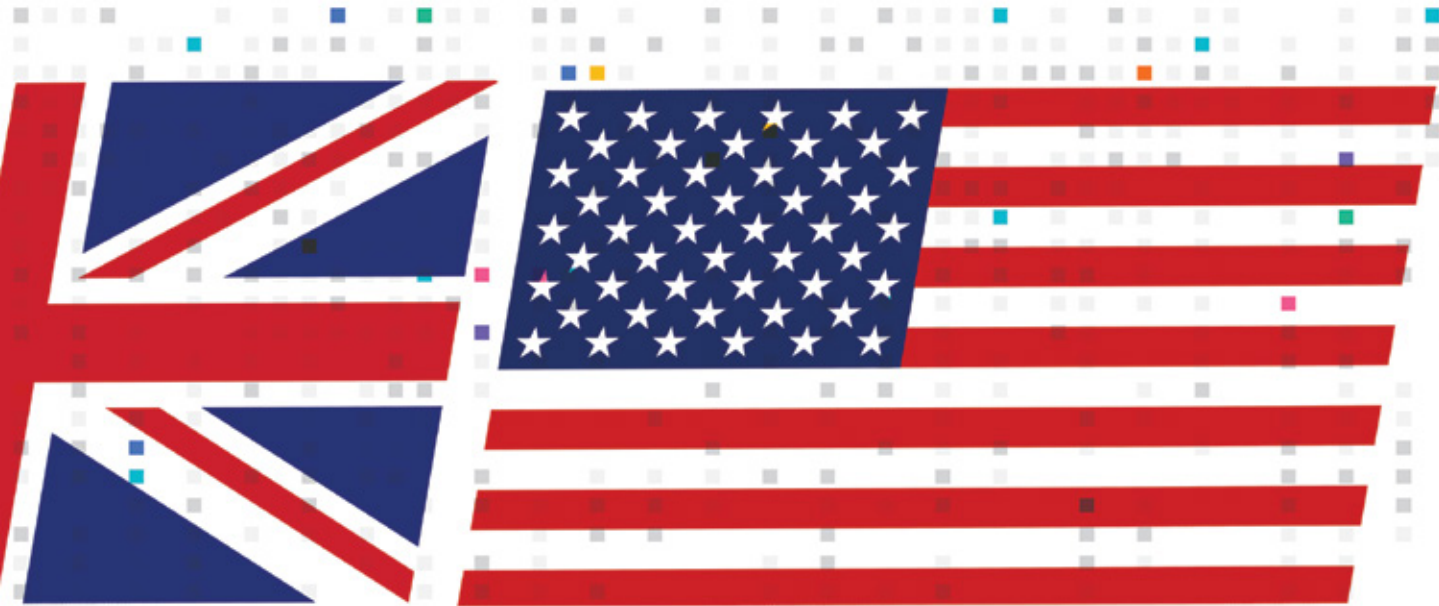
Even with this legislation implemented, there are "still a lot of caveats in terms of technologies that just can't be shared smoothly and seamlessly between the allies," said Bryan Clark, senior fellow and director of the Center for Defense Concepts and Technology at the Hudson Institute.

ITAR and missile control rules create barriers to sharing military technology and information, even with close allies. And while vital, these regimes have drastically slowed down the rate at which mature technologies can be shared between the AUKUS countries, Clark said.

"What's needed is legislation that provides broader technology-sharing approval and eliminates some of the barriers that ITAR and MTCR set up — in particular MTCR, because that governs a lot of uncrewed systems," he said.

"AUKUS is a framework for trying to get the discussions going and then get the legislation approved," he said. "That would kind of open up the floodgates when it comes to technology sharing, and that hasn't happened yet."

Michael Sharpe, chief executive officer of the AUKUS Forum, said the two sets of rules must evolve along with the threat environment, in as "short a space of time as possible" without sacrificing the protection of intellectual property.

"I like to think of AUKUS [as] creating one big factory across three nations," Sharpe said. "And if you put that lens on, what does that look [like] as far as workforce mobility, as far as technology and information sharing and even just getting new technologies onto the factory floor?"

AUKUS is built around develop-ing and harnessing new technological capabilities; in fact, it's the "number one driver," he said.

In 2023, the Australian Strategic Policy Institute released the Critical Technology Tracker project, which analyzes datasets from 2003 to 2023 to assess the state of the defense technology and capability race. The institute found China currently leads in 57 out of 64 critical defense technologies, a drastic shift from when the United States led in 60 of the 64 technologies from 2003 to 2007.

Nishank Motwani, senior fellow and director of alliance strategy at the institute, said the speed of Chinese industrial innovation is outstripping the United States, and AUKUS plays an important role in bolstering technological innovation and strengthening the three countries' defense industrial bases.

A robust innovation ecosystem is vital not only to the success of the AUKUS partnership but also to deterring potential conflict in the Indo-Pacific.

Motwani said the three countries cannot afford to be doing "business as usual."

"We're actually going to be failing the mission, which is to keep the Indo-Pacific free and open, to ensure that China is unable to change the status quo, whether through force or through other means," he said in an interview.

In order to foster a more robust innovation ecosystem and align the three AUKUS countries' defense industrial bases more efficiently, the partnership must provide proper demand signals, be more risk tolerant and harness private capital more effectively, Motwani said.

The three AUKUS nations need to publicize requirements for what they need to a more diverse group of industry partners, Motwani said. For example, a lot of the interest in Australia would come from small and medium-sized enterprises, he said. While Australia is spending money on defense, most of that money is going to the prime contractors, not the small enterprises.

"In the defense industrial base in Australia, there's a range of different small and medium enterprises that are not yet necessarily [contributing] to the defense industrial base developments that are taking place," he said. "There's a big brain drain, and there's also loss of economic opportunity and loss of opportunity when it comes to innovation."

To strengthen the innovation ecosystem, all three countries must also become more risk tolerant, Motwani said, adding that the current innovation cycle is far too slow; by the time a new capability or platform is developed and fielded, it might be too late. That inefficiency is no longer acceptable in the modern threat environment, Motwani said.

More risk tolerance must be built into the system, allowing Australia, the United Kingdom and the United States to take more chances by investing in small and medium enterprises and spur further innovation and technology development by giving them the opportunity to upscale, he said.

There's going to be accountability, but there have to be measures in place so the small and medium-sized businesses have more flexibility in terms of their ability to experiment and learn from their mistakes to produce

those capabilities, Motwani said.

Clark said while increased risk tolerance may benefit the development and fielding of capabilities that are less expensive and more short-lived, it could prove harmful in technologies that are designed to last an extended amount of time or operate with a human inside.

Capabilities like small uncrewed systems, radars, electronic warfare systems, sensors and low-Earth orbit space systems are designed to be very short-lived, allowing opportunities for "riskier" decisions to be made with less serious consequences in case of error, he said.

"You can make choices that might not pan out ... and then you choose a different path, but you haven't lost that much because it wasn't that expensive to get in the first place, and you could probably repurpose most of it to the new choice," Clark said. "The idea is [to] apply a lot more risk tolerance to things where the regret level is going to be low and keep the appropriate level of risk tolerance for things that are going to be long-lasting and involve humans being inside them."

Motwani said AUKUS must also harness private capital more effectively to boost innovation within the three defense industrial bases, and it is currently not doing enough. There are many different organizations in the private industry interested in investing in national security.

"It could be about operating ports, it could be about developing and deploying sensors, it could be about harnessing their human intelligence networks," he added. "There's a range of different ways that they can come into the picture, but that public-private partnership is something that can really drive [AUKUS] by bringing in capital and giving more ballast to some of these programs that simply don't have money."

The three partners' ability to seamlessly share data, particularly information regarding technology development and operation, also plays a large role in the partnership's mission.

Meganne Atkins, executive director of the U.S. Navy's AUKUS Integration and Acquisition Office, said there is "a lot of work to do" in the information and technology sharing space.

"It's a very difficult problem to get through, because there are many different aspects of it," she said during a panel at the Naval Submarine League's Annual Symposium and Industry Update in November. "Understanding what the exact problem is is very difficult. Is it a business proprietary issue? How are you securing that information?"

The three nations all have different geographic challenges and military strategies, meaning each country has its strengths, weaknesses and focus areas when it comes to technology development and procurement.

"Some of these capabilities are going to be more beneficial to some countries than others, and it gives you a chance to share that and align the technology with what the country needs most," Clark said.

On the U.S. side, information and technology sharing within AUKUS must improve in the classified information space, Motwani said. A lot of the cooperation and partnership between the United States and its allies takes place in the classified domain, and even the closest allies are unable to access classified information that is available on the U.S. side, he said.

Currently, "U.S. intel is classified as 'NOFORN [not releasable to foreign nationals],' and that means it excludes the allies," Motwani said. "When the default option for the classification of intelligence is 'NOFORN,' that becomes detrimental to what the mission set [has] set out to achieve, which is greater infor-
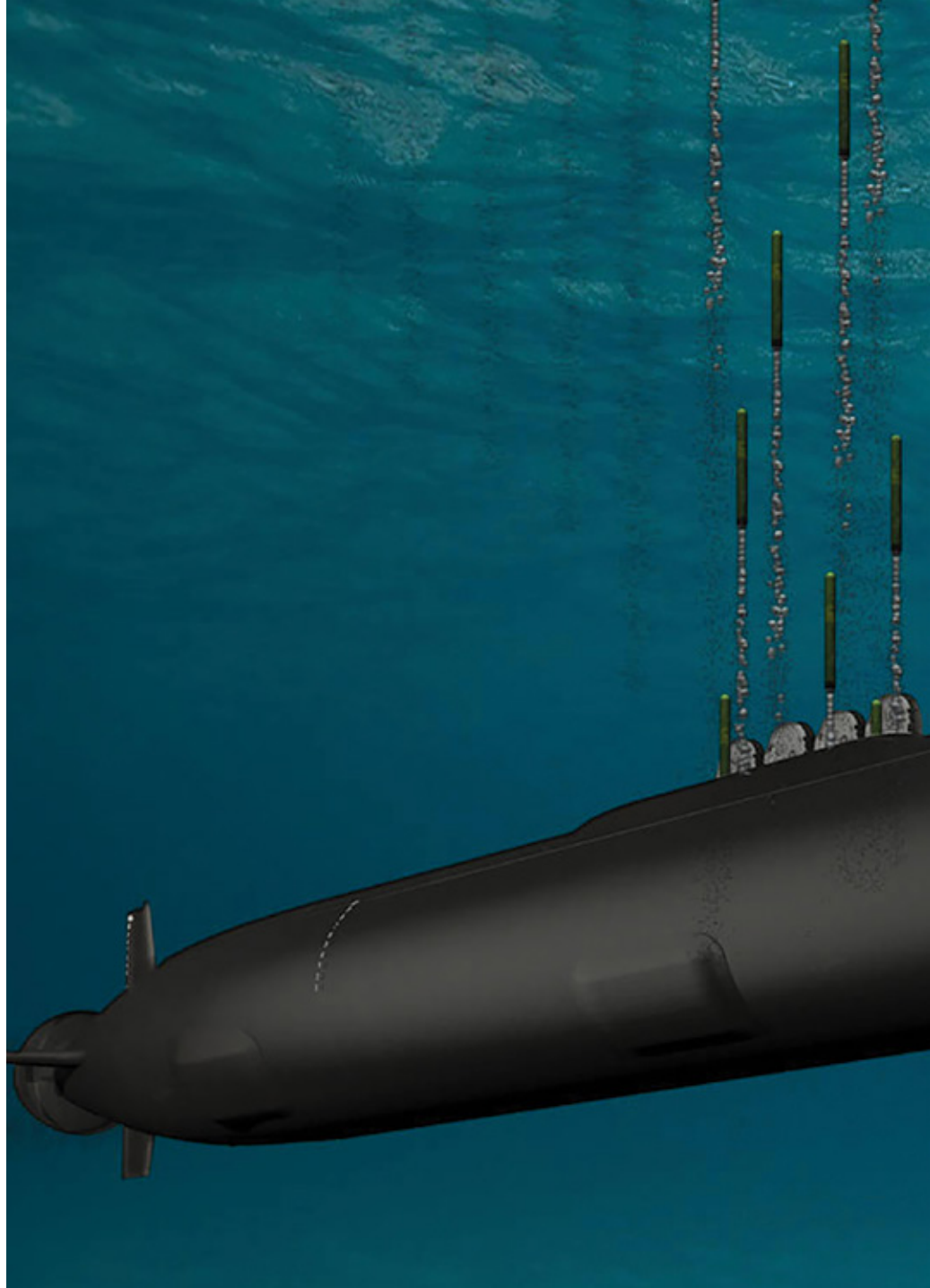
General Dynamics rendering
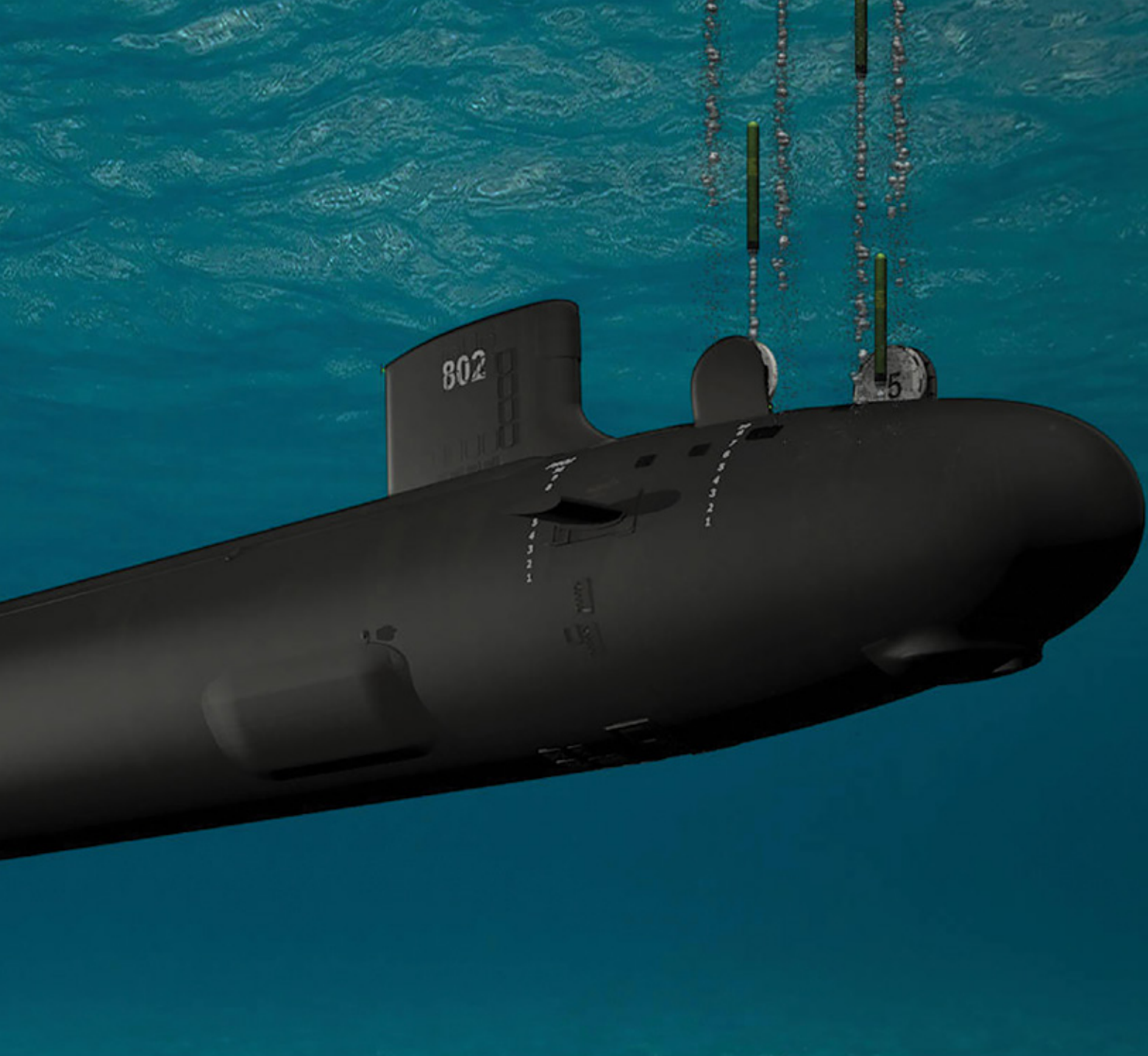
mation sharing to be able to equip our allies better, such that they have a common understanding to push back against a common threat."

In order to fully leverage existing capabilities and networks, Motwani said the partnership needs to establish a joint federated cloud system across the three countries that operates at a classified level, allowing the sharing of classified material "to harness the potential of their respective industrial bases [and] deliver the capabilities into the hands of the warfighters."

A joint cloud system would allow for technology and information to be more readily available to warfighters, building a more accurate and timely picture of the threat terrain across all domains.

Through this cloud system, the three countries could "filter down what they're seeing in their respective areas, back to not just their own command structures but across command structures, to see if there are any [new] patterns that are emerging, so they can deal with the threat much more effectively," Motwani said. "And having that in a cloud federated structure that comes across, let's say ... with AI built in, would really allow them to harness that potential to much greater effect."

AUKUS is "not a three- to five-year project," Sharpe said. "We're setting the foundations for decades ahead."

Bolstering its innovation ecosys-tem by investing in the three nations' industrial bases and streamlining the process for sharing technology and information will strengthen the partnership as a whole, Motwani said.

"This is a network of allies and partners. ... And the degree to which they're able to bring their capabilities in across all five domains, that is a significant strength," he said.

"They are obviously — it goes without saying — a lot stronger together than they are individually, but also when they operate with each other across different theaters, both Atlantic and Indo-Pacific, there is a lot that they learn from one another," he said. **ND**

VIEWPOINT
AUKUS Operations Require Coalition, Civilian Support

BY MARK SMETHURST

The AUKUS trilateral partnership between Australia, the United Kingdom and the United States has become a cornerstone of Western operations in the Indo-Pacific.

History tells us that civilian support and the private sector are essential for operational delivery. The three governments of the partnership realize this and are already implementing steps to ensure supply chains are reliable.

Recently, Australia announced in a press release it is investing $262 million in Australian dollars to "support local defense industry uplift and develop Australia's AUKUS nuclear-powered submarine supply chain."

Civilian support is required in two key areas to ensure long-term success: capacity and coordination.

An open and frank assessment of capacity is needed to establish where support is best deployed, and there must be greater coordination efforts between the partners to enable a policy of persistent engagement, such as sustained operations. These steps form the backbone of strong operations in the region.

Looking back at previous coalition operations within the Indo-Pacific, the 1999 East Timor crisis demonstrated why the fast delivery of security operations, goods and services is essential. Following an independence referendum on whether East Timor would remain a part of Indonesia, Western forces including the Australian Defence Force intervened alongside partners including Canada, the United Kingdom and the United States to prevent the conflict from spiralling further.

Despite the loss of civilian life — sadly estimated at 1,400 — Australia led an international peacekeeping force that put an end to the conflict. However, logistical support would have been impossible in these austere circumstances without coalition and civilian assistance, which provided 17 chartered foreign vessels. Had Australia not had this additional capacity, it would have struggled to enable the movement of equipment and materials from the Port of Darwin in Northern Australia to East Timor — a sea transit time of two to three days.

Today, it is similarly important that defense forces can call upon broader support from a healthy coalition of civilian operational support providers. Sustaining forces on the ground very much depends on this.

Logistics and communications are often the most challenging threats facing teams in the Indo-Pacific. AUKUS operations within the region will be particularly complex. Australia's experience in the East Timor crisis highlights that delivering operational support successfully hinges on healthy capacity. This requires knowing which relationships teams should leverage and when.

In the private sector, companies looking to ensure they have effective supply chains in place should consider the local offering available in addition to what may need to be contracted. This could include the resupply of vehicles and aircraft spares to the delivery of general sustainment equipment and rationing.

Moreover, home nations and other external civilian supply chains can be used for items that are more difficult to source locally or that are needed urgently. Although costly, this strategy can often provide faster and more reliable delivery of goods and services. By having an open and considered assessment of capacity and capability, teams delivering for AUKUS can ensure sustainment is reliable, especially when the scope of operations increases at short notice and gives certainty to teams on the ground.

On the role of coordination with civilian support, resources should be maximized by building good communication links with partners in the region. Coordinating the delivery of training for local teams in the Indo-Pacific avoids duplication. Where Australia, the United Kingdom and the United States work with civilian teams, collaboration maximizes operational bandwidth.

Likewise, multinational teams perform a similar role while also supporting training and capacity-building activities. The positive result of civilian support offered between teams is the support it provides to persistent engagement, potentially increasing the duration of operations. This must be top of the agenda for decision-makers.

To achieve this, relationships can be built and maintained through sustained visits, training and exercises, or through the exchange of information by collaborating in areas like defense training. With the help of the private sector, such an engagement strategy requires a deep understanding of existing relationships and knowledge of where collaboration can take place.

Building trust and familiarity between teams and the wider community must factor into this engagement strategy. It ensures leaders and teams build and maintain relationships with local partners and industry — connections that can be utilised when needed in the future.

Operations in the Indo-Pacific are likely to require greater capacity and an openness to coordinating efforts, so the AUKUS governments should continue to fully engage with the private sector. These two strategies will help ensure the continued success of the trilateral partnership, enabling reliable sustainment and a policy of persistent engagement. Ultimately, maintaining stability in the Indo-Pacific relies on an unwavering commitment to partnerships — both military and civilian. **ND**

Retired Brig. Mark Smethurst is a senior executive leader who served 35 years in the Australian army. He now provides board and advisory services to a variety of companies in Australia and internationally.

International Navigation

AUKUS Nations Making Inroads on Quantum Tech, But Barriers Remain

BY JOSH LUCKENBAUGH

When Australia, the United Kingdom and the United States established the AUKUS Quantum Arrangement in 2022, the three nations declared they would be integrating the emerging technology in trials and experimentation over the next three years.

Three years later, no joint quantum development program has emerged from the arrangement, but organizations across the three nations are making advancements in quantum tech that could soon provide benefits across the alliance.

For example, Australian company Q-CTRL in December tested its quantum navigation system on a ground vehicle using publicly available magnetic maps, and it outperformed a "strategic, defense-grade inertial navigation system, which is a standard backup that you use in a high-end system," said Michael Biercuk, founder and CEO of the company.

In the United States, Sandia National Laboratories in August announced that for the first time researchers used silicon photonic microchip components to perform a quantum sensing technique called atom interferometry — an ultra-precise way of measuring acceleration — thus achieving a significant milestone in the development of a "quantum compass for navigation when GPS signals are unavailable."

"If the folks at Sandia have figured out a way in which you could do this using silicon chips, gosh, then you've got something that is much more portable, much less expensive and much more versatile," said Arthur Herman, senior fellow and director of the Quantum Alliance Initiative at the Hudson Institute.

In the United Kingdom, the Defence Science and Technology Laboratory announced in a January press release it has developed an atomic clock using quantum technology that "will be a leap forward in improving intelligence, surveillance and reconnaissance by decreasing the reliance on GPS."

"The clock's precision is so refined that it will lose less than one second over billions of years, allowing scientists to measure time at an unprecedented scale," the release said. It is the first device of its kind to be built in the United Kingdom and could be deployable on military operations in the next five years. Along with enabling more precise navigation systems, quantum clocks can secure communications systems and

Sandia National Laboratories' silicon photonic modulator chip

enhance the accuracy of advanced weapon systems, the release added.

The AUKUS Quantum Arrangement — established as part of the trilateral security partnership's Pillar 2 to collaborate on emerging technologies — was meant to accelerate investments to deliver "generation-after-next" quantum capabilities.

However, the arrangement is "not a program — there's no money attached to it. There's no specific activity linked to it," Biercuk said in an interview.

Q-CTRL is doing work with the Australian and U.K. defense ministries and engaging with the U.S. Defense Department and U.S. defense companies. All of those activities are "supported, if you will, under AUKUS," Biercuk said.

"AUKUS is facilitating technology sharing. So, we're a registered participant with the State Department, which means that we can do cross-border transfers and the like," he said. "But we are yet to see a specific AUKUS quantum program that [involves] cross-border funding."

Herman said he had hoped from the beginning that the AUKUS Quantum Arrangement wouldn't "take the wheel" in terms of technology development, but instead "would be basically an oversight operation."

"That has been my impression, that they set themselves up to do that kind of oversight and [make] sure that everybody's moving in the same direction," Herman said in an interview.

"Since a lot of this is really very much on the cutting edge" of technology, allowing private companies to take the lead in how to develop quantum systems and how to deploy them "is probably going to be the best approach to this, as opposed to trying to innovate via committee," he said.

When the AUKUS Quantum Arrangement was announced, the three nations stated its initial focus area would be positioning, navigation and timing solutions. Quantum is

an attractive option for PNT because it "provides a way to do that without resorting to space at all," said Paul Stimers, executive director of the Quantum Industry Coalition.

Currently, positioning, navigation and timing is provided primarily by GPS satellites. Adversaries are developing systems to take out U.S. and allied space-based capabilities in a potential conflict, Stimers said in an interview.

"Our job right now is resilience," he said. "Our job is to make sure that our capabilities are able to withstand attack and ... able to deter attack. And so, having an alternative means of positioning, navigation and timing" like quantum that doesn't depend on space "is the best kind of resilience."

"Having the ability to have onboard sensors and timekeeping devices that can place you very, very, very precisely in four dimensions is a real game-changer," he said. "If you're looking at an adversary that plans to knock out GPS as a way of creating an access-denied environment — say, around Taiwan" for about two weeks — "that is a situation where having that assured PNT capability can potentially prevent a war."

What makes quantum sensors a good potential alternative to GPS is they are very sensitive — "they can measure very, very small signals" — and they are stable, as "the signature that you're pulling out, the signal, comes from the laws of quantum physics," Biercuk said. "It doesn't come from a mass on a spring that can deform over time or an electrical circuit whose resistivity can change over time, all of those conventional issues that you find in electronics equipment that limit the performance of today's GPS backups."

Along with performing "passive" functions like positioning, navigation and timing, quantum sensors could also be used in a more proactive way as "quantum sonar" systems "to sense other objects undersea, like enemy submarines," Herman said.

However, while quantum sensors perform well in a lab setting, "they absolutely go to zero in the field," Biercuk said. Q-CTRL has been developing software to stabilize its quantum sensors against "platform noise — the vibrations, the magnetic fields that come off spinning metal parts and things like that."

Other quantum sensor developers have taken a "brute force" approach
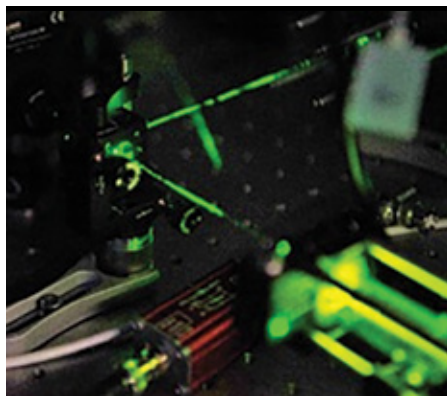
to making hardware more stable, he said.

"We've said, 'No, that doesn't make sense. We're going to trade hardware for software and use software in order to do a lot of the stabilization,'" Biercuk said.

While abundant innovation in quantum technology is happening across the AUKUS alliance, sharing technology and information on these advancements has been "very tough," Herman said.

One challenge is that "the people who are in charge of export control don't understand quantum technology," he said. "It's a brand-new technology, very different from so many of the other high-tech sectors in terms of what constitutes important components or what constitutes important IP or [the] knowledge base that would go into quantum technology."

It has been difficult for regulators to distinguish between if it is "something that just advances the science and therefore should flow through, or is this something with real national security and sensitive information consequences that we need to shut down and restrict very carefully," Herman continued. As a result, "regulators have tended to do what they usually do, and that is say 'no.'"

William Clark, vice president of quantum development at Infleqtion, said his company has offices in all three AUKUS nations, and the technologies being built at its U.K. office "have largely been developed as sovereign capabilities," so Infleqtion doesn't run into any export control issues.

"We're doing the same thing in Australia where we're developing ... a sovereign team there — one that can develop their own organic solutions," Clark said in an interview. "There are things on the research side that can be shared that are now not really restricted, but that's at a research level."

It becomes more difficult when trying to exchange information about actual applications, and thus more important to pay careful attention to export controls and International Traffic in Arms Regulations, he said.

While there are still asymmetries across the three nations' export control regimes that need to be ironed out, "if you consider AUKUS to be the umbrella that gives agency to these three independent nations to have their businesses work together more and work together with the associated [ministries of defense], that's actually working quite well," Biercuk said.

"It's a huge impetus for the U.K. government to engage with us via their various programs. It's a huge impetus for the U.S. government to go outside of its normal acquisition approaches and say, 'Hey, we have AUKUS exemptions for certain'" solicitations that are normally only open to U.S. organizations, he said. "So, it is a facilitator that is actually doing things, but there is no well-defined" AUKUS quantum program.

There is hope that as the AUKUS Quantum Arrangement's objectives become clearer, some of the current barriers to cross-border collaboration will come down, Clark said.

"We don't want to have three different versions of the same product," Clark said. The hope is that eventually each of Infleqtion's offices can focus on different pieces of the quantum puzzle, "and then you can bring them together to create these integrated systems that are better suited for bidding things under AUKUS."

"We see what's happening in the Indo-Pacific, and I think that the clock is ticking," he said. "There are things that could happen that if we're not acting now, then I don't know how you solve some of those problems."

Biercuk said all parties are enthusiastic about the potential for "a larger-scale, focused" quantum initiative between the three nations.

"It should not come as a surprise that anybody who's a program agent would love for there to be more capital injection. Anybody who's a performer would love to have more opportunities to bid on. I think everybody is pretty well aligned," he said.

"We're excited for what comes next in terms of taking the technology that we've now validated in the field ... and turning those into operational capabilities," he said. "We're ready to do it." **ND**

COMMENTARY
South Korea's Aircraft Carrier Program Strengthens ROK-U.S. Alliance BY JIHOON YU

South Korea is moving forward with plans to develop its first aircraft carrier, a decision that has sparked debate over its necessity and feasibility.

While some critics argue that the country's existing naval forces and alliance with the United States provide sufficient security, supporters see the carrier as essential for strengthening South Korea's defense posture, increasing its ability to respond to maritime threats and reinforcing its regional influence.

With rising security concerns from North Korea and China and shifting U.S. foreign policy under President Donald Trump's new administration, South Korea's carrier program is gaining renewed attention as a strategic investment in its national defense and global security role.

The development of South Korea's first light aircraft carrier — known as the CVX program — has faced both progress and setbacks due to changing political and budgetary considerations. Initially launched with strong support from the previous administration, the program was intended to enhance

Artist's rendering of a CVX strike group

the Republic of Korea Navy's power projection capabilities with a vessel capable of operating F-35B short takeoff and vertical landing fighters.

However, following a shift in political leadership, the project encountered delays as new defense priorities were reassessed, and debates over cost-effectiveness, operational necessity and alternative naval mod-

ernization options emerged.

Despite this period of uncertainty, recent developments indicate a renewed commitment to advancing the carrier program, particularly as maritime threats from North Korea and China continue to grow.

As a peninsula nation with an economy heavily reliant on maritime trade, South Korea's security is intrinsically tied to naval power. The growing threats from North Korea's naval advancements, including submarines equipped with ballistic missiles, and China's expanding maritime influence make it imperative for South Korea to bolster its naval deterrence capabilities. An aircraft carrier would allow South Korea to project power beyond its immediate waters, providing a more flexible and mobile response to emerging threats.

It would serve as a deterrent against North Korean provocations while also reinforcing South Korea's ability to respond independently in regional security challenges. Unlike land-based airpower, which is limited by geographical constraints, a carrier offers the flexibility to deploy forces wherever needed, reinforcing South Korea's global security commitments and enhancing its operational reach.

A significant consideration in this decision is how an aircraft carrier could contribute to the ROK-U.S. alliance under the Trump administration, which has already begun placing greater emphasis on allied burden sharing. Trump has signaled a shift in U.S. foreign policy that demands increased self-reliance from allies, raising concerns in South Korea about the long-term reliability of U.S. security commitments.

In this new strategic environment, an aircraft carrier would serve as a key asset in demonstrating South Korea's capability to take on a greater share of regional security responsibilities while ensuring that the alliance remains balanced. Instead of weakening ties with the United States, an aircraft

carrier would enable South Korea to operate more effectively alongside U.S. forces in joint military exercises, maritime security operations and crisis response efforts in the Indo-Pacific.

By increasing interoperability with U.S. forces, South Korea would strengthen its strategic position within regional security frameworks. As the United States recalibrates its military focus toward countering China and reassessing its commitments to allies, South Korea's carrier would serve as a force multiplier, reinforcing its commitment to shared security goals and ensuring continued U.S. military support.

It would also align with U.S. efforts to bolster allied capabilities — particularly in the Indo-Pacific — where naval power plays a critical role in maintaining balance. Furthermore, a carrier would provide South Korea with greater leverage in alliance negotiations, allowing it to present itself as a more capable and self-reliant security partner rather than a dependent ally.

While the development of an aircraft carrier is a complex and resource-intensive endeavor, the strategic benefits outweigh the costs. Although political shifts temporarily slowed the program's momentum, the growing security challenges in East Asia have reaffirmed its necessity. An aircraft carrier would enhance deterrence, reinforce South Korea's role as a regional security actor and strengthen its ability to contribute to the U.S. alliance amid shifting geopolitical conditions.

As U.S. expectations for allies continue to evolve under the Trump administration, South Korea's pursuit of an aircraft carrier is not just a matter of military ambition but a necessary step in securing its national interests and asserting its strategic autonomy in an increasingly uncertain global landscape. **ND**

Jihoon Yu is the director of external relations and an associate research fellow at the Korea Institute for Defense Analyses and a former ROK Navy submarine and strategic officer.

KIDA image

Trilateral Competition

AUKUS Challenge Prize Propels Partners' Electronic Warfare Tech BY LAURA HECKMANN

When Australia, the United Kingdom and the United States announced the trilateral AUKUS security agreement in September 2021, electronic warfare was not even listed among the technologies the partners planned to collaborate on as part of the agreement's second pillar.

When it was added months later, it not only recognized what the Defense Department called a "congested and competitive environment" but became the focus of the alliance's first trilateral innovation competition.

The electronic warfare working group was added to AUKUS Pillar 2 in April 2022 to "share understanding of tools, techniques and technology to enable our forces to operate in contested and degraded environments," a White House release said.

Announced in March 2024, the inaugural AUKUS Electronic Warfare Challenge launched three synchronized competitions across Australia, the United Kingdom and the United States to identify electromagnetic spectrum technology solutions that would "give AUKUS nations a strategic edge in both targeting and protection against adversarial electromagnetic targeting capabilities," a Defense Innovation Unit release stated.

The Defense Innovation Unit led the U.S. version of the competition, while Australia's Advanced Strategic Capabilities Accelerator and the United Kingdom's Defence and Security Accelerator helmed their own iterations.

Abigail Desjardins, deputy director of global partnerships at DIU and the organization's lead for AUKUS Pillar 2, said the first challenge allowed the

of the innovation challenge was to "bring to light the most advanced technology in each of our countries."

Desjardins said while the problem statement was agreed upon by all three nations, "we realized really quickly that as we were trying to launch a single challenge, we have very different acquisition processes in our three nations."

Given the fact that the AUKUS partners were trying to move fast on the first competition, "we elected to execute a challenge that had the same problem statement along the same timeline but leveraged trilateral acquisition processes," she said.

The U.K. and Australian challenges awarded developmental contracts that are still ongoing, whereas DIU awarded a financial prize to the winning vendor in the U.S. competition, she said.

Moore said the challenge helped the three nations better understand each others' procurement systems and informed an approach to "progressively [increase] alignment of our innovation systems."

Collectively, the competition drew 173 qualified vendors and "a lot of enthusiasm across all three systems," Desjardins said — likely because "this was the first industry-facing opportunity to engage with AUKUS Pillar 2."

DIU received 31 qualified submissions, ultimately awarding the top prize of $150,000 to a New York-based advanced sensing startup called Distributed Spectrum.

Alex Wulff, CEO and co-founder of Distributed Spectrum, described the company's technology as "building capabilities to basically give people situational awareness or visibility into the radio spectrum" by building software and sensors that "help people understand what's out there."

The company's winning pitch focused on detecting maritime activity — a relevant use case for the Indo-Pacific and the broader AUKUS goals.

While there are lots of planes, surface vessels and satellites that currently do this, "really it is a very difficult challenge to detect one ship out of the thousands and thousands of ships operating in the Pacific that's doing something that's a little suspicious," he said.

The only way to track specific vessels trying to hide is having coverage with "lots and lots of sensors over a very broad area," he said.

Distributed Spectrum's sen-

sors and software allow for "very low-cost, inexpensive radio sensing hardware to detect and kind of characterize radio activity from thousands, potentially, of sensors across a very large area," he said.

The solution the company pitched for the challenge was scattering its sensors at very large volumes across the Pacific on things like buoys or land-based platforms and essentially creating "one big radio sensing mesh" to provide what Wulff called "unparalleled situational awareness for that type of domain."

While Distributed Spectrum was the sole recipient of DIU's prize money, Australia selected three winners and the United Kingdom chose four.

Among the United Kingdom's winning projects were creating fake radio signals to mask the location of friendly military forces; combining an electronic warfare payload and an uncrewed air system; developing the ability to transmit and receive on identical frequencies simultaneously; and improving the ability to detect multiple individual faint signals in close geometric proximity to one another, according to a release from the U.K. government.

The Australian winners included an advanced electronic warfare communications manufacturer, a space and defense research company and a digital security company. Moore said two Australian defense industry partners have entered into 12-month contracts worth about $5 million in U.S. dollars "to further their technologies."

But as individual competitions, how will each challenge deliver its innovation for the greater good of AUKUS?

Desjardins said as the alliance's first competition, "I think it's more for elevating awareness of, in this case, the electronic warfare capabilities that exist within our three systems, and kind of identifying them, elevating them up for awareness across our defense enterprise, so that we are now aware not just of U.S. capabilities but now of capabilities that are being developed in the U.K. or in Australia."

Wulff said his understanding during the competition phase "was the competition organizers were really looking at capabilities that could benefit the whole partnership ... not just apply value to the U.S. forces, but something that could actually change the entire region."

He saw this mentality built into the setup of the competition and

three innovation organizations to look at how each does business within its own national system, and then how to "AUKUS-ify it." In other words: "How we could try and identify areas of commonality across our different processes so that we can move in a direction of being ... more trilateral in nature of how we approach and execute engagement with industry when we're talking about these types of problem statements."

DIU — as well as the Australian and U.K. accelerators — worked with the AUKUS electronic warfare working group to trilaterally develop a problem statement for the competition, Desjardins said in an interview.

Stephen Moore, first assistant secretary of AUKUS advanced capabilities for the Australian Department of Defence, said in an email the AUKUS partners agreed the key purpose

was impressed with DIU's follow-through plan.

Ordinarily, you win a competition, "and then that's kind of the end of it," he said. In this case, the DIU team worked after the competition to connect stakeholders

A Distributed Spectrum sensor

to organizations in the space and "some of the people that are in the electronic warfare working groups managing a lot of the AUKUS partnerships around this particular type of domain and are actually the ones who can work with us to help try and get the capability out there."

Wulff said specifics of what's next for his company and AUKUS are "still crystallizing," but "I can definitely say that they were very quick and effective at putting us in touch with the right people," including "the people that are kind of managing this type of international partnership."

Moore said the competition uncovered new ways of adopting the best ideas from the three innovation systems, and the AUKUS partners have shared access to "the best technological solutions from across all three of the national challenges."

Amid its successes, the challenge's solutions are still subject to the same classification and sensitive information sharing hurdles facing all of AUKUS.

In a July 2023 article, the Center for Strategic and International Studies noted that electronic warfare systems are based on accurate and reliable intelligence and information sharing, and as long as AUKUS partner nations are all working with different levels of information, "their [electronic warfare] systems will never fully integrate."

While the AUKUS Electronic Warfare Challenge won't solve the alliance's information and technology sharing problems, it did take them into account, Desjardins said.

"You'll see everything that we are doing is Distro A," meaning unclassified, she said. "So, we feel very strongly across the three innovation organizations that although we do things in a classified space in the normal course of our business, when it comes to these types of activities, we will focus on ensuring maximum reach across our industries and keeping things at the unclassified level."

Each country will still work with their services "to figure out, once we identify a viable, desirable, feasible capability, how we can test it for integration, if it needs to be tested for integration into other systems," she said. But "we really want to make sure that we are sourcing capabilities from our innovation ecosystems and not just relying upon vendors who already have clearances. We really want to find new and novel capabilities."

Moore said progress has already been made toward "aligning our innovation systems, including sharing information about the technology proposals at key milestones."

Desjardins acknowledged that while "innumerable challenges" still exist when trying to share information and technology across borders, AUKUS Pillar 2 is "giving us that framework to really work together to try and push through some of these bureaucratic — they're there for very valid reasons — but very challenging environments for some of the capabilities that we absolutely all need to have faster." **ND**

Protecting Small Pacific Islands from Cyber Threats

BY ELENA STEINER

Pacific Island nations face the dual threats of environmental crises and evolving cyber risks, jeopardizing their human security — access to livelihoods, health and cultural continuity. For small island developing states, where human security relies on cultural and social cohesion, cyber disruptions deepen vulnerabilities and threaten critical services and governance.

Culturally grounded initiatives that integrate human and cybersecurity solutions are required to address these intersecting crises. Ignoring local cultures and attendant worldviews risks ineffectiveness and even harm, leaving citizens ill-equipped to tackle these intersecting crises.

Strengthening resilience in the Pacific Island region — which is generally defined as Melanesia, Micronesia and Polynesia, to the north and east of Australia — is vital for their survival and also fundamental for global security and stability.

In such countries, traditional knowledge systems and social networks form the backbone of community resilience. These cultural frameworks guide decision-making, resource management and responses to crises.

While security is broadly understood as the defense of a sovereign state, human security is concerned with access to food and water, cultural continuity and resilience and social stability.

It follows that both are interconnected; elements that affect national security can have an impact on human security and vice versa. For example, cyber threats targeting critical infrastructure can disrupt access to resources and services, directly undermining human security. Addressing both dimensions in tandem is crucial for fostering sustainable resilience in these vulnerable regions.

Programs designed with a westernized focus on technological threats may miss the mark, as these small nations may lack existing structures and personnel to implement them. Critical vulnerabilities are then left unaddressed. Aligning cybersecurity initiatives with local understandings of human security creates relevance and therefore trust. The likelihood of adoption and long-term success is increased.

Culturally appropriate programs also recognize the importance of storytelling, oral traditions and community engagement in transmitting knowledge. For example, public awareness campaigns about cyber hygiene or disaster preparedness can draw on these traditions to embed messages in ways that resonate deeply with local populations.

In these cultures, where collective well-being often takes precedence over individual priorities, approaches emphasizing individual responsibility

ties and undermining local support.

Successful programs must actively involve these stakeholders from the outset, respecting their roles as custodians of cultural and social order. Relationships are paramount.

The challenges facing small island developing states are not isolated; they are a microcosm of global issues. Rising sea levels and intensifying climate events are early warnings of what other regions may face in the coming decades.

Similarly, the vulnerabilities in cybersecurity in these nations due to limited resources, reliance on external infrastructure and evolving threats mirror challenges in other small or underserved communities worldwide.

The strategic importance of these small developing nations to global security should also be considered. The Pacific Islands, for example, hold important geopolitical positions with regard to trade routes, international relations and stability.

Policymakers, researchers and development agencies can increase program success and address the needs of those they aim to serve in three ways. First is by prioritizing collaboration with local communities. Second, by recognizing the value of indigenous knowledge and traditional practices. And lastly, by aligning initiatives with the cultures and worldviews of those they aim to serve.

Addressing challenges in small island developing states creates models for scalable solutions that can benefit other vulnerable regions and sets a precedent for how the world navigates the complex challenges of the 21st century. In doing so, we strengthen the shared global security and resilience. **ND**

Elena Steiner is a social science researcher at Arizona State University's Global Security Initiative. Also contributing to this article were: Tim Stevens, associate professor in

may struggle to gain traction. Cybersecurity training emphasizing personal accountability, for instance, may need to be reframed to highlight community impacts, such as the risk of breaches to shared resources or public services.

Concepts of leadership and authority in many Pacific Island cultures influence how communities engage with external programs. Elders and chiefs often hold significant sway in decision-making processes. Interventions that bypass these leaders, even unintentionally, risk alienating communi-

A cybersecurity breach or destabilization in one of these nations could have regional implications and possibly influence broader international systems, particularly in neighboring countries connected through trade and shared infrastructure.

As the world grapples with intersecting crises — climate change, migration, cyber and human security — it is essential to move beyond one-size-fits-all solutions that risk wasting resources and damaging important international relationships.

international security at King's College London and director of the KCL Cyber Security Research Group; Debi Ashenden, professor of cybersecurity and director of the Institute for Cyber Security at the University of New South Wales; and Sally Burt, lecturer in cybersecurity in the School of Humanities and Social Sciences at the University of New South Wales, Canberra.

Undersea Warfare

AUKUS May Sink or Strengthen U.S. Submarine Industrial Base

BY LAURA HECKMANN

ARLINGTON, Virginia — The trilateral agreement known as AUKUS, a security partnership between Australia, the United Kingdom and the United States in part to provide Australia with nuclear-powered submarines, is full speed ahead.

But as the United States struggles to meet its own submarine goals, some fear its promise to deliver attack boats "down under" will demand sacrifices it can't afford.

The agreement is divided into two parts, Pillar 1 and Pillar 2, with the first focused on supporting Australia in acquiring conventionally armed, nuclear-powered submarines "at the earliest possible date," a U.S. Department of State release said.

The U.S. Navy, amid significant delays to its major submarine programs — including a 12 to 16 month delay to its Columbia-class submarines and a two to three year holdup on Virginia-class boats — earlier this year announced an ambitious goal to produce three submarines a year by 2028. The plan, called "1+2+Sustainment by 2028," refers to one Columbia-class and two Virginia-class subs, with sustainment to include supporting the AUKUS agreement.

Rear Adm. Jonathan Rucker, program executive officer for attack submarines, said at the Naval Submarine League's Annual Symposium and Industry Update in November that part of the plan is delivering "improved warfighting capability," which includes "enabling the AUKUS optimal pathway."

Pillar 1's optimal pathway comprises three phases and was described during a symposium panel as "short," "truncated" and "ambitious," adding to an already strained industrial base and learning curves inherent in trilateral partnerships such as cultural and operational differences.

Phase 1 involves embedding Australian personnel across partner navies and increased port visits beginning in 2023 and the establishment of the Submarine Rotational Force-West — a rotational presence at HMAS Stirling in Western Australia of one U.K. and up to four U.S. nuclear-powered submarines, as early as 2027, an Australian government fact sheet stated.

Phase 2 will focus on the acquisition of U.S. Virginia-class submarines "as soon as possible," with Phase 3 aiming to deliver SSN-AUKUS — a trilaterally developed submarine incorporating technologies from all three nations — as soon as the late 2030s.

Rucker called the U.S. Navy's production goals risky as the industrial base struggles with challenges that saw the service's submarine production goal fall short in 2024.

The goal by the end of the calendar year was a production rate of 1.5 boats per year, with a threshold of 1.3, Rucker said. "We continue to hover around a production rate of 1.1 to 1.2 boats per year. ... We will not make the goal. We'll be closer to 1.3."

Reasons for the shortfall include "continuing challenges" related to maintenance and workforce as well as "material delays," Rucker said. What he called sequence-critical material delays "directly [impact] the ability to build boats in the order they were supposed to be built."

What this means for AUKUS depends on who you ask.

Adm. Bill Houston, director of naval reactors, said at the symposium that AUKUS is a "tremendous opportunity" not only to rebuild the U.S. submarine industrial base but also to strengthen Australia's and the United Kingdom's.

"Those allies and partners, they are bringing capabilities to us," Houston said. "They will help our industrial base."

Meganne Atkins, executive director of the U.S. Navy AUKUS Integration and Acquisition Office, said during a panel at the symposium that building up the industrial base of each nation is one of the strategic goals of the partnership.

The intent is a "'rising tides lift all boats' mentality on our industrial base, so that we have multiple organizations that are able to support multiple classes of submarines across the entire AUKUS, from our U.S. Virginia-class to our Australian Virginia-class to our SSN-AUKUS in the future," she said.

Commonality is key, Houston said. Stovepiped development in three different directions is "exceptionally expensive and time-consuming." The United States has done low-rate production in the past, he added, "but we need to now capitalize on international, large, broad capabilities, which are common on all platforms."

Houston said SSN-AUKUS cannot be built "totally dissimilar from the current submarines we operate. Australia will be operating with Virginia-class submarines. Similarities between SSN-AUKUS and Virginia-class submarines [are] good. Driving commonality is good. As long as our industrial base across all three nations can support that, it will build resiliency."

Rucker described the current demands on the U.S. submarine industrial base as "unprecedented" and a continuing challenge. But he also called it "an amazing opportunity."

Virginia-class submarine USS Hawaii participates in a submarine tendered maintenance period as part of AUKUS Pillar 1 at HMAS Stirling in Western Australia.

"It is us that are going to get these submarines that we need," he said. "It is us that are going to knock down the obstacles and overcome the challenges." But partnering with allies like Australia and the United Kingdom to execute the AUKUS optimal pathway is part of what will move the United States forward, he said.

"Our challenges must be overcome. It's going to take a team effort," he added.

Rucker said the Navy's underperforming submarine production "still enables us" to reach the AUKUS goal "in the early 2030s." He suggested the tide has begun to turn with some material challenges.

All modules are completed for Virginia-class Block IV boats, "and we are just in the final assembly and test," he said. "So, the material challenges we had back as we started to have the problems in [the] 2018, 2019 timeframe, all that material is now starting" to "finish getting delivered for Block V."

Large casting — used to produce parts for submarines by pouring molten metal into a mold to create solid metal pieces — is one area that has seen improvement, he said.

The United States has had only one company for certain types of large casting, but two vendors have been brought in from the United Kingdom that have been qualified to U.S. standards, he said. "They support both the U.K. and U.S., so … they now have additional capacity."

Additionally, the Navy has also qualified a second U.S. casting ven-

dor, "so where we used to have one, we now have four," he said.

Additive manufacturing, or 3D printing, is another area the United States hopes to see expanded through AUKUS.

An Australian company "is actually part of our additive manufacturing consortium" in Danville, Virginia, Rucker said. "They are bringing capabilities, Australia and [the] U.K., to uplift their capability, but also add additional supplies to our health as well."

Atkins said the effort to qualify vendors for the U.S. submarine industrial base is "in its infancy … but we are certainly working towards that, all the way up through a vision of having common suppliers, common parts across the classes of submarines."

While the Navy remains publicly optimistic about its ability to fulfill AUKUS promises, others are not so sure.

Ron O'Rourke, naval analyst for the Congressional Research Service, expressed concern over the Navy's inability to meet its Virginia-class goals and the ripple effect it could have on AUKUS requirements.

The improvement in Virginia-class construction has been "less than promised," he said. "If that were to continue … then that could have implications" on AUKUS, he said.

A smaller submarine force "could impact views regarding how it would affect U.S. submarine capabilities to sell three to five Virginia boats to Australia as currently scheduled under the AUKUS arrangement," he said. "In fact, some observers have already expressed views related to this point."

Secondly, it could affect views regarding the importance of maximizing the total number of attack submarines across the AUKUS partners, he said. "If our force is going to be somewhat smaller," he said, "then if you look across those three countries, it may affect how they view the situation."

Another potential roadblock is information and technology sharing, Atkins said.

The U.S. State Department in August released an interim final rule amending International Traffic in Arms Regulations, or ITAR, that granted an exemption for the AUKUS agreement to "facilitate defense trade and cooperation" among the three nations, adding an expedited licensing process for

certain defense articles and defensive service exports to Australia, the United Kingdom and Canada, according to the Federal Register website. The rule went into effect Sept. 1.

While the ITAR exemption aids in technology sharing, "we have a lot of work to do" with information sharing, Atkins said. "It's a very difficult problem to get through, because there are many different aspects of it," including a cultural challenge for the submarine industrial base.

"We do have … a culture issue, because for many, many years, I would say, the U.S. government has told our submarine industrial partners, 'You can't share that. You've sent us licenses for many years.' … Now we've turned around to, 'Actually, we're going to share it all.'"

Atkins said "getting through that" is something the industrial partners are "just getting [their] hands around. I think it's going to be difficult."

Vice Adm. Rob Gaucher, commander of U.S. submarine forces, said at the symposium that while obstacles remain, one "big step forward" for AUKUS Pillar 1 occurred this summer when the USS Hawaii and USS Emory S. Land participated in the first-ever submarine tendered maintenance period in Western Australia.

The period marked the first time Australian personnel directly participated in the maintenance of a nuclear-powered submarine in Australia and involved all three AUKUS nations. Atkins said the majority of the work was executed by Australian personnel under U.S. supervision with the United Kingdom providing onsite support.

More than 50 Australian civilian maintenance personnel have begun training at the Pearl Harbor Naval Shipyard and Intermediate Maintenance Facility in Hawaii, "learning how we … actually perform the maintenance, the culture that is on a nuclear ship … things that you just can't teach without an actual submarine there to work on," she added.

Embedding partners in program offices, laboratories and naval reactors across the country will be crucial to the success of the program, because "the Australians will not have the same amount of time as the U.S. … to fill up their force," she said.

In order to meet the optimal pathway's timeline, "we've got to bring the Australians to the table with us, and we really have to get them to learn from us on the job," she added. ***ND***

Accelerate AUKUS Pillar 2 to Lead in Emerging Technologies

The Defense Department's first National Defense Industrial Strategy released in January 2024 noted that China's growing industrial strength across areas including shipbuilding, critical minerals and microelectronics constitutes an "imperative for increased and improved defense capabilities for both the United States and our allies and partners."

AUKUS — the trilateral security partnership between Australia, the United Kingdom and the United States established in 2021 to build nuclear-powered submarines for Australia — presents a critical opportunity to develop these capabilities in tandem with two of our closest allies.

In addition to the collaboration on nuclear-powered submarines, called Pillar 1, the partnership created a roadmap for cooperation on emerging technologies and interoperability known as Pillar 2, which aims to create a platform for the three nations to collaborate on science and technology.

Pillar 2 technologies include: undersea capabilities; quantum technologies; artificial intelligence and autonomy; advanced cyber; hypersonic and counter-hypersonic capabilities; and electronic warfare.

It is well understood that emerging technologies will play a strong role in shaping the future security environment.

The aim of Pillar 2 is to leverage the unique strengths of the AUKUS countries' respective innovation bases, to create larger markets for U.S. and allied defense firms and to reduce redundant research and development. Although the United States possesses the largest and most competitive technology sector in the world, the United Kingdom's and Australia's technology sectors remain extremely vibrant, with many complementary innovation ecosystems.

Indo-Pacific Command Commander Navy Adm. Samuel Paparo furthered this point regarding Pillar 2's value to the armed services in his confirmation hearing remarks, noting that "expanding trilateral advanced military technology sharing builds on the unique advantages of the joint force."

Yet, since AUKUS's creation, there has been limited publicly reported progress made on Pillar 2. The partners have jointly formed working groups and initiatives dedicated to its technological and functional areas of focus, and together the three countries have undertaken integrated exercises, tests and demonstrations of technologies such as uncrewed vehicles and artificial intelligence algorithms.

While these are positive initial steps, it is time to ramp up progress. The Pentagon, Congress and industry should work together to build out investment into Pillar 2 and develop transition pathways to move research-and-development projects into procurement and deployment.

The path to achieving these goals is currently lined with potential pitfalls and obstacles. A July 2024 Defense Innovation Board report, "Optimizing Innovation Cooperation with Allies and Partners," said the Defense Department is "failing to fully integrate allies and partners into a networked defense industrial base" — the exact type of engagement necessary to make Pillar 2 successful. Achieving this will require, among other efforts, collaborative research, procurement coordination and an integrated workforce.

Notably, workforce development across AUKUS remains a pressing challenge. While recent Australian Bureau of Statistics figures show the nation's defense industry grew 4.1 percent and added almost 4,000 people from 2022-2023, the sheer differences in size and resources between the United States and United Kingdom and Australia are stark.

Each member nation must invest to create both the critical workforces and innovation infrastructure required to win the technology competition with China.

To avoid duplicating technology investments and squandering the advantages presented by AUKUS collaboration, member nations will need to coordinate responsibility for developing specializations in distinct technology domains. Moreover, each member will need to ensure that its defense procurement systems are open to entry from any partner country.

The United States should also seek to preserve the defense industrial supply chains that underpin Pillar 2 technologies — especially when it comes to maintaining assured supply lines for copper, rare earths, semiconductors and other materials that are used in military programs.

Along these lines, the new administration should look to expand modifications of U.S. export controls that currently impede AUKUS implementation. Building on 2024 International Traffic in Arms Regulations exemptions, the United States should promote license-free trade in critical defense technologies by reexamining and shortening the Excluded Technology List.

If AUKUS fails to correspondingly adapt its framework to take advantage of these changes, it will constitute a significant missed opportunity.

Similarly, the new U.S. administration should review and align other policies related to security clearances, classified information and tariffs to ensure they support Pillar 2's technology development goals.

If the United States can safely and appropriately share Pillar 2 information with partners and industry using Five Eyes intelligence sharing as a model, it would help to significantly expand knowledge sharing across the alliance and create an opportunity for the Defense Department and its colleagues to establish university programs for students to work on Pillar 2 activities.

Finally, the United States should increase investment into Pillar 2 research and development and procurement initiatives. This will mean creating clear objectives and entry points for both suppliers and investors for a coherent demand signal on trilateral Pillar 2 acquisition.

With these measures, the United States can fully realize AUKUS Pillar 2's potential. **ND**

Anna Kim is an associate research fellow at NDIA's Emerging Technologies Institute.

POSTCARD FROM TAIPEI
Under Threat, Taiwan Struggles With Questions of Resilience

ANALYSIS BY STEW MAGNUSON

TAIPEI, Taiwan — "Resilience" was the buzzword at the recent inaugural HFX Taipei Forum held in Taiwan in February.

The ability to withstand disasters — man-made or otherwise — is a problem for any community, but more so for nations that live under threat from belligerent neighbors.

Taiwan is prone to earthquakes and typhoons, so it has experience bouncing back from destructive forces.

But a full-scale invasion launched by the People's Republic of China on Taiwan would be the equivalent of a category 5 typhoon, times 10.

A recent Center for Strategic and International Studies report, "Strengthening Resilience in Taiwan," spelled out exactly how bad things could get for the residents of Taiwan if China decides to take back the island by force.

It would be more than just a military operation. Beijing would likely use cyber operations to attack the nation's power grids, banking system and telecommunications. It would jam GPS and basically do anything it could to drive the residents of this modern society back to the Stone Age.

Taipei is a typical Asian metropolis, with most residents living in apartments in high-rise buildings. One bomb striking just one building could result in hundreds of casualties.

As for the military, strategists can conduct wargames all they want and draw their own conclusions, but there is one variable no one can be sure of until the bullets start flying: will any nation come to Taiwan's aid?

The United States has had a policy of "strategic ambiguity" — in other words, keep China and everyone else guessing. Taiwan's closest nearby allies — Japan and the Philippines — might join the fight but are not obligated to do so. Taiwan does not have any mutual security agreements. It very well could be on its own.

Officials at the conference took a defiant stand.

"I think there's only one country that is responsible for Taiwan, and that is Taiwan itself. And for that reason, we want to make more

investment in our security and we want to be stronger," said Joseph Wu, secretary-general of the National Security Council of Taiwan.

The week of the conference, the local press reported that Taiwan was considering buying some $8 billion in arms from the United States. Wu wouldn't confirm that figure but admitted that his government wanted to get talks underway.

While U.S. President Donald Trump has been talking tough on imposing tariffs on Taiwan — and has wrongly accused it of stealing chip manufacturing technology from the United States — Wu noted that Taiwan had many sympathetic friends in the previous Trump administration, and that many of them had returned for the second term.

Selling arms to Taiwan is one thing, but joining a war against China is quite another. Trump's aversion to putting "boots on the ground" in foreign nations is well known.

And internal politics is playing a role. The pro-defense, anti-Beijing Democratic Progressive Party has the presidency, but the opposition Kuomintang party holds one more seat in the Legislative Yuan. The lack of a legislative majority means the Democratic Progressive Party does not always get what it wants in terms of a security budget.

Also on the week of the summit, the Taipei Times reported that the freezing of funds by the Legislative Yuan could mean that Taiwan's Ocean Affairs Council cannot take delivery of two coast guard ships.

And then there is the matter of conscription. Resilience will require a population prepared to resist.

The CSIS report used Finland as an example of a society better prepared than Taiwan to defend itself against a hostile neighbor. Mandatory military service in Finland features robust training, and then conscripts go into the reserves.

Taiwan's conscription system has in the past been viewed as a joke, even by those who participated. It was only a four-month requirement. Soldiers famously trained with wooden guns, and some never fired a real weapon or were limited to shooting five bullets a year. Many spent their days mowing grass.

One insider told *National Defense* when a reservist is called in to do more training, "all they have to say is that they're sick. They hang up, and you never hear from them again."

Wang Ting-yu, chair of the Legislative Yuan's foreign affairs and national defense committee, said when he was an air force cadet in the 1980s, he fired six total bullets during his time in boot camp.

But Taiwan is getting more serious about training under the leadership of the Democratic Progressive Party, he said at the forum. The conscription period has been extended from four months to one year. Conscripts will fire 800 rounds by the time their mandatory service is complete, Wang said.

Those serving in the military now have opportunities to go the United States for multilateral training. Taiwan is hiring retired U.S. and European military trainers to teach vital skills.

And the Democratic Progressive Party is committed to raising Taiwan's defense spending to 3 percent of GDP, Wang noted — if the opposition party cooperates.

"The goal is to not only defeat the People's Liberation Army ... it is deterrence. We will try to be ready to deter the worst-case scenario," he said. **ND**

Pacific Power

Air Force Begins to Embrace Maritime Strike Role

BY JAN TEGLER

Defense analysts assert that the Air Force is embracing maritime strike in a way it hasn't for decades.

Over the last year, the service has announced multiple efforts aimed at bolstering its capability to combat Chinese naval forces. They include an additional buy of Lockheed Martin's sophisticated Long Range Anti-Ship Missile, integration of the weapon with new and existing fighter fleets and fast-track development of less costly, more rapidly producible maritime strike munitions.

The moves are a logical response to the challenges China's ballistic, cruise and hypersonic missiles present for the U.S. Navy in the Pacific, said retired Air Force Lt. Gen. David Deptula, dean of the Mitchell Institute for Aerospace Studies.

"The best way to achieve maritime dominance in the event of conflict in the Indo-Pacific is from the air, not from the sea," he said.

It's a notion Pacific Air Forces Commander Gen. Kevin Schneider acknowledged when *National Defense* asked how the Air Force views its role in maritime strike.

"The component commands of each combatant command operate under a joint warfare construct, which brings together all capabilities to bring effects. As such, the air component plays an integral role in joint warfare — one aspect of which is delivering effects in the maritime environment," he said in a written response.

In early January, Naval Air Systems Command announced that it is working to integrate the AGM-158C-1 Long Range Anti-Ship Missile, or LRASM, on the Air Force's new F-15EX and existing F-15E fleets.

The F-15EX, a modernized derivative of the aged F-15C/D air superiority fighter it's intended to replace, is joining the F-15E as the Air Force's only long-range tactical aircraft. Both Eagle variants can tote weapons loads that far outstrip those the service's stealthy F-35A and F-22 fighters can carry.

The Air Force already deploys LRASM on its fleet of B-1B bombers. With a reported range of approximately 300 to 500 miles, the missile is also employed by the Navy's F/A-18E/F Super Hornets and is being adapted for its F-35C fighters and P-8A Poseidon maritime reconnaissance aircraft.

The Air Force's efforts to build out maritime strike will have to align with the top priority of Indo-Pacific Command Commander Navy Adm. Samuel Paparo, which is deterring a potential Taiwan invasion, said Bryan Clark, a senior fellow at the Hudson Institute.

If the Air Force sticks to its long-favored role of attempting to achieve air superiority by attacking air bases on the Chinese mainland — for example, using B-2 or B-21 stealth bombers armed with the ground attack version of the LRASM, the Joint Air-to-Surface Standoff Missile — it may not prevent China from assaulting Taiwan.

"China might say, 'That's fine. We'll lose a bunch of aircraft, but we'll succeed in the invasion of Taiwan, our real goal,'" Clark said. "If instead you're buying LRASMs and other anti-ship weapons and you're putting them onto every aircraft that can carry them, you might change China's calculus."

In the early days of a campaign to defend Taiwan, "the Air Force will carry the brunt of the maritime strike load," said Mark Gunzinger, the Mitchell Institute's director of future concepts and capability assessments.

The Air Force's long-range bomber fleet will be able to deliver far more weapons against Chinese amphibious shipping and other warships in the area around the Taiwan Strait and the first island chain than the Navy, according to Gunzinger and Deptula.

"If you're talking about aircraft carriers, you're talking over a 1,000-mile stand-off in order to reduce the threat from anti-ship ballistic missiles and cruise missiles the [Chinese People's Liberation Army] have and are well-practiced to use against our warships," Gunzinger said.

Deptula added that once carrier strike groups and submarines exhaust their magazines of maritime strike munitions, "they're out of the fight for a period of time" and must replenish weapons expended at sea or transit to a port for resupply.

Clark said he thinks the Chinese navy would deploy some surface combatants, including its own carrier strike groups, farther away from the Taiwan Strait to manage the periphery of a fight. Weapons like China's DF-26 intermediate-range ballistic missile — which has an estimated range of 2,500 miles — would force carrier-based U.S. fighters to operate at the extreme edge of their range.

"You're going to have pilots doing 1,000-mile transits with refueling to get to the point where they can launch weapons that are then going to do a 500-mile transit approximately to get to the Strait," Clark said.

That would limit the effectiveness of maneuvering missiles like LRASM, which "would essentially have to head straight for targets because they would be out of fuel, making it easier for the enemy to predict where they would strike," Clark added.

The U.S. maritime strike munitions inventory is another challenge, the analysts agreed. The Air Force's fiscal year 2025 budget requested a multi-year procurement of LRASM with a planned buy of 549 extending to 2029 at a total cost of $1.7 billion.

That supply could be exhausted within days, Gunzinger noted, adding that LRASMs are also expensive
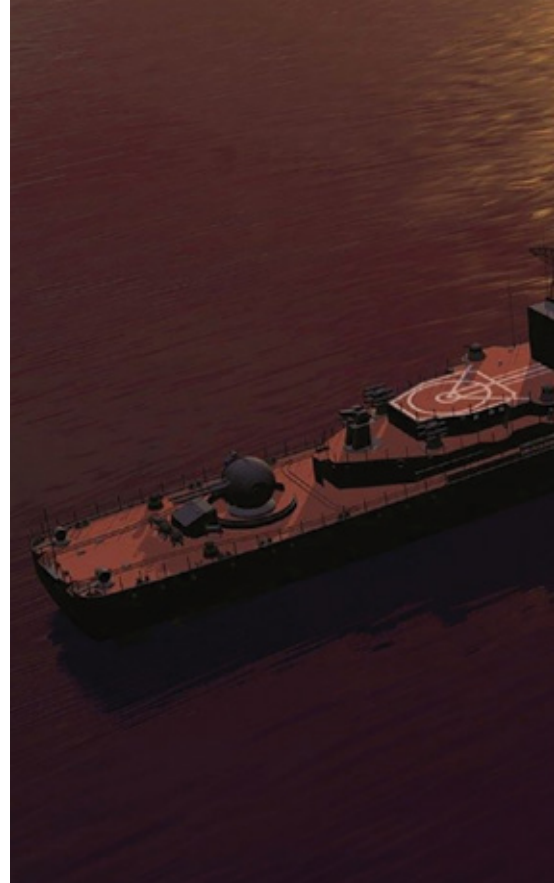
Artist's rendering of the Long Range Anti-Ship Missile

— over $3 million per missile — and difficult to manufacture rapidly because of their complex components and limited supply chain.

That's why the Air Force is exploring missiles and bombs "that cost tens to hundreds of thousands of dollars apiece instead of a million-plus, with a 500-nautical-mile range or so, carrying enough of a warhead to make a difference," Gunzinger said.

The Extended Range Attack Munition, or ERAM, is one of those. ERAM and a related version for the Navy are envisioned as precision-guided air-launched stand-off munitions that could be employed against ships with the help of seeker technology from the Air Force's QUICKSINK program, an effort aimed at adapting the GBU-31 Joint Direct Attack Munition for maritime strike.

Clark said a recent Air Force request for information to industry for ERAM specifies a "500-mile range and capability to build 1,000 in [the] first six months of production."

While not as precise or survivable against adversary countermeasures as LRASM, the Extended Range Attack Munition will be much easier to rapidly produce, using government and commercial-off-the-shelf parts that are in inventory — "kits, essentially, that contract manufacturers can use to build their structure and assemble them just like you do

a washer or dryer," he explained.

The "beauty" of these and other weapons the Air Force is developing, including the Franklin low-cost cruise missile that can be palletized and dropped from mobility aircraft including the C-130 Hercules transport aircraft, is that "they could be launched out in front of a wave of more capable, stealthy cruise missiles," Gunzinger said.

"An enemy detecting this inbound threat would have to respond and expend their defenses, perhaps creating an opportunity in time and space for the killer hornets — the LRASMs and other weapons — to successfully penetrate and kill ships," he said. "The combination of those lower costs with higher-end weapons could actually reduce, maybe significantly, how many of those higher-end weapons are needed."

But the Air Force faces another challenge. The bomber fleet that might employ these weapons is comparatively small, with less than 20 B-2 Spirits in inventory. It's most capable bomber, the B-21 Raider, is not yet in service.

Would that small force have the bandwidth to conduct maritime strike as well as other urgent missions in the opening phase of a South China Sea conflict?

Schneider would not "get into the hypotheticals of any proposed scenarios" but said the Air Force

"will continue to expand our capabilities to provide options to the Joint Force commander to deliver lethal effects in a variety of scenarios."

Clark said he thinks the role of the Air Force in maritime strike, though vital, is currently limited. The service's B-1B Lancer and B-52 Stratofortress bombers will have to operate "at the edge of a fight," he explained, and the service is torn on how to use its B-2s and B-21s.

"The B-21 is going to be an ideal platform for that counter-maritime fight in the Taiwan Strait because they can get close enough to use LRASMs and other munitions with a high degree of lethality, and I think the Air Force recognizes that," Clark said. "But there aren't enough B-21s to attack shipping and take out the Chinese air force before it takes off if they're needed for both missions simultaneously."

Thus, he said, the Air Force will have to decide which mission to focus on.

"And they don't want to state a priority in public," Clark said.

Clark said analysis done by the Hudson Institute shows that if the Air Force uses its short-range fighters including the F-35A and high-signature B-1B and B-52 bombers for maritime strike, "you lose a lot of them."

But if B-2s and B-21s are used in combination with the Navy's submarine force and Indo-Pacific Command's "hellscape" concept — wherein a variety of airborne and sea-based drones engage a wide range of targets — the United States can succeed, Clark said.

"The argument is that if you combine those stealthy assets with hellscape where you use a bunch of uncrewed systems basically acting as a mobile minefield in the Taiwan Strait as Adm. Paparo advocates, our modeling shows that is very successful," he explained. "And you don't have to get the rest of the force involved."

Deptula said the Air Force's role in maritime strike is up to Indo-Pacific Command and joint planners, and that it's a matter of allocating limited resources.

"You can put together a plan that disperses F-15EXs and puts them at forward airfields where they do have the range to be able to prosecute maritime targets," he said. "That's not insignificant. The value of an EX is that it can be rapidly rearmed and brought back into the fight. That's the utility of reusable airpower." **ND**

VIEWPOINT
Despite Headlines, China's DeepSeek, Chip Makers Still Lagging BY HOLMES LIAO

The technological rivalry between China and the United States has intensified since 2023. China's Huawei in 2023 introduced the Mate 60 Pro smartphone, which featured the 7-nanometer Kirin 9000S chip manufactured by China's Semiconductor Manufacturing International Corp., and released the Mate 70 a year later.

These developments were seen as a bold statement that China had successfully circumvented U.S. technological restrictions on the semiconductor sector, providing critics of these sanctions with arguments against their effectiveness.

At the beginning of this year, China's DeepSeek released the large language model DeepSeek-R1, which performed exceptionally well on multiple artificial intelligence benchmarks, rivaling OpenAI's o1 model. Reports indicate that DeepSeek-R1's training costs were only a fraction of those for comparable U.S. models, and it was even made available as open source.

These advancements have raised questions about whether U.S. sanctions on China's high-tech sector have been effective and whether China has managed to catch up or even overtake the United States in AI and semiconductors.

China's semiconductor industry includes several major players — such as SMIC, Hua Hong Semiconductor and Yangtze Memory Technologies — all of which have made progress in different areas. The surprise release of Huawei's Mate 60 Pro in August 2023 stunned the world, as U.S. export controls on advanced chips had been in place since 2020, theoretically preventing China from acquiring the technology and equipment necessary for 7nm chip production.

However, a teardown analysis revealed that SMIC manufactured the chip using deep ultraviolet lithography rather than the more advanced extreme ultraviolet lithography. The latter was banned in 2019 and the former in 2023.

China's ability to produce 7nm chips largely stems from stockpiling equipment and materials rather than genuine technological breakthroughs.

Before the U.S. sanctions took full effect, Chinese companies procured many deep ultraviolet lithography machines from ASML in the Netherlands, ensuring short-term production capabilities. However, China's processes lag behind those of Taiwan, the United States and South Korea in terms of efficiency, yield rates and cost-effectiveness.

Additionally, Taiwan's lack of regulatory enforcement has allowed some semiconductor professionals to assist China in building its industry.

Taiwan Semiconductor Manufacturing Co. has already moved into 3nm production and plans to introduce 2nm chips this year. While China's ability to produce 7nm chips using deep ultraviolet technology is impressive, transitioning to 5nm or 3nm will be significantly more challenging. These advanced processes require extreme ultraviolet lithography, which has been under strict U.S. export bans. Furthermore, issues such as multipatterning exposure and high-purity materials present additional hurdles.

China's semiconductor manufacturing remains heavily reliant on foreign technologies. Key machinery comes from U.S. companies such as Applied Materials and Axcelis, Japan's Tokyo Electron, Sumitomo, Nikon and Canon and Germany's Lapmaster Wolters, just to name a few. Even for 7nm production, China requires maintenance and upgrades from these suppliers, many of whom comply with U.S. export controls.

Moreover, semiconductor development is not just about manufacturing; it also depends on electronic design automation software. Currently, China still relies on American companies such as Synopsys, Cadence and Siemens for these essential tools. While China has reportedly begun reverse engineering and developing its electronic design software, U.S. sanctions are likely to slow its progress in advanced semiconductor design.

Additionally, the supply of critical materials — including high-purity silicon wafers, advanced photoresists, wet process chemicals and precision packaging materials — remains dominated by suppliers from the United States, Japan and Europe.

Even if China makes strides in certain raw materials, its overall semiconductor industry remains constrained. As its existing manufacturing equipment ages and access to upgrades is blocked, China will likely face declining production capacity and increasing technological lag.

Huawei's latest smartphones may symbolize China's resilience against U.S. semiconductor restrictions, but such a strategy is difficult to sustain. As the United States tightens export controls on chipmaking equipment and materials, China's high-end semiconductor supply chain is expected to face growing difficulties, making further technological progress increasingly challenging.

Beijing has invested heavily in efforts to build a self-sufficient semiconductor ecosystem, but progress remains limited. Aside from advancements in memory chips, China has yet to achieve major breakthroughs in high-end logic chip manufacturing.

Similar to its semiconductor sector, China's AI industry has shown remarkable progress, particularly in the field of large language models. Models such as DeepSeek-R1, Baidu's Ernie Bot, Alibaba's Tongyi Qianwen and Huawei's Pangu demonstrate the competitiveness of Chinese enterprises in AI development. Nevertheless, China's AI advance-

ments remain heavily reliant on U.S. hardware and software foundations. Training large-scale AI models in China still depends on Nvidia's A-series and H-series graphics processing units from the United States, which are now subject to U.S. export control bans.

Although Chinese firms stockpiled tens of thousands of Nvidia-designed, TSMC-manufactured GPUs before the restrictions took effect, these chips will eventually become obsolete and degrade over time.

Huawei has been actively developing its Ascend series of AI GPUs, claiming they have reached approximately 80 percent of the performance level of Nvidia's top-of-the-line H100 GPU. However, Huawei's GPUs still lag behind Nvidia's in terms of power efficiency, computational performance and manufacturing yield rates.

Huawei's upcoming Ascend 910C GPU may present an improvement, but without a robust software ecosystem such as Nvidia's CUDA, it will still face significant challenges in adoption even in its domestic market.

As Nvidia's Blackwell GPU and the upcoming Rubin GPU — set for release in 2026 — become fully integrated into the AI ecosystem, China's inability to access high-performance AI training chips may lead to an increasingly pronounced computational power gap.

Additionally, Chinese companies have attempted to acquire high-end GPUs through smuggling and black market purchases. In 2023, the U.S. government discovered that Chinese firms were rerouting Nvidia chips through third-party countries such as Hong Kong and Singapore to bypass export restrictions. In response, the United States tightened enforcement measures and imposed sanctions on violating companies.

Unless China can build alternative, illicit procurement channels, such as cloud computing centers in the Middle East, these backdoor acquisition methods are likely to be shut down.

Notably, while Nvidia's stock price may fluctuate due to short-term market sentiment after the release of Deep-Seek-R1, in the long run the emergence of new AI models will underscore Nvidia's indispensable role in the U.S.-China technological competition.

Beijing's "Made in China 2025" initiative is a state-led industrial policy designed to transform the nation into a global leader in high-tech manufacturing. While semiconductors are a key component of the initiative, China also aims to become the global leader in AI by 2030.

China's technological progress has been largely driven by state-led initiatives, with long-term planning, government subsidies, coordination across sectors and support for state-owned enterprises serving as key strategies to accelerate development. This approach has enabled China to achieve rapid advancements in semiconductors, software and AI.

However, it also comes with inherent limitations, including market distortions, insufficient competitiveness, international technological restrictions and constraints on innovation.

The semiconductor industry remains the most affected by U.S. restrictions. In addition to export controls on advanced chipmaking equipment and materials, China's domestic semiconductor sector has struggled despite massive government funding.

The state-backed "Big Fund" has injected tens of billions of dollars into the industry, yet mismanagement and corruption have hindered its effectiveness. Notable failures, such as the bankruptcy of state-backed semiconductor conglomerate Tsinghua Unigroup, have exposed corruption, inefficiencies and resource misallocation in China's state-led approach.

As mentioned earlier, U.S. export bans on advanced AI chips have limited the computational power available to Chinese tech giants in their AI endeavors. While Huawei has introduced the Ascend 910 and Kunpeng 920 AI chips, they still lag behind Nvidia's A100/H100 and Apple's A18.

A similar issue arose in China's solar energy sector during the 2000s. Although the industry initially thrived under government subsidies, over-reliance on state support nevertheless led to weak market competitiveness. Wuxi Suntech — once a global leader in solar panels — ultimately went bankrupt after subsidies were reduced, illustrating the risks of excessive government intervention.

As China's *Caijing* magazine has pointed out, country's photovoltaic industry has been largely driven by administrative directives rather than organic market demand, distorting investment behavior and harming long-term industry sustainability.

The U.S. technology export restrictions against China are motivated not only by national security, economic interests and technological competition but also by concerns such as intellectual property theft, human rights violations and authoritarian governance.

By integrating technological competition with geopolitical and ideological conflicts, the United States seeks to minimize China's influence on the global stage.

While China has managed to achieve certain technological milestones through short-term strategies, its long-term success depends on its ability to establish a truly market-driven innovation system. Without reducing reliance on state subsidies and developing an independent semiconductor and software ecosystem, it may struggle to maintain a lasting advantage in the global technology race.

While China faces significant hurdles in maintaining the pace of rapid technological advancement, its steady progress in AI, software and semiconductors cannot be overlooked.

The United States currently holds a dominant position in the global technology landscape, bolstered by its deep industrial supply chains, free market-driven innovation and its role in setting global technological standards.

U.S. leadership nonetheless is not guaranteed. As China adapts to export controls, invests more in domestic alternatives and leverages global influence, it may narrow the technological gap. The future of U.S. dominance will depend on its ability to sustain innovation, secure supply chains and navigate an increasingly competitive global landscape. **ND**

Holmes Liao has over 35 years of professional experience in U.S. aerospace and defense industries. He previously served as an adjunct distinguished lecturer at Taiwan's War College. He can be reached at holmes.liao@hotmail.com.