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Dear Reader,

Doing technology foresight nowadays is becoming more and more challenging, would it be only because what Jules Verne stated has become a plain truth: “Whatever a person can imagine, one day someone will realize it.”

Noticing the speed at which the world of technology continues to develop and evolve, the creativity and innovation in areas belonging until recently to science-fiction only, forces you to focus with major intensity on the purposes and objectives you would like to achieve. It appears far too dangerous to wait for the maturity of one technology to build on the new offered functionalities, while similar effects might be obtained by combining more matured technologies and systems.

Navigating the latest news of these deftech-scan, we hope to provide you some insights of what is currently ongoing in all military spheres... and beyond!

We wish you a nice reading

Foresightfully Yours,



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Introduction and Executive Summary

This DEFTECH SCAN examines occurrences in military technology and capability development taking place from mid-August to mid-October with some references to events in late June and July that were not captured in the previous DEFTECH Scan report. It contains reporting on recent military, security, and industry activities and announcements in Australia, the United Kingdom (UK), the United States (US), Turkey, Indonesia, UAE, France, Russia, and China. Key insights and themes from the reporting period include:

UK and China Shows and US Activity: Two large aerospace and defence shows occurred during the reporting period. The DSEI exhibition in the UK occurred from 14 – 17 September and announcements, discussions, and demonstrations that occurred during the show are prominently featured through the report. The Aviation China 2021 show took place from 28 September – 3 October. A sampling of new and advanced Chinese uncrewed aerial systems (UAS) displayed during the show are profiled in the Uncrewed Systems section of this report. In addition, there was an exceptional amount of relevant activity in the United States that is broadly relevant to large and small militaries, much of which is also included in the report.

Climate Change: Climate change is shaping the future activities of defence and security communities at many levels including in the design of development of platforms. At the DSEI exhibition, the UK Ministry of Defence (MoD) discussed on-going efforts to reduce emissions of the Royal Navy through new designs that increase energy efficiency. The discussion follows a July announcement that the Royal Air Force is seeking to develop a zero-carbon aircraft by the end of the decade. In the United States, the Department of Defense is taking a range of measures to better adapt to the challenges created by climate change, including increasing training of national guardsmen for climate change related missions, increasing reliance on digital engineering to reduce carbon emissions, and developing more powerful computer models to better predict significant weather events.¹

Domestic Defence Industry Focus: Developments in Turkey, the UK, Indonesia, UAE, France, and Australia all underscore the importance of domestic industry development to domestic politics and economics, international geopolitics, and the strategic resilience of a growing number of actors. International procurement deals and research and development partnerships must find a balance between supporting local industry and protecting technology and intellectual property, gaining market access, furthering geopolitical relationships, and, of course, the development of useful military capabilities.

Artificial Intelligence: The report emphasizes the growing importance of AI to the future of military capabilities and operations at several levels: speeding up the processing of the abundance of information available to analysts and decision-makers, enabling autonomous systems, target identification, enabling virtual training, and beyond. Militaries and defence communities are focusing on developing more sophisticated capabilities and seeking to form research and development relationships both within domestic industries and internationally. The report also highlights the use of AI in an actual operational environment, revealing that in some countries these technologies are moving from a largely development phase to deployment. As AI is increasingly incorporated into military operations, though, there will be implications for military personnel who will need to learn how to operate in conjunction with AI agents to trust the outputs these agents produce.

¹ Patrick Tucker, “Climate Change Is Already Disrupting the Military. It Will Get Worse, Officials Say”, *Defense One*, 10 August 2021, [Climate Change Is Already Disrupting the Military. It Will Get Worse, Officials Say - Defense One](#)

Energy, Power, and Design

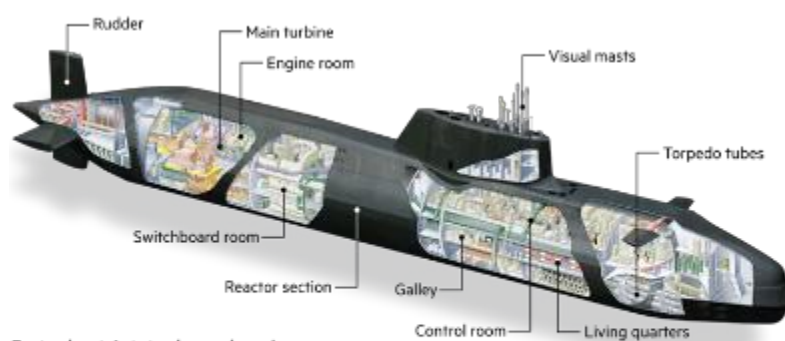
Key Insights:

- AUKUS as a Catalyst for Nuclear Propulsion Proliferation:** The AUKUS nuclear submarine development deal between Australia, the UK, and US has placed in the spotlight the value of nuclear propulsion for submarines, especially in the Indo-Pacific where the enhanced endurance and range of nuclear submarines are highly relevant. As the deal moves forward, some have expressed concern that it could kick-off efforts of other Asian states to develop nuclear propulsion for submarines.
- Indigenization of Defense Industries Includes Engines:** Aero-engines are a notoriously difficult technology to develop, and only a handful of nations have demonstrated a reliable ability to create advanced aero-engines. Turkey is currently in the process of developing several types of domestic engines, including a high-performance engine for fighter jets. At a less sophisticated level, a Turkish company delivered the first domestically developed engine for two missile programs. In the UK, home of one of the world's most accomplished engine manufacturers in Rolls Royce, efforts have been made to ensure that innovative British aerospace companies have access to Rolls Royce's advanced technology as well as its digital engineering capabilities.

The AUKUS Fracas and the Nuclear Propulsion Chain Reaction in the Indo-Pacific: The announcement of the Australia-UK-US (AUKUS) nuclear powered submarine development partnership and cancellation of a \$90 billion contract with French company Naval Group for 12 diesel-electric submarines was perhaps the most discussed defense technology story of the reporting period. Much of this discussion revolved around the deal's geopolitical impacts, both the potential fallout of the three countries' relationship with France and how it affects the geopolitical balance in the Indo-Pacific region.

However, the deal has also served as a useful platform for discussion of the merits of the two types of submarine propulsion: diesel-electric and nuclear. The former can run silently using only its batteries but needs to surface more frequently to run its diesel engine and charge its batteries.

Astute class nuclear submarine



Facts about Astute class submarines

97m in length and will displace 7,400 tonnes of sea water when fully stored
Can circumnavigate the world without ever surfacing
When armed with Tomahawk cruise missiles, Astute class submarines can strike targets up to 1,200km from the coast with pinpoint accuracy

Source: BAE Systems
© FT

Figure 1: The British Astute class nuclear submarine, one of two design options currently considered of interest to Australian nuclear submarine development along with the US Virginia class nuclear submarine. Source: BAE Systems [via FT](#)

Nuclear powered submarines by contrast can stay underwater for much longer periods of time, resurfacing in theory only for maintenance, resupply, or human factors reasons. This increased range and endurance is especially relevant for Australia, given its distance from many of the shipping lanes and maritime approaches that are central to its economic activity and from potential hotspots that are important to its strategic interests in the region. The ability to stay on mission longer in these areas is a capability that Australia has clearly prioritized. Prime minister Scott Morrison stressed the perceived capability

mismatch in his discussion with French President Emmanuel Macron after the cancellation was announced saying that there were “very real issues about whether a conventional submarine capability” would address Australia’s needs.²

The tradeoff related to nuclear submarines, of course, is that it takes a significant amount of time and money to develop the “nuclear infrastructure” of trained human capital, sufficient safety protocols, docking facilities, and developing a nuclear reactor for a submarine. One defence expert quoted in article by *FT* referred to nuclear-powered submarines as “the most complex machines that humans make, even more so than the space shuttle.”³

Some observers suggest that the US and UK decision to share highly enriched uranium with Australia for the development of its nuclear submarines could have ripple effects across the region. Other countries, most notably India, South Korea, and possibly Japan, could now seek nuclear powered submarine capabilities whether it be in partnership with the United States, United Kingdom, or even France, which produces nuclear subs that use low enriched uranium. The US and UK use highly enriched uranium designs. Highly enriched uranium can also be used to develop nuclear weapons. South Korea appears to have already asked to acquire nuclear propulsion capabilities. The Trump Administration reportedly rebuffed a South Korean request to share highly enriched uranium and technology for nuclear-powered submarines due to proliferation concerns.⁴

Turkish Delight Propelled by Kale: Turkish engine developer Kale R&D has completed the delivery of the first KTJ-3200 engine, the first turbojet engine developed in Turkey. It is expected to power the Turkish made stand-off missile and Atmaca anti-ship missile. *Defense News* described the engine as being similar “architecturally speaking”⁵ to the French TR40 engine, though the latter is slightly lighter and more fuel-efficient. The engine was purpose built for powering missiles and drones through the entire length of their flight.

While KTJ-3200 is not formally related to other on-going Turkish efforts to build indigenous jet and helicopter engines, the development is reflective of the advancement of engine technology programs within the Turkish defence industry. Kale R&D has also been developing turbojet engines for Roketsan’s medium-range anti-ship missile system, known as OMGF, and Tubitak Sage’s Kuzgun-TJ smart ammunition. Tusas Engine Industries’ TS1400 engine is expected to power Turkey’s first general-purpose helicopter, known as the Gokbey, and will also help in development of an indigenous jet engine.⁶



Figure 2: A model of the Aeralis modular military aircraft with the single and double engine modules hanging below the fuselage for demonstration purposes. Source: [Army Recognition](https://www.armyrecognition.com)

Speaking of Jet Engines . . . UK-based aircraft manufacturer Aeralis signed a memorandum of understanding (MoU) with Rolls Royce to explore propulsion solutions for

² Sylvia Pfeifer, Demetrei Sevastopulo, Anna Gross, “The nuclear technology behind Australia’s Aukus submarine deal”, *FT*, 19 September 2021, [The nuclear technology behind Australia’s Aukus submarine deal | Financial Times \(ft.com\)](https://www.ft.com/content/19-sept-2021/the-nuclear-technology-behind-australia-s-aukus-submarine-deal)

³ Ibid.

⁴ Ramesh Thakur, “AUKUS: The Driving Force Behind Nuclear Propulsion in the Pacific”, *The National Interest*, 30 September 2021, [AUKUS: The Driving Force Behind Nuclear Propulsion in the Pacific | The National Interest](https://www.nationalinterest.org/feature/aukus-the-driving-force-behind-nuclear-propulsion-in-the-pacific/15444)

⁵ Tayfun Ozberk, “Turkish firm Kale delivers homemade turbojet engine for missiles”, *Defense News*, 21 September 2021, [Turkish firm Kale delivers homemade turbojet engine for missiles \(defensenews.com\)](https://www.defensenews.com/missiles/2021/09/21/turkish-firm-kale-delivers-homemade-turbojet-engine-for-missiles/)

⁶ Ibid.

Aeralis’ “pioneering modular military aircraft.”⁷ Announced during the DSEI show in London, the agreement will provide Aeralis “unmatched access to established UK aerospace resources, as well as a fully integrated digital enterprise”, highlighting the increasing focus on and maturing of *both* modular crewed and uncrewed aircraft as well as digital engineering processes that help reduce time and costs associated with aircraft design and production.

Given that the Aeralis aircraft can be reconfigured with different single and twin-engine modules, the MoU will explore how Rolls Royce’s future propulsion system technology can be used across multiple Aeralis variants. According to Tristan Crawford, CEO of Aeralis, “The fully integrated digital infrastructure that we will build alongside our aircraft is the first of its kind and we could not think of a better partner to be doing it with.”⁸

Human Performance Enhancement and Protection

Key Insights:

- **Covid Costs and Rapid Identification of the Next Pandemic:** The costs of the Covid-19 pandemic for militaries around the world have been high as small and large militaries seek to protect military personnel and defense industrial supply chains and work with civilian governments to increase testing and treatment of society at large. To help get ahead of the next pandemic and reduce costs of coping with outbreaks, some militaries are engaging industry to acquire or refine wearable technologies that can alert individuals to the potential for sickness before symptoms become evident, though the widespread use of wearables does generate a knock-on challenge of protecting the personally identifiable information of military personnel that these systems collect.
- **A Stark Choice: Data Savviness or Death:** AI and data have become core to emerging military operations in a fast-moving and complex environment marked by a surfeit of information, more autonomous systems, and human machine teaming. However, leveraging AI requires military personnel be trained to use it and trust it and to completely understand the broader context in which data is a “strategic asset.” A failure to develop this enhanced understanding could have literally existential consequences for small and large militaries.

Wearables, Readiness, and the Costs of the Covid-19 Pandemic: The United States Air Force (USAF) and its Readiness Management Agency are engaging commercial industry to develop proximity tracing options, data integration services, and biometric-capturing wearable devices that can alert personnel to sickness earlier.

The system will be designed to present data about the wearer’s bodies including, according to a USAF request for information (RFI), “heart rate fluctuation, O2 levels, heart rate, heart rate variability, temperature, inter-beat interval, etc.” In addition, the USAF intends to use solutions to track officials’ proximity to one another when working and to integrate data from dozens of commercial streams while also maintaining the security of military personnel data.⁹

Overall, the coronavirus pandemic has cost the US Department of Defense (DoD) at least \$13.6 billion over the last year, a number that DoD expects to increase as the US military increases its testing of civilian personnel. The majority of this cost--\$7.1 billion—has been dedicated to ensuring the resilience of the DoD’s supply chain, including upfront payments to defence contractors and reimbursement of pandemic-related expenses. The supply chain issue is a sensitive one for DoD as some companies have blamed Covid-19 for missed deadlines on important platform and weapons projects. For example, 21

⁷ “Aeralis announces industry collaboration with Rolls-Royce”, Rolls Royce press release, 15 September 2021, [AERALIS announces industry collaboration with Rolls-Royce – Rolls-Royce](#)

⁸ Ibid.

⁹ Brandi Vincent, “USAF Wants Wearables to Spot Outbreaks Faster”, *Defense One*, 7 September 2021, [USAF Wants Wearables to Spot Outbreaks Faster - Defense One](#)

fewer F-35s were delivered in 2020 than planned. The remaining \$6.5 billion of cost was dedicated to the vague category of “other Covid-related costs.”¹⁰

Defying Gravity to Stop Crime: The United Kingdom’s Defence Science and Technology Laboratory (DSTL) held an event in August to encourage creative solutions for meeting crime and terrorism threats. One of the technologies displayed to senior officials from the National Police Chief’s Council and the Home Office during the event was Gravity, a human jetsuit system.



Figure 3: The Gravity jet suit was demonstrated in August. Source: [DSTL Youtube channel](#)

Professor Paul Taylor, the Police Chief Scientific Advisor, captured the impression left by the demonstration: “seeing a human flying is really impressive. To see something that feels like you’re watching science fiction took all those watching by surprise.”¹¹

Gravity’s demonstration involved a scenario in which a suspect fled a vehicle check point on foot. The jet suit operator was easily able to track down and apprehend the fleeing suspect.¹²

This is not the first time the Gravity jetsuit has been displayed. The system has been under development for several years and was even used in a Royal Marines underway boarding exercise in May 2021¹³. In tests in 2018, the 100 horsepower Gravity suit was able to fly safely at 32 miles per hour.¹⁴

Give Me Data or Give Me Death, Possibly Literally: The United States Army is pursuing a program to encourage soldiers to embrace working with and trusting data and AI algorithms as a core element of keeping them alive in a conflict environment. The program, known as “Project Ridgway”, is designed to help both soldiers and commanders better understand how data—both what they collect and produce—can create advantages or vulnerabilities on the battlefield.¹⁵

Colonel Dan Kearney, the XVII Airborne Corps plans officer responsible for the program, noted that most soldiers do not “really appreciate or understand data as a strategic asset” and that there needs to be a cultural change to address this liability. According to Kearney, “We have to put the force in a position so that when artificial intelligence efforts are thrust upon us, we are in a position to move ahead and employ them immediately. You want leaders to trust that the algorithm is going to go ahead and extrapolate from the right data sets to go ahead and come out with this recommendation.”¹⁶ Over time, the program will seek to identify soldiers to develop more skills to manage data and build applications, ensure data governance, and enhance cloud computing, data storage technologies, and other aspects of data infrastructure.¹⁷

Bridging the Gap: Another Step Forward for Virtual-Real-World Training: In mid-August, the USAF announced that for the first time, a T-38 trainer aircraft will be equipped with commercial provider

¹⁰ Marcus Weisgerber, “The Pandemic Has Cost the Pentagon at Least \$13.6B and Counting”, *Defense One*, 8 September 2021, [The Pandemic Has Cost the Pentagon at Least \\$13.6B and Counting - Defense One](#)

¹¹ “Up, up and away . . . can human jet suits be used to capture criminals?”, Gov.UK, 12 August 2021, [Up, up and away... can human jet suits be used to capture criminals? - GOV.UK \(www.gov.uk\)](#)

¹² “Police with Jet Suits? | Gravity Industries Demonstration”, DSTL YouTube channel, 12 August 2021, [\(11\) Police with Jet Suits? | Gravity Industries Demonstration - YouTube](#)

¹³ Gravity Industries YouTube channel, “Royal Marines underway boarding”, 1 May 2021, [Royal Marines Jet Suit Boarding Ex - YouTube](#)

¹⁴ “How Gravity Built the World’s Fastest Jet Suit”, *WIRED* YouTube channel, 9 November 2018, [\(11\) How Gravity Built the World’s Fastest Jet Suit | WIRED - YouTube](#)

¹⁵ Patrick Tucker, “Learn to Use Data or Risk Dying in Battle, New Army Project Teaches”, *Defense One*, 22 September 2021, [Learn to Use Data or Risk Dying in Battle, New Army Project Teaches - Defense One](#)

¹⁶ Ibid.

¹⁷ Ibid.

Red 6's augmented reality training system that will enable the real-world aircraft to engage in a dogfight against virtual world Russian and Chinese aircraft that are projected inside the pilot's helmet.

"Innovation within training is needed now more than ever to remain competitive with our adversaries." – Winston Bennett, USAF Systems Directorate Source: [Defense One](#)

The \$70 million, five-year contract involves the company integrating its Airborne Tactical Augmented Reality System (ATARS), which has been previously featured in DEFTECH Scans, with the Northrop Grumman T-38 Talon, followed by the integration of

ATARS onboard a fourth-generation jet such as the F-16. Integration on the T-38 is expected to take about 12 months.

Red 6 CEO Daniel Robinson commented to *Defense News* that "it's a big, bold vision, but [this vision] is really fast becoming a reality. I think over the next 12 months you're going to see something that no one can deny is absolutely transformational."¹⁸ Part of the vision is also building a "multiplayer" version in which multiple aircraft are able to engage the same augmented reality adversary.¹⁹

Cyber and C4ISTAR

Key Insights:

- **AI Continues to be a Priority:** AI development for military purposes is a continuing priority area for large and small militaries. AI is a key enabler of future military operations, notably by speeding up processing of information, freeing up humans to perform high value tasks, identifying targets, enabling autonomy, and reducing the time and cost associated with complicated tasks such as training and even manufacturing. And, as previous DEFTECH Scan volumes have stressed, it is not just an enabler of *future* capabilities. The reporting period saw another first: the use of AI in a live, real world combat environment.
- **Update on Space Debris and Space Situational Awareness:** The August volume of DEFTECH Scan detailed efforts in Finland and Japan to develop small plywood satellites as a means of redressing the growing problem of space debris and space situational awareness. In late August, [Defense One](#) reported the US Space Command revealed it is tracking 35,000 objects in Low Earth Orbit (LEO), a 22% increase from just two years ago, further revealing the increasing scale of space situational awareness challenge. The increase is due "to the mega constellations that we've seen launched. Also some debris-generating events", according to Stephen Whiting, the head of Space Operations Command.

"United" in AI Research: UK and UAE Sign AI Defense Research Deal: On 16 September, Mohamed bin Zayed, the crown prince of Abu Dhabi and deputy supreme commander of the UAE's armed forces met with British Prime Minister Boris Johnson in the UK to launch the "Partnership for the Future", which includes a MoU on artificial intelligence.

The partnership will focus on four main areas:

1. Aligning existing R&D programs
2. Aligning supply chains
3. Maintenance, repair and operations

¹⁸ Valerie Insinna, "Red 6 lands contract to put augmented reality on a T-38 training jet", *Defense News*, 16 August 2021, [Red 6 lands contract to put augmented reality on a T-38 training jet \(defensenews.com\)](#)

¹⁹ Ibid.

4. Further securing supply chains

Sources also reported that the deal will seek to support start-ups and small and medium-sized enterprises in both countries with the hope that the UAE military will be able to gain access to more products and technologies and to the know-how that supports them from both domestic developers and UK companies.

2021 has been an important year not only for the development of AI-related military capabilities throughout the world, but also for the technological advancement of the UAE's domestic defense industrial base. In addition to the AI MoU with the UK, the local defense conglomerate EDGE Group signed directed energy research MoUs with European companies MBDA and Cilas during the February 2021 IDEX exhibition.²⁰

AI Applications Being Pursued and Deployed: The announcement of the UK-UAE partnership (which was not actually signed until the following day, 17 September) occurred during the DSEI defence exhibition in London where the topic of AI and its future application in the UK military was prominently featured. The chief of the UK military's defence intelligence, Lt. General James Hockehull, delivered comments outlining the UK's "ambitious" plans to leverage AI to speed up the processing of information, relieving human operators and analysts of repetitive tasks. According to Hockehull, "open source intelligence and automation together will fundamentally change how intelligence operates."²¹

The key challenge facing intelligence analysts is the volume of data available. There is too much data for humans to process, manage, and exploit. Machine learning, automation, and data science solutions are required to support analysts and to free them to assess processed intelligence. Open architecture systems are also a central part of the data management and processing challenge. As Hockehull noted, "there will be less willingness to buy bespoke architectures or standalone platforms."²²

Notably, Hockehull's comments also emphasized the need for non-technical innovations that will help the UK MoD better engage with industry to build sustainable software solutions, such as moving away from "hand-to-mouth annual contracting."²³

The reporting period saw another important milestone in the actual deployment of AI. During the US Air Force Association's Air, Space, & Cyber Conference on 20 September, Secretary of the Air Force Frank Kendall referenced the use of AI to help identify a target (s) in a "live operational kill chain", marking another milestone in the development and integration of AI into emerging military capabilities.²⁴

²⁰ "SIGN4L SIGNS MOU WITH EUROPEAN DEFENCE ENTITIES MBDA AND CILAS TO EXPLORE COOPERATION IN HIGH-ENERGY LASER WEAPONS SYSTEMS", MBDA Press Release, 26 February 2021, [SIGN4L Signs MoU with European Defence Entities MBDA and CILAS to Explore Cooperation in High-energy Laser Weapons Systems | Press Release | MBDA \(mbda-systems.com\)](https://www.sign4l.com/press-release/sign4l-signs-mou-with-european-defence-entities-mbda-and-cilas-to-explore-cooperation-in-high-energy-laser-weapons-systems)

²¹ Vivienne Machi, "British military intel chief has 'ambitious plans' for automation", *Defense News*, 16 September 2021, [British military intel chief has 'ambitious plans' for automation \(defensenews.com\)](https://www.defensenews.com/military/2021/09/16/british-military-intel-chief-has-ambitious-plans-for-automation/)

²² Ibid.

²³ Ibid.

²⁴ Amanda Miller, "AI Algorithms Deployed in Kill Chain Target Recognition", *Air Force Magazine*, 21 September 2021, [AI Algorithms Deployed in Kill Chain Target Recognition - Air Force Magazine](https://www.airforce.mil/air-operations/2021/09/21/ai-algorithms-deployed-in-kill-chain-target-recognition/)

Crewed Platforms

Key Insights:

- **Climate Change Impacting Platform Design:** Concerns over climate change are changing the way militaries approach several important activities, including the design of ships and aircraft that increase energy efficiency and reduce carbon emissions. The UK MoD is pursuing multiple programs across the Navy and Air Force to improve design techniques and platform efficiency.
- **There Is Such a Thing as Too Much Technology:** While not explicitly profiled in the section below, it is worth highlighting comments from 21 July 2021 by the US Chief of Naval Operations, Admiral Michael Gilday, [that revealed the increasing challenges related to moving “too fast” in the development and integration of modern technologies onto platforms](#). Admiral Gilday observed that the Navy’s development of the Gerald Ford aircraft carrier (CVN-78) has been complicated and slowed by an effort to integrate 23 new technologies. According to Gilday, the US Navy should take “a much more deliberate approach with respect to integrating new technologies to any platform”, focusing on introducing “maybe one or two new technologies on any complex platform in order to make sure we keep risk at a manageable level.”

Stealthy Fast Attack Boats in Southeast Asia: Indonesian shipbuilder PT Lulin launched a new Fast Attack Craft Trimaran for the Indonesian Navy (TNI – AL) on 21 August 2021. Admiral Yudo Margono, the chief of staff of the TNI – AL, noted that the ship, known as the KRI Golok (688) is the first made of composite material that increases the strength, endurance, and corrosion resistance of the trimaran. It also incorporates a “wave piercing design”²⁵ that cuts through waves rather than moving up and over them as well as stealthy properties that reduce the ship’s radar signature.

The KRI Golok (688) has a total length of 62.53 metres, a width of 16 meters, a height of 18.7 metres, and a weight of 53.1 tonnes. Its maximum speed is 28 knots with a cruising speed of 16 knots. It is armed with 30 mm cannon and 12.7 mm gun and can carry 25 crew members, according to *Naval News*.



Figure 4: The PT Lulin stealthy trimaran. Source: TNI-AL, via Naval News

²⁵ Xavier Vavasseur, “PT Lulin Launches New Stealth Trimaran Vessel For Indonesian Navy”, *Naval News*, 21 August 2021, [PT Lulin Launches New Stealth Trimaran Vessel for Indonesian Navy - Naval News](#)



Figure 5: A still from the ABS-CBN news report detailing the activities of Type 022 boats in the South China Sea. Source: ABS-CBN screencap via [The Drive](#)

It is envisioned as a multi-mission vessel capable of carrying out “any given operational task, both Military Operations for War (MOOW) and Military Operations Other Than War (MOOTW)”, though Admiral Margono stressed the ship’s relevance in the “hit and run fast missile boat tactic.”²⁶

Significantly, the reveal of the new capability focused on the significance of this new advanced capability being delivered by an Indonesian company as part of an effort to reduce reliance on foreign suppliers.²⁷

Stealthy fast attack capabilities are growing in significance in the contested waters of the South China Sea and critical shipping lines that run through maritime Southeast Asia as states pursue capabilities that ensure presence and the ability to react quickly to fast-moving contingencies in the contested waters.

In April 2021, Chinese stealthy catamaran fast-attack missile craft were reportedly involved in an incident with a boat chartered by a Philippine media company in the South China Sea. Type 022 *Houbei* class vessels confronted the Philippine boat near Second Thomas Shoal, a contested submerged reef located in the disputed Spratly Islands and chased it away. The civilian boat had been monitoring the activities of the Chinese catamarans.²⁸

Better Late Than Never:

Coping with Climate Change:

The UK MoD released its climate change roadmap in March 2020 with the goal of being zero carbon emissions across the force by 2040.²⁹

At the DSEI exhibition in September, representatives of the Royal Navy discussed some of its most important initiatives to mitigate the service’s impact on the environment, including the redesign of several ship classes. During a panel discussion Mat Darking, director of ships acquisition, Defence Equipment and Support (DE&S) portfolio manager

Responding to Climate Change: New Missions and Models

On 10 August, *Defense One* published an analysis of how climate change is affecting DoD activities. Many of these effects are not unique to DoD and are shared by both small and large militaries throughout the world.

At the top of the list of impacts was the need to train members of the US National Guard for humanitarian assistance and support for civil authority missions that are becoming more common as guardsmen are more frequently deployed in response to extreme weather events such as forest fires, hurricanes, other storms, and droughts. In addition, DoD is focusing on measures such as increasing digital engineering in the supply chain in order to reduce its carbon footprint and developing more powerful and high-fidelity computer models that can more accurately predict weather events and their impacts.

Source: Patrick Tucker, “Climate Change Is Already Disrupting the Military. It Will Get Worse, Officials Say”, *Defense One*, 10 August 2021, [Climate Change Is Already Disrupting the Military. It Will Get Worse, Officials Say - Defense One](#)

²⁶ Ibid.

²⁷ Ibid.

²⁸ Thomas Newdick, “Now China Has Cruise Missile Carrying Catamarans Chasing Away Ships In The South China Sea”, *The Drive*, 8 April 2021, [Now China Has Cruise Missile Carrying Catamarans Chasing Away Ships In The South China Sea \(thedrive.com\)](#)

²⁹ Andrew Chuter, “British Air Force aims to world’s first service with certified zero-carbon aircraft”, *Defense News*, 30 July 2021, [British Air Force aims to be world’s first service with certified zero-carbon aircraft \(defensenews.com\)](#)

identified several elements being incorporated into the design of the Tide-class fast fleet tanks and Type 26 and Type 31 frigates as part of this effort:³⁰

- Gas turbine and diesel generator technology that would maximize fuel efficiency and power
- Redesigned low signature propellers, bow domes and fins to reduce drag
- A slimmer hull design that would also reduce drag and promote fuel efficiency
- Modular designs that eliminate for a range of different types of variants

Darking also emphasized the need for heightened engagement with industry, including purchasing some technologies more or less off-the-shelf from commercial industry rather than engaging in the years long process of designing and developing a bespoke component, such as a new “green engine”. As part of the DSEI panel, Darking, also offered that the Royal Navy intends “to be a fast follower, and to exploit the technologies and advancement made within the commercial sector.”³¹

A related effort was revealed In late July 2021 when the British Royal Air Force announced its goal of becoming the first military service in the world to register and certify a zero-carbon aircraft by sometime between 2027 and 2030, marking one of the more ambitious efforts to achieve the MoD’s zero carbon objectives. The new airplanes will be designed to replace the Grob 115 training aircraft, which is used for elementary flight training for the Royal Air Force. The program is expected to begin in 2023.³²

Weapons Systems and Munitions

Key Insights:

- **Superweapons and New Competitions:** A new report from Chatham House examines Russia’s efforts at military modernization and incorporation of new technologies. It also profiles six superweapons—an ICBM, three hypersonic weapons, and two nuclear-propelled weapons—arguing that these are seen as critical to deterring and defeating US (among others) missile defence efforts. While some programs seem to have reached a significant level of maturity, others still have technological challenges to overcome—especially the nuclear-powered Skyfall cruise missile. Moreover, the utility of Russia’s hypersonic weapons is compromised by an insufficiently robust reconnaissance-strike complex / kill chain.
- **Deniable Directed Energy:** Directed energy weapons have become a valuable tool for deniable hybrid warfare / gray zone operations. Continued reports of “Havana Syndrome” among US diplomats and government personnel stationed abroad have catalyzed—perhaps belatedly—multiple studies to better understand the causes of the damaging and, to date, unexplained neurological symptoms. Speculation has centered on use of directed energy / radio frequency weapons by a state actor.
- **Geopolitics and the Future of UK-France Collaboration:** Tensions emanating from the AUKUS deal are affecting the future of UK-France collaboration on multiple weapons programs. High-level talks between the UK and France on the next stage of the joint next generation future anti-ship weapon program were postponed in September.

³⁰ Vivienne Machi, “Here’s what a ‘green’ ship design could look like for the Royal Navy”, *Defense News*, 17 September 2021, [Here’s what a ‘green’ ship design could look like for the Royal Navy \(defensenews.com\)](https://www.defensenews.com/defense/2021/09/17/here-s-what-a-green-ship-design-could-look-like-for-the-royal-navy/)

³¹ Ibid.

³² Andrew Chuter, “British Air Force aims to world’s first service with certified zero-carbon aircraft”, *Defense News*, 30 July 2021, [British Air Force aims to be world’s first service with certified zero-carbon aircraft \(defensenews.com\)](https://www.defensenews.com/defense/2021/07/30/british-air-force-aims-to-world-s-first-service-with-certified-zero-carbon-aircraft/)

Russia's Super Weapons: A September 2021 report from Chatham House entitled *Advanced military technology in Russia* examined Russia's efforts to develop and integrate a range of advanced technologies and the capabilities they enable.

The report included a series of essays that identified trends in Russia's military technology developments and advanced capabilities; military research and development, innovation, and breakthrough technologies; Russian space systems and development and applications of robotics and AI. Among the key insights was that:³³

"Russia has been incrementally integrating novel force-multiplier technologies into established weapons systems, including nuclear and non-nuclear strategic weapons and general purpose forces, as well as asymmetric non-military methods and means. These new systems have the potential to provide an advantage in time and space. Uncertainties remain, nonetheless, about Russia's ability to keep up with the competition."

The report also includes a chapter profiling six Russian superweapons:³⁴

- The RS-28 Sarmat intercontinental ballistic missile (ICBM)
- The Avangard hypersonic glide vehicle capable missile system that combines the SS-19 Stiletto ICBM and the Yu-71 HGV
- The Poseidon nuclear-armed, nuclear-powered uncrewed underwater vehicle (UUV)
- The 9M730 Burevestnik "Skyfall" ground-launched, nuclear-powered cruise missile, which would, in theory, have near unlimited range and be able to fly low to the surface of the earth evading radar detection
- The 9-S-7760 Kinzhal (Dagger) air-launched ballistic missile (ALBM), which is reportedly capable of achieving hypersonic speeds of Mach 10 and manoeuvring through all stages of flight
- The 3M22 Tsirkon (Zircon) ship-launched hypersonic anti-ship missile, which has an estimated top speed of Mach 9.

The list includes four "strategic systems" (Sarmat, Avangard, Poseidon, Skyfall) which, according to the report are "vital to ensuring Russia's ability to penetrate current and future US missile defence systems (as well as those of other adversaries) and to guarantee a second-strike capability for the foreseeable future."³⁵

These systems have been the topic of commentary since their introduction in 2018 ranging from "overreaction to contempt."³⁶ Russia has demonstrated the feasibility of some of these systems, but vulnerabilities and challenges related to the actual use of these weapons remain. For example, the report assesses that Russia's hypersonic "kill chain" is underdeveloped, significantly undermining the utility of its hypersonic weapons.

Moreover, there are technical barriers slowing the development of other systems. As the report notes about the Skyfall nuclear-powered cruise missile, "the technical barriers to attaining" a miniaturized nuclear reactor that could power a cruise missile are "considerable."³⁷ Indeed, the program suffered a failed test in August 2019 when a suspected Skyfall missile crashed into the White Sea killing at least five Russian personnel.³⁸ Weapons expert Jeffrey Lewis noted in comments to CNN in August 2021 that

³³ Samuel Bendett, Mathieu Boulegue, Richard Connolly, Mararita Konaev, Pavel Pdvig, Katarzyna Zysk, "Advanced military technology in Russia: Capabilities and implications", Chatham House, September 2021, p.4, <https://www.chathamhouse.org/sites/default/files/2021-09/2021-09-23-advanced-military-technology-in-russia-bendett-et-al.pdf>

³⁴ Ibid, p. 24 – 28.

³⁵ Ibid, p. 29.

³⁶ Ibid.

³⁷ Ibid, p. 32.

³⁸ Zachary Cohen, "New satellite images show Russia may be preparing to test nuclear powered 'Skyfall' missile, *CNN.com*, 18 August 2021, [New satellite images show Russia may be preparing to test nuclear powered 'Skyfall' missile - CNNPolitics](#)

there are “substantial questions, however, about whether the system can be made to work successfully, to say nothing of the threat that testing this system may pose to the environment and human health.”³⁹

Havana Syndrome and the Future of Directed Energy: Two United States diplomats were medically evacuated from Vietnam after “Havana Syndrome” incidents were reported in the capital city of Hanoi ahead of Vice President Kamala Harris’ visit to the country. The trip was delayed briefly due to concern about the incident.⁴⁰

Havana Syndrome is used to describe the unexplained and frequently debilitating neurological injuries US diplomats and government personnel have suffered in several countries that seem to be tied to acoustic incidents in which affected individuals hear strange sounds. The first reported incident occurred in Havana, Cuba in 2016 when US personnel attached to the embassy there reported symptoms “ranging from headaches and dizziness to memory loss and measurable cognitive decline.” In the five years since the first attack more than 200 US personnel have reported similar episodes of “acoustic incidents” and similar symptoms.⁴¹

The cause of the illnesses remains unknown, though speculation has focused on the use of a high-powered microwave or other form of directed radio frequency pulses by a foreign state. Some observers believe the US government was slow to respond to complaints from abroad, though there has been a marked increase in the intensity and clarity of response recently. In September 2021, the US Congress passed legislation appropriated funding for treatment for personnel suffering from these symptoms and both the Director of the CIA and Director of National Intelligence have created task forces to study the issue.⁴²

The discussion around these conspicuous and persistent attacks highlights the use of directed energy for non-lethal purposes as part of “hybrid” or “grey zone” efforts. Recall the suspected use of a high-powered microwave by the People’s Liberation Army against Indian forces along the Line of Actual Control (LAC) in 2020. After a tense stand-off and a deadly brawl (no lethal weapons are allowed along the LAC), Indian troops were reportedly forced to abandon their position after many began to vomit. In November 2020, Professor Jin Canrong, a professor of international relations at Beijing-based Renmin University, described the incident, noting that [the PLA] didn’t publicize it because we solved the problem beautifully. They [India] didn’t publicize it, either, because they lost so miserably.” The Chinese government has denied the use of directed energy weapons in the conflict.⁴³

Notably, on 29 June, the USAF released a report entitled *Directed Energy Futures 2060: Visions for the next 40 years of U.S. Department of Defense Directed Energy Technologies*. The report asserts that the US and world are “approaching or have passed a tipping point for the criticality of Directed Energy (DE) capabilities as applied to the successful execution of military operations for the United States, Allies, and for the United States’ rivals and potential adversaries. It highlights that “at least 31 nations have DE weapons for counter unmanned airborne system (C-UAS) missions”, including laser pointers, which “both state and non-state actors have used . . . during operations: military, policing, during protests, and to imperil civil and military pilot”⁴⁴, further highlighting the range of difficult to detect, sub-threshold of kinetic response applications of directed energy weapons.

³⁹ Ibid.

⁴⁰ Josh Lederman and Andrea Mitchell, “Two Diplomats Evacuated from Vietnam after ‘Havana Syndrome’ Incidents”, *NBC News*, 24 August 2021, [2 U.S. diplomats to be evacuated from Vietnam after "Havana Syndrome" incidents \(nbcnews.com\)](https://www.nbcnews.com/health/2-u-s-diplomats-evacuated-vietnam-havana-syndrome-incidents-nbcnews.com)

⁴¹ IntelBrief: Havana Syndrome Continues to Frustrate U.S. Intelligence Community”, The Soufan Center, 11 October 2021, [IntelBrief: Havana Syndrome Continues to Frustrate U.S. Intelligence Community - The Soufan Center](https://www.soufancenter.org/intelbrief-havana-syndrome-continues-to-frustrate-u.s.-intelligence-community/)

⁴² Ibid.

⁴³ Didi Tang, “China turns Ladakh battleground with India into a ‘microwave oven’”, *The Times*, 17 November 2020, [China turns Ladakh battleground with India into a ‘microwave oven’ | World | The Times](https://www.thetimes.co.uk/article/china-turns-ladakh-battleground-with-india-into-a-microwave-oven-12345678)

⁴⁴ “Directed Energy Futures 2060: Visions for the next 40 years of U.S. Department of Defense Directed Energy technologies”, US Air Force Research Lab, 29 June 2021, [Directed Energy Futures 2060 Final29June21 with clearance number.pdf \(af.mil\)](https://www.af.mil/Portals/12/Documents/20210629/20210629%20Directed%20Energy%20Futures%202060%20Final%20with%20clearance%20number.pdf)

AUKUS Implications for the Future of UK-France Weapons Collaboration:⁴⁵ As part of its protest of the cancelling of the Naval Group deal, France postponed the scheduled 23 September meeting between French Minister of Defence Florence Parly and British Defence Secretary Ben Wallace. Among the most immediate impacts of the impasse could be the future of the UK-France joint development of the Future Cruise / Anti-Ship Weapon (FC/ASW). The programme was launched in 2017 to develop a new generation of deep strike and anti-ship missiles to replace the British Storm Shadow and French Scalp cruise missiles by 2030. Development is being led by MBDA, which was scheduled to finish the concept phase in July 2021. Approval for continuation of the program is likely to have to wait until the Parly-Wallace meeting can be rescheduled, which will likely have to wait until the dust settles from the fallout of the AUKUS deal.

Robotics and Uncrewed Systems

Key Insights:

- **China's Uncrewed Systems:** China continues to demonstrate progress in the development of an array of advanced uncrewed systems, ranging from supersonic UAS to high altitude long endurance UAS to even personal protection micro-UAS. These systems are seen as crucial not just to China's efforts to gain advantage in the current "informatized" / highly-networked environment of current military operations, but also the future "intelligentized" environment in which AI is more completely integrated into military capabilities and operations
- **Launch and Recovery Flexibility and Air-Launched Effects:** Militaries of all sizes are increasingly contemplating and developing concepts of air power that incorporate launch flexibility and systems of systems approaches in which one uncrewed system adds flexibility and range to another uncrewed system or crewed platform. A Russian concept for using a cyclocopter to launch a long-range drone released during the reporting period is a useful example as are the air-launched effects that are increasingly being integrated into loyal wingman programs around the world.

Airshow China Show 2021: The Airshow China 2021 exhibition was held in Zhuhai, China from 28 September to 3 October.

The event highlighted China's growing capability and confidence in the development of uncrewed aerial systems (UAS) as several new and advanced UAS were displayed, including:

- **The CH-6 high-altitude, long-endurance (HALE) multi-role UAS:** The modular CH-6 is equipped with two fuel-efficient small-to-medium-sized turbofan engines and has an endurance of 20 hours. It was a service ceiling of 15 km and a top speed of 700 kilometres an hour. The system is designed to carry out persistent intelligence, surveillance, and reconnaissance missions, target tracking, strike, anti-submarine missions, maritime patrols, early warning missions and close-range air support. It is expected to be offered on the export market.⁴⁶



Figure 6: The CH-6 HALE UAS displayed at the Airshow China 2021 exhibition. Source: [via South China Morning Post](#)

⁴⁵ Andrew Chuter, "Decisions on new British-French cruise missile are left hanging after submarine row", *Defense News*, 21 September 2021, [Decisions on new British-French cruise missile are left hanging after submarine row \(defensenews.com\)](#)

⁴⁶ "Exclusive: CH-6 drone makes debut at Airshow China, 'powerful UAV affordable, reliable'", *Global Times*, 27 September 2020, [Exclusive: CH-6 drone makes debut at Airshow China, 'powerful UAV affordable, reliable' - Global Times](#)

- **The WZ-7 HALE:** Designed for border reconnaissance and maritime patrol, the WZ-7 was first shown as a concept model at Airshow China 2006. The UAS is believed to be China's primary HALE UAS for reconnaissance operations near strategically vital locations.⁴⁷
- **The WZ-8 supersonic UAS:** The WZ-8 was originally revealed during the 1 October 2019 military parade in Beijing marking the 70th anniversary of the founding of the People's Republic of China. The UAS is supersonic and is believed to be focused on target acquisition and battle damage assessment, using its supersonic speed to cover long-distances quickly.



Figure 7: The WZ-7 HALE UAS. Source: : AFP [via South China Morning Post](#)

- **The CH-817 personal protection vertical take-off and landing micro-drone:** According to Janes, the CH-817 is manufactured from lightweight alloys and composite materials and features a bisected, cylindrical fuselage module with a pair of mid-mounted coaxial two-bladed rotors, which can fold along the fuselage module's diameter for transport and storage. A complete package “can comprise a UAV, a handheld operator control unit, and a pair of first-person view (FPV) goggles.”⁴⁸ The system can perform attack and reconnaissance missions. Shi Win, chief engineer and designer of the China Aerospace Science and Technology Corporation (CASC) CH series noted that “we call it a flying grenade.”⁴⁹

Russia's Cyclolets: Russia is exploring an inventive approach to extending the range of its ship-based ISR assets to ensure over-the-horizon reconnaissance and patrolling that is currently unavailable through the use of existing helicopters, which are limited in their duration and range.

The concept involves employing a system of systems approach that includes a cyclolet / cyclocopter and a long-duration drone. Cyclocopters are, as aviation and defence journalist Kelsey Atherton described in a 2 September *Popular Science* article, “strange also-rans in the history of early aviation. Essentially, instead of fixed wings jutting out the side, or a big rotor above the centre mass of a vehicle, a cyclocopter features at least two partial cylinders, with blades in the cylinder, that spin to generate vertical lift and forward momentum. In appearance, it looks like a paddlewheel for air instead of water.”⁵⁰

Reporting from Russian state-owned media RIA Novosti from 27 August details a plan to incorporate longer-range drones on ships that do not have the space to launch them by using a three-tonne cyclocopter as a de facto runway. According to the head of the project group from Russia's Foundation for Advanced Studies Yan Chibisov, “the platform lifts an airplane-type drone into the air, provides access to the desired speed and launch angle, as if it were taking off from an airfield. That is, it completely

⁴⁷ Kelvin Wong, “Airshow China 2021: China highlights its confidence in homegrown military UAVs”, *Janes.com*, 29 September 2021, [Airshow China 2021: China highlights its confidence in homegrown military UAVs \(janes.com\)](#)

⁴⁸ Kelvin Wong, “Airshow China 2021: CASC unveils CH-817 micro-surveillance and attack VTOL UAV”, *Janes*, 1 October 2021, [Airshow China 2021: CASC unveils CH-817 micro-surveillance and attack VTOL UAV \(janes.com\)](#)

⁴⁹ “Exclusive: CH-6 drone makes debut at Airshow China, ‘powerful UAV affordable, reliable’”, *Global Times*, 27 September 2020, [Exclusive: CH-6 drone makes debut at Airshow China, ‘powerful UAV affordable, reliable’ - Global Times](#)

⁵⁰ Kelsey Atherton, “Russia wants to launch little drones off of other drones off of ships”, *Popular Science*, 2 September 2021, [Russian drones could launch from other drones off ships | Popular Science \(popsci.com\)](#)

replaces the runway, becoming an airfield . . . On landing, the same platform catches up with the drone, flies up and picks it up itself.”⁵¹

Work is expected to launch by the end of 2021 and will last for three-and-a-half to four years.⁵²

Runway independence for launch and recovery has been gaining momentum in militaries around the world as they seek to increase operational flexibility and reduce the burdensome logistics tails associated with launch of many systems. So, too, is the system of systems concept of air launch and recovery is gaining momentum not just in Russia where the Grom loyal wingman UAS is now capable of launching up to 10 Molniya small reconnaissance and strike drones but throughout the world. Programs such as the India Combat Air Teaming System (CATS) include a crewed fighter jet that work with, among other assets, a drone carrier system that can release up to four air-launched flexible assets capable of swarming. These systems are designed to extend the effective range of the crewed platform—whether it be a fighter jet or, in the case of the cyclocopter concept, a ship—and their survivability by keeping them further away from potentially dangerous threats and contested environments. DARPA’s Gremlins program is exploring technologies associated with the launch and mid-air recovery of swarms of low-cost, reusable / attritable UAS systems with an expected lifetime of about 20 uses.⁵³

⁵¹ “In Russia, it was proposed to create ship-based drones based on cyclolets (translated to English)”, *RIA Novosti*, 27 January 2021, updated 28 August 2021, [In Russia, it was proposed to create ship-based drones on the basis of cyclolets - RIA Novosti, 27.08.2021](#)

⁵² Ibid.

⁵³ Paul J. Calhoun, “Gremlins,” Defense Advanced Research Projects Agency, available at <https://www.darpa.mil/program/gremlins>.



<https://deftech.ch/>