AUGUST 2024

Building a Mutually Complementary Supply Chain between Japan and the United States

Pathways to Deepening Japan-U.S. Defense Equipment and Technology Cooperation

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A Report of the CSIS Japan Chair and the CSIS Defense-Industrial Initiatives Group

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Contents

Introduction

Defense industrial capacity commands increased attention among like-minded allies and partners around the globe in the wake of Russia's invasion of Ukraine. The war has highlighted the need for defense industrial resilience in the West, given the rapid depletion of matériel and the limits on surge production capacity that have illuminated fragile defense supply chains. Meanwhile, the security environment in the Indo-Pacific region has continued to deteriorate. China's coercive actions around Taiwan and across the East and South China Seas, combined with North Korea's repeated provocations, are clear reminders that "Ukraine today may be East Asia tomorrow," as Japanese prime minister Kishida Fumio famously said in a speech in June 2022.[1] The United States and its allies, including Japan, have demonstrated a shared commitment to enhancing defense cooperation and promoting broader networks of security cooperation. Developing a more robust and resilient defense industrial ecosystem is a key element of this common strategy.

In response to this worsening regional security environment, Japan has taken unprecedented steps to strengthen its defense posture, with significant increases in defense spending and plans to acquire advanced capabilities, including long-range counterstrike. It is also taking steps to enhance defense cooperation with the United States and other partners, such as Australia and the Republic of Korea. As part of this broader strategy, Japan has identified strengthening its defense industrial base as "virtually defense capability itself."[2] Strengthening the defense industrial base dovetails with U.S. defense strategy, which also stresses the importance of building a resilient defense ecosystem and collaborating with allies toward that end. The Department of Defense's (DoD) first National Defense Industrial Strategy includes supporting "a resilient defense industrial ecosystem among the U.S. and close international allies and partners" as one of its four strategic priorities.[3]

Japan has taken unprecedented steps to strengthen its defense posture, with significant increases in defense spending and plans to acquire advanced capabilities, including long-range counterstrike.

Deeper defense industrial cooperation requires deliberate investment and planning, and it can take several forms, including codevelopment and coproduction of complete systems at the high end and supplying subcomponents to a shared system at the low end. The former is the hardest to achieve, given the need to identify common requirements and align technology and manufacturing capacity in a way that benefits both countries. Cooperation in integrating supply chains of subcomponents is often a more practical approach. The challenge in both cases is identifying appropriate opportunities.

Uncrewed aerial systems (UAS) are an increasingly important capability where both the United States and Japan are making investments to counter new and existing threats. The U.S. Replicator initiative, which aims to field large numbers of small drones on a rapid timeline, is an innovative approach to counter China's defense industrial scale and mass. Japan is focused on the critical need for UAS, necessitated in part by a declining population that is impacting manpower in the Self-Defense Forces. Japan's Ministry of Defense (MOD) has announced a plan to invest JPY 1 trillion (USD 7.1 billion) over the next five years to develop uncrewed systems.[4]

At the subcomponent level, electro-optical sensors have become one of the largest needs for both the consumer and defense markets. They are critical components for weapons and platforms (including for long-range precision targeting, consistent radio communications, automation networks, cryptanalysis, etc.), but capacity shortages have limited their production.

With support from the MOD's Acquisition, Technology, and Logistics Agency (ATLA), the Center for Strategic and International Studies (CSIS) conducted a study to explore avenues for enhancing U.S.-Japan defense equipment and technology cooperation, with an emphasis on UAS and electro-optical sensors as potential targets of opportunity. The methodology included a literature review of analysis on the two case study topics; reviews of government policy documents; case studies on previous examples of bilateral cooperation, as well as international trade data; and interviews with experts at nine U.S. and Japanese companies with relevant expertise. The team also held two private research workshops to discuss opportunities and challenges with a broader range of industry participants. The interviews and workshops were held under the Chatham House Rule.

This report starts with an overview of Japan's defense industry. It next briefly summarizes the history of U.S.-Japan defense industrial cooperation and then presents the two case studies, examining current challenges in the industrial supply chain and assessing how Japan can best plug in to the U.S. defense ecosystem. The report also addresses structural impediments to U.S.-Japan cooperation and concludes with insights that can assist in overcoming those barriers to support the strategic objectives of both governments and help build a more robust and secure defense supply chain globally.

An Overview of Japan's Defense Industry

Following World War II and the introduction of Japan's postwar constitution in 1947, the Japanese defense industry essentially collapsed. The war-renouncing clause in the constitution (Article 9) and Japan's decision at the outset of the Cold War to prioritize economic development over investments in the military limited the development of Japan's domestic defense industrial base (DIB). Throughout the Cold War, Japan focused on a policy of "exclusive self-defense" (*senshu bouei*), relying heavily on the United States for its security.

Japan introduced strict restrictions on arms exports as part of its postwar policies. The Three Principles on the Transfer of Defense Equipment and Technology, adopted in 1967, limited arms transfers by prohibiting exports to communist countries, countries subject to embargoes under UN Security Council resolutions, or countries engaged in or likely to be engaged in international conflicts. Japan imposed additional restrictions in 1976 that virtually prohibited arms exports, a policy that was sustained with little change for the next 40 years. These limits on exports were combined with policy that limited Japanese defense spending to about 1 percent of GDP. Consequently, Japan's defense industry relied exclusively on the government for contracts to support the Japan Self-Defense Forces (JSDF), a small market that was adequate for meeting Japan's defense needs but prevented the development of a robust and competitive defense industry.[5]

After the Cold War, concerns about the threat posed by North Korea's nuclear weapons and missile programs and China's rapidly advancing military capabilities prompted the Japanese government to place a renewed emphasis on defense. The government issued *National Defense Program Guidelines* in 1995, 2004, and 2010, all of which emphasized enhancing defense cooperation with the United

States. Japan released its first National Security Strategy in 2013, adopting a more ambitious strategy aimed at further strengthening Japan's defense capabilities—albeit still within the framework of strict 1 percent limits on defense spending.

Although Japan had previously taken modest steps to enable defense industry cooperation with the United States, during this period it began to ease broader restrictions on defense exports for the first time. In 2012, Japan introduced modest measures to allow exports of equipment for peacekeeping operations and participation in international joint development and production of equipment. In 2014, under the leadership of Prime Minister Abe Shinzo, Japan revised its policy to allow exports in several categories of non-lethal equipment.

This history of limits on exports, combined with relatively small budgets centered on equipment for self-defense, has long limited opportunities for bilateral cooperation. Nevertheless, there have been a handful of high-profile bilateral projects. Most significant was collaboration in jointly developing the Standard Missile 3 (SM-3) Block IIA ballistic missile defense interceptor that began in 2006. Japan also collaborated with the United States on the F-35 stealth fighter through in-country final assembly and maintenance of aircraft, as well as production of some components.[6]

The release of Japan's second National Security Strategy in December 2022—and the attendant increases in defense spending and support for the defense industrial base—signaled a new era of opportunity in defense industrial cooperation. In December 2023, Japan further eased export rules to allow exports of complete systems manufactured under license, in addition to the export of parts and components. Restrictions on the categories of equipment approved for export (largely limited to nonlethal systems) remain in place, however—a factor that will constrain opportunities in the near term, absent broader reform.

Challenges for Japan's Defense Industrial Base

Japan's defense industry has a structure unique among advanced economies. As a result of the history described above, there are no dedicated defense "primes" in Japan. Rather, defense manufacturing is centered on a limited number of large industrial conglomerates for which defense is but a small share of overall business. The four major Japanese defense companies—Mitsubishi Heavy Industries (MHI), Kawasaki Heavy Industries (KHI), Fujitsu, and Ishikawajima Heavy Industries (IHI)—have secured positions on the Stockholm International Peace Research Institute (SIPRI) list of top 100 defense companies worldwide, but the broader landscape reveals a more mixed story.[7] Until recently, Japan's defense industry risked entering a spiral of decline. Over 100 smaller enterprises that support the major firms have withdrawn from the defense industry since 2003, according to the MOD, and even some larger enterprises have cut back on defense business.[8] For example, Sumitomo Heavy Industries recently halted machine gun production, while Komatsu discontinued armored vehicle development for the Japan Ground Self-Defense Force (GSDF).[9]

Several factors have contributed to this trend. As noted, limits on defense exports mean that the JSDF has been the sole customer for most of these companies. Japan has lacked state-run defense facilities and relies solely on the private sector to manufacture defense equipment for the JSDF. Low demand and meager profits mean that returns on investment were too low for Japanese companies to stay in the defense market: other nations' defense companies enjoy operating profit margins exceeding 10 percent, while Japan's defense industry remains at only 2-3 percent.[10] Legislation passed in 2023 attempts to directly target these deficiencies and will be addressed further below.

The decline of Japan's defense industry has been a source of deep concern in the Japanese government, which prompted the focus on strengthening the industrial base captured in the new National Security Strategy. The MOD has publicly recognized that the challenge with incentives "not only interferes with the stable procurement of defense equipment essential for the SDF operations, but also causes the loss of proper competitive environment and innovation in the long term, resulting in losing its ground on Japan's technological superiority in security."[11] Addressing these challenges is crucial to ensuring that Japan's defense industry remains capable of meeting national security needs.

International Partnership Experience

The defense industries of partner nations can contribute to their common defense in multiple ways. One is cooperative development, where common requirements lead partner governments to collaborate on complete systems. A second example is one in which a contractor in one nation serves as the lead integrator of a system and brings in companies from other nations to provide subsystems or components. Two recent examples of U.S.-Japan partnership are summarized as follows.

The SM-3 Block IIA, jointly developed by Raytheon and MHI, is an example of cooperative development. Japan agreed to fund roughly half of the project and manufacture critical missile components for use by both countries.[12] The approach of "component compartmentalization" had the benefit of featuring clean dividing lines between each country's contributions, with each government managing their respective industry partner and managing the budget for their portions.[13] This approach to joint acquisition reflected constraints on policies and practices in place at the time, but kept industry-to-industry engaement at arm's length. Future joint acquisition programs seem more likely to follow the precedents now being set by Japan's participation in the Global Combat Aircraft Program (GCAP) and the Glide Phase Interceptor (GPI) program described below.

Another example is Japan's participation in the F-35 fighter jet program. Though not one of the founding partners of the F-35 consortium, Japan "is acquiring the most [F-35s] of any international customer."[14] MHI operates a F-35A Final Assembly and Checkout (FACO) facility, where it conducts maintenance, repair, overhaul, and upgrade (MRO&U) activities for Japanese and U.S. aircraft in Japan.[15] Japanese companies, including MHI, Mitsubishi Electric (MELCO), and IHI Corp., manufacture radar parts, electro-optical distributed aperture system (EODAS) components, and engine parts for Japan's F-35 fleet.[16]

While policy restrictions in areas such as export control and information security impacted the implementation of F-35 production and support in Japan, its eventual success now provides important operational as well as industrial base benefits for both countries that could be expanded further in the future.

Revitalizing Japan's Industrial Base

Beyond the SM-3 Block IIA and F-35 programs, Japan has a long history of manufacturing U.S.-origin equipment under license. Some examples include the F-15J (manufactured by MHI), the CH-47J Chinook (manufactured by KHI), and the Patriot Advanced Capability-3 (PAC-3) air and missile defense interceptor (manufactured by MHI). Japan has exported components of both earlier PAC-2 systems and the F-15 engine.

Beyond these efforts, however, Japan has a thin record of international cooperation on defense equipment; it has recently introduced a range of new policies and regulations to strengthen its defense industrial base.

The Defense Buildup Program, released along with the National Security Strategy and National Defense Strategy in December 2022, set out capability priorities for Japan's buildup over the five years from 2023 to 2027. One of seven priorities listed in the buildup program is uncrewed systems, including "utility/attack UAVs and miniature attack UAVs."[17]

Japan has a thin record of international cooperation on defense equipment; it has recently introduced a range of new policies and regulations to strengthen its defense industrial base.

Japan subsequently enacted new legislation in October 2023 to enhance its defense industrial base. The new law aims to achieve three key priorities: ensuring national security independence, bolstering deterrence, and contributing to domestic industries through technology spillover.[18] To achieve this, the legislation emphasizes strengthening the DIB as a top priority while also importing technology and pursuing joint development. The focus extends beyond finished products to maintaining technological superiority and stable manufacturing of parts and components. As the policy states, "both prime contractors and suppliers are equally essential to stably manufacturing defense equipment."[19] The law provides for the government to take ownership of defense manufacturing facilities; provides subsidies to strengthen supply chains, as well as for investments in areas like enhanced cybersecurity; and provides funding to modify equipment for export. Although Japan's approach places a heavy emphasis on indigenous development and production, it recognizes the vital role of collaboration with other countries.[20]

Building on these steps, and after lengthy discussions among Japan's ruling political parties, export policies were revised in December 2023 to allow exports of complete systems manufactured under license to the country of origin and other likeminded states. These modifications expanded the scope of nations eligible for importing defense equipment from Japan and also opened the door for the export of lethal weapons, though exports to nations involved in conflict are still barred. In

March 2024, Japan's ruling parties announced an agreement to allow exports to third countries of a new fighter aircraft to be developed with the United Kingdom and Italy under the GCAP.

The Future: Potential to Expand Cooperation

These recent policy reforms are sparking change in Japan's defense industry and increased interest in international partnerships. According to interviews with industry representatives conducted for this study, some Japanese firms are increasing capital investment in their defense businesses and assigning more personnel to the defense sector.[21] Simultaneously, U.S. companies have noticed increased engagement from their Japanese counterparts. Some U.S. firms primarily involved in commercial manufacturing have shifted their focus toward defense discussions with Japan in the last two years. Other U.S. companies are closely monitoring developments in the Japanese regulatory system and contemplating increased collaboration with Japan across a range of products.[22] These dynamics suggest an evolving landscape that could further advance U.S.-Japan defense industrial cooperation over time. Three current efforts in particular highlight the potential for expanded Japanese defense industry engagement in the international marketplace: GCAP, the GPI cooperative development program, and the Loyal Wingman drone project.

GLOBAL COMBAT AIR PROGRAM (GCAP)

In December 2022, Japan, the United Kingdom, and Italy announced a multinational initiative to develop a sixth-generation fighter. With the goal of introducing the aircraft into service by 2035—an ambitious timeline—it is the first major program undertaken by Japan with a partner other than the United States. The three partners have established a joint program office to oversee the effort, but as of this writing, they have yet to finalize agreement on workshare for the project. The recent revision of Japan's export policy was instrumental in allowing this project to go forward, as it projected confidence in Japan's defense market potential.[23] After intense internal negotiations, the ruling coalition in Japan approved GCAP exports to third countries but did not announce broader reforms; steps to allow exports of lethal equipment were set aside for the time being. If successful, GCAP could serve as a driver for broader defense industry reform and revitalization in Japan.

GLIDE PHASE INTERCEPTOR (GPI) COOPERATIVE DEVELOPMENT

In August 2023, President Biden and Prime Minister Kishida announced plans to pursue joint development of a glide phase interceptor to counter the threat posed by hypersonic missiles.[24] On May 15, 2024, the Missile Defense Agency and MOD finalized the GPI Cooperative Development Agreement.[25] This project will strengthen industrial base capabilities in both countries to develop and produce advanced counter-hypersonic systems. While project management will resemble that used for the earlier SM-3 Block IIA missile, its workshare provisions reportedly allow for more direct industry-industry collaboration in sharing experiences related to all areas of missile development.[26]

LOYAL WINGMAN DRONE

Japan is also exploring cooperation with the United States and Australia on developing drones for military operations through the Collaborative Combat Aircraft (CCA) program. In a statement released after Prime Minister Albanese's visit to Washington in September 2023, the White House announced an "intention to explore trilateral cooperation with Japan on Unmanned Aerial Systems.

Our cooperation aims to enhance interoperability and accelerate technology transfer in the rapidly emerging field of collaborative combat aircraft and autonomy."[27] This would be the first time that these three nations worked together on a specific project. In April 2024, the U.S. Air Force selected Anduril and General Atomics to build "production representative" test CCA, the first phase of the project. Future rounds of CCA acquisition are expected to involve "most strategic" U.S. partners.[28] Japan's role in future CCA projects remains under discussion.[29]

Case Study One

Uncrewed Aerial Systems

Introduction to UAS

Uncrewed aircraft (UA) is a blanket term for flying vehicles without a human on board. The nomenclature for these systems has evolved over time, with the term unmanned aerial vehicle (UAV) common in the past and then replaced by the term remotely piloted aircraft (RPA). The U.S. Air Force popularized RPA to draw attention to the non-autonomous nature of these aircraft; ultimately, a human is still designing, controlling, and operating these systems.[30] Uncrewed aerial systems (UAS) is the latest iteration in terminology; in this report, it is used to encompass UA, UAV, and RPA. (Note that "drones" is another common term.) UAS refers not just to the aircraft itself, but also to the various subsystems and operating networks required for successful flight.

The DoD categorizes UAS into one of five groups depending on speed, operating altitude, and weight.[31]

The Role of UAS

UAS have been used for decades, initially for intelligence, surveillance, and reconnaissance (ISR). UAS can collect information in greater detail over longer periods of time than crewed aircraft. Uncrewed aircraft also require fewer personnel and have somewhat lower operating costs per hour.[32] Other defense applications include early detection of enemy aircraft or missiles, as well as delivering weapons to targets, much like a piloted aircraft delivers a missile or bomb. UAS can also be used for suicide missions where they divebomb targets.

Table 1: UAS Systems Classification

UAS Category*	Max Gross Takeoff Weight (lbs)	Normal Operating Altitude (ft)	Airspeed (knots)	Examples
Group 1	< 20	< 1,200 above ground level (AGL)**	< 100	T-Hawk, RQ-11 Raven, Puma
Group 2	21–55	< 3,500 AGL	< 250	ScanEagle
Group 3	< 1,320	< 18,000 mean sea level (MSL)***		RQ-7 Shadow
Group 4	> 1,320		Any airspeed	MQ-18 Predator, RQ-5 Hunter, MQ-1C Gray Eagle, MQ-88/C Fire Scout
Group 5		> 18,000 MSL		MQ-9 Reaper, RQ-4B Global Hawk, MQ-4C Triton

Notes: (*) If a UAS shares most characteristics of one group, but holds even one characteristic of a higher group, it is categorized in the higher-ranking group. (**) AGL is the literal height over the ground at which an object is flying. (***) MSL refers to the height above mean sea level (or true altitude).

Source: U.S. Army UAS Center of Excellence, *"Eyes of the Army": U.S. Army Roadmap for Unmanned Aircraft Systems* (Fort Rucker, AL: U.S. Army UAS Center of Excellence, January 2010), https://rosap.ntl.bts.gov/view/dot/18249; and "Unmanned Aircraft System (UAS) Basics," Missile Defense Advocacy Alliance, July 17, 2024, https://missiledefenseadvocacy.org/missile-threat-and-proliferation/missile-basics/unmanned-aircraft-systems-uas/.

Militaries also use UAS for close air support, cargo and resupply, and communications relay.[33] UAS can replace certain crewed missions, including aerial refueling, air-to-air combat, strategic bombing, battle management and command and control (BMC2), suppression and destruction of enemy air defenses, and electronic warfare.[34] Looking ahead, UAS experimental concepts include aircraft system-of-systems (SOS) development, AI-enabled manned-unmanned teaming (MUMT), mission support or "loyal wingmen," autonomous dogfighting, swarming, and lethal autonomous weapon systems (LAWS).[35] The Missile Technology Control Regime, of which both the United States and Japan are members, has been a brake on some UAS cooperation for larger systems, but U.S. reinterpretation of the regime in 2020 loosened these restrictions.[36]

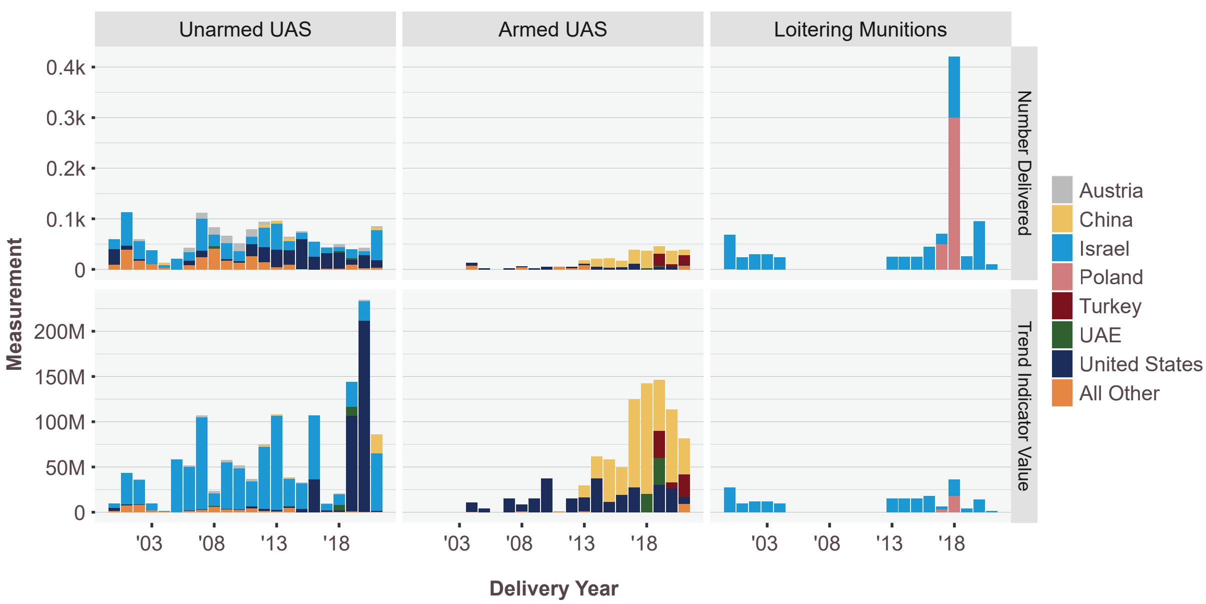
UAS also have commercial applications. Examples include capturing video from above (e.g., for data mapping or even filming scenes for movies), but the most common commercial use is in agriculture.[37] Farmers use drones to monitor both livestock and water levels, in addition to producing imagery to analyze details of crop health. Today, Japan uses more than 3,000 drones for agricultural purposes.[38] Other notable applications include disaster recovery and surveying land, and parcel delivery has also been explored as a use case.

UAS offer advantages over crewed aircraft. If UAS are shot down, no warfighter is harmed or lost. UAS are effective against certain targets where a mission using crewed aircraft would be more risky and costly. They can be harder to detect and destroy given their minimal signature, and they are generally less expensive to produce. Cost efficiency allows more UAS to be deployed and therefore support a higher volume of fire. This has proven to be very effective in the Russo-Ukrainian war, with Russia using inexpensive Iranian-made Shahed-136 drones to overwhelm Ukrainian air defenses before deploying cruise missiles.[39]

UAS are especially significant for missions that can be characterized as "dull, dirty, or dangerous."[40] "Dull" refers to lengthy missions that might be repetitive, such as long reconnaissance missions that do not need onboard pilots.[41] "Dirty" refers to potential human exposure to chemical, radiological, or biological contamination.[42] "Dangerous" missions are those that directly put operators in harm's way.[43]

As shown in the figure below, the worldwide demand for UAS has increased, placing a premium on capability to produce UAS at scale. This could create an opportunity for the United States to partner with other countries by leveraging industrial base strengths, which would mitigate U.S. production challenges and supply chain constraints.[44] Japan's industrial capabilities could be useful in efforts to fill gaps in U.S. industrial capacity.

Figure 1: UAS and Loitering Munition Deliveries by Exporter, 2000–2021



Source: "SIPRI Arms Transfers Databse," SIPRI, June 12, 2022, https://www.sipri.org/databases/armtransfers; CSIS analysis.

Japan's UAS Demand, Collaboration, and Industrial Capacity

Japan has been relatively slow to adapt military drone technology, primarily using UAS for reconnaissance purposes.[45] In years past, Japanese authorities assumed that because low-cost drones were unable to fly across the ocean, they would add little value to Japan's national security.[46] Attitudes now reflect increased emphasis on the importance of UAS to the Japan Maritime Self-Defense Force (MSDF) in particular. For example, UAS could prove crucial to improving Japan's situational awareness around the Senkaku Islands. UAS, in addition to uncrewed maritime vehicles, are arguably critical in providing consistent and cost-efficient surveillance of these islands, which are under near-daily pressure from Chinese Coast Guard vessels.[47] The uptick in Japanese UAS interest also reflects JSDF recruitment and retention challenges. UAS can help ameliorate this shortfall."[48]

Most of Japan's drone manufacturers produce commercial systems. Japanese companies that develop and produce UAS for military use tend to be bigger players, such as MHI, MELCO, and Subaru Corporation.[49] The Japanese government has steadily begun to increase its investments in domestic UAS technologies. The MOD is seeking to develop combat UAS capable of "breakneck maneuvers," with Subaru working on remote and flight control systems and MHI and MELCO developing information dissemination capabilities between aircraft.[50]

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The strength of Japan's UAS manufacturing capabilities varies across application (commercial vs. defense) and class (Groups 1–5 listed in Table 1). Japan has historically invested in its smaller commercial drone market, leading to the emergence of Japanese UAS manufacturers such as Autonomous Control Systems Laboratory. In contrast, the United States mostly relies on imports from other suppliers, particularly China, for smaller consumer and commercial drones. The company DJI China controls more than 70 percent of the global drone market via its manufacturing of consumer and commercial drones. However, even commercial drones have proven to be dual-use technologies, and civilian drones made by DJI can be adapted for battlefield use, as has been seen in the Russo-Ukrainian war.[51]

Current Opportunities for U.S.-Japan UAS Industrial Collaboration

The United States plans for significant investments in UAS systems, but collaboration with international partners could prove challenging. One issue is specific to existing systems with heritage supply chains. Bringing new suppliers into the network, including international partners, can require significant costs for engineering, testing, and other inputs, and even with those investments the components would start higher on the production cost learning curve. New programs offer fresh opportunities for industry, including from partner nations, to compete to become part of the initial supplier landscape. The United States has initiated two relevant efforts that may yield new opportunities to join the supply chain.

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Replicator Initiative

In August 2023, the DoD launched the Replicator initiative, a program to "quickly scale and field thousands of attritable autonomous systems within the next 18 to 24 months, leveraging AI, robotics, and commercial technology."[52] This initiative seeks to better integrate emerging private sector technologies into the military's operational framework; lower costs by deploying smaller uncrewed systems that require less maintenance; and overcome the "valley of death"—the period between developing a new technology and introducing it to market in a viable application where new technologies often run into obstacles and get interest and funding to make the transition to a program of record.[53] Accomplishing these goals could prove challenging.

U.S. government acquisition approaches are often complex and lengthy, with additional delays not uncommon when projects include multiple contractors from the defense and commercial sectors. Once UAS requirements are set, another challenge may be preparing the U.S. industrial base for rapidly scaling UAS production, as the smaller U.S. UAS industry has spent years struggling to compete against lower-cost imports from China. As a military program, Replicator will lead to an increase in domestic production of small UAS, but the United States will need to leverage ally and partner capacity to help meet its goals.

Japan can make a significant contribution to Replicator via its strength in manufacturing small, commercial UAS. Japanese industry can be leveraged to fill the gap in U.S. production and enhance interoperability, especially considering that Replicator's initial purchases will be small UAS.[54] U.S. capability gaps in two specific areas offer potential opportunities for Japanese engagement: increased survivability for UAS and high-volume small UAS production.

A consistent challenge for allies and partners in industry is understanding the Pentagon's requirements and knowing where to pitch their capabilities—a challenge often shared by small businesses in the United States. The Pentagon will need to provide more granular detail in its plan for operationalizing Replicator to enable Japanese industry to effectively plug in. In addition to a more detailed directive of what capabilities it wants these UAS to possess, the DoD will need to provide actual contracts with funding.[55] Japan could usefully emphasize the importance of DoD information sharing as a tool to better facilitate cooperative efforts.

Collaborative Combat Aircraft (CCA)

As noted above, CCA is a U.S. Air Force initiative designed for UAS to accompany crewed missions. These UAS are intended to act as a force multiplier to offer ISR support and additional offensive firepower capability to fifth- and sixth-generation fighters. The United States plans to field around 1,000 CCAs.

The U.S. Air Force has stressed that there is no single model for CCA, and that a variety of aircraft can offer different capabilities.[56] This opens the potential for nations to develop UAS that are compatible with the larger CCA program. Japan and the United States could direct collaborative efforts toward a CCA that (a) is useful for Japan's strategic threat environment and

(b) effectively and efficiently utilizes its industrial capacity, with specific emphasis placed on its component production.

THE POTENTIAL FOR COLLABORATION ON COMPONENTS

Japan's industrial capacity and skills could prove valuable when considering international collaboration under CCA. Interviews with industry conducted for this project identified several areas of potential strength for Japan, including microelectronics, wiring boards, UNICORN radar system and other radar systems, disaster relief pods, calibration services, avionics boxes, engines, landing gear, and other electronic components. Japan also has advanced capabilities in maintenance, repair, overhaul, and sustainment of batteries, engines, and actuators. U.S. industry additionally highlighted Japanese strengths in software development and data sharing.

Additional Considerations for UAS Cooperation

New programs should provide opportunities for allies and partners to engage and invest in UAS programs. However, there are potential roadblocks specific to UAS technology worth highlighting.

First, the United States has used operational experience to inform its product development. UAS have made critical contributions across a range of conflicts since the beginning of Operational Enduring Freedom in Afghanistan in 2001.[57] This has allowed the United States to capitalize on a feedback loop of combat exposure and innovation. Japan, on the other hand, lacks the combat experience that could shape its design and development plans and approaches.[58]

Second, the MOD has directed money into UAS research and development (R&D) but has yet to make UAS a formal procurement requirement.[59] The MOD's R&D push has allowed Japanese efforts to focus on building out a broad set of Japanese capabilities rather than gearing toward a partner-first approach. This incentivizes Japanese industry to focus on redeveloping and domestically reproducing technologies—from land-based vehicles to undersea vessels—that already exist.[60] This limits Japan's ability to enter effective partnerships if the partnering nation already has those capabilities. A continuing instinct for indigenous development of new systems thus poses risks for the future competitiveness of Japanese industry in the UAS market. Based on interviews with industry conducted for this study, the Japanese government is not sending a strong demand signal for UAS production. Unless the Japanese government invests in its industry or subsidizes production processes, Japanese industry may remain hesitant to partner with U.S. industry—and U.S. industry will be less likely to pursue partnerships with Japanese firms.[61]

Case Study Two

Electro-Optical Sensors

Introduction to EO/IR Systems

Electro-optical and infrared (EO/IR) systems consist of visible and infrared sensors that help the user to operate in adversarial environmental conditions. The use of EO/IR systems enables warfighters to achieve higher battlefield awareness through ISR capabilities. Other defense applications for EO/IR systems include night vision devices, visible-light cameras, laser range finders, and more.[62] EO/IR sensors provide real-time situational awareness and surveillance capabilities—detecting, tracking, and identifying potential threats—which supply critical information for military operations.[63]

There are generally two types of EO/IR sensors: non-imaging EO/IR systems (point targets) and imaging EO/IR systems (extended targets). Depending on the mission, one sensor may be more appropriate than another. A point target sensor operates by detecting energy emissions rather than imagery. For example, if an adversary launches a missile, a point target sensor will detect the immense energy emitting from the launch and relay that to the operator. Conversely, an extended target sensor will generate detailed imagery rather than a point of heat. Extended target sensors are often fielded on satellites, aircraft, and other optics.[64]

The Role of EO/IR Systems

EO/IR applications are segmented by platform: land-based, air-based, and sea-based. The sea-based segment of the market is experiencing large growth as maritime assets are becoming a priority for operational plans, especially in the Asia-Pacific theater. Unlike the radar technology traditionally used by ships, which relies on emitting active radiation signals and waiting for a return signal, EO/

IR sensors are passive and detect signals naturally emitted by objects. This passive operation is a key strategic advantage as it assists Navy ships in avoiding detection and prevents them from becoming targets themselves.

Japan is upgrading MSDF vessels by incorporating advanced sensor systems to allow them to identify targets, detect and perform threat assessments, and support weapons engagement for both offensive and defensive engagements. One example is the advanced integrated combat information center developed by MHI for the new stealth frigate commissioned by the MSDF. Mitsubishi Electric supplied the radar and the EO/IR sensor. Another is the Shipboard Panoramic Electro-Optic/Infrared (SPEIR) system developed by L3Harris for the U.S. Navy to enhance fleet protection.[65]

Airborne platforms are a major user of EO/IR systems. The explosive growth in the use of small UAS for this and other purposes has propelled industry to design smaller EO/IR systems that can be fitted to these platforms and that can dissipate heat so as not to disrupt the function of the UAS.[66] EO/IR systems provide significant improvement over visible light surveillance cameras.

Land-based EO/IR systems have a multitude of applications such as night vision goggles; drone detection; target recognition, identification, and location; and laser terminal guidance. Systems are continually being upgraded as threats evolve. For instance, the U.S. Army is developing a self-contained Laser Target Locator Module III (LTLM III) that meets updated performance requirements for its next-generation laser target locator.[67]

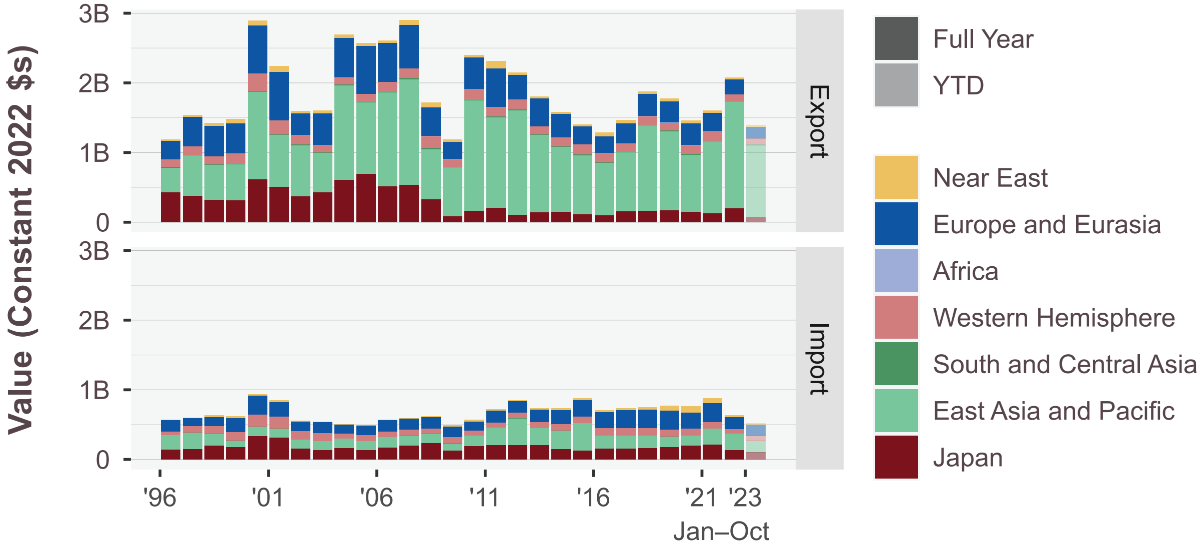
Japan's EO/IR Sensor History, Collaboration, and Industrial Capacity

For decades, Japan has developed its national sensing architecture to counter Chinese and North Korean threats and has produced EO/IRs under license or indigenously toward this end. The foundations for Japan's sensor architecture lie in its technical cooperation with the United States. In 1980, the United States and Japan established a joint Systems and Technology Forum between the DoD and the then Japan Defense Agency.

Through this cooperation, the United States was able to access Japan's advanced technology base in electro-optics and other electronics.[68] Figure 2 shows the length and depth of U.S.-Japan trade in dual-use EO sensors within the context of global U.S. trade in the same. Long a source of U.S. imports, the rough trade balance parity since 2009 speaks to Japan's ongoing comparative advantage in this sector. In 1983, the DoD dispatched a team of senior scientists to assess Japan's electro-optical manufacturing base and identify any technologies that could be incorporated into U.S. defense supply chains. The technologies flagged by the DoD analysts in 1983 eventually found their way into U.S. systems and were credited with supporting the United States' success in the 1991 Gulf War.[69]

Since the late 1980s, the development of advanced sensors has been a priority for Japanese defense. In 1988, Japan awarded contracts for the development of Aegis destroyers as a component of its efforts to develop a robust sensor architecture. In 1989, the JSDF united its disparate sensor and shooter systems under the auspices of the Base Air Defense Ground Environment (BADGE).[70]

Figure 2: U.S. Dual-Use Trade in Electro-Optical Sensors



Source: "DataWeb," USITC, May 2024, https://dataweb.usitc.gov/; and CSIS analysis.

Japan eventually began to procure more foreign-designed sensor systems at the turn of the millennium, generally featuring licensed production arrangements that preserved the Japanese EO/IR industrial base. Among others, these systems included Northrop Grumman's E-2C Hawkeye and the Lockheed P-3 Orion. Additionally, Japanese military electro-optical production coincides with the development of indigenous systems, such as the OH-1 light helicopter or armored vehicles.

Japan's sensor architecture was further strengthened by the procurement of air defense systems and other "shooters." The United States is Japan's primary source of missile defense systems, but Japan has long manufactured (under license) Patriot missile defense systems for its own use. The recent announcement of the export of these systems to the United States represents the culmination of U.S.-Japanese strategic cooperation in developing Japan's sensor-to-shooter architecture over the course of several decades.[71]

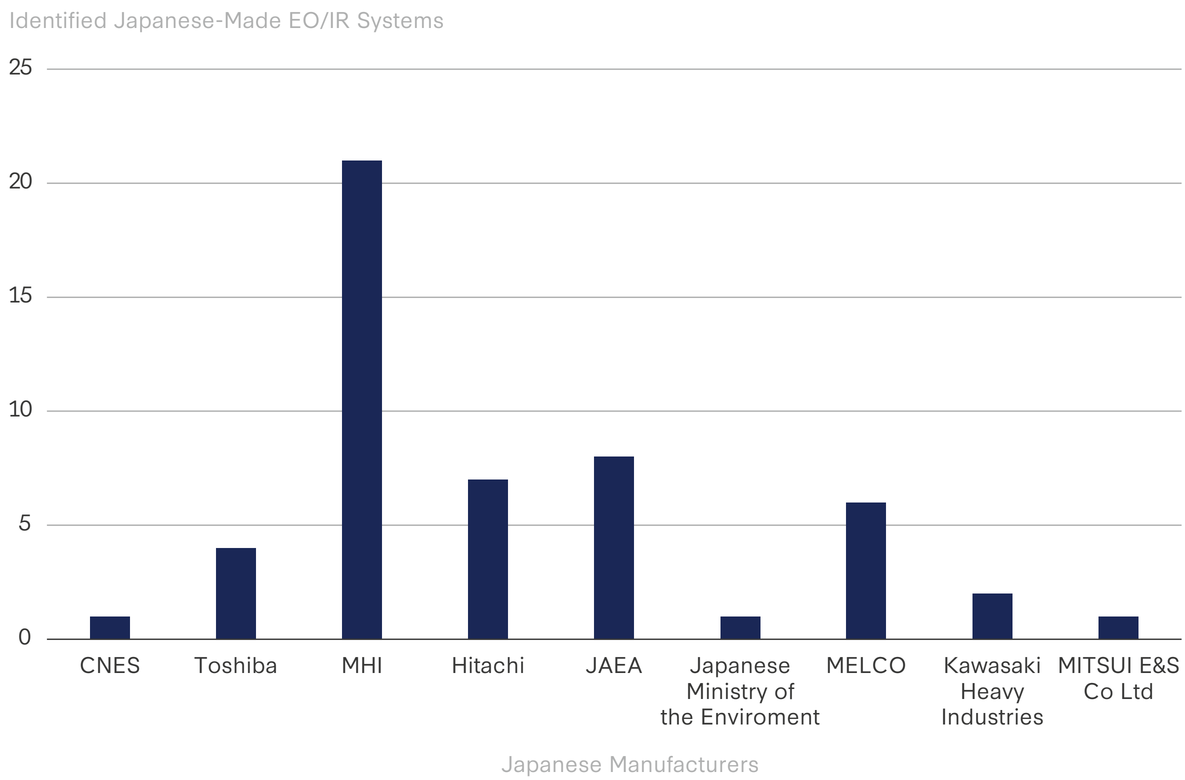
Opportunities for Industrial Collaboration

The United States has been cultivating an interconnected regional security architecture with Australian, Japanese, and South Korean engagements and with increased multilateral sensor information sharing. In December 2023, the United States, South Korea, and Japan finalized an agreement to share real time missile-warning data from their various sensor networks to strengthen trilateral monitoring of North Korean missile tests.[72] All three states possess sensor capabilities which are arrayed against North Korea; with the agreement to share data in place, allied cohesion is substantially strengthened. These initiatives are strengthened by other networking and digital lines of effort. During Prime Minister Kishida's visit to Washington in April 2024, the two governments announced plans for an integrated air and missile defense architecture with Australia in the years ahead. At the industry level, in January 2024, Northrop Grumman and MELCO signed a memorandum of understanding to develop a joint networking solution for Japan's air and missile defense systems to leverage the sensor-to-shooter architecture to its fullest with efficient fire controls.[73]

Japan's EO/IR Industrial Base

Japan's EO/IR industrial base is concentrated around the capabilities of a small group of enterprises, with Mitsubishi Corporation listed as the prime contractor for the majority of identified EO/IR records in the data.[74] Along with final assembly, Japanese EO/IR production includes subcontractor participation, opening up the market for a broader range of opportunities. For example, MHI's sensors may include circuitry and optics developed by the Nippon Electric Corporation.[75] This characteristic of the Japanese EO/IR sensor industrial base is important when considering the possibilities and limits of cooperation.

Figure 3: Japanese Manufacturers of EO/IR Sensors



Source: Janes Defense Markets Forecast.

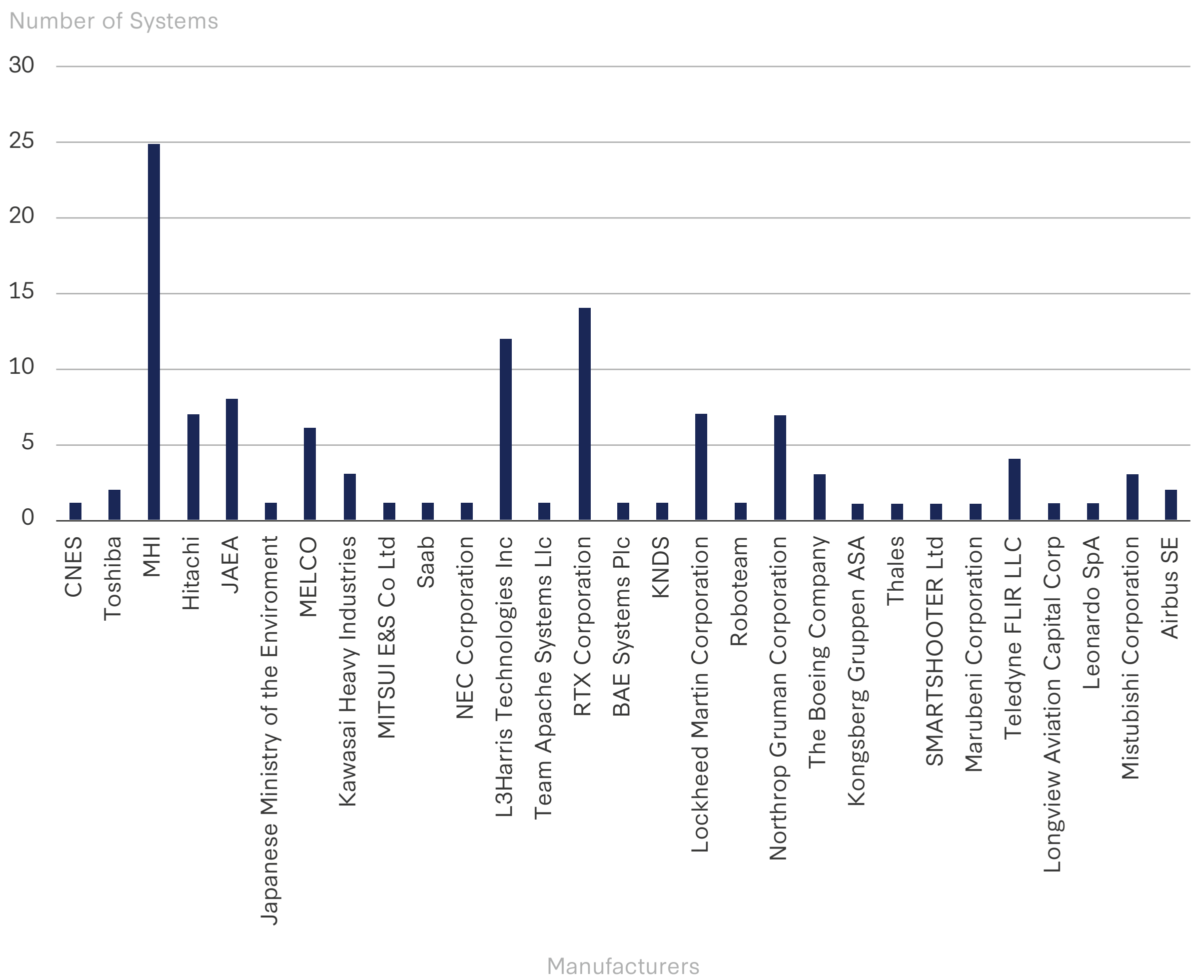
The leading prime contractor for Japan's recorded EO/IR sensors is MHI—even factoring in traditional U.S. defense contractors.[76] In fact, most of the identified U.S.-made sensors belong to technologies fielded on the F-35, the Mitsubishi F-2, and select naval vessels. Across the recorded platforms, advanced fire control capabilities consistently recur as U.S. exports to Japan. In CSIS's interviews with industry representatives, a continuous frustration highlighted by Japanese interviewees was the lack of codevelopment opportunities for higher-end systems. Japanese interviewees asserted that Japan likes to codevelop with the United States and wondered why their workers could not be brought into certain programs that are relevant to their work.[77]

A continuous frustration highlighted by Japanese interviewees was the lack of codevelopment opportunities for higher-end systems.

Additional Considerations

Japan has gradually developed its EO/IR industrial base to match its security needs. These investments are unlikely to decrease, as the threats that prompted the development of Japan's EO/IR sensor architecture persist. Japanese EO/IR producers have consistently plugged into either U.S.-produced or U.S.-licensed systems. As Japan begins to deepen its security role in the region and as its concepts of counterstrike continue to materialize, this field will remain important for bilateral and multilateral cooperation.

Figure 4: Prime Manufacturers of Japan's EO/IR Sensors



Source: Janes Defense Markets Forecast.

Key Insights

Enhancing defense industrial cooperation is a stated goal of the Japanese and U.S governments, and the two nations are well positioned to work together. The nations have a Security of Supply Arrangement (SOSA), which allows them to request priority delivery for defense items.[78] They also have a Reciprocal Defense Procurement Agreement, which has benefits including some exemptions from "Buy America" provisions.[79] The nations have a track record of working together successfully, including on the SM3 Block IIA missile, the F-35 Joint Strike Fighter, and other programs. Collaborations include both the codevelopment of systems and the integration of Japan into the supply chains of systems designed and produced in the United States, experiences which provide a foundation for future work. In the course of this research, the authors identified both opportunities and challenges for defense industrial cooperation.

The catalyst for cooperation is the urgency of the security environment. Both countries view China as the core national security challenge, and they share a common view that action is needed to sustain deterrence. That said, the recognition that "production is deterrence" will open up opportunities only if governments create funded requirements and issue contracts for specific items.[80] While collaboration in the form of codevelopment requires the buy-in of both governments, individual governments can encourage—and even fund—domestic industry with the goal of building capabilities and capacities to help them compete for participation in global supply chains.

The authors found a number of sticking points that government action could potentially alleviate or reduce, either directly or by providing incentives to industry. Other challenges are more intractable; the role of government in those can be education.

Government Policy

Insight 1: Increases in equipment orders and the need to increase production may create challenges for firms involved in Japan's defense industry.

U.S. industry recognizes the opportunities in Japan that stem from budget increases and revisions to defense export policy. Many Japanese companies in the defense sector are responding to these changes, and some are making substantial investments in facilities to allow them to increase production of dual-use or defense-specific items.[81] However, these developments also create new challenges, particularly related to industrial capacity. For example, while the defense budget has increased, the overall size of the workforce at most companies has not, although some firms are reallocating personnel into the defense business. Japanese defense manufacturers have nearly exclusively sold to the domestic market based on a near-flat defense budget for over half a century, so the increase in orders from the MOD puts a strain on defense companies as they look to grow across the full scope of capabilities necessary for production. MHI may be an exception, as the company moves personnel from its commercial aircraft or commercial shipbuilding business into its defense business, but other companies are less well positioned to do this.[82] The challenge is that no matter the strength of the present-day demand signal, Japanese companies may be cautious about making significant investments in growing capacity given the uncertainty of demand over the longer term. Investment that grows capacity also increases costs—and without sustained increased demand over time, a higher cost basis could make companies less competitive for future projects.

Insight 2: Broader defense equipment export reform in Japan will be essential to advancing international cooperation and building a globally competitive Japanese defense industry.

The still-limited reforms to defense export policy, coupled with the increased spending on defense, have resulted in Japanese industry continuing its principal focus on supplying the JSDF. While legislative reform will serve to make this business more profitable in the short term, it will do little to improve the competitiveness of Japanese industry internationally. Japan's attractiveness to U.S. industry as a partner will hinge on increased confidence that items codeveloped or coproduced can be exported to third countries, not to mention that Japanese regulatory policy will adjust to encourage this possibility—a prospect that remains limited today. The mixed messages sent by the Japanese government about the priority to be placed on defense equipment exports continues to send a chilling signal to both U.S. and Japanese industry.

Insight 3: Japan's lingering instinct for indigenous, national solutions for high-end capabilities poses obstacles for international cooperation.

While there are promising areas of international collaboration under Japan's new policies—including GCAP, GPI, and CCA—there are also numerous examples of the MOD seeking to develop indigenous capabilities despite the existence of international options that could be adapted to meet Japan's requirements. Examples include Japan's ambitious simultaneous investments in multiple variants of the Type-12 cruise missile; extensive R&D funding for multiple classes of UAS; and the stated intent to develop an autonomous "kill-chain" architecture to support counterstrike capabilities, tied together with an indigenous C2 network. While every industrialized country seeks to preserve some degree of autonomy in defense production, this focus on indigenous development—a long-standing feature of Japan's defense strategy—over existing international options risks inefficient use of resources, delays in capability delivery, or both.

Insight 4: Increased early engagement between both Japanese and U.S. industry and government would facilitate industrial cooperation.

There are important opportunities for U.S.-Japan cooperation on the horizon, such as the CCA and the Replicator program as discussed above. Japanese domestic programs could in future iterations tie into a larger U.S. program, but this incorporation could be at risk if early steps are not taken to lay groundwork for future cooperation. The U.S. Air Force has announced its intention to cooperate with partner industries in the future with regard to the CCA and is understandably focused on getting the details of this global approach right. Cooperation would benefit from increased and consistent forward-leaning communication to government and industry leaders in both countries on what steps they should be taking now.

Economic

Insight 1: U.S. industry often views international codevelopment and coproduction of new systems as more expensive than indigenous production and may be hesitant to pursue opportunities absent government incentives and encouragement.

International codevelopment and coproduction have clear benefits from an alliance perspective, including interoperability and expanded defense industrial capacity, but the challenges need to be recognized up front so that strategies can be developed to overcome them. International cooperation adds complexity and costs to programs because of the challenges of coordination, including requirements setting, decisionmaking timelines, different resources and acquisition systems, and cultural variance. Interviews conducted for this project revealed that U.S. industry often views international collaboration on new systems as challenging, particularly when partnering with an international company for the first time. A U.S. company may judge codevelopment or coproduction with a Japanese company to be more expensive than what a U.S. company can do either (a) on its own or (b) with another U.S. company—even when collaboration has clear technological and manufacturing benefits.[83] Nevertheless, many U.S. firms express a strong desire to collaborate with Japan to take advantage of strong Japanese industrial capabilities and technological expertise, in recognition of the robust alliance between the two nations. (Project interviews highlighted particular interest in microelectronics and certain subcomponents, such as composite materials and airframe structures.) Government encouragement and policy focus, including through the creation of subsidies designed to support codevelopment by covering some of the costs of collaboration, could be useful and perhaps necessary to facilitate cooperation. Of course, without a requirement or a government contract with funding, cooperation is unlikely to happen.

Industrial

Insight 1: Japan has advanced manufacturing capabilities that prove especially important to U.S. commercial companies.

Japan has advanced capabilities in various technologies—including microelectronics and carbon fiber composites—and is proficient in high-quality and high-volume commercial marketplace production. The United States has very limited capacity in some of these arenas, including wiring boards, which have been offshored to Southeast Asia.[84] Japan's comparative advantage in these fields underpins its bustling commercial industry, which has allowed it to become a key source of supply for a number of large foreign industrial producers, including Boeing. Bringing these capabilities and capacities to collaborative efforts could give Japanese industry market access while helping U.S. firms overcome their own limitations.

Insight 2: Modular open systems provide a framework for cooperation on codevelopment and coproduction, but current U.S. policy and industrial regimes do not tap into the full potential this architecture offers.

Modular open systems approaches, which allow for the incorporation of subsystems produced by different companies into standard interfaces, represent a possible means of expanding U.S.-Japan cooperation. Interviews with Japanese industry professionals conducted for this project found limited awareness of open systems approaches, however, which could be related to a lack of incentives for industry.[85] The success of this framework is dependent on U.S. approval for technology developed and produced abroad to be incorporated into U.S. systems.

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Endnotes

1 Kishida Fumio, "Keynote Address by Prime Minister KISHIDA Fumio at the IISS Shangri-La Dialogue," (Keynote address, IISS Shangri-La Dialogue, June 10, 2022), https://japan.kantei.go.jp/101_kishida/statement/202206/_00002.html.

2 Japan Ministry of Defense, *National Defense Strategy [Provisional Translation]* (Tokyo: Japan Ministry of Defense, December 2022), 33, https://www.mod.go.jp/j/policy/agenda/guideline/strategy/pdf/strategy_en.pdf.

3 "Fact Sheet: National Defense Industrial Strategy," U.S. Department of Defense, January 2024, https://www.businessdefense.gov/docs/ndis/NDIS-Fact-Sheet_JAN24.pdf.

4 Akhil Kadidal, "Rise of the Machines: Japan Plans to Replace Some Manned Air Assets with UAVs," Janes, June 8, 2023, https://www.janes.com/defence-news/news-detail/rise-of-the-machines-japan-plans-to-replace-some-manned-air-assets-with-uavs.

5 Taisuke Hirose, "Japan's New Arms Export Principles: Strengthening U.S.-Japan Relations," CSIS, October 14, 2014, https://www.csis.org/analysis/japans-new-arms-export-principles-strengthening-us-japan-relations.

6 "Japan Air Self-Defense Force's 5th Generation Fighter," Lockheed Martin Corporation, https://www.f35.com/f35/global-enterprise/japan.html.

7 "日本の防衛産業とは 売上高世界トップ100に4社のみ"[Japan's defense industry: only four companies in the world's top 100 by revenue], *Nihonkeizaishinbun*, November 9, 2023, https://www.nikkei.com/article/DGXZQOCB083QD0Y3A101C2000000/.

8 "Stop Japanese Businesses' Exodus from Defense Industry," *Yomiuri Shimbun*, October 3, 2022, https://japannews.yomiuri.co.jp/editorial/yomiuri-editorial/20221003-62181/.

9 Kenji Asada and Annu Nishioka, "Komatsu Ends Work on Key Japan Self-Defense Force Vehicle," Nikkei Asia, February 21, 2019, https://asia.nikkei.com/Business/Companies/Komatsu-ends-work-on-key-Japan-Self-Defense-Force-vehicle.

10 "Basic Policy on Enhancing Defense Production and Technology Bases, " Japan Ministry of Defense, October 12, 2023, https://www.mod.go.jp/atla/soubiseisaku/basicpolicy/basicpolicy_en_202310.pdf.

11 Ibid.

12 Bjørn Elias Mikalsen Grønning, "Operational and Industrial Military Integration: Extending the Frontiers of the Japan–US Alliance," *International Affairs* 94, no. 4 (2018): 755–772.

13 Gregory Sanders and Samantha Cohen, *Designing and Managing Successful International Joint Development Programs* (Washington, DC: CSIS, January 2017), 48–50, https://www.csis.org/analysis/designing-and-managing-successful-international-joint-development-programs.

14 "Japan Air Self-Defense Force's 5th Generation Fighter," F-35 Lighting II, https://www.f35.com/f35/global-enterprise/japan.html.

15 IHI Corporation, "IHI Completes F-35 Joint Strike Fighter Engine Regional Depot," press release, June 29, 2023, https://ihiap.com/ihi-completes-f-35-joint-strike-fighter-engine-regional-depot/.

16 Franz-Stefan Gady, "Japan Rolls Out First Domestically-Built F-35 Stealth Fighter," *The Diplomat*, June 6, 2017, https://thediplomat.com/2017/06/japan-rolls-out-first-domestically-built-f-35-stealth-fighter/.

17 Japan Ministry of Defense, *Defense Buildup Program [Provisional Translation]* (Tokyo: Japan Ministry of Defense, December 2022), 9, https://www.mod.go.jp/j/approach/agenda/guideline/plan/pdf/program_en.pdf.

18 Japan Ministry of Defense, *Basic Policy on Enhancing Defense Production and Technology Bases [Provisional Translation]* (Tokyo: Japan Ministry of Defense, October 2023), 9, https://www.mod.go.jp/atla/soubiseisaku/basicpolicy/basicpolicy_en_202310.pdf.

19 Japan Ministry of Defense, *Basic Policy on Enhancing Defense Production*.

20 Ibid.

21 Interview(s) with company representative.

22 Interview(s) with company representative.

23 Jon Hemler, "GCAP: A Trilateral Update," *Defense Security Monitor*, September 14, 2023, https://dsm.forecastinternational.com/2023/09/14/gcap-a-trilateral-update/.

24 U.S. Department of Defense, "U.S. Department of Defense and Japan Ministry of Defense Press Release on the Commencement of Glide Phase Interceptor Cooperative Development," press release, August 18, 2023, https://www.defense.gov/News/Releases/Release/Article/3498431/us-department-of-defense-and-japan-ministry-of-defense-press-release-on-the-com/.

25 U.S. Department of Defense, "U.S. Department of Defense Statement on the Signing of the Glide Phase Interceptor Cooperative Development," press release, May 15, 2024, https://www.defense.gov/News/Releases/Release/Article/3775546/us-department-of-defense-statement-on-the-signing-of-the-glide-phase-intercepto/.

26 Interview with Missile Defense Agency officials, May 30, 2024.

27 The White House, “United States-Australia Joint Leaders’ Statement Building an Innovation Alliance,” press release, October 25, 2023, https://www.whitehouse.gov/briefing-room/statements-releases/2023/10/25/united-states-australia-joint-leaders-statementbuilding-an-innovation-alliance/.

28 Stephen Losey, “US Air Force Readies to Award Collaborative Combat Aircraft Deals,” Defense News, February 13, 2024, https://www.defensenews.com/air/2024/02/13/us-air-force-readies-to-award-collaborative-combat-aircraft-deals/; and Ryo Nakamura, “U.S. Military Eyes Japan’s Participation in Autonomous Aircraft Program,” Nikkei Asia, January 26, 2024, https://asia.nikkei.com/Politics/Defense/U.S.-military-eyes-Japan-s-participation-in-autonomous-aircraft-program.

29 Secretary Kendall has specifically mentioned anticipating Japanese participation at some point in the program. See, for example, Josh Luckenbaugh, “SINGAPORE AIRSHOW: Air Force Official Looks for Robotic Jet Partnerships in Asia, Talks F-35 Woes,” National Defense, February 20, 2024, https://www.nationaldefensemagazine.org/articles/2024/2/20/air-force-discussing-collaborativ e-combat-aircraft-with-allies.

30 Ryoji Shirai, “Incorporating Unmanned Aerial Systems into the Japan Air Self-Defense Force,” Brookings Institution, September 2024, https://www.brookings.edu/articles/incorporating-unmanned-aeria l-systems-into-the-japan-air-self-defense-force/.

31 “Air Force Small-Unmanned Aircraft Systems Guide & Reporting Procedures,” U.S. Department of Defense, https://media.defense.gov/2022/Mar/14/2002956269/-1/-1/1/SUAS%20IDENTIFICATION%20AND%20REPORTING%20GUIDE.PDF.

32 Edward G. Keating, John Kerman, and David Arthur, “Usage Patterns and Costs of Unmanned Aerial Systems, ” Congressional Budget Office, June 1, 2021, 16, https://www.cbo.gov/system/files/2021-06/57090-UAS.pdf.

33 Kelley M. Sayler and Michael E. DeVine, *Unmanned Aircraft Systems: Roles, Missions, and Future Concepts* (Washington, DC: Congressional Research Service, July 18, 2022), https://crsreports.congress.gov/product/pdf/R/R47188.

34 Ibid.

35 Ibid.

36 Gregory Sanders et al., *Rising Demand and Proliferating Supply of Military UAS* (Washington, DC: Center for Strategic and International Studies, May 24, 2023), 43–47, https://www.csis.org/analysis/rising-deman d-and-proliferating-supply-military-uas.

37 Sven Eriksson and Maths Lundin, *The Drone Market in Japan* (Tokyo: EU-Japan Centre for Industrial Cooperation, September 2016), https://www.eu-japan.eu/sites/default/files/drone_market_in_japan.pdf.

38 Ibid.

39 Andrew E. Kramer, “Russian Missile Barrage Staggers Ukraine’s Air Defenses,” *New York Times*, December 29, 2022, https://www.nytimes.com/2022/12/29/world/europe/russia-strikes-ukraine.html.

40 Defense Technical Information Center, *Unmanned Systems Integrated Roadmap, FY2013-2038* (Washington, DC: Office of the Under Secretary of Defense, January 1, 2014), https://apps.dtic.mil/sti/citations/ADA592015.

41 R. Kurt Barnhart, Douglas M. Marshall, and Eric Shappee, eds., *Introduction to Unmanned Aircraft Systems*, 3rd ed. (CRC Press, 2021), https://www.taylorfrancis.com/books/edit/10.1201/9780429347498/introduction-unmanned-aircraft-systems-douglas-marshall-eric-shappee-kurt-barnhart.

42 Ibid.

43 Ibid.

44 Department of Defense, *Securing Defense-Critical Supply Chains: An Action Plan Developed in Response to President Biden's Executive Order 14017* (Washington, DC: Department of Defense, February 2022), https://media.defense.gov/2022/Feb/24/2002944158/-1/-1/1/DOD-EO-14017-REPORT-SECURIN G-DEFENSE-CRITICAL-SUPPLY-CHAINS.PDF; and Jerry McGinn and Michael T. Roche, A *'Build Allied' Approach to Increase Industrial Base Capacity* (Fairfax, VA: George Mason University Center for Government Contracting, June 2023), https://business.gmu.edu/ news/2023-06/build-allied-approach-increase-industrial-base-capacity.

45 Tsuyoshi Minami, "Japan Needs a Better Military Drone Strategy," East Asia Forum, August 20, 2021, https://eastasiaforum.org/2021/08/20/japan-needs-a-better-military-drone-strategy/.

46 Ibid.

47 Tate Nurkin and Ryo Hinata-Yamaguchi, "Emerging Technologies and the Future of US-Japan Defense Collaboration," April 17, 2020, 3, https://www.atlanticcouncil.org/uncategorized/emerging-defens e-technologies-and-the-future-of-us-japan-defense-collaboration/.

48 Ibid.

49 A CSIS analysis of U.S. federal contracting data found that highest values of DoD UAS contracts were placed at UAS manufacturers General Atomics, Northrop Grumman, Boeing, Textron, Raytheon, AeroVironment, and Lockheed Martin. Sanders et al., *Rising Demand and Proliferating Supply*, 37.

50 Junnosuke Kobara, "Japan Aims to Deploy Unmanned Fighter Jets in 2035," Nikkei Asia, January 1, 2021, https://asia.nikkei.com/Politics/Japan-aims-to-deploy-unmanned-fighter-jets-in-2035#:~:text=Japan%20 aims%20to%20deploy%20unmanned%20fighter%20jets%20in%202035,-Aircraft%20designed%20to&-text=TOKYO%20%2D%2D%20Japan%20has%20begun,the%20rise%20of%20drone%20warfare.

51 Brad Howard, "Can U.S. Drone Makers Compete with Cheap, High-Quality Chinese Drones?," CNBC, October 11, 2023, https://www.cnbc.com/2023/10/11/can-us-drone-makers-compete-with-cheap-high-quality-chinese-drones.html#:~:text=Chinese%20drone%20maker%20DJI%20remains,consumer%20electronics%20for%20many%20decades.

52 Lauren Kahn, "Scaling the Future: How Replicator Aims to Fast-Track U.S. Defense Capabilities," War on the Rocks, September 20, 2023, https://warontherocks.com/2023/09/scaling-the-future-how-replicat or-aims-to-fast-track-u-s-defense-capabilities/. Attritable systems are those that trade exquisiteness and maintainability for reusable cost-effective alternatives.

53 Kahn, "Scaling the Future."

54 Noah Robertson, "Replicator: An Inside Look at the Pentagon's Ambitious Drone Program," Defense News, December 19, 2023, https://www.defensenews.com/pentagon/2023/12/19/replicator-an-inside-loo k-at-the-pentagons-ambitious-drone-program/.

55 Ibid.

56 "On-Demand Video: Fireside Chat with Andrew Hunter," Costello College of Business, George Mason University, accessed March 19, 2024, https://mstm.gmu.edu/news/2023-05/demand-video-fireside-cha t-andrew-hunter.

57 John Schaus and Kaitlyn Johnson, *Unmanned Aerial Systems' Influences on Conflict Escalation Dynamics* (Washington, DC: Center for Strategic and International Studies, August 2, 2018), https://www.csis.org/analysis/unmanned-aerial-systems-influences-conflict-escalation-dynamics.

58 Interview(s) with company representative.

59 Ibid.

60 Ibid.

61 Ibid.

62 *Military Electro-Optical and Infrared Market* (Tinsukia, India: Next MSC, September 2020), https://www.nextmsc.com/report/military-electro-optical-infrared-systems-market.

63 "Military Electro-Optics/Infrared Systems Market by Platform, Product Type, Component, Cooling Technology, Sensor Technology, Imaging Technology, Point of Sale and Region - Global Forecast to 2028," Markets and Markets, April 2023, https://www.marketsandmarkets.com/Market-Reports/electro-optical-market-234736604.html.

64 G.M. Koretsky, J.F. Nicoll, and M.S. Taylor, *A Tutorial on Electro-Optical/Infrared (EO/IR) Theory and Systems* (Alexandria, VA: Institute for Defense Analyses, January 2013), https://www.ida.org/-/media/feature/publications/a/at/a-tutorial-on-e-lectro--opticalinfrared-eoir-theory-and-systems/ida-document-d-4642.ashx.

65 TechNavio, *Global Military Electro-Optical and Infrared Systems Market 2016-2020* (Bangalore, India: TechNavio, November 2016), https://www.technavio.com/report/global-defense-global-military-electro-optical-and-infrared-systems-market-2016-2020.

66 Ibid.

67 Dylan Malyasov, "U.S. Army Eyeing Next Generation Laser Target Locator," Defence Blog, February 9, 2021, https://defence-blog.com/u-s-army-eyeing-next-generation-laser-target-locator/.

68 Mark A. Lorell, *Troubled Partnership: A History of U.S.-Japan Collaboration on the FS-X Fighter* (Santa Monica, CA: RAND Corporation, 1995), https://doi.org/10.7249/MR612.2.

69 "Japan Claims Big Role in U.S. Weapons Success," *Chicago Tribune*, February 3, 1991, https://www.chicagotribune.com/1991/02/03/japan-claims-big-role-in-us-weapons-success/.

70 "Japan Names Aegis Contractors, " *Janes Defence Weekly*, September 3, 1988, https://customer.janes.com/display/jdw03870-jdw-1988.

71 Motoko Rich and Hisako Ueno, "Japan Relaxes Export Restrictions to Sell Patriot Missiles to U.S.," *New York Times*, December 22, 2023, https://www.nytimes.com/2023/12/22/world/asia/japan-export-patriot-missiles-us.html.

72 Gabriel Dominguez, "Japan, U.S. South Korea to Share Missile-Warning Data," *Japan Times*, November 13, 2023, https://www.japantimes.co.jp/news/2023/11/13/japan/politics/japan-us-south-korea-trilateral-analysis/.

73 John Hill, "Mitsubishi and Northrop Grumman Integrate Japan's Air Defence Systems," Army Technology, January 17, 2024, https://www.army-technology.com/news/mitsubishi-and-northrop-grumman-integrate-japans-air-defence-systems/.

74 Staff, "Markets Forecast," Janes, n.d., https://www.janes.com/.

75 "Three Principles on Defense Equipment and Technology," Japan Ministry of Foreign Affairs, April 1, 2014, https://www.mofa.go.jp/fp/nsp/page1we_000083.html; and interview(s) with company representative.

76 Staff, "Markets Forecast."

77 Interview(s) with company representative.

78 "Security of Supply Arrangement Between the Department of Defense of the United States of America and the Ministry of Defense of Japan," OUSD A&S, January 12, 2023, https://www.businessdefense.gov/docs/sofs/USA-JPN_SOSA-Signed.pdf; and "Agreement Between the United States of America and Japan Extending the Agreement of June 3, 2016," U.S. Department of State, May 28, 2021, https://preview.state.gov/wp-content/uploads/2021/06/21-528-Japan-RDP-extension-TIMS-62805.pdf.

79 "Agreement Between the United States of America and Japan Extending the Agreement of June 3, 2016," U.S. Department of State, May 28, 2021, https://preview.state.gov/wp-content/uploads/2021/06/21-528-Japan-RDP-extension-TIMS-62805.pdf.

80 This has become a frequent talking point of senior DoD leaders, and it was most recently affirmed by Undersecretary of Defense Hicks at a speech at the Ronald Reagan Institute in Washington, D.C., on March 20, 2024. U.S. Department of Defense, "Remarks by Deputy Secretary of Defense Kathleen Hicks 'Why America Needs the Defense Industrial Base'," press release, March 20, 2024, https://www.defense.gov/News/Speeches/Speech/Article/3713091/remarks-by-deputy-secretary-of-defense-kathleen-hicks-why-america-needs-the-def/.

81 Interview(s) with company representative.

82 Ibid.

83 Interview(s) with company representative.

84 Interview(s) with company representative.

85 Ibid.

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