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Developing a "Build Allied" Approach to Increasing Industrial Base Capacity

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Abstract

The war in Ukraine has clearly demonstrated the need for surge capacity in our defense industrial base. Increasing U.S. production of defense systems is part of the solution to this capacity deficit, but engaging the industrial capacity of American partners and allies is a critical, mutually beneficial, and cost-effective approach as well.

The case studies and analysis in this paper illustrate that we clearly have many of the building blocks in place for a robust "Build Allied" approach. There have been and are in development a number of co-development, co-production, second sourcing, licensed production, and sustainment efforts involving our allies and partners. The case study findings show that these successful efforts have largely been driven by strong leadership, focused cooperative efforts, and effective enablers. Moreover, there is clearly an increased appetite for "Build Allied" efforts to meet National Defense Strategy objectives and address defense industrial capacity shortfalls.

The paper's recommendations focus on strengthening "Build Allied" enablers such as the Australia, United Kingdom, and United States Agreement, the National Technology Industrial Base, and the Defense Exportability Features program, as well as overcoming barriers such as export controls, technology security and foreign disclosure processes, and aspects of the defense acquisition system.

Introduction

Research Issue

The war in Ukraine has clearly demonstrated the need for surge capacity in our defense industrial base. From the skyrocketing demand for and lack of ability to rapidly increase production of Javelins and HIMARS or the shuttered production of Stingers, our defense acquisition system has shown itself to be more brittle than resilient in some critical ways. In response, Under Secretary for Acquisition and Sustainment Dr. Bill LaPlante has strongly emphasized the importance of production, going as far to say that "we as a country did our best to not do production in defense" in our efforts to keep costs down and maintain program schedules (*Bridging the Valley of Death*, 2022). Beyond the current fight in Ukraine, looming security threats in East Asia underscore the importance of producing systems at scale *and* replacing or sustaining them as systems attrit or are destroyed in combat.

Increasing U.S. production of defense systems is part of the solution to this capacity deficit, but a Buy America *only* approach does not fit how we currently produce defense systems nor how we wage wars. Instead, engaging the industrial capacity of American partners and allies could be a mutually beneficial and more cost-effective approach. NATO and other allies have provided equipment to Ukraine, most allies buy U.S. defense systems, and many also produce major parts or sub-systems that are incorporated into platforms principally delivered by U.S. primes.

This paper will examine a select number of international industrial collaboration efforts to address this research question: How can the DoD develop an effective Build Allied approach that creates surge capacity and industrial resilience in support of the National Defense Strategy (NDS) objectives?

The National Defense Strategy

The emphasis on the importance of allies starts at the top. The President's National Security Strategy calls for robust collaboration "to remove barriers to deeper collaboration with allies and partners, to include issues related to joint capability development and production to safeguard our shared military-technological edge" (*2022 National Security Strategy*, 2022). The National Defense Strategy (NDS) further underscores the imperative of increasing this cooperation to build "enduring advantages" in the joint force (*2022 National Defense Strategy*, 2022). The NDS specifically references the need for the Department to work or collaborate with allies and partners 32 times, so this is clearly a DoD priority. This major allied emphasis is also coupled with a sense of urgency given what the NDS calls the "pacing challenge" of China.

There are numerous ways that U.S. forces currently collaborate with partners and allies. Two decades of combat in Afghanistan and Iraq clearly demonstrated that we fight with our allies and partners. These operational activities are central to U.S. strategy, and we conduct regular operations, exercises, and other engagements with countries across the globe under the broad rubric of security cooperation.

Industrial collaboration to "support modernization and future capability development" and "collaborative development and production" is also part of security cooperation, as the NDS notes (*2022 National Defense Strategy*, 2022, p. 10). Co-production, licensed production, cooperative programs, foreign military sales, direct commercial sales, and other efforts are examples of this international industrial collaboration. DoD leaders such as LaPlante have called for an increase in these efforts.

Developing a Build Allied approach

Objective

The objective of a "Build Allied" approach is to create a larger industrial base through international industrial partnerships to build the systems needed for current and future contingencies. This would create more industrial capacity that supports both American and allied capabilities to scale and strengthen the production of existing and future systems. This will also help to increase the rate of production and reduce supply chain bottlenecks that have created challenges in replenishing stockpiles during periods of high operational demand.

Components

The principal components of a "Build Allied" approach include:

- **U.S. subsidiaries.** The creation or expansion of the U.S. footprint by foreign-headquartered companies as a result of investment, program win, or corporate merger.
- **Co-development.** Systems or subsystems cooperatively designed and developed in two or more countries. Shared responsibilities include design, engineering, and applied research.
- **Co-production.** Production of a defense system in two or more countries. Involves the transfer of production technology and complex or sensitive subsystem components from the country of origin to countries producing the system. Recipient may expand production to include subsystems and components.
- **Second-sourcing or licensed production.** Execution of established acquisition strategy to qualify two producers for the part or system. Sometimes called dual sourcing (*Definitions for Co-Development*, n.d.).
- **Sustainment of existing systems.** Maintenance, repair, or overhaul of defense systems.

The good news is that these principal components of a "Build Allied" approach already exist. International cooperative programs such as the F-35 Lightning II and the NATO Sea Sparrow Consortium, for example, include many of these components. Foreign Military Sales (FMS) programs often include co-production and sustainment elements as part of government-to-government agreements. Direct commercial sales (DCS), on the other hand, generally do not build allied industrial capabilities but do strengthen the U.S. industrial base by extending production lines often well beyond the delivery to U.S. forces.

The challenge, however, is that these "Build Allied" components are often perceived as exceedingly difficult and sometimes not worth the effort by government officials or industry executives. Moreover, most of these components are by their nature not transparent because they are government-to-government agreements or proprietary contractual relationships, so they do not have a great deal of visibility outside of a specific program. Developing a more explicit "Build Allied" approach would explicitly promote and foster the consideration and use of these components.

Methodology

To develop this "Build Allied" approach, we will start by examining the bilateral and multilateral enablers that can spur increased production. Then we will examine the barriers to a robust "Build Allied" industrial campaign. Next, we will look at case studies of where allied industrial capabilities contribute to the development, fielding, and sustainment of weapons systems. Finally, we will make a series of recommendations to implement this "Build Allied" approach.

Enablers

We will first examine a number of enablers for a robust "Build Allied" approach. Some of these are long-standing (Reciprocal Defense Procurement MOUs, Security of Supply Arrangements, U.S. subsidiaries), some have been around for a few years (DEF and NTIB), and two are just getting started (AUKUS and NATO DIANA).

U.S. Subsidiaries

The most obvious enabler is the fact that many foreign companies have U.S.-based subsidiaries manufacturing products or conducting services for unclassified and classified DoD programs. For those conducting classified work, these subsidiaries operate under Foreign Ownership, Control or Influence (FOCI) regulations governed by the Defense Counterintelligence and Security Agency, which limits communications and sharing of information between the parent company and the U.S. subsidiary (Defense Counterintelligence and Security Agency, n.d.).

Companies such as BAE Systems, Leonardo DRS, Thales, Elbit, and many others have long-standing major U.S. subsidiaries that regularly compete and win DoD programs. Recently, however, companies such as Saab and Fincantieri Maritime Marine have won the Air Force Trainer and Navy Frigate programs, respectively, through foreign designs coupled with significant investments U.S.-based production (McGinn, 2021, p. 4). In the Army's Optionally Manned Fighting Vehicle (OMFV) competition, three of the five industry teams include major contributions by non-U.S. headquartered firms (Dean, 2023).

Reciprocal Defense Procurement and Acquisition Policy Memoranda of Understanding (RDP MOUs)

There are currently 28 countries that have RDP MOUs with the United States (Defense Pricing and Contracting, n.d.).[1] These MOUs establish agreed-upon procurement principles that foster transparency and openness to competition in each country's respective defense marketplace.

The largest tangible benefit for the non-U.S. signatory countries is that companies headquartered in these countries are waived from Buy America provisions when competing for DoD programs (DFARS 225.872-1, n.d.). The existence of this exemption, however, is often not well recognized in some program offices or on Capitol Hill, and others are opposed to these exemptions in the first place.

Nonetheless, RDP MOUs are key enablers of international cooperative efforts and are central in many of the case studies below. Having greater recognition of the power of these agreements would enable more "Build Allied" efforts.

Security of Supply Arrangements (SoSAs)

There are currently 13 bilateral Security of Supply Arrangements between the United States and partner countries (*Security of Supply*, n.d.).[2] Not surprisingly, all SoSAs are with RDP MOU countries. These arrangements implement part of the Declaration of Principles in the RDP MOUs and recognize the "mutual interdependence of supplies needed for national

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[1] The countries are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom of Great Britain and Northern Ireland..

[2] The following countries have SoSAs with the United States: Australia, Canada, Denmark, Finland, Israel, Italy, Japan, Latvia, the Netherlands, Norway, Spain, Sweden, the United Kingdom.

security" as well as calling for the signatories to "explore solutions for achieving assurance of supply" (*Security of Supply*, n.d.). Some of the signatory nations have established industry codes of conduct as a measure of reliance of their respective industry partners to support defense priorities.

The most telling part of these efforts, however, is the fact that they are *arrangements* not agreements. That underscores the relatively informal and voluntary nature of these bilateral initiatives. There arrangements are confidence-building measures, and there is value in that, but they are not formal commitments by the respective government signatories. Thus, it is not surprising that these arrangements have not been invoked directly in any specific case to date.

Defense Exportability Features

The Defense Exportability Features (DEF) program attempts to address one of the biggest challenges in technology sharing, the level of technology that is incorporated in each specific weapons system. One of the major considerations in TSFD processes is determining what level of capability in each weapons system can be shared with which specific partner. If a program producing an advanced radar for U.S. forces, for example, wants to later export that system to an ally or partner, the radar will likely need to be reverse engineered to a lower capability level for export. That reverse engineering is much more expensive than designing various capability functionality at the front end of a program.

DEF was first authorized by the National Defense Authorization Act for Fiscal Year 2011 (n.d.) to pilot developing and incorporating technology protection features in designated defense systems during research and development. The program was promoted through the department's Better Buying Power initiative which recognized that incorporating exportability features in initial designs provided benefits such as reduced costs, improved U.S. competitiveness, stronger ties to friends and allies, and improved interoperability (DoD AT&L, 2012). DEF's primary objectives are to reduce costs, demonstrate quicker availability of domestic platforms for the international market by incorporating exportable features in design work, and identify lessons learned (*Defense Exportability Features*, n.d.).

As noted in the 3DELRR case below, DEF was established with the intent to incorporate exportable features in design work to help enable quicker availability for international cooperative efforts. While DEF has been useful in 3DELRR, it needs significant scaling to become a core "Build Allied" component. It was funded initially as a pilot program and has continued to limp along at low funding levels, receiving little attention in the last several years.[3] The Ukraine conflict, however, may help revive DEF's prospects. A $50 million reprogramming action in April 2022 transferred money into DEF to "design and incorporate exportability features…that enhance interoperability of…systems with those of friendly foreign countries" (*Reprogramming Action*, 2022).

National Technology Industrial Base (NTIB)

The NTIB has deep roots and was first codified in U.S. law in 1992 when the United States and Canada were one national technology industrial base. It garnered greater attention when the 2017 National Defense Authorization Act (NDAA) added the United Kingdom and Australia to NTIB and, recently, New Zealand was added to the NTIB through the 2023 NDAA.[4] The NTIB has become a strong vehicle for government-to-government initiatives such as the

[3] DEF, for example, received $12.6 million in base funding in the FY2023 President's Budget submission (Office of the Secretary of Defense, 2022).

[4] For a more detailed treatment of NTIB, see McGinn (2021, pp. 6–7).

sharing of best practices for countering the potential national security impacts of foreign direct investment.

With its industrial base focus, the NTIB would seem to be a natural vehicle for a "Build Allied" approach. The NTIB, however, has not had any success in fostering industrial collaboration with one minor exception. The 2019 NDAA did create an exemption for NTIB U.S. subsidiaries operating under a Special Security Agreement to obviate the need for a national interest determination for proscribed information (McGinn, 2021, p. 4). Overall, however, the NTIB has not been utilized to foster industrial collaboration in any meaningful way, and many have begun to question the NTIB's utility as a vehicle for such efforts (Greenwalt, 2022). This is a major missed opportunity, but this can be turned around. The NTIB governments and industries can work together to create better incentives for utilizing the NTIB to truly spur industrial base collaboration through rule changes, contract clauses, and other mechanisms.

Australia, United Kingdom, and United States (AUKUS) Agreement

Announced in September 2021, AUKUS is an enhanced trilateral security partnership between Australia, the UK, and the U.S. for the governments to strengthen the ability of each to support security and defense interests and build on longstanding and ongoing bilateral ties (*Joint Leaders Statement on AUKUS*, 2021). The UK and U.S. sharing of nuclear propulsion technology for nuclear attack submarines with Australia is the first and most publicized initiative of the agreement, Pillar I. Under that agreement, Australia will develop, build, and deploy a conventionally-armed, nuclear-powered submarine of the existing Virginia-class boats (*Fact Sheet: Implementation*, 2022).

Under Pillar II, there are multiple other advanced capabilities initiatives: undersea capabilities, quantum technologies, artificial intelligence and autonomy, advanced Cyber, hypersonic and counter-hypersonic capabilities, electronic warfare, innovation, and information sharing. The potential to collaborate, for example, on operating manned and unmanned aircraft operating in tandem is already being considered as the U.S. Air Force begins its collaborative combat aircraft program and the Royal Australian Air Force deploys its own robotic wingman, the MQ-28 Ghost Bat (Easley, 2023).

The very nature of AUKUS makes it incredibly conducive to a "Build Allied" approach because it is explicitly focused on capability development and industrial capacity. There are significant concerns, however, about implementing the AUKUS agreement in the face of headwinds over export controls and technology sharing and foreign disclosure issues (Center for Strategic and International Studies, 2023).

NATO DIANA

The North Atlantic Treaty Organization (NATO) has conducted numerous acquisition programs in the past several decades, as evidenced by the three NATO case studies in this paper. With 30 members today, gaining consensus in NATO is challenging, but the three cases illustrated the benefits and challenges of conducting procurement in the Alliance. Multilateral development programs like NATO AGS are exceedingly hard to pull off given all the negotiations required to achieve consensus on each step of the program. Collaborative NATO procurement efforts like Tanker and the Sea Sparrow Consortium, on the other hand, have been more successful.

With these experiences, it will be interesting to see how NATO's Defence Innovation Accelerator for the North Atlantic (DIANA) develops. Established in 2021, attention on DIANA increased in the wake of the war in Ukraine and the need to "build greater resilience into how allies get tech to troops at speed" (Murray, 2023). DIANA is launching three pilot programs on energy resilience, secure information sharing, and sensing and surveillance in

the summer of 2023, so the progress of those efforts will be telling for the future of DIANA (*Barbara McQuiston*, 2023).

Barriers

The United States and allies have operated together for decades in Afghanistan, Iraq, and elsewhere. We have established close relationships for sharing intelligence, operational data, and UK and Australian personnel can even operate on U.S. classified networks at combatant commands. Despite these intimate connections, industrial collaboration has always been much more difficult. This section looks at four principal barriers—export controls, technology security and foreign disclosure, the defense acquisition system, and Buy America—to better understand the challenges that need to be addressed to create a "Build Allied" culture that drives government and industry behavior in the coming years.

Export Controls

Export controls are a perennial issue in defense trade and security cooperation. Governed by the International Trafficking in Arms Regulations (ITAR) for defense items and services and the Export Administration Regulation for commercial dual use items, export controls are designed to prevent the transfer of military technology to unfriendly nations or hostile organizations. Numerous efforts have been undertaken reform the export controls system since the 1990s, and some progress has been made.

The failure to make significant progress in export controls with our closest allies has been puzzling, however. There is a long-standing exemption to the ITAR for Canada that permits the transfer of some unclassified defense items and services without an export license (U.S. Department of State, Directorate of Defense Trade Controls, n.d.). This exemption is limited, and companies sometimes avoid using the exemption for fear of costly ITAR violations (Christensen & Goldstein, n.d.). Efforts to obtain Congressional approval for similar ITAR exemptions for the UK and Australia failed in the early 2000s, and the governments then took a different approach, signing bilateral defense trade cooperation treaties in 2007. These treaties, ratified by the Senate in 2010, created a "trusted community" of companies that could share technology and compete for opportunities within this trusted community (*United Kingdom and Australia*, n.d.).

Unfortunately, these treaties have never come close to reaching their potential. They are used for government-to-government transactions to a limited degree, and they have almost never been used by industry. The lack of robust dialogue between government and industry as well as restrictive Senate Treaty implementation language were major factors in this failure and must be avoided in any future reform effort.

Officials involved with AUKUS and informed observers have clearly noted the importance of export control reform to facilitate program success (Clark, 2023). Industry groups in AUKUS countries have outlined strategies for operationalizing AUKUS, including the creation of an AUKUS industry forum, the establishment of a trusted body of government and industry officials to develop certification standards, and recommended U.S. statutory support for the UK and Australia (Aerospace Industries Association, 2023). At the same time, Congress is preparing for the consideration of export control reform legislation. The House recently passed a lopsidedly bipartisan bill directing State and the DoD to report on the licensing requirements for AUKUS collaboration under Pillar II on hypersonic weapons, artificial intelligence, and quantum technologies (Harris, 2023).

Technology Security and Foreign Disclosure

A less well-known but equally important area that can impede international collaboration is the technology security and foreign disclosure (TSFD) processes governed by DoD policy. TSFD policies cover sensitive technology areas such as anti-tamper, low observable and counter low observable, electronic warfare, and others. These are generally highly classified technologies that individually reviewed by various DoD offices to determine their suitability for release to foreign partners. As outlined in Figure 1, there are 13 separate TSFD processes or "pipes" (*DoD International Acquisition Guide*, n.d., pp. 25–26).

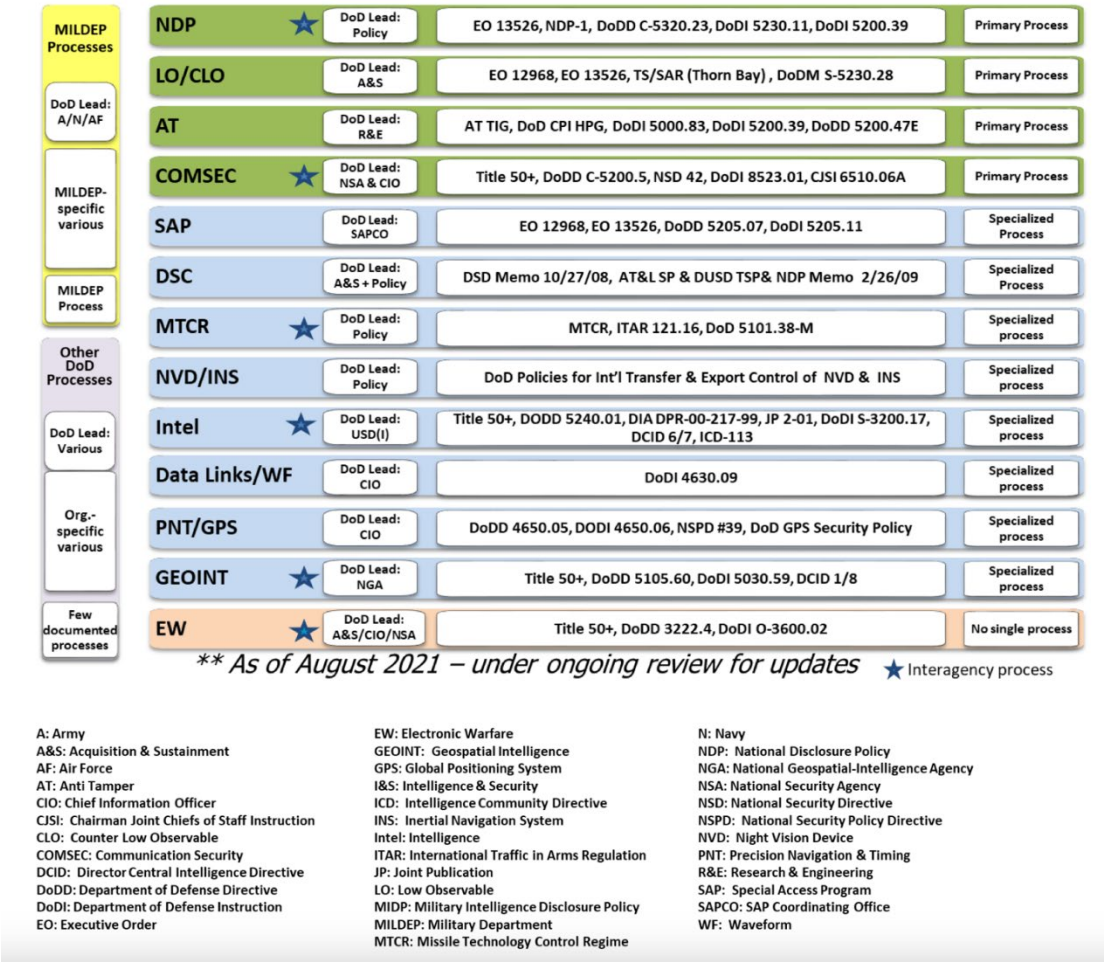

Figure 1. Technology Security and Foreign Disclosure Processes

Balancing these reviews as part of international cooperative efforts is challenging, and the DoD established the Arms Transfer and Technology Release Senior Steering Group in 2013 to coordinate guidance and timely address technologies under review in the "pipes" (*Arms Transfer and Technology Release*, 2020).

These technology reviews generally occur at the front end of the export control process and are essential for determining the level of technology sharing for particular programs. AUKUS Pillar I and Pillar II efforts will require TSFD reviews, and it is therefore promising to hear that DoD has initiated a review of these processes in light of AUKUS (Harris, 2023).

Defense Acquisition System

Elements of a "Build Allied" approach are part of the defense acquisition system in numerous ways. DoD Directive 5000.01, *The Defense Acquisition System* (2022), directs acquisition professionals to "enable allies and partners to enhance U.S. military capability, collaboration opportunities, potential partnerships, and international acquisition and exportability features and limitations will be considered in the early design and development phase of acquisition programs." Under the DoD Adaptive Acquisition Framework (AAF), program managers (PMs) "are required to consider acquisition strategies that leverage international acquisition and supportability planning to improve economies of scale, strengthen the defense industrial base, and enhance coalition partner capabilities to prepare for joint operations" (*Operation of the Adaptive Acquisition Framework*, 2022).

The recently revised *Guide to DoD International Acquisition and Exportability Practices* (2022) goes into greater depth on international acquisition issues. The Guide outlines practices such as international cooperative programs, the involvement of international in acquisition strategy, the integration of exportability features, and foreign military sales. There have been many large and small cooperative efforts over the past decades, as will be highlighted in the below case studies.

Despite this broadly supportive framework, however, international acquisition efforts often struggle. Defense acquisition professionals and their industry partners work diligently from source selection and throughout the program life to get things right and build the most capable systems for the warfighter. Incorporating allies and partners into the development, execution, and sustainment of programs is not always a top-level priority, however. In the development of acquisition programs, for example, requirements documents are regularly marked SECRET NOFORN, which makes it difficult to share with non-U.S. firms (McGinn, 2021, p. 4). The constant pressure to maintain cost and schedule during the conduct of a program also inhibits international collaborative efforts. This is changing to a degree, as noted in some of the case studies below, but one specific area that calls out for attention is the rating of Program Executive Officers (PEOs) and Program Managers (PMs). While many PEOs and PMs conduct a significant amount of FMS and DCS business in their portfolios, they are not evaluated on how well they conduct these cooperative efforts in their performance reviews (Webster, 2023).

Tension Between Domestic Manufacturing and Buy America

Multiple whole-of-government reviews of the defense industrial base during the Trump (*Assessing and Strengthening*, 2018) and Biden (*Securing Defense-Critical Supply Chains*, 2022) Administrations underscored significant shortcomings in U.S. manufacturing capabilities. These shortfalls had been recognized for some time, but these and other efforts increased the focus on strengthening domestic American manufacturing. Numerous investments in areas such as rare earths processing, batteries, castings, and, in particular, microelectronics have been targeted to help on-shore or re-shore these important capabilities.

At the same time, however, this focus on domestic manufacturing has led to calls in some quarters for increased Buy America legislation or regulations. Representative Donald Norcross, for example, has attempted to add an amendment to the National Defense Authorization Act the past several years to increase the Buy America requirement on major defense acquisition programs (McGinn, 2020). The addition of a dedicated Buy America

office in the Executive Office of the President has similarly worked to strengthen these requirements through regulation.[5]

These efforts are counterproductive. Aerospace and defense manufacturing is already one of the strongest domestic sectors because of existing Buy America requirements and the need for these national security capabilities to be delivered from the United States. Focusing on Buy America also ignores the principal industrial base challenge—too many single and sole source suppliers, largely from China and other unreliable markets. Moreover, there are some areas where close allies and partners have competitive advantages, such as mining or magnets. Finally, it is challenging for American officials to argue for increased international sales of U.S. defense systems when pushing for increased Buy America thresholds.[6]

Case Studies

To create a solid approach, we examined several past and current programs that have "Build Allied" components to understand what worked well and what did not. Specifically, we examined the F-35 Lightning II, NATO Air Ground Surveillance, Three-Dimensional Expeditionary Long-Range Radar, Next Generation Jammer, Ramjet, NATO Sea Sparrow consortium, the second engine for the Advanced Medium-Range Air-to-Air Missile, the Mine-Resistant Ambush-Protected vehicle, and NATO tanker. For each case study, we examined the purpose of the program, its development and deployment, and made findings relevant for future "Build Allied" efforts.

1. F-35 Lightning II

Purpose

The F-35 Lightning II program is simply the biggest program in history. The United States alone will spend $400 billion procuring nearly 2,500 aircraft and then spend another $1.27 trillion sustaining the fleet over 66 years (GAO, 2021). In the early days of the program, DoD officials and the international community—both governments and industrial bases—recognized the significant benefits to partnering in every aspect of the program.

> The F-35 program is DOD's largest international cooperative program. DOD has actively pursued allied participation as a way to defray some of the cost of developing and producing the aircraft, and to "prime the pump" for export sales of the aircraft. Allies in turn view participation in the F-35 program as an affordable way to acquire a fifth-generation strike fighter, technical knowledge in areas such as stealth, and industrial opportunities for domestic firms. (Congressional Research Service, 2022)

Development and Production

The United Kingdom was the only international partner involved in the early days of concept development and demonstration. In 1995, by agreeing to contribute $200 million, the British earned a seat at the DoD's table for requirements definition and aircraft design. Four years later, the British committed to spending another $2 billion for system development and demonstration, making them the largest non-U.S. contributor to the developmental effort, which would have a significant effect on industrial base rewards as the

[5] https://www.madeinamerica.gov (retrieved April 1, 2023)

[6] For a more detailed treatment of this issue, see McGinn (2020) and Daniel Fata and Jerry McGinn (2022).

program progressed (Congressional Research Service, 2022, p. 31). The bilateral partnership for the development effort quickly grew. Denmark, Netherlands, and Norway were the next countries to join the effort, followed by Canada and then Italy (Kenlon, 2021). Collaborating and financially contributing to the development effort then led to production agreements.

Turkey and Australia joined the seven original countries in signing an MOU for JSF Production, Sustainment, and Follow-on Development (PSFD), committing each nation to shared non-recurring costs and non-financial contributions, which also provided some assurances for their industrial bases, stating "…industries that are in the nations of Participants procuring JSF Air Systems under this MOU and that were awarded SDD subcontracts will normally also be awarded subcontracts for low rate initial production and full rate production work, as well as for related sustainment and follow-on development work" (*Memorandum of Understanding*, n.d.). This benefitted industrial bases around the world. In the United Kingdom, BAE provides the aft fuselage, empennage, and electronic warfare suite; Rolls-Royce is a partner on the engine and is a subcontractor for the lift system; and other firms serve as suppliers (Congressional Research Service, 2022, p. 32). Alenia Aeronautica is the largest aeronautical company in Italy, and so it naturally had a significant part to play with the JSF, a role which started with aircraft wing construction. Italy and Japan would earn final assembly production line work, which also translated into sustainment efforts. As described next, Italy's production path came through the JSF International Cooperative Program, whereas Japan's production path came through Foreign Military Sales.

Cooperative Production Through the Cooperative Program

U.S. law provides authority to enter into cooperative projects with friendly foreign countries for concurrent production in the U.S. and in another member country of a defense article jointly developed (*Authority of President*, n.d.). The authority for international agreements relating to cooperative research, development, test, evaluation, production, follow-on support, information exchange, and related personnel exchange and standardization agreements is delegated to the Director, International Cooperation in USD(A&S; *International Agreements*, 2019). This cooperative project path provided the legal framework for Italy to contribute to the development of the program and then produce aircraft. Italy's production and sustainment opportunity was realized when the Italian Parliament approved $775 million for the construction of the Final Assembly and Check Out (FACO) line in Cameri (Nones et al., 2009). Italy's F-35 FACO is owned by the Italian Ministry of Defense and is operated by Alenia Aermacchi, in conjunction with Lockheed Martin. Its success has been highlighted not only by aircraft rolling off the assembly line but also its selection by the DoD as the F-35 Heavy Airframe Maintenance Repair, Overhaul and Upgrade facility for the European region as well (*The First Italian F-35*, 2015). Investments in the Cameri facility led to new production opportunities, too. In 2019, the first Dutch F-35 rolled off the Cameri line (*F-35 for the Netherlands*, n.d.).

Co-Production Through Foreign Military Sales (FMS)

Japan's production path came through FMS. U.S. law provides authority for coproduction or licensed production outside the United States of defense articles of U.S. origin when such production best serves the foreign policy, national security, and economy of the United States (Foreign Relations and Intercourse, n.d.). Authority for co-production using FMS procedures is conducted under the oversight of the Defense Security Cooperation Agency (*Security Assistance Management Manual*, 2023). The JSF prime, Lockheed Martin, partnered with Japan's Mitsubishi Heavy Industries (MHI) to stand up the Komaki South FACO facility for the F-35 in Nagoya, Japan (*Japan Air Self-Defense Force's*, n.d.). And

similar to Italy's Cameri FACO, the Japanese FACO provided valuable high-tech work in the country, and the DoD selected it as the North Asia-Pacific regional heavy airframe Maintenance Repair Overhaul & Upgrade facility (*First Japanese-Built F-35*, 2017). Two additional Japanese companies contribute to the program, further expanding the industrial base. Mitsubishi Electric Company produces mission systems radar and electro-optical components, while IHI Corporation produces F135 engine components and supports the FACO.[7]

Findings

- **Negotiating commitments early sets the stage for production.** The bilateral development agreement between the U.S. and the UK led to multilateral development agreements that added Denmark, Netherlands, Canada, and Italy, that led to multilateral production agreements that added Turkey and Australia. All of these agreements paved the way for FMS to Israel, Japan, Korea, Belgium, Poland, Singapore, Finland, Switzerland, and Germany (*F35 Lightning II Program Status*, 2023). While the United States will buy the lion's share of F-35s, the international community will buy another 800 of the aircraft (GAO, 2021).
- **Large international production programs are very hard but very sticky.** Negotiating agreements like the F-35's PSFD MoU is exceedingly difficult, and keeping the program together can likewise be very challenging. In 2015, for example, Canadian Prime Minister candidate Justin Trudeau campaigned on ending the country's participation in the program (Malenic, 2015). After Trudeau's election, withdrawal seemed like a real possibility; however, Canada remained in the program (Blatchford, 2022). The Turkish scenario was quite different. Following its plan to acquire the S-400 Russian-made air defense system, Turkey was removed from the F-35 program ("Turkey Officially Kicked Out," 2019). Fortunately, plans were in place to address the possibility as the F-35 Production, Sustainment, and Follow-On Development MOU, which spans 45 years, specifically addresses amendment, withdrawal, and termination (*Memorandum of Understanding*, n.d.). In addition, the sheer size of the program and the respective national commitments through the PSFD MOU enabled it to survive and even thrive despite regular turbulence.
- **Cooperative production is beneficial for increased resilience and capacity.** The international FACOs developed for the F-35 program created additional capacity and resilience. Having them created inherent surge capacity for the program as well as more of an "in-theater" base for repair and sustainment work. This is especially critical given the cost of sustainment work, which for the United States will cost more than three times the amount to acquire the system. This is typical for fixed wing aircraft, in which the United States averages spending 64% of life cycle costs for operations and support (Office of the Secretary of Defense, Cost Assessment and Program Evaluation, 2020).
- **International programs can significantly increase the world-wide industrial base.** The F-35 program has suppliers in nearly every U.S. state, with an economic impact in the United States of $72 billion (*Evaluating the Impact of the F-35*, n.d.). The value of F-35 work in the United States alone would place the program in the Gross Domestic Product top 70 list (*GDP by Country*, n.d.). The world-wide effort

[7] Japan 5th Generation Fighter

includes over 1,700 companies at various tiers of work worldwide. These companies, moreover, are doing more than providing widgets. The collaboration specifically targets sustainment, upgrades, and collaborative initiatives among fleets and supporting industries (*Memorandum of Understanding*, n.d.).

2. NATO Alliance Ground Surveillance (AGS)

Purpose

NATO Defense Ministers identified the need for an Alliance-owned and -operated integrated ground surveillance capability for unrestricted and unfiltered access to ground surveillance data in near real-time. Consisting of air, ground, and core mission support segments, the Alliance Ground Surveillance (AGS) provides that integrated ISR capability (*Alliance Ground Surveillance [AGS]*, 2022). Fifteen participating nations—Bulgaria, Czech Republic, Denmark, Estonia, Germany, Italy, Latvia, Lithuania, Luxembourg, Norway, Poland, Romania, Slovak Republic, Slovenia, and the United States—all contribute to the AGS (*NATO Alliance Ground Surveillance Management Agency*, n.d.).

Development and Production

During the Cold War, the NATO Integrated Air Defence System (NATINADS) provided a one directional look for the well-defined threat of manned aircraft. As challenges changed to a less predictable environment, this system evolved into the NATO Integrated Air and Missile Defence System (NATINAMDS) to address the full range of air and missile threats (*NATO Integrated Air and Missile Defence*, 2022).

In 1995, NATO Defence Ministers agreed to a new acquisition effort; however, over the next several years, multiple approaches based on existing assets or a development program based on an American or European radar failed to obtain sufficient support. In 2007, consensus was gained for an air segment based on Global Hawk Block 40 Unmanned Air Vehicle and a ground segment to largely be developed and built by European and Canadian industry. In 2009, the NATO AGS Memorandum of Understanding was signed, establishing the NATO Alliance Ground Surveillance Management Agency (NAGSMA) and serving as the basis for the procurement.[8] NAGSMA then became critical to managing the AGS program effectively, obtaining and sustaining international operational efficiency, as well as establishing and maintaining good working relations with all stakeholders.[9]

Organizing and funding the effort were obviously keys to success. Each of the 15 participating members had a seat at the table, financially contributed to the program, and supported through their industrial bases. Overall coordination was conducted through the NATO Alliance Ground Surveillance Management Organisation, which included a Board of Directors (*NATO Alliance Ground Surveillance Management Organisation*, n.d.). All members financially contributed to establishing the AGS Main Operating Base, communications, and life-cycle support of the AGS fleet; however, some replaced part of their financial contribution through contributions-in-kind (*NATO AGS Factsheet*, 2014). All NATO members, not just the 15 participating AGS members, now contribute to the on-going capability, and the overall program management and life cycle support responsibility is now in the hands of the NATO Support and Procurement Agency as NATO common funds for

[8] AGS

[9] NAGSMA

infrastructure, communications, operation and support follows the Alliance's normal funding authorization procedures.[10]

The industrial bases of all acquiring countries were also engaged. The team included Northrop Grumman, Germany's Airbus Defence and Space, Italy's Leonardo, Norway's Kongsberg, and other defense companies from each of the members.[11] Northrop Grumman was the prime contractor, who also manufactured the Global Hawk air vehicle, supporting systems, and payloads, including an advanced ground surveillance radar sensor radar (*NATO at Chicago Summit*, 2012). Airbus built the Mobile General Ground Stations (*Airbus Defence and Space*, 2016). Leonardo provided the Sigonella Mission Operations Support system, Transportable General Ground Stations, application software for those functionalities, and Wide Band Data Link; the Italian company was also responsible for industry contributions for Bulgaria and Romania (*Leonardo NATO AGS program*, n.d.). Kongsberg provided the System Master Archival/Retrieval Facility (SMARF) for storing, managing and disseminating Joint ISR data (*NATO AGS SMARF*, n.d.). A host of other international industry team members included Cassidian, Selex Galileo, ICZ, A.S., ComTrade d.o.o, BIANOR, Technologica, Zavod Za Telefonna Aparatura Ad, SELEX ELSAG, Elettra Communications, UTI Systems, and SES (*NATO at Chicago Summit*, 2012).

Findings

- **Multilateral cooperative development programs are really challenging to pull off.** AGS took an inordinate period of time to come to fruition. It took almost 15 years from a NATO Ministerial decision in 1995 until the PMOU was signed by 15 nations in 2009. It then took another 12 years, until early 2021, before NATO AGS declared initial operating capability.[12] That 27 years (!) demonstrates the challenges with negotiating workshare, changing national priorities, maintaining consensus, and numerous other factors in a multilateral effort. The F-35 case demonstrated some of these same challenges, but it is an order of magnitude harder to manage a group effort like AGS compared to a U.S.-led program like F-35.
- **Gaining consensus on a governance model is critical.** The 2009 MOU, along with the AGS Charter, sets the legal, organizational, and budgetary framework needed for ultimate success (*NATO's Allied Ground Surveillance Program*, 2009). This laid the framework to address problems as they surfaced and created a life cycle management philosophy. In AGS's case, the consensus led to the NATO Support and Procurement Agency being designated as the life cycle manager, with responsibilities to include sustainment, system upgrades, and ensuring system safe for flight compliance.[13] This life cycle approach is a best practice in the Defense Acquisition System and helped to make a large program like AGS sticky (*The Defense Acquisition System*, 2022).

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[10] AGS

[11] Ibid

[12] AGS

[13] NSPA's AGS website at https://www.nspa.nato.int/about/life-cycle-management/ags

3. Three-Dimensional Expeditionary Long Range Radar (3DELRR)

Purpose

The Three-Dimensional Expeditionary Long Range Radar (3DELRR) program will provide the U.S. Air Force their principal "long-range, ground-based sensor for detecting, identifying, tracking and reporting aerial tracks for the Joint Force Air Component Commander through the Theater Air Control System" (*Air Force Budget Exhibit*, 2019). 3DELRR participates in the DEF program described earlier to increase exportability with the intent of increasing production quantities and lowering life cycle costs (*Air Force Budget Exhibit*, 2019). This approach has already resulted in one sale to a foreign customer, and there is additional interest by other potential customers.

Development and Production

When the Air Force began the process of replacing the outdated AN/TPS-75 radar system, its request for proposals included the need for bidders to address exportability, as the service would evaluate this aspect as a source selection factor (*GAO Decision*, 2016). Raytheon, Lockheed Martin, and Northrop Grumman submitted proposals, and they all included exportability features in their designs (Albon, 2014). Unfortunately, progress on the program was halted for several years while legal action took place in the courts (GAO, 2018). However, the ground work for embracing the exportability concept in the program had been laid. The Air Force's subsequent request for bids called for implementing anti-tamper design and applying differential capabilities aligned with the DoD Anti-Tamper guidelines as well as identifying the bidder's costs with and without foreign purchases (*Request for Proposal FA8730*, 2016). Lockheed Martin won the ensuing competition with its TPY-4 long-range radar (*3DELRR to Move Forward*, 2022). Eight months later, the Norwegian Armed Forces selected the same TPY-4 because, first, Norwegian industry has been a crucial partner in the radar's development as Lockheed Martin leveraged an extensive Norwegian supplier-base, and second, it lowered the foreign partner's risk by integrating into the prime's production line for the Air Force (*Royal Norwegian Air Force Selects*, 2022).

A subsystem of the TPY-4 provides an excellent example of the importance of the relationship between U.S. primes and the international supplier base. The Platform Electronics SubSystem, built by KONGSBERG Defense & Aerospace, is critical for TPY-4's long-range surveillance (*Royal Norwegian Air Force Selects*, 2022). Lockheed Martin is in talks with multiple additional international customers to purchase TPY-4 and anticipates generating $1.3 billion in future sales over the next 10 years (Katz, 2022).

Findings

- **DEF was a key enabler for the 3DELRR program**. 3DELRR officials acknowledged increased competition for the program which resulted from participating in the DEF program (*GAO Report on Defense Acquisitions*, 2017). DEF, described earlier, encourages government program managers to design and develop technology protection features in systems early in their acquisition life cycle to facilitate foreign sales (*Defense Exportability Features*, n.d.).
- **Focused bilateral partnership efforts set up future success**. The early involvement of the Norwegian government and industry in the development of 3DELRR through DEF helped secure the prompt engagement of an international partner and created a framework for future nations as well. This will advance interoperability over time.

4. Next Generation Jammer (NGJ)

Purpose

The Next Generation Jammer (NGJ) is an evolutionary acquisition program providing Airborne Electronic Attack capability in three increments for each of the low, middle, and high frequency bands. NGJ Mid Band and NGJ Low Band Programs are joint cooperative programs between the U.S. Navy and the Australian Department of Defence (*Next Generation Jammer*, n.d.).

Development and Production

The NGJ Mid-Band program focuses on providing Airborne Electronic Attack capability the middle frequency bands of the electromagnetic spectrum. Recognizing the benefits of working together to address a common requirement, the United States and Australia signed a cooperative development agreement in October 2017 and, based on the program's success, signed a PSFD MOU in May 2020 (*Next Generation Jammer Mid-Band Selected Acquisition Report [SAR]*, 2021). The program has continued to make progress, earning a Milestone C decision in 2021, which enabled the award of initial production contracts (*Next Generation Jammer Mid-Band Selected Acquisition Report [SAR]*, 2021). Production pods are scheduled to be delivered in September 2023 (*DOT&E FY2021 Annual Report*, n.d.).

The NGJ Low Band program addresses advanced and emerging threats in the lower frequency bands. It is also a joint cooperative program between the United States and Australia and currently in the Engineering and Manufacturing Development acquisition phase.[14]

Cooperation benefits are widely known. For the NGJ, the Navy has specifically identified them as sharing of best technologies in the world, strengthening technology capabilities, increasing military effectiveness at home and abroad, reducing duplication of effort across nations, and overall reducing costs (*U.S. and Australia Expand*, 2020).

These NGJ programs support Australia's overall Advanced Growler Airborne Electronic Attack Capability (AEAC) Project, which introduces enhancements to airborne electronic attack by investing up to $6 billion between 2016 and 2035 (*Advanced Growler Airborne Attack Capability*, 2020). This large investment has benefitted both the U.S. and Australian industrial bases. Raytheon Australia works with the U.S.- based prime contractor Raytheon on advanced technologies which enable interoperability for the allies, and for the NGJ there is a special focus on the companies providing real-world training scenarios and services (*Thousands of Missions*, 2017). Test ranges are also an important element of delivering a capability, and the cooperative programs have realized benefits in this aspect, too. Supporting the NGJ program, the AEAC Project awarded Australia's CEA Technologies a contract to provide advanced capabilities for electronic warfare ranges, which is supporting training exercises that also include U.S. forces (*CEA Technologies to Upgrade*, 2023).

Findings

- **Focused bilateral partnership efforts set up future success.** The Next Generator Jammer program re-emphasizes overall cooperative benefits such as sharing of the best technologies, increasing military effectiveness, reducing duplication of effort, and reducing costs. It also highlights the connections between partner industrial

[14] Next Generation Jammer

bases due to the global nature of multinational corporations, transnational enterprises, and joint ventures. Additionally, NGJ highlights ancillary benefits in terms of training scenarios and test ranges.

5. Tactical High-Speed Offensive Ramjet for Extended Range (THOR-ER)

Purpose

Tactical High-Speed Offensive Ramjet for Extended Range (THOR-ER) is an effort to develop advanced solid fuel ramjet technologies applicable to long range high-speed and hypersonic weapons. Fruit of the DoD's (2020a) Allied Prototyping Initiative, this partnership program between the United States and Norway provides cooperative opportunities in co-development and co-production for the governments and industrial bases of both nations.

Development and Production

THOR-ER is an effort of the DoD's Allied Prototyping Initiative, launched in 2020 to identify and develop high impact prototyping projects in which the United States and partner nations share technologies and resources for their industries to co-develop leap-ahead capabilities (Office of the Secretary of Defense for Research and Engineering, 2020). The ramjet technical program relies upon collaborative research efforts involving multiple U.S. and Norwegian organizations including the Office of the Under Secretary of Defense for Research and Engineering (R&E), the R&E's Joint Hypersonics Transition Office, Naval Air Warfare Center Weapons Division, the Norwegian Defence Research Establishment, and the Norwegian company Nammo (DoD, 2022).

THOR-ER's test program reached a notable milestone in 2022 with a successful in-flight demonstration of ramjet propulsion technology with "new high energy fuels, advanced air injection, and throttling methodologies" which are critical for the program's success (DoD, 2022). The technical success in accelerating to above Mach 2 was noted by Under Secretary of Defense for Research and Engineering Heidi Shyu and Norwegian Armaments Director Morten Tiller, who praised the collaboration and demonstration of the power of bilateral cooperation (DoD, 2022). THOR-ER's development is also distinguished by each partner providing equitable contributions, and both will consider the potential for co-production ("DoD and Norway Working on Ramjets," 2020).

The senior leadership engagement and funding sponsorship through the Allied Prototyping Initiative has been a critical enabler for THOR-ER. This OSD (R&E) program lays the foundation for decision-making with sharing philosophies in terms of funding, technologies, subject matter expertise, and industrial base strengths while pursuing the endgame of maximizing modernization through better ideas together; increasing interoperability by starting with a common specification, and reducing vulnerabilities by collectively addressing challenges and enabling flexibility in the supply chain.[15] As an Under Secretary effort, the Allied Prototyping Initiative is not constrained to just one technical area and so can address any of the OSD (R&E)'s critical technology areas, including Biotechnology, Quantum Science, Future Generation Wireless Technology, Advanced Materials, Trusted AI and Autonomy, Integrated Network Systems-of-Systems, Microelectronics, Space Technology, Renewable Energy Generation and Storage, Advanced Computing and Software, Human-Machine Interfaces, Directed Energy, Hypersonics, Integrated Sensing and Cyber (Under Secretary of Defense for Research and Engineering, n.d.).

[15] API Briefing

THOR-ER is the first effort announced under the Allied Prototyping Initiative, which notes the importance the DoD has placed in promoting co-development and co-production for lead-ahead capabilities. The second effort, the Southern Cross Integrated Flight Research Experiment (SCIFiRE), also advances technology, but in partnership with Australia (DoD, 2020b).

Findings

- **Importance of senior leader sponsorship.** The Allied Prototyping Initiative is managed by the Directorate for Advanced Capabilities within the Office of the Under Secretary of Defense for Research and Engineering, which provides the top-level support critical to coordinating and earning signatures on the government-to-government International Agreements necessary for international collaboration. The same is true on the industry side. And industry executives see the value in how one effort can create prospects for another, as evidenced in Nammo partnering with Boeing to jointly develop and produce the next generation of extended-range artillery projectiles, based on Nammo's ramjet technology ("DoD, Norway Partner on Ramjets," 2020).
- **Focused bilateral partnership efforts set up future success.** In 1905, the United States established diplomatic relations with Norway, and the two nations have enjoyed a long tradition of friendly relations for many years (U.S. Department of State, 2023). Nammo has built a workforce with the technical skills involved in developing and producing specialty ammunition and rocket motors for customers around the world (*Nammo*, n.d.). For the THOR-ER program, the U.S.-Norway partnership has proven very successful.
- **Understanding the importance of the production potential.** The Allied Prototyping Initiative specifically highlights the importance of co-development efforts leading to co-production. The industrial bases understand the importance of production to their ability to make money, and Pentagon acquisition chief Bill LaPlante has also emphasized the importance of co-production and licensed production (McGinn, 2023). LaPlante has further stressed this criticality: "All that matters is getting into production" ("Strategy & Policy," 2020).

6. NATO Sea Sparrow Consortium

Purpose

The NATO Sea Sparrow Surface Missile System Project started as a four-country international technology development effort for anti-ship missile defense capabilities more than 50 years ago and has grown to be "the largest and longest running cooperative smart defense initiative in NATO history" with 12 participating nations—Australia, Belgium, Canada, Denmark, Germany, Greece, Netherlands, Norway, Portugal, Spain, Turkey, and the United States—benefitting from the progression over the years of the RIM-7 Sea Sparrow to today's RIM-162 Evolved Sea Sparrow (*NATO Sea Sparrow*, n.d.).

Development and Production

In the early 1960s, the U.S. Navy began work with the Applied Physics Laboratory at Johns Hopkins University on a Basic Point-Defense Missile System to defend against Soviet advances in anti-ship missiles (Wildenberg, 2018). This work spurred multiple proposals in NATO, which led to Denmark, Italy, Norway, and the United States Signing an International Development MOU, which established the NATO Sea Sparrow Surface Missile System project (*NATO Sea Sparrow*, n.d.). Raytheon was the prime contractor for a 3-year

development effort which led to successful operational testing by the Americans and Norwegians, clearing the way to production (Roe, 1991). This set the stage for decades of use and upgrades, culminating with today's Evolved Sea Sparrow Missile (ESSM).

ESSM planning and consensus building for the development effort has led to benefits across industrial bases into production efforts, too. The 1999 agreement for cooperative engineering and manufacturing development included workshares and cost shares by country. For example, Australia earned thrust vector control work while Canada's was in the control section (*DOD IG Report*, 2002). That development partnership became the baseline for the production effort, which is governed by the Production MoU that also outlines another workshare arrangement by participating nations (*Evolved Sea Sparrow Missile [ESSM]*, 2020). The ESSM Consortium crosses multiple industrial bases, including Australia's BAE Systems, Canada's Honeywell, Denmarks' Terma, Germany's RAMSYS, Diehl BGT Defence, and MBDA-LFK, Greece's ELFON, INTRACOM, and HAI, Netherlands' Thales, Norway's Nammo Raufoss, Spain's Indra, Turkey's Roketsan, and the United States' Raytheon, Alliant Techsystems, BAE Systems Land and Armament, and Lockheed Martin (Smolny, n.d.).

The production effort is significant. Figure 2 below shows that the U.S. Navy has been buying the missile for decades.

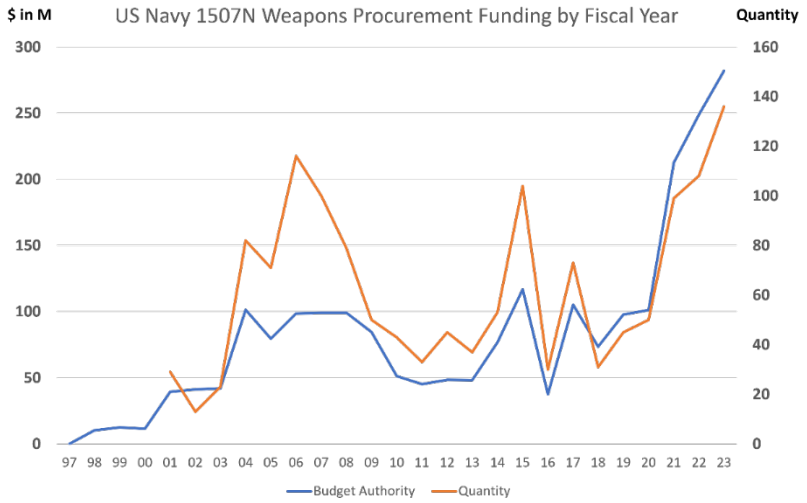

Figure 2. U.S. Navy Procurement Funding: $2.2 Billion in FY97-23 for 1,450 Missiles[16]

Additionally, Raytheon expects to produce and deliver another 1,500 rounds based on customer requirements, which will make the missile a staple for many years yet to come (*ESSM Missile*, n.d.). The ESSM is a model answer for Under Secretary for Acquisition and Sustainment Dr. Bill LaPlante's call for an increase in co-production, licensed production, and cooperative programs (McGinn, 2023).

Findings

- **Starting small can pay off big in the long run.** The initial partnership of the 1960s focused on the threat of Soviet anti-ship missiles. The general missile threat lasted for decades, and will into the foreseeable future, which has led to long-term success

[16] Based on P-1 documents in each Fiscal Year for 1507N Weapons Procurement for ESSM. Available at https://comptroller.defense.gov/Budget-Materials/.

and NATO's largest and longest running cooperative smart defense initiative. While technology changed over time, Sea Sparrow demonstrated that the collective approach over time works. Also, Sea Sparrow's development agreements led to production agreements, which now have spanned decades.

- **Workshare agreements can be enablers.** While the United States generally seeks a best value procurement without guarantees of specific workshares, sometimes the workshare approach is needed to encourage international participation, which will, in the end, provide the greatest overall benefits.

7. Advanced Medium-Range Air-to-Air Missile (AMRAAM) Alternate Engine

Purpose

The AIM-120 AMRAAM is an all-weather, beyond-visual-range missile used on U.S. Air Force F-15, F-16, F-22 and F-35A aircraft and the U.S. Navy and Marine Corps' F/A-18, F-35B/C, EA-18G and AV-8B aircraft (*AMRAAM*, n.d.). In 2011, AMRAAM's rocket motor experienced technical problems, which led to the program office and prime contractor Raytheon to seek and ultimately certify an alternative rocket motor supplier (*Director of Operational Test and Evaluation*, n.d.). This alternate engine came from Nammo, a Norwegian provider of rocket motors for both military and civilian customers.[17] AMRAAM has led to procurement by 40 countries and other opportunities by integration efforts (*Modern, Versatile, and Proven*, n.d.).

Development and Production

AMRAAM rocket motor problems began in 2011, when acceptance testing experienced unpredictable performance at low temps due to propellant hot spots and burn-through failures (*Director of Operational Test and Evaluation*, n.d.). Problems escalated, the prime contractor (Raytheon) and the rocket motor supplier (ATK) took legal action against each other, and no AMRAAMs were delivered for two years (Judson, 2016).

Nammo saw an opportunity and after an investment of $12 million of internal and Norwegian government funds developed and delivered an alternative engine to Raytheon in Tuscon, Arizona (Judson, 2016). Raytheon and Nammo then quickly worked through the process to qualify the engine (*Raytheon Partners with NAMMO*, 2011). Their work was soon rewarded with a successful Live-Fire Test (Host, 2013). Within the first year after the test, Nammo had produced and delivered 1,000 motors to get the program back on schedule (*Director of Operational Test and Evaluation*, n.d.). This alternate engine has been a significant contributor to AMRAAM's upgrades, testing and production; capabilities fully demonstrated in 4,900 shots and 13 air-to-air combat victories; and its selection as the baseline weapon for the National Advanced Surface-to-Air Missile System, NASAMS (*Modern, Versatile and Proven*, n.d.).

NASAMS itself represents another international success. This air defense system consists of Raytheon's Sentinel A3 radar and a suite of effectors, including AMRAAM, AMRAAM-ER, and AIM-9X plus the Norwegian Kongsberg Defence & Aerospace's fire distribution center and launcher, providing safety for the U.S. National Capital Region as well as 12 other countries (Norway, Finland, Spain, The Netherlands, Oman, Lithuania, Indonesia, Australia, Qatar, Hungary, Ukraine, and one undisclosed; *NASAMS*, n.d.). Of special note is the recent military aid package to the Ukraine which included two NASAMS from the United States (Bertuca, 2022).

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[17] Nammo

Findings

- **Developing a second source can unlock new capabilities and capacity.** The AMRAAM case provides an excellent example of tapping into the best technological capabilities, regardless of borders. NAMMO, with substantial host government support, developed an alternative engine and thereby gained access to the U.S. market. The Norwegian company's alternate rocket motor not only brought the U.S. program back from a 2-year schedule slip, but it advanced the platform beyond the program to integrate with another system-of-systems. Most importantly, the alternate engine helped establish additional capacity that has been critical as the demand for AMRAAM has skyrocketed. The program office's willingness to consider international solutions is an enabler for the Build Allied approach.

8. Mine-Resistant, Ambush-Protected (MRAP) Vehicle

Purpose

MRAPs were developed in the mid- to late-2000s to address the dramatic increase in casualties in Iraq and Afghanistan resulting from improvised explosive devices (IEDs; Wilson, 2007). Then Secretary of Defense Bill Gates personally led the effort to rapidly increase the production and deployment of MRAPs, based principally off existing foreign designs, during this period (Hasik, 2021). The late Ashton Carter highlighted the success of the MRAP program, explaining that forces in MRAP vehicles were 14 times more likely to survive roadside explosions in Afghanistan and Iraq than forces riding in Humvees (Vanden Brook, 2012). The Army and Marine Corps had a limited number of MRAP vehicles for specialized missions, but in 2006 "US combatant commanders identified the urgent operational need for an increased number of MRAP vehicles in theater to provide better protection against underbody mines, improvised explosive devices, rocket-propelled grenades and small arms fire" (Browne, 2016).

Development and Production

MRAP's Engineering Origins

The MRAP solution dates back decades. During the Rhodesian Civil War of the 1970s, mining of roads brought casualties and in South Africa, guerilla groups began to mine roads as well. The engineering solution was for a high ground clearance, V-shaped hull, and wide wheelbase which would direct the blast's energy away from occupants of the vehicle; the design quickly demonstrated success. Rhodesian forces suffered only one fatality from the first 99 blasts against this new design and the South Africans adapted quickly, producing 19,000 vehicles with V-shaped hulls. The story of IED lethality also unfortunately spread, so much so that in the 1980s in Sri Lanka, Indian troops—who did not have the newly designed vehicles—preferred to walk (Hasik, 2021, pp. 45–47).

While the high ground clearance, V-shaped hull, and wide wheelbase design had been in place from decades, it was not one company who owned the design in the following years. After the South African conflicts, the industry for this new design was concentrated in the Olifant Manufacturing Company, which was then acquired by Reunert, which was later acquired by Vickers, who sold a 20-year license to General Dynamics Land Systems (GDLS), and on a parallel path, Vickers merged with Alvis, which BAE Systems then acquired (Hasik, 2021, p. 47).

SECDEF Leadership, Simplified Requirements, and Rapid Industry Engagement

It cannot be overstated how critical Secretary Gates's direction and engagement throughout the MRAP was to its success. He drove a radically different acquisition approach

focused on an extremely limited set of requirements centered on improving soldier survivability.

Building upon the proven technology, the MRAP program office was able to deliver at tremendous speed to concurrently produce, test, and field the vehicles (GAO, 2009). On November 9, 2006, the MRAP program office's Request for Proposal solicited bids in three categories. Urban areas were the focus for Category I, the smallest version, which would be capable of carrying four troops. Category II's mission sets were convoys, medical evacuations, and explosive ordnance disposal (EOD) and would carry up to 13 troops. Category III, the largest size with the most hazardous mission, targeted IED clearing operations and EOD (Hasik, 2021, pp. 131–132).

Manufacturers responded with bids, and the MRAP program office awarded multiple initial contracts. Designs which passed tests for maintainability, mobility, and survivability were rewarded with more contracts (Hasik, 2021, p. 135). The government was able to quicken deployment of the vehicles as it elevated the program's priority, which paved the way for industry to invest of their own capital to purchase critical components before delivery options were exercised, as well as retained integration responsibilities for mission equipment packages (GAO, 2009). This approach was not business as usual. "Not since the beginnings of the nuclear submarine production in the late 1950s and early 1960s had the US military run so many parallel designs for the same purpose" (Hasik, 2021, p. 8).

Multiple Designs From a Variety of Manufacturers

The Buffalo Mine-Protected Clearance Vehicle was manufactured by Force Protection, which later acquired by General Dynamics. This design was inspired by the Casspir, a South African landmine-protected armored personnel carrier (APC; *Buffalo Mine-Protected Clearance Vehicle*, 2021). The Caiman vehicle came from Armor Holdings, which was later acquired by BAE Systems (Hasik, 2021, p. 138). Cougars, which included Command and Control, EOD, Patrol, Convoy Support, Forward Observation, Reconnaissance, and Medical Evacuation configurations, came from Force Protection, which was later acquired by General Dynamics (*Cougar 6x6*, n.d.; Hasik, 2021, p. 135). The MaxxPro MRAP came from Navistar (*MaxxPro MRAP*, n.d.). The RG-31, which served as an Armored Personnel Carrier, Command Vehicle, Ambulance, Armored Utility Vehicle, Surveillance Vehicle, EOD and Combat Engineer, was manufactured by GDLS through the Vickers license (*RG-31*, n.d.), and BAE Systems manufactured the RG-33, which was not covered by the Vickers license to GDLS (Hasik, 2021, p. 132).

In less than 3 years from the government's proposal request, 16,204 vehicles were produced and 13,848 were fielded (GAO, 2009). These MRAPs saved thousands of lives and had a tremendous impact on the survivability of military servicemen and women during their use (Vanden Brook, 2012).

Findings

- **Importance of senior leader sponsorship.** The Secretary drove the Department's MRAP effort, and he regularly and personally intervened to ensure that the program stayed on track to deliver life-saving capabilities with speed to deployed warfighters.
- **Use of existing foreign designs.** Decades ago, the Rhodesian Civil War and conflicts in South Africa served as the impetus for a design solution marked by high ground clearance, a V-shaped hull, and a wide wheelbase which would direct the blast's energy away from occupants of the vehicle. That design served well the coalition forces subject to roadside explosions in Afghanistan and Iraq in the post 9/11 operations. The U.S. acquisition system embraced that design approach and

then successfully turned to industry for multiple solutions – which led to great success.

- **Rapid development and fielding.** The MRAP decision to use only proven technologies, emphasized in the government's invitation for industry to offer non-developmental solutions, proved to be key in taking the foreign design of a high ground clearance, V-shaped hull, and wide wheelbase to U.S. production in a very short time frame, even earning a "very good overall" assessment for schedule and performance results by the Government Accountability Office (GAO; 2009). MRAP's schedule success runs contrary to a typical DoD program in which schedule delays are the norm. The GAO has found that more than half of major programs report schedule delays and not one of the programs reviewed had reported accelerating any deliveries (GAO, 2022). For the MRAP, the government's decision to start with a non-U.S. design not only did not slow things down, it accelerated fielding, which was most critical in times of war.
- **Multi-sourcing.** With the MRAP, the government recognized that no single firm had the capacity to meet the demand in a timely manner, and so the source selection strategy discounted the traditional one-winner approach. The government awarded contracts to nine commercial sources, thereby expanding production capacity to the maximum extent (GAO, 2009). This multi-sourcing approach allowed firms to focus on their best value solutions for the three requirement categories. Bids were requested for Category I (small vehicles primarily intended for operations in urban combat environments), Category II (medium sized vehicles for convoys, transporting troops, and ambulatory purposes), and Category III (large vehicles for IED clearing operations and Explosive Ordnance Disposal; Hasik, 2021, p. 132). This provided firms the flexibility to match their proven solution to a specific need, without having to develop a comprehensive solution for all MRAP needs in a winner-take-all environment.

9. NATO Multinational Multi Role Tanker and Transport Fleet

Purpose

NATO's Multinational Multi Role Tanker Transport (MRTT) fleet provides Belgium, the Czech Republic, Germany, Luxembourg, the Netherlands, and Norway strategic transport, air-to-air refueling, and medical evacuation capabilities. In this partnership, the six participating nations benefit from economies of scale by pooling the MRTT aircraft and sharing costs (*Multinational Multi Role Tanker Transport [MRTT] Fleet [MMF]*, n.d.).

Procurement

In 2012, the European Defence Agency initiated the project and 4 years later, the acquisition phase began with the signing of a procurement contract with Airbus for two A330 aircraft plus the first 2 years of support. The number of participating nations as well as the fleet size has grown over the years. The Netherlands and Luxembourg were the original partners in 2016, Germany and Norway joined a year later, followed by Belgium and the Czech Republic, each in subsequent years. The fleet size currently stands at seven aircraft, with two more expected in 2024 and a 10th in 2026 (*Multi-Role Tanker Fleet [MMF] Expands*, n.d.).

Two important agreements laid the foundation for the program's success. The program Memorandum of Understanding documents the participating nations' promise to pool the aircraft and share costs. The MRTT Fleet Support Partnership agreement

documents the NATO Support and Procurement Agency's commitment to acquire and own on behalf of NATO the aircraft and related support equipment, provide in-service support, manage follow-on support, administer finances, and manage host nation support arrangements (*Multinational Multi Role Tanker Transport [MRTT] Fleet Support Partnership*, n.d.).

Findings

- **Cooperative procurement is a lot easier than cooperative development**. The MRTT Fleet case provides an excellent example of cooperating to benefit from economies of scale by pooling aircraft and sharing costs to *purchase* existing aircraft rather than *developing* bespoke cooperative programs like NATO AGS. Initial capabilities were delivered in four years as opposed to 27, and NATO support of the fleet provided stability. While the fleet of seven obviously has limitations, it provides significant capabilities for participating NATO members.

Conclusions and Recommendations

The case studies and preceding analysis illustrate that we clearly have many of the building blocks in place for a robust "Build Allied" approach. There have been and are in development a number of co-development, co-production, second sourcing, licensed production, and sustainment efforts involving our allies and partners. The case study findings show that these successful efforts have largely been driven by strong leadership, focused cooperative efforts, and effective enablers. Moreover, there is clearly an increased appetite for "Build Allied" efforts in the wake of defense industrial capacity shortfalls that have become starkly evident since the start of the Ukraine war last year.

In addition to the principles identified in the case study findings, getting to a vigorous "Build Allied" approach requires accelerating the enablers for true international industrial collaboration, thereby overcoming the barriers that threaten the desired NDS objectives. The following recommendations are focused in that manner.

A "Build Allied" approach is ultimately a win-win proposition for all parties involved. Pursuing programs, initiatives, and recommendations like those described below will help to accelerate international industrial collaboration to build the industrial base capacity and resilience we need to face the national security challenges of tomorrow.

Recommendations

	Recommendation
Defense acquisition system	- The Deputy Secretary should issue a memo to Service Secretaries and DoD components outlining the importance of partnering with allies and partners in acquisition to achieve NDS objectives, highlighting principal enablers such as AUKUS, RDP MOUs, the Allied Prototyping Initiative, and DEF.
	- The Office of the Assistant Secretary of Defense (Acquisition) should prioritize, promote, and perhaps even modify existing DoD 5000.01 guidance to better emphasize international collaboration opportunities such as co-development, co-production, second-sourcing, licensed production, and sustainment.
	- The military departments should examine requirements development processes to facilitate the early involvement of allied and partner companies in DoD programs (e.g., avoid citing classified, U.S.-only documents in either informal or formal requests for information or solicitations where possible).
	- The military departments should add international cooperation evaluation factors to annual performance appraisals for PEOs and PMs to foster greater prioritization of international acquisition activities.
RDP MOUs	- Congress should request a study in the FY24 NDAA of the impact of RDP MOU countries' contributions to the U.S. defense industrial base through participation in DoD programs *and* the purchase of U.S. defense systems through foreign military or direct commercial sales to increase Congressional awareness of the benefits of RDP MOUs and counterproductive nature of additional Buy America legislation.
	- Using DAU and other venues, the DoD should educate acquisition professionals across the Department about the Buy America exemption for RDP MOU countries to help spur international collaboration opportunities.
SoSAs	- The Office of the Assistant Secretary of Defense (Industrial Base Policy) should work with SoSA signatories to modify the respective arrangements to address specific capability areas (e.g., materials, microelectronics, magnets, unmanned systems) where bilateral industrial cooperation can strengthen industrial resilience.
DEF	- Building off 2022 Ukraine supplemental reprogramming, the OUSD (A&S) should increase DEF base funding to $50 million in FY24 budget submission focused on capabilities being developed for the pacing China challenge.
	- The Office of the Assistant Secretary of Defense (Acquisition) should work with the military departments to increase the awareness and effectiveness of DEF in acquisition program development efforts.
NTIB	- The Office of Defense Pricing and Contracting should establish DFARS clauses focused on facilitating NTIB participation in solicitations for acquisition programs.
	- Once finalized, the DoD use DAU and other venues to educate the acquisition workforce on the use of NTIB clauses for use in programs across the DoD.
	- Once finalized, NTIB country trade associations should advertise NTIB clauses to NTIB-based companies to facilitate additional collaborative initiatives.
AUKUS	- The military departments should build on specific and focused Pillar II activities in hypersonics and unmanned systems to accelerate collaboration and demonstrate capabilities as soon as feasible in FY24 to maintain investment momentum and stakeholder engagement.
	- Congress should grant Australia and the United Kingdom ITAR waivers under the FY24 NDAA for AUKUS classified and unclassified programs.
	- Congress should direct the Department of State in the FY24 State Department Authorization to review and update the Canada ITAR waiver to make it more applicable for today's national security threat environment as well as expand that revised waiver to include Australia and the United Kingdom.
TSFD	- The OUSD (Policy) and OUSD (A&S) should reinvigorate the ATTR SSG to measure and report the effectiveness of TSFD efforts in support of AUKUS initiatives.

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