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*A Report of the Federated Defense Project*
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CSIS | CENTER FOR STRATEGIC & INTERNATIONAL STUDIES

FEDERATED DEFENSE PROJECT

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# Executive Summary

CSIS launched the Federated Defense Project to assess and recommend concrete ways for the United States and its partners to integrate their defense capabilities in support of shared interests. Rather than creating interdependencies that would hinder autonomous action or bind partners to commitments to which they only share a tangential interest, the federated defense strategy builds on the natural interests of allies and partners to develop closer working ties to the United States and one another in order to manage the challenges posed by constrained resources and a daunting geostrategic environment.

Buttressing any form of federated defense must be a set of bottom-up, organic interactions within the private sector to develop the capabilities that will underpin these security architectures. The expansion of business-to-business relationships among providers of platforms, supplies, and services to the network of trusted partners and allies is a key building block in ensuring adequate capabilities development, integration, and interoperability. To date, this interaction has occurred *despite* the many barriers that exist to their success. A federated approach will seek to enable this cooperation and lower these barriers, leading to greater cooperation, collaboration, and integration through global value chains (GVCs). Addressing the findings below is essential to the successful execution of a federated approach to defense.

## Findings

1. *GVCs Are the Present and Future of International Commerce.*

   Globalization is not a policy choice; it is a fact of the global operating environment that must be recognized. Today, one in three goods crosses national borders, and 80 percent of that global trade can be tied to GVCs coordinated by transnational corporations.[1] The firms that have adapted to leverage the advantages enabled by globalization have increased operating efficiency, accelerated product and process change, improved access to innovation, reduced cost, raised productivity, expanded global reach, and increased supply resilience. Throughout the commercial sphere, GVCs are delivering higher returns to capital and allowing for faster adaptation to changing markets. That trend will continue.

1. UN Conference on Trade and Development (UNCTAD), *World Investment Report 2013: Global Value Chains: Investment and Trade for Development* (Geneva: UNCTAD, 2013), http://unctad.org/en/publicationslibrary/wir2013_en.pdf.

2. *The Defense Department Can Gain from GVC Integration*.

   The Defense Department could realize significant gains by easing restrictions on global business-to-business interaction in the defense industry wherever feasible. As technological innovation becomes more diffuse, the Defense Department will need to reach farther to uncover and access the cutting-edge technologies. This innovation can best be delivered by a cadre of suppliers, innovators, and producers that includes the industries of the United States' trusted partners and allies.

3. *The Defense Department Is Insufficiently Leveraging GVCs*.

   The acquisition system of the U.S. government and the Department of Defense significantly hinders a value chain approach by its suppliers, putting them directly at odds with commercial reality. Domestic content requirements, joint venture requirements, and technology transfer requirements are typical of the "old view" of trade, denying access to markets and commercial partnerships and dissuading engagement of potential foreign partners. Delaying GVC integration will only increase future costs and give an unnecessary edge to competitors who are able to realize such gains independently.

4. *A Federated Defense Model Is Achievable Only if the Defense Industry Can Better Access and Incorporate GVCs.*

   Commercial integration, cooperation, and collaboration at the private-sector level will be the foundation that supports federated strategies at the governmental level, while government can enable commercial integration by thoughtfully reducing barriers to private-sector cooperation in the defense industry. This additional interaction and integration of technology will improve coordination among partners and interoperability in a more organic manner than simply assigning tasks and diffusing capabilities. GVC integration and the diffusion of technology among partners likely will enable a more cost-effective means to provide logistical support to large multinational operations. The status quo alternative takes more time and money, which is unrealistic at a time when defense budgets are shrinking by law. Given that future conflicts are likely to be multinational and dispersed geographically, adopting GVCs will be essential for future warfighting and allied cooperation.

# Introduction

> Unprecedented levels of global interconnectedness through technology, travel, trade, and social media provide common incentives for, and more effective means of, fostering international cooperation.
>
> —*Quadrennial Defense Review 2014*

U.S. security policy is most successful when it can draw from the assistance of its allies and partners. The nature of global challenges and the recent drawdowns in defense spending—both in the United States and for many of its partners—have compelled the need for a fundamental reevaluation of how the United States and its partners can optimize the benefits of their relationships. New structures must be designed that can best leverage partners' resources, capabilities, and interests and broadly manage the barriers to better cooperation.

CSIS launched the Federated Defense Project to assess and recommend concrete ways for the United States and its partners to integrate their defense capabilities in support of shared interests. Rather than creating interdependencies that would hinder autonomous action or bind partners to commitments to which they share only a tangential interest, the federated defense strategy builds on the interest of allies and partners to develop closer working ties to the United States and one another in order to manage the challenges posed by constrained resources and a daunting geostrategic environment.

A federated defense approach will necessarily require a shared strategic interest among partner nations, government-to-government agreements, and a coordinated approach to building capabilities among partners. These agreements and architectures will require long-term investments in relationship-building. Other elements of the CSIS Federated Defense Project—in particular, those focused on institutional foundations and regional assessments—address these broad strategic requirements.

Buttressing any form of federated defense must be a set of bottom-up, organic interactions within the private sector to develop the capabilities that will underpin these security architectures. The expansion of business-to-business relationships among providers of platforms, supplies, and services to these militaries is a key building block in ensuring

adequate capabilities development, integration, and interoperability. To date, this interaction has occurred *despite* the many barriers that exist to their success. A federated approach will seek to enable this cooperation and lower these barriers.

This report focuses on the ways that a federated approach can strengthen strategic partnerships and deliver more innovative defense technologies at a lower cost by better leveraging global supply chain networks to expand the military supplier base and increase the net capability available to the network of partners and allies. First, it will identify the factors necessitating a federated approach to value chains. Then, it will identify the barriers currently preventing a more federated system range, followed by two case studies that illuminate those barriers. It will then look at mechanisms by which cross-border defense market interaction can occur, and conclude with findings intended to better leverage the rise of global value chains for a more affordable, capable federated approach.

# 1 The Imperative for a New Approach

The Department of Defense (DoD) has long predicated its acquisition practices on a closed-loop, industrial base system that emphasizes indigenous capacity and internally funded development. While this system has slowly opened over the past 30 years, the speed of technological change and globalization of innovation and production has outpaced the system's ability to absorb these changes. The outcome of these global shifts is, as bluntly stated by Secretary of Defense Chuck Hagel, "that we are entering an era where American dominance on the seas, in the skies, and in space can no longer be taken for granted."[1] At the same time, DoD's ability to reverse this shrinking technological gap is being further challenged by declining resources and reduced purchasing power.

## The Global Industrial Innovation Environment

Throughout the current budget drawdown, DoD has focused on protecting its core interests and riding out budget uncertainty without significant changes to its business model. The model of innovation and acquisition that DoD has long relied upon does not hold up in a world where the money, talent, and technology driving innovation, at both the high end and the low end, are increasingly found outside of that closed system. Technological development supporting DoD is focused almost exclusively on three loci of innovation: research and development (R&D) organizations inside DoD specifically tasked with R&D responsibilities, including service laboratories and the Defense Advanced Research Projects Agency; nongovernmental recipients of federal research funding, including Federally Funded Research and Development Centers (FFRDCs), think tanks, and universities; and the shrinking cadre of heritage defense contractors who receive contracts to pursue specific R&D projects[2] and have their independent R&D efforts reimbursed by DoD. These R&D activities funded by DoD represent less than 2 percent of the $1.6 trillion worth of global R&D.[3] Including all federally funded research, across all industries, the U.S. government funds less than 8 percent of global R&D. This means that even with the broadest definition of the global innovation to which DoD has access, it is failing to exploit at least 92 percent of it.

1. Secretary of Defense Chuck Hagel, "FY15 Budget Preview" (speech in Pentagon Press Briefing Room, Arlington, VA, February 24, 2014).

2. Per CSIS analysis of data from the Federal Procurement Data System, 48 percent of DoD R&D contract obligations in 2013 were performed by the Big 6 contractors: Lockheed Martin, Northrop Grumman, Raytheon, General Dynamics, Boeing, and BAE Systems.

3. Martin Grueber and Tim Studt, *2014 Global R&D Funding Forecast* (Columbus, OH: Battelle, December 2013), http://www.battelle.org/docs/tpp/2014_global_rd_funding_forecast.pdf.

While many, including DoD, focus on the numerator of this equation—the amount of DoD research and development spending—the important number is the denominator: the rise of the globalized R&D complex.

While recent budget cuts have impacted DoD's research and development enterprise and the defense-industrial base that supports it, the much more significant challenge comes from long-term globalization trends. DoD's position in the global innovation base is fundamentally different than it was 30 years ago. DoD was once a net supplier of innovation to the global market, spinning off military technologies into commercial products. Now, it is a net consumer of global commercial innovation, relying on the explosion and diffusion of global knowledge, research, technology, and production. The fact of the matter is that DoD is a much smaller player and a customer with much less influence than it once had.

While we should be concerned about the spread of high-end military technology through both imitation and innovation, the wide availability of defense-relevant technologies in the global commercial market is equally critical. As noted in testimony to Congress by Alan Shaffer, principal deputy assistant secretary of defense for research and engineering, "[m]any technologies of importance to the Department's capability developments are driven by the commercial sector, and have become a global commodity."[4] The ramifications of this trend were recognized even back in 1996, as then–Under Secretary of Defense for Acquisition and Technology Paul Kaminski noted:

> In some leading-edge technologies critical to success on future battlefields, the commercial sectors of the economy have the advantage . . . for example, electronics, computers, information processing and communications.
>
> In addition, today's global economy allows everyone, including potential adversaries, to gain increasing access to the same commercial technology base. To the extent that commercial technology can enhance military capability, the military advantage will go to the nation with the best cycle time to capture commercial technologies, incorporate them in weapon systems and field new operational capabilities.[5]

Despite this, DoD still employs an acquisition system that favors traditional suppliers and results in long development programs with complicated, drawn-out acquisition processes leading to technology that has obsolete subsystems by the time it is fielded. Prior periods of defense budget cuts have resulted in significant changes. Secretary of Defense Bill Perry pushed through reforms to adopt commercial specifications and grow purchases of commercial off-the-shelf products in the 1990s. So far, the imperative to redouble efforts at

4. Alan R. Shaffer, principal deputy assistant secretary of defense for research and engineering, testimony before the Committee on Appropriations, Subcommittee on Defense, U.S. Senate, 113th Congress, May 14, 2014, http://www.appropriations.senate.gov/sites/default/files/hearings/Written%20Statememt%20Mr%20%20Shaffer.pdf.

5. Paul G. Kaminsky, "U.S. Perspective on Defense Industrial Base Trends" (prepared remarks by Paul G. Kaminski, under secretary of defense for acquisition and technology, to the NATO Workshop on Political-Military Decision-making, Warsaw, Poland, June 21, 1996), http://www.defense.gov/Speeches/Speech.aspx?SpeechID=1012.

these kinds of reforms has not yet permeated DoD during the current drawdown, but it needs to if DoD is going to access cutting-edge technologies at the lowest cost in this new environment.

Outside of the Defense Department's closed-loop system, technological progress is reshaping commercial environments worldwide. Falling trade costs and lowered barriers to the movement of ideas and know-how have led to the rise of complex, IT-enabled production networks known as global value chains (GVCs). The commercial success of GVCs is a direct consequence of their ability to harness dispersed, specialized knowledge. Technical know-how has become widely distributed, across both geographies and industrial sectors. With the dispersion and diffusion of both production and innovation, the United States no longer enjoys the level of dominance it had two or three decades ago in technological innovations, in their applications, or in the processes or practices by which they are brought into use. Yet such dominance is a core tenet of the U.S. defense strategy, which is predicated, in part, on decisive technological superiority. The accelerating pace of change exacerbates this threat by challenging DoD's ability to access emerging technologies. This challenge extends to the U.S. defense industrial base, which for institutional and policy reasons has shrunk considerably and has not adapted to fully leverage dispersed knowledge.

DoD is not alone in having to address this changing global innovation ecosystem. Large innovation-based firms also are struggling to adapt to the new globalized world. A major shift in the ability to source production from those who are specialized in a particular task has allowed firms to harness innovation from sources around the world rather than relying on their internal R&D departments. This "open innovation" model has been a driving force for maximizing innovation potential in the private sector. Rather than depend on an internal R&D infrastructure, open innovation leverages the innovative capacity of huge networks of small and medium enterprises that are eager to license and sell their intellectual property. In a Harvard Business Review case study, Procter & Gamble increased its R&D productivity 60 percent and lowered expenditures when it set a goal of acquiring 50 percent of innovations from outside the company.[6] To counteract these trends, DoD must increase the as-yet-under-realized gains to be had through greater defense industry integration into GVCs. In its most recent Annual Industrial Capabilities Report to Congress, DoD avers that "the base upon which the Department [of Defense] relies is more global, commercial, and financially complex than at any time in our Nation's history."[7] This is true of nearly every sector in the global economy, and while the role of global commercial industry in the defense-industrial base has grown, DoD has been slow to adapt to the new technological realities. The current business model—the national-centric, defense-focused industrial base approach where states are relatively self-reliant for production—has become outdated as the commercial world has uncovered the benefits of GVCs, where firms specialize in creating value at different stages within a larger international production chain.

6. Larry Huston and Nabil Sakkab, "Connect and Develop: Inside Procter & Gamble's New Model for Innovation," *Harvard Business Review*, March 2006.

7. Under Secretary of Defense for Acquisitions, Technology and Logistics, *Annual Industrial Capabilities Report to Congress* (Washington, DC: U.S. Department of Defense, October 2013), 5, http://www.acq.osd.mil/mibp/docs/annual_ind_cap_rpt_to_congress-2013.pdf.

This leads firms to locate processes where they can be performed most efficiently, making extensive use of licensing and partnership arrangements. As a result, complex final goods have increasingly become "packages of many nations' productive factors, technology, social capital, and governance capacity."[8]

Leveraging this innovation can provide both efficiency and capability gains, even within the restrictions of a tightening budget. Innovation is not inherently a question of money; it is primarily an issue of maximizing access to knowledge. As noted in the *Quadrennial Defense Review 2014*, "the pace of technological and scientific innovation in the private sector . . . has the potential not only to revolutionize entire industries but also to enable new ways of providing for U.S. security in the future."[9] While DoD may never move to a completely open innovation model due to the national security concerns associated with many defense items,[10] the institutional barriers to leveraging a broader spectrum of global innovation are enormous and onerous. Of particular note to this study are the impacts of the barriers to leveraging GVCs for innovation—those barriers that constrain business-to-business relationships that could otherwise deliver vital gains in technology and innovation, and also strengthen relationships among U.S. partners and allies.

# Barriers to Federated Value Chains

Within the twenty-first-century global industrial and innovation environment, there are myriad barriers that actively hamper efforts to better leverage GVCs. Some of these barriers will receive deeper examination in the institutional foundations for the Federated Defense segment of this project, but it is important to describe the scope of these challenges here. These barriers hinder cross-border business-to-business interaction in two major ways: preventing U.S. firms from doing more business internationally (with foreign governments or foreign firms) and impeding foreign firms from doing business with the United States. Some of these challenges are statutory and driven by Congress, while some are regulatory and others are institutional or cultural.

The statutory challenges represent the highest hurdles to change due to the complex political challenges Congress faces. For U.S. companies looking to sell more to partners and allies, the first crucial barrier is export controls. The United States tightly controls exports of military technology at the component and platform levels through the U.S. Munitions List (USML) and the Commerce Control List (CCL), pursuant to the Arms Export Control Act,

8. Richard Baldwin, "Trade and Industrialization after Globalization's 2nd Unbundling: How Building and Joining a Supply Chain Are Different and Why It Matters," Working Paper 17716, National Bureau of Economic Research, December 2011, http://siteresources.worldbank.org/INTRANETTRADE/Resources/Baldwin_NBER_Working_Paper_17716.pdf.

9. U.S. Department of Defense, *Quadrennial Defense Review 2014* (Washington, DC: U.S. Department of Defense 2014), 6, http://www.defense.gov/pubs/2014_Quadrennial_Defense_Review.pdf.

10. Addressing this significant issue is beyond the scope of this paper; however, the findings take into account the need for a filter to balance trading off between DoD's security needs and DoD's access and efficiency needs. While businesses may not have the same level of concern in their value chain, the steps they take to assure their own access and security would have relevance to the discussion. At a minimum, the differences and similarities between business actions and current DoD actions could serve as a starting point for discussion.

as implemented through the Export Administration Regulations (EAR) and International Trade in Arms Regulations (ITAR). Further controls derive from voluntary nonproliferation regimes the United States is involved in, including the Missile Technology Control Regime, the Wassenaar Arrangement, the Nuclear Supplier Group, and others. While U.S. export controls derive from statute, the regulatory implementation has become the more difficult obstacle. The lists are considered to be out of date and slow to respond to emerging technologies, a growing concern with the accelerating pace of technology change. Increased license application volume and complexity are stretching resources thin and slowing the process.

The key statutes barring further inclusion of foreign companies into the industrial supplier stream are domestic content restrictions. The Buy American Act was originally created in 1933 and designed to protect domestic U.S. labor by giving preference to U.S. producers in government procurement, consistent with the protectionist policies enacted in response to the Great Depression. The Berry Amendment was enacted in 1941 to ensure a domestic source of food and clothing for the U.S. military and applies exclusively to DoD purchases.[11] Though each measure was a product of its time, they remain in force and continue to attract interest from members of Congress seeking to protect domestic industry and jobs. Their effect (and the effect of similar measures) on access to innovation is twofold—first, like all policies designed to protect domestic industry, they have anticompetitive effects that lead to higher costs and inefficiencies and inhibit innovation. Second, they reinforce the idea that products are created by single sources that can be interchanged depending on policy preferences—in this case, that DoD can source its purchases from unitary, individual producers when the commercial reality is that production is disaggregating among a series of specialized producers.[12]

One barrier inhibiting involvement between international and domestic suppliers is the process surrounding the Committee on Foreign Investment in the United States (CFIUS). The committee reviews mergers and acquisitions of U.S. firms by foreign entities that could affect national security. CFIUS was transformed by the Exon-Florio amendments of 1988 from a largely administrative body to one with a broad mandate and authority to advise the president on foreign transactions. In 2007, the Foreign Investment and National Security Act (FINSA) provided Congress with greater oversight of CFIUS and expanded the meaning of "national security." The act requires CFIUS to investigate all deals in which the acquiring entity is owned or controlled by a foreign power, irrespective of the nature of the enterprise. While CFIUS reviews have resulted in a few relatively high-profile cases of foreign investment being blocked due to national concerns, CFIUS also serves as a deterrent to prospective investors due to the length of the review process and the concern that mitigation actions impose inappropriate and unnecessary business restraints on the acquirer. Leaving aside judgment of the CFIUS review process or of individual cases, the United States

11. Valerie Bailey Grasso, "The Berry Amendment: Requiring Defense Procurement to Come from Domestic Sources," Congressional Research Service, February 24, 2014, http://fas.org/sgp/crs/natsec/RL31236.pdf.

12. Nevertheless, Buy American acquisition restrictions have been waived for many U.S. allies and trading partners via reciprocal defense acquisition and procurement memoranda of understanding, as discussed later in this article.

should recognize its dampening effect on foreign investment in the United States and on competition for DoD contracts.

While the applicability of specific legal statutes depends on a variety of situational factors, major concerns include providing employees with security clearances and establishing facility security clearances for workplaces and contracting sites. As foreign citizens are often ineligible to receive security clearances, and companies with Foreign Ownership, Control and Influence (often abbreviated as "FOCI") cannot receive facility security clearances without appropriate mitigation measures to ensure that only U.S. citizens or other appropriately cleared individuals can access classified materials, these provisions typically necessitate the hiring of U.S. citizens. The needs of private industry to access classified information or data are regulated by the National Industrial Security Program (NISP). Additionally, all vendors seeking to provide goods or services to the U.S. government are required to comply with laws and regulations concerning affirmative action programs, equal employment opportunity requirements, ethics disclosure and training, and additional regulations.

There are a number of other regulatory hurdles that increase the cost of doing business with DoD and deter global commercial firms from wanting to do business with DoD. The Truth in Negotiations Act (TINA) requires certification of cost and pricing data. Financial and Cost Accounting Standards (FAS/CAS) require expensive, unique accounting systems. Other reporting and contractual requirements force the giving up of exclusive rights to intellectual property and technical data. While these policies exist to protect national security interests and/or the good stewardship of taxpayer dollars, they have countervailing effects that increase costs and delay and impede innovation. To use one example, a major aerospace firm produces a plane for defense use that is similar to one it produces for commercial use, but the firm has stated that the added bureaucratic and overhead costs associated with producing the plane for defense use increases the production costs by 30 to 40 percent. These added costs not only make acquisitions more expensive but also limit the market to those firms that can bear the defense-unique costs, effectively closing off acquisitions from other firms that would otherwise be competitive if those costs were reduced. As DoD responds to current security challenges, including implementation of new regulations like the counterfeit parts rule, there are concerns that DoD is in fact becoming more insular and segmented from the commercial world, not less.

While there are many structural challenges in the DoD acquisition system, both regulatory and statutory, some of the most difficult to overcome grow out of the institutional culture. These challenges come from incentive structures and cultural behaviors. Both bureaucracies and militaries are inherently resistant to change. The acquisition enterprise is also exceedingly complex, leading to cultures of risk avoidance and compliance, as opposed to focusing on delivering outcomes. A symptom of this risk aversion is the adherence to traditional acquisition mechanisms from trusted longtime partners in industry.

The challenge facing DoD is not that the culture is outmoded, but that there has been a shift in the external environment that has upended DoD's role in its market. The "not invented here" syndrome is ingrained in DoD, whose historic role at the cutting edge of

technology allowed it to rely closely on developments from DoD, the labs, the Defense Advanced Research Projects Agency, or their close partners in industry. But DoD has been slower to recognize the value that can be brought by innovations outside its purview. The cultural challenges amplify the problems created by the statutory and regulatory barriers.

# Case Studies

This report will present two case studies—unmanned aerial systems (UAS) and microelectronics—to demonstrate the costs that these barriers add, directly harming the Defense Department's ability to access leading technology and innovations. In the case of UAS, there are parallel development streams between the commercial sector and the defense sector, but barriers between the two development streams are inhibiting innovation, driving up costs, and hindering the global competitiveness of U.S. firms. In the case of microelectronics, restrictions for those doing business with DoD have undercut the global competitiveness of U.S. firms and have blocked the U.S. defense market from leveraging the innovations in the commercial market.

## UNMANNED AERIAL SYSTEMS

UAS, also called unmanned aerial vehicles (UAVs) and colloquially known as drones, have been increasingly utilized in U.S. military operations and have attracted similar attention from other governments for intelligence, surveillance, and reconnaissance (ISR) and strike capabilities. Their role is expected to continue to increase not only in the United States but worldwide as their effectiveness and efficiency (financial, logistical, and in terms of manpower risk) make them an appealing option for defense planners around the globe.

UAS are part of a dynamic, globalized, and rapidly growing market that has emerged only over the past 15 years. The Royal Aeronautical Society summarized the global UAS industrial landscape as follows: "The U.S. is by far the most extensive user and producer of UAS platforms and associated equipment; Israel has carved a very important niche; Europe is catching up, but is struggling to stay in the game; more important perhaps, UAS activity is already globalized, with basic technology and industrial capability widely spread and ubiquitous."[13] Historically, the United States and Israel have dominated the UAS market, and only nine other countries—France, Germany, Italy, Turkey, the United Kingdom, Russia, China, India, and Iran—currently possess armed UAS for military use.[14] Eighteen countries are developing indigenous capability.[15] There are already 4,000 UAS platforms

13. Keith Hayward, "Unmanned Aerial Vehicles: A New Industrial System?," Discussion Paper, Royal Aeronautical Society, November 2013, http://aerosociety.com/Assets/Docs/Publications/DiscussionPapers/UASDiscussionPaper.pdf.

14. Amanda Vicinanzo, "Will New Minidrones Push FAA to Keep Pace with Expanding UAS Market?," *Homeland Security Today*, June 16, 2014, http://www.hstoday.us/briefings/industry-news/single-article/will-new-minidrones-push-faa-to-keep-pace-with-expanding-uas-market/8560eaf1d7f21f0a835bce703b619896.html.

15. Samuel J. Brannen, *Sustaining the U.S. Lead in Unmanned Systems: Military and Homeland Considerations through 2025* (Washington, DC: CSIS, February 2014), http://csis.org/files/publication/140227_Brannen_UnmannedSystems_Web.pdf.

worldwide.[16] Israel is the largest exporter of UAS, with sales totaling $4.6 billion between 2005 and 2012, while the worldwide market value of military drone production is expected to climb from $942 million in 2014 to $2.3 billion by 2023.[17]

The greatest growth in UAS purchases will come from East Asia, where defense budgets are growing and states in the region are expected to spend more on defense than North America in the next decade, while the Middle East, Saudi Arabia, and the United Arab Emirates (UAE) are expected to double their defense spending over the next decade, with a similar situation in Latin America.[18] In short, the market for UAS will only grow stronger as states upgrade their capabilities and rivals seek to gain a competitive edge—Japan alone expected to expand its drone program by approximately 600 percent by 2025.[19]

The United States possesses 20 percent of the world's UAS projects with 42 separate design centers and over two-thirds of world market share.[20] UAS production in the United States is dominated by two major U.S. suppliers based on global market share: General Atomics (20.4 percent) and Northrop Grumman (18.9 percent), while Boeing, AAI, and Lockheed Martin also hold a share of the global market.[21] Projected worldwide UAS spending on research, development, test, and evaluation (RDT&E) is expected to rise from $6.6 billion in 2013 to $11.4 billion in 2022, with the United States accounting for 62 percent of that spending.[22]

In ten years, the Defense Department has gone from being nearly the entire market for UAS to just one of many customers of UAS technology. DoD has been slow to adjust to the changing dynamics of this supply-and-demand relationship. The U.S. market for drones is shrinking because the Defense Department is reducing its purchases in reaction to reduced budgets and the drawdown from the wars in Afghanistan and Iraq. DoD's spending on RDT&E will decline for the third consecutive year, with the Fiscal Year 2014 (FY14) budget down from the FY13 level by roughly one-third.[23] The largest U.S. drone manufacturers are consequently looking for foreign buyers to expand their sales. But the potential to reach foreign buyers is hampered by export restrictions that have the unintended effect of advantaging foreign UAS manufacturers. For example, Latin America, Brazil, Chile, Colombia, Ecuador, Peru, and Venezuela all recently purchased UAS from Israel rather than the

16. Dan Parsons, "Export Controls Threaten U.S. Edge in Foreign UAV Markets," *National Defense Magazine*, May 2014, http://www.nationaldefensemagazine.org/archive/2014/May/Pages/ExportControlsThreatenUSEdgeinForeignUAVMarkets.aspx.

17. Forecast International, "Forecast International Expects UAV Market to Rise Strongly through the Next Decade; Unmanned Land- & Sea-Based Systems' Values also Growing," press release, April 15, 2014, http://www.forecastinternational.com/press/release.cfm?article=279#.VDbtQPmwJrN.

18. Larry Abramson, "Defense Contractors See Their Futures in Developing World," National Public Radio, July 6, 2013, http://www.npr.org/2013/07/06/199264458/defense-contractors-see-their-futures-in-developing-world.

19. Daniel A. Medina, "Drone markets open in Russia, China and rogue states as America's wars wane," *The Guardian*, June 22, 2014, http://www.theguardian.com/business/2014/jun/22/drones-market-us-military-china-russia-rogue-state.

20. Hayward, "Unmanned Aerial Vehicles."

21. Glennon J. Harrison, "Unmanned Aircraft Systems (UAS): Manufacturing Trends," Congressional Research Service, January 30, 2013, http://fas.org/sgp/crs/natsec/R42938.pdf.

22. Ibid.

23. Brannen, *Sustaining the U.S. Lead*.

United States.[24] The situation is similar to what happened in the satellite industry, when U.S. exports were restricted, thus encouraging the development of non-U.S. alternatives, and U.S. dominance in the satellite market was ceded once purchasers discovered it was easier and more cost effective to buy from foreign producers.[25]

The result is that the majority of innovation in UAS technology is happening outside the United States and beyond the reach of the Defense Department. On the defense side, there are several barriers that inhibit U.S. manufacturers' access to foreign UAS markets. Armed UAS are not approved for export under the International Traffic in Arms Regulations (ITAR), which is governed by the State Department's Directorate of Trade Controls. According to one expert, "The pace and development of the market is going to have to be absolutely tied to these ITAR rules and regulations. . . . It's not exactly clear how these regulations will evolve."[26] These process challenges impose significant costs on producers as one follows production throughout the supply chain.[27]

Additionally, UAS that can fly farther than 300 kilometers and carry more than 500 kilograms (like the Global Hawk or Predator) are treated as missiles and fall under the Missile Control Technology Regime (MCTR), therefore requiring export licenses from both the State Department and Commerce Department.[28] The MCTR was created in 1992 as a voluntary set of regulations designed to govern the sale of missiles that could deliver nuclear weapons. However, they also unintentionally created a barrier on the sale of UAS (whose technology was too nascent for negotiators to envision its future potential and how it might be considered under the agreement). Reforming the MCTR will not be easy or quick, since it is a multilateral agreement among 34 states and any revisions must be approved unanimously.[29] Neither Israel nor China (an emerging UAS producer) is a member of the MCTR, and consequently those two countries are not bound by the requisite export restrictions.[30] The United States has so far only exported armed UAS to the United Kingdom.[31]

The president's export control reform initiative has addressed some of these issues. By transferring some UAS components from ITAR to the less-restrictive Export Administration Regulations, manufacturers can export specific components but, as with any dual-use item sold abroad, still must obtain a license from the State and Commerce Departments (prior to the reform, if any component was subject to ITAR, then the rest of the system was as well).[32] Manufacturers can also now sell unarmed, "export versions" that are MCTR

24. Jason Koebler, "American Defense Companies Try to Break Israel's Grasp on Latin American Drone Market," *U.S. News and World Report*, July 15, 2013, http://www.usnews.com/news/articles/2013/07/15/american-defense-companies-try-to-break-israels-grasp-on-latin-american-drone-market.
25. Parsons, "Export Controls Threaten U.S. Edge in Foreign UAV Markets."
26. Medina, "Drone markets open."
27. Hayward, "Unmanned Aerial Vehicles."
28. Parsons, "Export Controls Threaten U.S. Edge."
29. Ibid.
30. Ibid.
31. Brannen, *Sustaining the U.S. Lead*.
32. Parsons, "Export Controls Threaten U.S. Edge."

compliant, such as General Atomics' 2013 sale of an unarmed version of its Predator, Predator XP, to the United Arab Emirates.[33]

On the commercial side, the Federal Aviation Administration (FAA) is due to release its guidelines for commercial UAS in 2015 (though it will likely be delayed). Given the potentially enormous economic benefits that integrating commercial UAS into U.S. airspace could offer, it is inevitable that the FAA will eventually allow some degree of integration that accounts for public safety and skepticism. Until then, "the only regulation they have is that you can't use them,"[34] meaning that U.S. commercial producers must either sell to foreign purchasers or wait for the FAA's guidelines to be released.[35] There is also the risk of regulatory incongruence between the United States, European Union, and other regulatory infrastructures.[36] One analyst compares UAS to nuclear energy, where utilization is hampered by a strict regulatory environment, opaque certification procedures, and controversy within the public[37]—but the difference for UAS is that it has the potential for a vibrant and innovative commercial sector well beyond that pursued on nuclear energy. But until the FAA updates its guidelines, U.S. manufacturers will experience little potential for growth.

As commercial UAS value chains develop concurrently with the global UAS market, it will become increasingly necessary for Defense Department procuring agents to access these value chains if DoD wants to stay current on the rapidly evolving technology. For example, one of the keys to improving a UAS's complex interaction of weapons, sensors, navigation, etc., is the development of new electrical systems—expertise that can be acquired by hiring new personnel, training current personnel to address these challenges, and/or acquiring firms already possessing the necessary expertise.[38] Some firms are building market presence by creating technology transfer agreements and other partnership agreements, frequently with the goal of developing indigenous competency, as in Finmeccanica's agreement with the United Arab Emirates.[39] BAE Systems' UAS drew from sources as diverse as mountain bike manufacturers, glider companies, and other firms outside of the aerospace realm.[40] As uses and capabilities expand, the technologies required to enable these capabilities will become increasingly esoteric and will continue to require the leveraging of a broad base of knowledge beyond what indigenous R&D programs can provide in a cost-effective and timely manner.

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33. Jason Koebler, "General Atomics to Sell Unarmed Predator Drones to Foreign Countries," *U.S. News and World Report*, June 17, 2013, http://www.usnews.com/news/articles/2013/06/17/general-atomics-to-sell-unarmed-predator-drones-to-foreign-countries.

34. Jonathan Downey, CEO, Airware, quoted in Michael V. Copeland, "Beyond Surveillance: Envisioning the Future Drone Workforce," *Wired*, May 20, 2013, http://www.wired.com/2013/05/the-business-of-putting-robots-in-the-sky/.

35. Patrick May, "Look up: The commercial drone market is about to take off," *San Jose Mercury News*, March 1, 2014, http://www.mercurynews.com/business/ci_25256472/look-up-commercial-drone-market-is-about-take.

36. Hayward, "Unmanned Aerial Vehicles."

37. Ibid.

38. Ibid.

39. Ibid.

40. Ibid.

Beyond the policy barriers, institutional barriers in the U.S. defense environment play a role as well. Large defense contractors have an inherent advantage under the current process because they understand the byzantine and complex acquisition procedures and have long-established relationships with the DoD acquirers, who equally benefit from their familiarity with the large contractors.[41] Small producers are not only unfamiliar with the process but also less able to absorb the added bureaucratic costs associated with involvement in the defense market and other government-imposed, non-value-added activities.[42] The result is a system that is too stagnant, with high barriers for new entrants, and favors suppliers that make the most of their relationship with the government, but not conducive to innovation.[43] Meanwhile, acquisition experts express frustration with the weak industrial base supporting defense. The National Defense Industrial Association characterized the results as, "The available pool of U.S. manufacturers is shrinking. What is surprising is that there are plenty of capable domestic suppliers that choose not to participate in the industry."[44]

This latent pool of domestic suppliers that choose not to participate should concern the Defense Department and U.S. policymakers. The practical result of these barriers is that most U.S. UAS manufacturers are left with the federal government as their only customer, particularly the existing large defense-focused contractors familiar with the process and with the ability to produce the UAS that the Defense Department requests. Smaller firms that will ultimately outnumber the large contractors will shun the barriers and higher costs and look for markets elsewhere, innovating for the global market (possibly including defense capabilities) and ignoring the Defense Department.

## MICROELECTRONICS

Microelectronics—also known as microchips, integrated circuits, or semiconductors—are core components to nearly every cutting-edge electronic and information technology today. Whether used for missiles or smartphones, they underpin all computing and electronic technology. These components have a long history within the defense industry, but one that has seen several shifts in relation to commercial industry.

Today, microelectronics design and manufacturing is a $300 billion global industry that supports a $2 trillion electronic products market and roughly $6 trillion in related services.[45] DoD's participation in that industry represents a small fraction of the global demand—at

41. Ibid.

42. Steven A. Melnyk, Kenneth W. Sullivan, and Christopher Peters, *Recovering the Domestic Aerospace and Defense Industrial Base*, National Defense Industrial Association, Manufacturing Division—Supply Chain Network Committee, January 2012.

43. Steven A. Melnyk, Kenneth W. Sullivan, and Christopher Peters, "Recovering the Domestic Aerospace and Defense Industrial Base," National Defense Industrial Association, January 2012, http://www.ndia.org/Divisions/Divisions/Manufacturing/Documents/NDIA_White_Paper-Recovering_A-D_Industrial_Base_FINAL_012412.pdf.

44. Ibid.

45. Stephanie S. Shipp et al., *Emerging Global Trends in Advanced Manufacturing* (Alexandria, VA: Institute for Defense Analyses, March 2012), https://www.ida.org/upload/stpi/pdfs/p-4603_final2a.pdf.

most 1 to 2 percent of global consumption.[46] This is a vastly different market than the early days of semiconductor development, when DoD was an early driver of both innovation and demand, supporting early research, development, and subsequently, production.[47] The United States was the global leader until new technology enabled the disaggregation of the manufacturing and design sides of the process, leading to vertical disintegration in the 1980s.[48] This led to the offshoring of manufacturing and the rise of Asia (first Japan, then Taiwan, now China) as the center of semiconductor production.[49] The new portability of skills and processes combined with lowering global trade costs and advantageous conditions in developing economies (lower wages, tax preferences, subsidies, etc.) drove the foundry business away from the United States.[50]

In response to this shift in the global center of semiconductor manufacturing, DoD intervened, cofinancing through DARPA an R&D consortium called SEMATECH with the remaining U.S. semiconductor industry designed to maintain U.S. industry's leading technological edge.[51] While DoD fought to maintain technology leadership in the sector, it also recognized that global commercialization had turned the industry on its head, and that DoD's acquisition policies and practices for these components were outdated. By the 1990s, there was growing awareness of the divergence of needs and costs associated with integrated circuits purchased to military specifications (mil-spec) and those in the burgeoning commercial market.[52] Initially, cost concerns drove the move away from mil-spec integrated circuits, as defense-unique products failed to capitalize on the substantial economies of scale driving down cost in the commercial market. Then-Secretary of Defense Bill Perry concluded that mil-spec for semiconductors alone added $1 to $2 billion annually to the cost of technology.[53]

While cost was and continues to be an important factor in driving the use of commercial integrated circuits (ICs), there are also significant noncost factors driving DoD's need for access to commercial microelectronics. First, low demand for mil-spec parts, low profit potential, and the high investment costs required to maintain position on the technological cutting edge led to growing uncertainty over the continued supply of mil-spec integrated circuits. Second, commercial access is important for accessing cutting-edge technology, as semiconductors are a prominent example of the global commercial market having passed

46. Defense Science Board, *Report of the Defense Science Board Task Force on High Performance Microchip Supply* (Washington, DC: U.S. Department of Defense, February 2005), http://www.acq.osd.mil/dsb/reports/ADA435563.pdf.

47. In 1962, nearly 100 percent of semiconductors were produced for military use, but by just 1968, this had fallen to around 40 percent of total production. P. R. Morris, *A History of the World Semiconductor Industry* (London: Peter Peregrinus Ltd./Institution of Electrical Engineers, 1990).

48. Shipp et al., *Emerging Global Trends*.

49. Ibid.

50. Defense Science Board, *High Performance Microchip Supply*.

51. Douglas A. Irwin and Peter J. Klenow, "High-tech R&D subsidies: Estimating the effects of Sematech," *Journal of International Economics* 40 (1996): 323–344, http://www.dartmouth.edu/~dirwin/docs/Sematech.pdf.

52. Robert W. Rolfe et al., *Accelerating the Use of Commercial Integrated Circuits in Military Systems* (Alexandria, VA: Institute for Defense Analyses, October 1995), http://www.dtic.mil/dtic/tr/fulltext/u2/a310296.pdf.

53. Acquisition Advisory Panel, *Report of the Acquisition Advisory Panel to the Office of Federal Procurement Policy and the United States Congress* (Washington, DC: Acquisition Advisory Panel, January 2007), http://www.acquisition.gov/comp/aap/24102_GSA.pdf.

DoD for ownership of the leading technological edge. In addition, commercial access enables better incorporation of cutting-edge technology because of the reduced lead time to acquire non-mil-spec components. And in a world where Moore's law still holds, cutting time to market can mean a generation's difference in computing power. The Packard Commission encapsulated the issue in its report, finding that even in 1986, "commercial semiconductors were approximately an order of magnitude less expensive, were approximately two orders of magnitude more reliable, and were developed in less than 12 months, compared to the 17–51 month lead-time for military-unique components."[54] A final concern was that, as the market passed DoD by, the large global producers were no longer captive to DoD's needs, and were increasingly unresponsive to meeting defense-unique needs. During the 1990s, five of the 10 largest semiconductor producers refused to do business with DoD because of onerous procurement and reporting requirements.[55]

The drive for greater commercial access in DoD began to wane in the early 2000s with the growth of concerns over counterfeiting, tampering, and information security issues. In 2003, Deputy Secretary of Defense Paul Wolfowitz issued the Defense Trusted Integrated Circuit Strategy, to be administered by the National Security Administration's (NSA) Trusted Access Program Office.[56] DoD guidance in response to these trust issues warned that systems relying on ICs for critical capabilities may be vulnerable if not manufactured, produced, and delivered in a trusted manner. Then, in 2009, a new "Strategy for Systems Assurance and Trustworthiness" established the DoD Supply Chain Risk Management Threat Analysis Center inside of the Defense Intelligence Agency.[57]

The rise in concern over security issues, elevated now to the level of inclusion in multiple recent National Defense Authorization Acts, has encouraged segmentation between the commercial and military markets once again. Security-related procurement requirements for these crucial components are increasing. The concerns over information and technology security are valid and important, but these fixes do not deal with the core problem of cutting-edge technology awareness, access, and incorporation.

Advances in this sector will continue to outpace the ability of DoD to replicate its cutting-edge technology. Efforts such as the DoD's "trusted foundries" or "diminishing manufacturing sources and material shortages" initiatives illustrate just how expensive

54. Jacques S. Gansler, William C. Greenwalt, and William Lucyshyn, *Non-Traditional Commercial Defense Contractors* (College Park: University of Maryland School of Public Policy, November 2013), http://www.acquisitionresearch.net/files/FY2013/UMD-CM-13-119.pdf.

55. Ibid.

56. Sammy Maynard, "Trusted Manufacturing of Integrated Circuits for the Department of Defense" (presentation, National Defense Industry Association, Manufacturing Division Meeting, October 28, 2010), http://www.ndia.org/Divisions/Divisions/Manufacturing/Documents/119A/5%20Trusted%20Foundry%20NDIA%20Manufacturing%20Division%202010%20screen.pdf.

57. Under Secretary of Defense for Acquisition, Technology and Logistics and Assistant Secretary of Defense for Networks and Information Integration/DoD Chief Information Officer, *Report on Trusted Defense Systems in Response to National Defense Authorization Act, Section 254* (Washington, DC: U.S. Department of Defense, December 2009), executive summary and addendum, http://www.acq.osd.mil/se/docs/Trusted Systems-Exec_Summ-wAddendum-wTitlePgNoteinPDF.pdf.

and difficult it will be for the DoD to catch up with the market on its own.[58] But, again, it's not just cost. The Trusted Foundry Program is limited; DoD and intelligence agencies must still tap the commercial market for leading-edge microchips. The trusted DoD foundries currently under contract are not at the leading edge. For example, Intel, the world's largest semiconductor manufacturer, declined to participate in the Trusted Foundry Program. The first trusted foundry, operated by IBM in Burlington, Vermont, develops products that are four generations behind the products of IBM's state-of-art, nontrusted foundry in East Fishkill, New York.[59] The capabilities of DoD platforms in development are still using 1990s microelectronic technology. Systems are becoming more dependent on and limited by their processing power, and new architectures and networking platforms require faster and denser chips. The trusted foundries cannot supply them. DoD must be able to procure leading-edge chips and systems from the commercial market.

In short, while DoD has sought to deal with its obsolescence challenges and provided a temporary fix to its semiconductor security issues, these are not optimal responses. DoD continues to be limited in its ability to harness one of the most militarily critical, fastest-moving technology areas due to its inability to leverage the cutting-edge semiconductor technology provided by the global commercial market.[60] Furthermore, the less connected DoD is to these leading-edge developers, the more difficult it is for it to stay aware of and engaged in technology developments that impact requirements, program development, technology of allies and partners, and competitor capabilities.

## KEY TAKEAWAYS

The above cases illustrate significant barriers to DoD's ability to leverage the benefits of GVCs to deliver best value (capability and efficiency) for national security. The erosion of U.S. technological superiority derives from DoD's inability to fully and/or effectively adapt its policies, institutions, mechanisms, and culture to the vastly different global industrial and commercial environment that has arisen in the last 30 years. As Samuel J. Brannen asserts, "[it] is often not the first country to innovate technologically that ultimately realizes the greatest operational advantages of a new military capability, but the military that best imagines the potential of a new technology and *reorders bureaucracies and conventions to exploit latent advantages*" (emphasis added).[61] Defense planners must realize that other countries—allies, competitors, opponents, and everything in between—are positioning themselves to be able to access defense-related innovation regardless of any barriers or controls that the Defense Department and the U.S. government at large enact. Under current policy, DoD's growing move away from the global commercial sector in microelectronics has negative economic consequences in rising component costs of these components, and also has negative implications associated with accessing leading-edge technology for mission critical platforms. The Defense Department's UAS fleet will become increasingly

58. Gansler, Greenwalt, and Lucyshyn, *Non-Traditional Commercial Defense Contractors*.
59. More advanced chips have smaller half-pitches (22 nm) and larger wafers (300 nm).
60. Lawrence K. Harada, "Semiconductor Technology and U.S. National Security," U.S. Army War College, April 2010, http://www.dtic.mil/dtic/tr/fulltext/u2/a526581.pdf.
61. Brannen, *Sustaining the U.S. Lead*.

expensive to procure and behind the technological curve as global and domestic suppliers look to other markets, giving a significant and unnecessary advantage to competitors.

These case studies illustrate how the barriers to global supply chain cooperation have tangible and damaging effects on the Defense Department's ability to effectively procure cutting-edge technologies. In the case of UAS, the MCTR was created to address the use of intercontinental ballistic missiles that may be used as vehicles for nuclear warheads, but was drafted in a way that has proven to be a barrier to signatories' sales of UAS. Other statutory measures like ITAR have placed constraints on the export of UAS technology (in part the result of policy disagreements between the executive and legislative branches of the U.S. government[62]), the resolution of which likely would lead to increased exports. In the case of microelectronics, the Defense Department's requirement for a commercially isolated trusted foundry program has kept leading-edge technologies out of its reach.

If the advantage goes to those who are best able to reorder bureaucracies and conventions to develop latent strengths that leverage global and commercial excellence, the United States will be at a disadvantage that will grow more pronounced over time. How can the United States regain this advantage?

62. Ibid.

# 2 Developing a Federated Approach by Leveraging Global Value Chains

The evolving defense acquisition environment demands a reordering of DoD's approach to acquisition and the supplier base on which it relies. The barriers to federated value chains and the case studies described in prior sections document the mechanisms by which defense trade is restricted. A federated defense approach would facilitate ongoing, if slow, shift toward a more integrated defense market among partner and allied nations.

By leveraging the resources and knowledge of partners, a federated defense system will allow the defense industry to do more with less. As enumerated in *International Cooperation in Acquisition, Technology and Logistics*, there are five interconnected benefits to a federated strategy:

1. Operational benefits: Increasing military effectiveness by improving interoperability with allies and partners.
2. Economic benefits: More affordable products as a result of cost-sharing, achieving economies of scale, avoiding duplicative effort, and increased cooperation at the business-to-business level.
3. Technical benefits: Easier access to leading innovation around the globe and reducing the technological gap among allies and partners.
4. Political benefits: Increased interaction across more levels, stronger alliances and relationships.
5. Industrial benefits: Defense industry will be more competitive and innovative from exposure to an open global market, forming a healthier industrial base.[1]

A federated model is achievable and already occurring in limited cases. The goal would be to build out these cases of successful cooperation to include a broader array of U.S. partners. The private sector, working in cooperation with national governments, is an ideal vehicle to support this goal because it is global by nature, is constantly in search of new markets and partners, and can easily leverage innovation to its advantage. This section

1. Office of the Director for International Cooperation, *International Cooperation in Acquisition, Technology and Logistics Handbook* (Washington, DC: U.S. Department of Defense, May 2012), https://acc.dau.mil/adl/en-US/474405/file/76282/IC%20Handbook%20May%202012.pdf.

will first identify the current mechanisms through which this interaction already occurs and then look at the characteristics and potential mechanisms for developing a more federated approach to defense.

# Mechanisms for International Cooperation and Commerce

The defense trade is highly regulated, and the key tenet for a federated defense approach would be to continue to break down unnecessary or counterproductive defense-related trade barriers in order to encourage the kinds of international business activities that are already happening. Mechanisms for increased and more effective defense industrial cooperation and integration range widely from those that have little U.S. government connection to those that require cabinet-level, congressional, or even presidential involvement. These layers of connectivity have all expanded with growing global connectivity but remain suboptimal for the demands of today's global environment.

## INTERNATIONAL COOPERATION

Government-to-government (G2G) agreements and relationship structures dictate the bounds within which business transactions and relationships occur. Whether via general trade relationships or the many specialized rules regarding trade in defense articles, components, and materials, agreements between governments can be the biggest hurdles or enablers for greater international engagement. Consequently, high-level governmental agreements also incur the highest barriers to execution and implementation due to the range of stakeholders and degree of political visibility.

Reciprocal defense acquisition and procurement memoranda of understanding (RDP MoUs)[2] complemented by Security of Supply arrangements[3] are primary DoD G2G agreements intended to increase access and lower barriers to trade in national security items with partner and allied nations. These agreements take the step from basic defense relationships to codified acquisition agreements. They seek to rationalize and standardize acquisitions, exchange information, and lower barriers to defense trade. These can range from aligning science and technology efforts to sharing R&D costs to waiving the acquisition restrictions of the Buy American statute, to promising to seek to assure the mutual supply of defense goods and services.

2. With Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Egypt, Finland, France, Germany, Greece, Israel, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, and the United Kingdom. See Deference Procurement and Acquisition Policy, "Reciprocal Defense Procurement and Acquisition Policy Memoranda of Understanding," http://www.acq.osd.mil/dpap/cpic/ic/reciprocal_procurement_memoranda_of_understanding.html.

3. With Australia, Canada, Finland, Italy, the Netherlands, Sweden, and the United Kingdom. See U.S. Department of Defense, "Manufacturing and Industrial Base Policy: Security of Supply," http://www.acq.osd.mil/mibp/sec.supply.html.

This report does not address G2G relationships except as they pertain to limiting or encouraging international business cooperation and interaction. While Foreign Military Sales (FMS) ideally represent a crucial pillar for relationship-building and interoperability, they are strictly governmental transactions in which firms simply supply the goods. This report also does not cover business-to-government (B2G) relationships. Direct Commercial Sales represent the primary B2G involvements, executed by a contractor and a foreign government, with the license but not the direct involvement of the U.S. government. Similarly, U.S. purchases of foreign goods direct from international suppliers falls into the B2G category.

At the high end of the industrial spectrum are international cooperative agreements, defined as an "acquisition program or technology project that includes participation by one or more foreign nations, through an international agreement, during any phase of a system's lifecycle." These agreements are highly structured, with involvement of government agencies from negotiation through implementation, and require strict agreements on national responsibilities, funding, etc. While the actual R&D or production may be undertaken by firms within the countries, DoD is very involved.

Use of international cooperative agreements has expanded in recent years. Since the 2008 National Defense Authorization Act, Acquisition Category 1 (ACAT-1) projects[4] are required to provide an analysis of the potential for international partnering, and program managers are encouraged to pursue opportunities that encourage international involvement and improve interoperability. These cooperative agreements can range from RDT&E cooperative research to acquisitions, production, and logistics support. International cooperative programs can help reduce weapons system costs, enhance interoperability, and increase program stability.[5] Under the auspices of these cooperative agreements, firms undertake the research, development, and production required to fulfill the technology requirement. The structure of the international firms participating in the program can be wide ranging.

Each of the above types of cooperation is a positive step in improving cooperation among partners and allies. The institutional foundations report of the Federated Defense Project will delve more deeply into the international agreements that strengthen both strategic and tactical cooperation at the government level. But in order to leverage GVCs,

4. Acquisition Category-1 programs are equivalent to Major Defense Acquisition Programs (MDAPs), which have total acquisition costs of at least $2.79 billion and have been designated as such by the under secretary of defense for acquisition, technology and logistics.

5. Defense Acquisition University, *Defense Acquisition Guidebook* (Fort Belvoir, VA: Defense Acquisition University, June 2013), https://acc.dau.mil/CommunityBrowser.aspx?id=488721; Office of the Deputy to the Under Secretary of Defense (Policy), *International Security Programs Handbook* (Washington, DC: U.S. Department of Defense, 1993), http://fas.org/sgp/library/ipshbook/Chap_08.html. "DoD Instruction 5000.2 requires a thorough analysis of opportunities to conduct cooperative R&D or production for major defense acquisition programs with allies at early decision points in the acquisition process. DoD 5000.2-M (reference rrr) expands the considerations to include foreign military sales, component co-development and incorporation of subsystems from allied sources. The acquisition strategy for non-major programs must include a similar analysis for consideration by DoD Component program review authorities."

companies need to be free to cooperate/collaborate absent the high barriers to interaction that populate the international defense market.

## INTERNATIONAL COMMERCE

While international cooperative agreements are important to pooling resources of partner nations and forcing top-down interaction through offsets, codevelopment, and collaboration programs, these government-influenced programs tend to suffer major challenges. In fact, in a study of international collaborative efforts, the RAND Corporation provided an elucidating footnote, which clarified that "private market arrangements between . . . contractors from different countries are not considered here because these private contract arrangements did not tend to suffer the same types of problems as government-initiated collaborations."[6]

There are three crucial cooperation/collaboration mechanisms through which businesses interact: international teaming, joint ventures, and subcontracting. These mechanisms are what need to be encouraged in order to better capture the efficiency, affordability, and innovation gains made possible in a federated defense approach. In international teaming, companies seek out agreements with international partner corporations to bid jointly on acquisition programs. International teaming agreements involve companies from different countries cooperating and/or collaborating prior to or during the contract proposal process to improve their bid. These teaming agreements generally are prime contractor/subcontractor arrangements for purposes of bidding, though they can create much deeper ties between the corporations and their supplier bases. If the contract is won, the partners integrate their combined capabilities to develop, produce, and if necessary support the contract deliverables. These partnerships can also help access new markets, develop niche capabilities and fill gaps, and help establish strategic alliances.[7] A clear recent example is in the U.S. next generation trainer aircraft (T-X) program, where four teams have bid, each with an American contractor teaming with foreign firms in pursuit of both the U.S. and export markets.[8]

A joint venture is similar to a teaming agreement, except the companies involved create a new legal entity with buy-in from the participating prime contractors, who then share responsibility for executing the contract through the new corporation.

The preponderance of global corporate interaction occurs through contractual arrangements, and this is the level of analysis on which this report is focused. These arrangements vary widely, from subcontracting arrangements centered on performance of the

6. Mark Lorell and Julia Lowell, *Pros and Cons of International Weapons Procurement Collaboration* (Santa Monica, CA: RAND, 1995), http://www.rand.org/content/dam/rand/pubs/monograph_reports/2007/MR565.pdf.

7. Jim Grzella, "Lessons on International Partnering: Teaming for Success" (presentation, 22nd ROK-U.S. Defense Industry Consultative Committee Meeting, Seoul, Korea, November 1, 2013), http://www.ndia.org/Divisions/Divisions/International/Documents/2013%20DICC%20-%20Seoul,%20Korea/Lessons%20on%20International%20Partnering.pdf.

8. Northrop Grumman and BAE Systems (United Kingdom); Lockheed Martin and Korean Aerospace Industries (Republic of Korea); General Dynamics and Alenia Aermacchi (Italy); and Boeing and Saab (Sweden).

requirements of a single prime contract, to contractual arrangements independent of any single prime contract, focused on a strategic relationship, addressing corporate or market objectives. In the modern global commercial market, these strategic relationships provide the backbone of the supply chain infrastructure. In the traditional DoD market, relationships are predominantly governed by prime contractor or subcontract terms, with only the prime contractor responsible for the relationship with DoD. Defense supply chains are vast and complex. The relationships up and down the supply chain, from lower-tier raw materials and commodity piece parts providers, to subcomponent and component providers, to subsystem and prime integrators, are managed fundamentally through these prime contractor/subcontractor relationships.

The defense supply chain already is global, but the transaction costs for integrating a supply chain across borders when hindered by the current defense procurement systems prevent optimizing these global supplier relationships to the degree seen in commercial markets that have leveraged GVCs for greater efficiency and innovation.

# Findings

In 1989, when the process we now refer to as "globalization" was beginning to accelerate, Deputy Under Secretary of Defense for Industrial and International Programs Robert McCormack wrote, "[T]he global nature of today's international marketplace and the realities of flattening or decreasing defense budgets dictate a more interdependent and streamlined approach to how and what we buy, with other nations participating in a greater share of development and production."[9] Twenty-five years later, globalization continues to deepen as technological changes in information, communication, and transportation reduce barriers to the movement of goods, ideas, people, and culture. While important advances have been made in the internationalization of defense development and production, the defense sector continues to lag most other industries with respect to leveraging the economic and technological benefits of GVCs. As it did in 1989, the United States faces declining defense resources increasing the need for more global, integrated, and efficient programs. However, many of the barriers to leveraging the benefits of increased globalization of defense development and production remain today.

DoD has taken steps toward greater involvement with partners and allies, including seeking joint development opportunities, increasing bilateral relations, and pursuing security assistance activities. While these strategic G2G agreements set the environment for interaction, most cross-border connectivity occurs at the business-to-business level. This leads to four key takeaways for policymakers as they consider how to get the most out of a commercially focused private sector that, increasingly, DoD needs more than the private sector needs it.

9. Robert McCormack, "Bolstering Defense Industrial Cooperativeness through International Cooperation," *Defense* 89 (March/April 1989): 10–13, http://www.disam.dsca.mil/pubs/Vol%2011-4/McCormack.pdf.

1. *GVCs Are the Present and Future of International Commerce.*

Globalization is not a policy choice; it is a fact of the global operating environment that must be recognized. International flows of goods, services, and finance have eclipsed one-third of global Gross Domestic Product–one in three goods sold or financial transactions made now occurs internationally.[10] Eighty percent of that global trade can now be tied to GVCs coordinated by transnational corporations.[11] Globalization has proceeded in pace with the technological innovations that accelerated the rate at which goods, technology, and ideas can be transferred, allowing for deep specialization and fragmentation of the production process. The firms that have adopted these advantages enabled by globalization have improved operating efficiency and accelerated the pace of product and process change to better meet demand and enhance values. These organizations have also discovered how to leverage and insert outside innovation into their products and how to disseminate these innovations faster, more broadly, and more efficiently.

The GVCs that have come to define today's commercial business environment have proliferated due to the extensive benefits they provide to the firms that employ them. These benefits include access to innovation, cost reduction, productivity increase, global reach, and supply resilience. The earlier example of Procter & Gamble, which increased its R&D productivity 60 percent and lowered expenditures after it changed its R&D systems to access innovations from outside the company, demonstrated the productivity and innovation gains to be achieved by switching from a centralized to a globally networked model. Apple, which specializes in invention, design, and branding while using GVC partners to manufacture components and handle assembly, has grown shareholder value and return on capital. Apple is the exemplar of a fast-moving innovator that owns no manufacturing assets but instead focuses on core competencies while using specialized partners across the production chain to deliver goods at speed and scale. Throughout the commercial sphere, GVCs are delivering higher returns to capital and allowing for faster adaptation to changing markets. That trend will continue.

2. *The Defense Department Can Gain from GVC Integration.*

The natural state of the business environment today is one composed of and defined by GVCs. The Defense Department could realize significant gains by easing restrictions on global business-to-business interaction in the defense industry wherever feasible. As technological innovation becomes more diffuse, the Defense Department will need to reach farther to uncover and access the cutting-edge technologies. U.S. allies and partners, which are already among the most advanced and dynamic

10. James Manyika et al., *Global flows in a digital age: How trade, finance, people, and data connect the world economy* (San Francisco, CA: McKinsey & Company, April 2014), http://www.mckinsey.com/insights/globalization/global_flows_in_a_digital_age.

11. UN Conference on Trade and Development (UNCTAD), *World Investment Report 2013: Global Value Chains: Investment and Trade for Development* (Geneva: UNCTAD, 2013), http://unctad.org/en/publicationslibrary/wir2013_en.pdf.

innovators in the world, will provide a secure and ready source for these future innovations.

In the future (as in the past), militaries will find success by leveraging the diverse resources and knowledge of capable and reliable partners, giving them access to technologies and processes they could not have acquired independently. While DoD does not respond to the same incentive structure that a firm in the larger commercial sector does, opportunities presented by GVCs are still attainable within the incentive structure of the Defense Department. At its core, DoD wants to deliver the best products and services to its warfighters for the best value, and this can best be delivered by a cadre of suppliers, innovators, and producers from throughout the industries of the United States' trusted partners and allies.

3. *The Defense Department Is Insufficiently Leveraging GVCs.*

These gains will not be realized under the current scenario because the Defense Department hinders a value chain approach by its suppliers, putting them directly at odds with commercial reality. Domestic content requirements, joint venture requirements, and technology transfer requirements are typical of the "old view" of trade.[12] Export restrictions directly inhibit businesses' ability to engage overseas, denying access to markets and commercial partnerships that are vital to innovation. Barriers to inward investment equally dissuade potential foreign partners from working with U.S. firms. The security concerns that spawned these restrictions and many of the regulations discussed earlier are reasonable, and persist today. Nonetheless, DoD needs to recognize the importance of managing these risks in ways that maximize access to the increasingly crucial technology developments in the global market as well as global skill sets. DoD must account for and manage the risks from particular partners, or products and components, or supply security in ways that also recognize the efficiency and innovation access tradeoffs of security measures and barriers to trade.

The "life cycle" during which the Defense Department moves from being a leading technological innovator to a direct consumer now happens over a shorter time horizon. As technologies advance, failing to develop an industrial model that keeps pace with the external environment carries increasing risks. The result is that the commercial base for the Defense Department outside of the heritage defense suppliers could continue to shrink, diminishing potential sources for innovation, especially as warfighting and logistical technology evolves. The Defense Department has maintained its technological edge relative to other militaries and nonstate actors, but this edge will be harder to sustain if DoD fails to take advantage of the opportunities possible from utilizing GVCs. Delaying GVC integration will only increase future costs, make the transition more complicated, and give an unnecessary edge to competitors who are able to realize such gains independently.

12. Ted Moran, "From Trade to Trade-and-Investment" (presentation, CSIS, Washington, DC, October 30, 2013), http://csis.org/event/global-value-chains-and-development.

4. *A Federated Defense Model Is Only Achievable if the Defense Industry Can Better Access and Incorporate GVCs.*

A federated defense approach is the most workable solution to the broad security challenges facing the United States and its partners because it allows for the ideal calibration of political, military, and commercial integration. As states move progressively toward this scenario, commercial integration at the private-sector level will be the foundation that supports federated strategies at the governmental level, while governments can enable commercial integration by thoughtfully reducing barriers to private-sector cooperation in the defense industry.

As in the commercial world, the ideal model for the defense industry is an unfettered free market where firms can trade and interact freely across borders—taking advantage of the productivity and innovation of the global markets. A completely open U.S. defense market may be unrealistic because of the need to protect intelligence and other classified information and because of legitimate security of supply concerns, but the market can be much more open than it is currently and to the benefit of defense planners around the world. By removing the most onerous barriers or amending those that have unintended consequences for the defense industry, the U.S. government can open up its defense industry to greater commercial possibilities including faster turnarounds, more innovative capabilities, and more efficient acquisitions, while still recognizing and managing the most significant risks.

Both the United States and its partners will benefit from easier access to each other's innovations. This additional interaction and integration of technology will improve coordination among partners and interoperability in a more organic manner than simply assigning tasks and diffusing capabilities.

Lastly, GVC integration and the diffusion of technology among partners likely will enable a more cost-effective means to provide logistical support to large multinational operations. The status quo alternative takes more time and money, which is unrealistic at a time when defense budgets are shrinking by law. Given that future conflicts are likely to be multinational and dispersed geographically, adopting GVCs will be essential for future warfighting and allied cooperation.

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