Defense Business Board

DBB FY25-01

Industry Partnerships for Crises

November 12, 2024

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1. Executive Summary

1.1. Tasking

On May 16, 2024, the Deputy Secretary of Defense tasked the Defense Business Board with examining the current state of Department of Defense (DoD) dependencies on, and ability to, partner with the private sector to surge capability. The Terms of Reference (ToR) document, formally tasking the Business Operations Subcommittee, can be found in Appendix A. The primary deliverable is a set of recommendations on ways the Department can build better partnerships with the private sector for a reliable and rapid "expand-on-demand" capacity in a crisis.

While the Study takes place against the backdrop of DoD's increased focus on the munitions industrial base owing to shortages and the increased burden of supporting U.S. allies and partners, it is not acutely scoped to munitions alone. This Study proposes actions the DoD can take *today* to establish, structure, and manage relationships with the private sector to quickly expand capacity across a broad array of products to address tomorrow's national security crises.

1.2. Introduction

The subcommittee tasked with this initiative interviewed over 25 key executives in the DoD and private industry. It began every interview with the same question: "Is there a capacity problem in the defense industrial base?" All parties shared concerns. The overwhelming agreement across the defense landscape is troubling, particularly in a military-industrial complex that often struggles to achieve consensus.

The COVID-19 pandemic, wars in in the Middle East and Europe, and tensions in the Indo-Pacific theater have intensified demand for supplies and equipment in support of U.S. allies. Peer competitors are on the rise, with increased technological and production capacity, growing bolder every day in their ambitions to alter the stability of the post-Cold War international order.

This is not the first time the U.S. has been tested in this way and during each successive time in its history, it has emerged more capable and resilient then before. To develop the surge capability and amass the capacity needed to emerge from these challenges, the DoD will need to strengthen its own processes, people, and the capability it has always relied on, its industrial partnerships.

1.3. Bottom Line

The DoD is in many ways a difficult partner. It has limited authority over its own budget, decision makers and priorities change frequently, processes are complex, and information is purposely guarded. Finding the entry point to begin a business relationship with the DoD is often a bridge too far for most companies.

That said, it is clear the DoD understand the capability and scale that the private sector provides and the challenges it must overcome to harness its full potential. To that end, it has implemented many changes and improvements to foster greater

access and collaboration. It is this Board's assessment that the Department is on the right track but, it must continue to remove barriers to prepare for the next crisis that will inevitably come.

More importantly, the DoD must learn from the lessons of the past to beat the lead times that have gated U.S. victory in many historic conflicts. It was production lead times that caused American forces to fight World War I (WWI) with foreign equipment, to wait nearly two years for the "arsenal of democracy" that assured its victory in WWII, or to resupply its own weapons inventories dispatched in support of Ukraine.

To overcome the "lead time dilemma," DoD must rethink its own policies, utilize novel contracting approaches, possibly pursue statutory changes, embark on new partnership agreements, and embrace additional investment in the domestic industrial base in a way it hasn't before. Innovative approaches, like those used on Replicator, the DoD's ambitious project to deliver drones to warfighters, should become the rule, not the exception.[1]

1.4. Findings and Recommendations Summary

The views and experiences of professionals and executives in and outside the Department were critical to providing perspective on this project. Ultimately, the subcommittee coalesced around the following key findings and recommendations. Additional detail on the findings and examples can be found in Section 5 of this report; recommendation details are found in Section 6.

	Findings Summary	Report Section
1	The Civil Reserve Air Fleet and similar public-private partnerships are the gold standard for mechanisms to ensure capacity in a crisis.	5.1
2	Companies need signed contracts and profitable financial results to remain in business with the DoD.	5.2
3	Foreign military sales or commercial sales can be used to level demand curves for some systems/supplies.	5.3
4	The requirements and design processes used in DoD acquisition are not optimized for partnerships with the broader commercial sector.	5.4
5	For other supplies and systems where there is neither FMS nor commercial demand, direct investment may be necessary.	5.5
6	Adversarial tensions often pervade contractual relationships between DoD and industry, to the detriment of supply, cost, response, and surge capacity.	5.6
7	Regulations and statutes need to adjust to account for the changing environment of the defense industrial base. Contract strategies, bona fide need rules, and new start policies are all opportunities for improved partnership.	5.7

	Recommendations Summary	Report Section
1	Assess developing a "Software Surge" program. Investigate the costs and benefits associated with building a pool of software developers to be "activated" to make changes to familiar systems during a crisis.	6.1
2	Develop a set of metrics that accurately assesses the "surge health" of contractor-provided weapons systems. Metrics should be applied to establish a "surge readiness score" or as the basis for rewards to primes/subs who meet established surge metrics.	6.2
3	Negotiate capacity ahead of time. Establish variable pricing agreements/pricing tables on select weapon systems procured in high quantity to expedite awards should demand escalate and additional budget be made available.	6.3
4	Establish a "capacity-as-a-service" pilot program to negate the effects of long lead item delays on capacity for critical weapon systems. Establish contractual vehicles with mechanisms to share fixed costs/holding costs of long lead components to ensure latent production capacity on select critical capabilities.	6.4
5	Implement a collaborative planning, forecasting, and replenishment-type process, including probabilistic forecasting Option Theory, leveraging technology, driven by the DoD, and encompassing its major munitions and material suppliers.	6.5
6	Expand the Warstopper program. Increase the budget for DLA's Warstopper program by 10x to identify and invest in additional national security-critical businesses to ensure capacity during crisis.	6.6
7	Map the critical weapons and materiel supply chains (sources and point of origin) to ascertain chokepoints and vulnerabilities in terms of supplier risk and surge capacity and response.	6.7
8	Develop and hire the necessary talent who understand private sector business imperatives: demand management, demand-supply matching, forecasting, options planning, and the common and advanced technologies available.	6.8
9	Revise bona fide need rule exemptions. Refine DoD bona fide need policies to allow for critical long-lead parts and components to be stocked at wartime consumption rates.	6.9
10	Work with Congress to exempt existing acquisition programs transitioning from the development to the procurement phase from being considered "new starts" to avoid unnecessary cost increases and program delays during continuing resolutions (CRs).	6.10
11	Work with Congress to, where reasonable, transition the defense budget structure from individual program line items to portfolios based on common capabilities.	6.11

1.5. Acknowledgements

Throughout its review, the subcommittee was impressed by the professionalism and ambition of various DoD organizations to recognize challenges and foster ways to improve partnerships. Some of these programs, organizations, and activities are highlighted below; we commend them for their exceptional work:

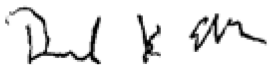
- **TRANSCOM's Civil Reserve Air Fleet (CRAF) Program:** A cooperative disaster preparedness program established in the 1950s to supplement DoD transport aircraft requirements with commercial aviation assets from over 25 U.S. companies. The success of the program is attributed to a commitment to transparency and equity that fosters participation and ensures access to essential airlift during crises.
- **Defense Logistics Agency's (DLA) Warstopper Program**: A program created in the wake of Operation Desert Storm to ensure the availability of mission critical items during a wartime surge if peacetime requirements are insufficient to maintain an industrial capability. It partners with the Joint Staff and Service leads to identify at-risk commodities within the DoD inventory and then takes action to mitigate delays.
- Space Systems Command**'s** (SSC) Commercial Space Office (COMSO): Touted as the United States Space Force's "front door," the COMSO provides small and non-traditional defense companies a starting point and partner to enter and navigate government business opportunities. Through the Commercial Augmentation Space Reserve (CASR), a new initiative in 2025, the COMSO plans to establish a CRAF-like partnership with commercial space businesses to leverage the scale of the private sector for national security objectives.
- Joint Program Executive Office for Armaments & Ammunition (JPEO A&A): JPEO A&A is at the forefront of the effort to replenish U.S. munitions. Despite only modest facility investments since WWII, the office is making strides to ramp-up production by partnering with the defense industrial base on several initiatives to broaden the munitions production infrastructure in the U.S. Further, JPEO A&A is working with partners to navigate the heavily bureaucratic environmental permitting process to onshore domestic supplies for tomorrow's crises.

1.6. Final Comments

The DBB appreciates the Deputy Secretary's confidence in entrusting the Board with this important Study. We sincerely applaud the hardworking professionals of the defense industrial base who toil tirelessly to support our Nation. Without their dedication, America would not be the preeminent power it is today.

Respectfully submitted,

Dr. Christopher Gopal
Subcommittee Co-Chair



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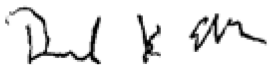

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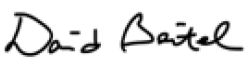

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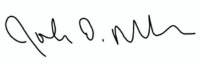

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3. The State of the Defense Industrial Base

Today's defense industrial base was shaped by the events of American and economic history. From the Great War to Great Power Competition, the relationship between DoD and the private sector has always been, and will likely always be, dynamic. To identify the actions to foster continued progress, it is first important to baseline the direction in which the relationship is moving, summarized in the sections below. Additional historical context can be found in Appendix I.

3.1 The DoD has become increasingly reliant on industry over time.

The DoD has continually become more reliant on industry for the capabilities it brings to bear in conflict. Prior to WWI, the Army and Navy operated just a few arsenals and shipyards with limited production capacity. Mobilizing commercial industry was the only way to accomplish an arms buildup for major war. Over time, defense became a sustainable, primary business.

Today, the defense industrial base employs over 1.1 million U.S. workers across almost 60,000 companies, operating in facilities throughout all 50 states. In fiscal 2022, DoD vendors were awarded contracts worth over $390 billion and supplied nearly all the weapon systems, equipment, and supplies utilized by military operations around the globe. Many of these products were provided as part of contracts with the five major integrators accounting for one-third of all contract dollars awarded each year since 2019.[2]

The DoD continues to maintain dozens of industrial facilities, as it did over 150 years ago, but has turned over the manufacturing of end items in these places to the private sector. For instance, the Army owns ammunition plants that produce most of the military's conventional ammunition, propellants, and explosives, but all are contractor operated.[3] The Air Force maintains depots and the Navy operates public shipyards, but their mission is to maintain, repair, and overhaul existing systems, not to produce new ones.

Over time, technological innovation has become more commercial as well. In 1960, the Federal Government accounted for 65% of all research and development (R&D) expenditures in the U.S.—twice as much as U.S. companies.[4] By the late 70s, and ever since, U.S. businesses steadily outspent the Federal Government. Today, U.S. companies make up 77% of all R&D spending in the U.S. Even more stark is the decline of Federal Government R&D spending on defense, which as a share of global R&D fell from 36% to 3.1% from 1960 to 2019.[5]

While the DoD continues to advance the reaches of science through the Defense Advanced Research Projects Agency (DARPA) and other Service-led research laboratories, it relies heavily on the achievements of private industry to develop and leverage leading technologies in areas such as autonomous vehicles, artificial intelligence (AI), reusable rockets, additive manufacturing, and quantum computing.

With big tech focused on these emerging technologies for non-defense applications, venture capitalists (VCs) have been pouring money into budding defense technology startups in hopes of attracting government interest. Since 2021, VCs have invested $100 billion into technology startups. However, as of fiscal 2023 these startups had only received about 1% of the annual defense budget.[6]

3.2 The defense sector has consolidated since the end of the Cold War; its supply chain has shrunk and become less resilient.

The defense business landscape underwent transformative change following the Cold War. In the Department's meeting with major industry executives in the fall of 1993, it announced that it could no longer generate the demand needed to maintain the sector at its current size. Within a constrained fiscal environment, it didn't want to fund half-empty production facilities at the expense of limited R&D dollars. Department leadership at the time estimated that it would only have budget to employ a single major company in nearly half of its 16 product categories.[7]

Soon, the number of prime contractors dwindled and nearly two-thirds of production capacity was lost. The industry became less competitive and more fragile almost overnight, and since that time, has not improved.[8] While a February 2022 DoD report did not find correlation between consolidation and an increase in program price, it did identify a lower overall motivation to deliver cost, schedule, and performance benefits to the Government. The researchers also concluded that risk had increased in the availability of key suppliers.[9] Concerns over availability are not only attributed to the shrinking domestic marketplace, but to fears over large system integrators (and smaller companies) who have sourced the same group of suppliers in adversarial countries, creating potential "chokepoints" and supply disruptions as well.

There is clear evidence that consolidation has hurt supplier availability. In a non-competitive environment, there has heretofore been little incentive for major primes to source and maintain multiple suppliers for the same subcomponent. Fewer primes and delivery orders have led many lower tier suppliers to close their doors, unable to sustain a business that relies on military-unique products and raw materials. Talented, highly skilled workers have departed for other opportunities. They are not joining the DoD or defense-dependent large companies and are difficult to recruit back. The 1.1 million defense sector workers cited above, is down from 3 million in 1985. In the last five years, over 17,000 companies have left the defense sector, including droves of small businesses, whose participation has declined by 40% since 2011.[10][11]

Consolidation has also magnified the power of the primes in the defense ecosystem as well. If sub-tier suppliers want to work with the DoD, their best chance is through one of these major systems integrators. But because their contract is with the prime and not the Government, sub-tier suppliers do not benefit from the DoD's advantageous financing terms, like progress payment, which obviate the need for

high interest debt. A 2023 Institute for Defense Analysis study found that primes made progress payments to their suppliers only 50% of the time, and in 30% of the cases reviewed, paid invoices late even after full delivery of material.[12] For suppliers, often operating under tight profit margins already, unfavorable financing and cashflows can often spell insolvency for their businesses.[13] But in a heavily consolidated market, they have little recourse if they want to participate in the defense business.

3.3 Military systems have become fewer in quantity and more complex.

If there wasn't enough pressure on the supply chain already, DoD requirements for the systems it needs to maintain its strategic advantage have never been more complex. Today's billion-dollar weapons programs and platforms are filled with advanced stealth coatings and other exotic materials, semiconductors, satellite navigation, software, composites, and the like. One interviewee told the subcommittee that a particular system his command employs contains 75 times more parts than the legacy version. The infrastructure, special tooling, equipment, and skills needed to develop and manufacture modern systems make WWII-style mobilizations seem unlikely in the future, at least in a reasonable amount of time.

Smaller fleets and shorter production runs further discourage entry in the defense space as firms calculate the risk of return on their capital investment. The U.S. Navy is smaller than it was 40 years ago.[14] Today's Air Force maintains a fighter aircraft force that is 40% the size of what it had during the Cold War.[15] The U.S. Army has roughly 30% less tanks than it did in 1980.[16] Lower quantities don't just mean fewer orders, it can drive a steeper production learning curve that may limit profits, especially when prices are firm.

With a strong push toward fixed price contracts in the preceding decade, even the major defense contractors are hesitant to take on new projects that could lose money. In January 2024, Northrop Grumman announced that, due to inflation, pandemic supply chain stressors, and labor challenges, it would lose $1.5 billion building the B-21 Raider.[17] The Air Force plans to buy just 100 aircraft to modernize its fleet of bombers (it had 1,526 in 1960). At these quantities, it will take years for Northrop to make profits. The experience has caused the company to pass on the Air Force's sixth generation fighter program due to risk-reward calculations.[18]

An often ignored and critical driver of increased complexity and cost is the DoD process for developing and changing key requirements for weapons systems. The subcommittee heard from several officials in DoD and private industry that the DoD tends to change and revise its requirements after the design phase. This is often done with little attention to the necessity for the changes, program costs, impacts on capacity or delivery schedules. This results in smaller quantities, higher costs, and delivery delays. More, some from industry noted with frustration experiences in which they had provided proposals based on projected buy quantities, only to have the government later reduce those quantities substantially. As a result, what were

thought to be modestly profitable (and sustainable) contracts in the end resulted in losses which discouraged further pursuit of similar contracts.

3.4 Corporations have expanded globally, relying on raw materials, low-cost manufacturing, and labor from foreign markets, while offshoring production assets, technologies, and capabilities to foreign firms.

Innovation in the transportation, communication, and information technology sectors, coupled with economic policies on trade, have driven the steady globalization of business over the last century. Today, more than 90% of North American firms have relocated at least some of their production overseas, including most S&P 500 companies who owe 41% of their revenue to foreign consumers.[19][20]

Free trade policies on the part of Western nations have encouraged businesses to move their production facilities to locations where labor and other costs are lowest and where regulations are minimal (if not non-existent). The problem with this was that several large economies and countries adopted a more mercantile policy, with tariffs, taxes, restrictions, and tax incentives. The trend ignited a redistribution of jobs around the world, especially in factories. In the U.S., the number of manufacturing jobs fell from a peak of nearly 20 million in 1979 to less than 13 million in 2018.[21]

Globalization has also influenced the market for raw materials, like the rare earth metals used to manufacture today's advanced electronics and weapon systems. As it became easier to shop the world for low-cost inputs, mining and processing thinned to isolated countries or regions that could do it cost-effectively. The Mountain Pass mine, which sits on the border of California and Nevada, was once the world's largest producer of rare earths. Mountain Pass is what Saudi Arabia is to oil, one industry expert remarked. But the mine shut down in 2002 amid financial and environmental challenges—it was just too costly to operate.[22]

By contrast, companies in countries with access to cheap labor and relaxed regulatory environments have prospered over the last thirty years—including those within China, who as of 2023 own 60% of the world's rare earth market.[23] The impact on the U.S. has been significant—declining skillsets, education preference for liberal studies over hard skills, and poor STEM performance by U.S. students.

3.5 Impacts on Weapons, Munitions, and Material Acquisition and Surge Capability.

These factors, have in turn, given rise to several challenges and problems in the delivery of fast, on-time, on-budget, cost-effective, and rapid-response weapons, material, and munitions supply. They include:

- Lack of competition among contractors, as contracts are often awarded to a relatively small number of companies. This is the result of increased consolidation in the industry, a flawed requirements process, and the increasing complexity of new weapons systems.

- Lack of flexibility and the use of a "one-size-fits-all" set of acquisition and contracting processes in an age of increasing technology developments, life cycles, needs, and warfare demands.
- Cost overruns owing to a broken requirements generation and completion process, shortcomings in program acquisition and management talent, a complex web of regulations, increasing product complexity, R&D costs, and the cost of maintaining production capacity and a skilled workforce.
- Limited innovation given the lack of competition, focus on cost containment, and limited demand commitments.
- Heavy dependence on foreign suppliers for specialized materials, many in adversarial countries, often procured on an "as-needed" basis. The reliance creates significant vulnerabilities in the supply chain and makes it difficult to respond quickly to changes in demand.
- Lack of a long-term, end-to-end supply chain, planning and execution perspective involving DoD, Congress, and contractors, which can lead to a lack of a long-term supply strategy, surge capability, and a supply-demand mismatch.
- Talent shortfalls in design, development, technology, data, analytics, manufacturing, and supply chain management.
- Budget and financial constraints which include "the color of money," timeframes, and resources allocated.

These problems are evident in the shortages of munitions being experienced today. In addition, they also manifest themselves in the results of major programs.

Unequivocally, these are challenging programs with complex issues. Equally complex, is the system the DoD uses to identify and fulfill its needs. It is the complexity of the DoD demand system that makes the signal it produces as difficult to optimize as it is important to the proper functioning of the defense industrial base.

Oversimplified, demand for materiel in the DoD comes from users (e.g., warfighters) based on the gaps between the current inventory and mission needs compelled by operational and strategic guidance (e.g. Operations Plans, National Military Strategy, National Defense Strategy), validated by a collaborative body (e.g. Joint Combat Capability Assessment Process), balanced with other near term and strategic priorities (e.g. Defense Planning Guidance, Affordability Assessment), budgeted for by a headquarters sponsor (e.g. Major Commands, Service Plans & Programs Leads (the "8's")), acquired by program offices (e.g. Army JPEO for A&A, Air Force PEO Weapons) partnered with defense companies, and supported by logisticians (e.g. DLA, Depots, Arsenals, and Shipyards), who create tangential demand themselves through parallel processes to maintain the equipment based on warfighter utilization requirements. If the demand necessitates an item or capability

that does not exist, it enters one process (e.g., Joint Capabilities Integration and Development System (JCIDS)). If demand necessitates a change in quantity or tactics for an existing asset based on periodic threat assessments or adjustments to strategic guidance, it is handled through another (e.g., Munitions Requirements Process (MRP)).

There are processes to react to urgent needs (e.g., Joint Urgent Operational Need) and waivers/pathways to skip processes or portions of the process altogether (e.g., Sole Source Justification & Approval, Middle Tier Acquisition). Processes, decision authorities, and execution differs based on the amount and type of money used to procure the item (e.g., work capital funds, micro-purchase thresholds, appropriation categories, new starts, major programs). Some materiel is governed by special steering committees and working groups (e.g., MRP Steering Group, Position, Navigation, and Timing Steering Group) and include dozens of stakeholders across the Combatant Commands, Military Departments, Defense Agencies, and beyond. Other materiel is regulated by policies and laws that dictate where and from whom it can and cannot be purchased (e.g., Buy America Act, Federal Acquisition Regulation Prohibited Sources, the Berry Amendment).

In short, the way DoD depicts and fulfills its needs today is multifaceted, multifactorial, and methodical. While the system is the result of decades of deliberate formulation to produce results under a bevy of constraints, it often struggles to produce the quick, decisive action needed in crisis.

The structural, management, and institutional factors that operate within the demand system depicted above cannot be effectively addressed in a piecemeal functional fashion. In today's integrated, risky, and variable, uncertain, complex, and ambiguous (VUCA) environment, they must be addressed holistically for maximum effectiveness.

4. Why partnerships are increasingly important for the DoD.

To succeed over its adversaries in the face of the defense sector trends of the time, it is imperative that the DoD enhance the structure that has sustained it for decades: partnerships. Here's why:

4.1 G**reat power competition threatens to unseat the U.S. as the world's** only superpower and to substantially harm its freedom of movement.

Intensified competition with China and to a lesser extent, Russia, has vaulted "great power competition" back into the lexicon of national leaders, especially within the DoD. The NDS's characterization of the U.S.-China relationship has evolved over time, from one that encouraged "a degree of hope" in 2005 to the "most serious and comprehensive challenge to U.S. national interests" by 2022.[24][25] Burgeoning cooperation between China and other regional threats, including North Korea, Iran and its proxies, only exacerbates these fears. The outlook on Russia has also deteriorated and continues to decline on an almost daily basis, underscored by its invasion of Ukraine in 2022.

The Chinese Communist Party (CCP) and its leader President Xi have openly decried the current global order in the post-WWII world, which it perceives as unfairly stacked in favor of the U.S. and other western democracies. The CCP has not been afraid to communicate its vision to disrupt the current international system and has been working towards this goal for quite some time.[26]

Between 2001 and 2011, China increased its military spending 189%, with massive annual defense budgets second only to the U.S.[27] Through its Military-Civil Fusion (MCF) strategy, an aggressive nationalization of its defense industrial sector, China has made impressive strides towards its goal to build the most technologically advanced military in the world. It currently possesses the world's largest maritime and ground forces with 234 warships and over 2.2 million soldiers. China has developed its own fifth generation fighter jet, has rejected talks to quell the growth of its nuclear triad, and in space, has taken major steps to build a satellite constellation double the size of SpaceX's Starlink.[28][29][30]

China has used its growing military capabilities to redraw the map in the South China Sea, staking claims to islands and waterways that violate the sovereignty of its neighbors. Its rhetoric has more recently escalated across the broader Indo-Pacific, including land disputes along its border with India, threats to annex the self-governing Taiwan, and claims on the Spratly Islands.[31]

In total, the growth of China and its global aspirations present a challenge for the U.S. and its Allies. China is not just after economic growth and prosperity; it does not only desire leadership on the world stage—to make a monopolar world from the unipolar system that has existed since 1991. China's actions indicate that it wants to exist without counterbalance, free to conduct policy in the world in the manner it chooses. Freedom to act unencumbered by sanctions, or diplomatic and military pressure, or trade and currency restrictions and that its partners can do the same—whether Russia, or North Korea, or Iran. Even if that policy violates the rights and sovereignty of people, corporations, economies, or other nations around the world.[32]

4.2 Adversaries **utilize a "whole of country" approach, integrating defense** and private industry.

Many countries have adopted, and others are launching specific initiatives using, a "whole of country" approach to defense supply, manufacturing, and technology development. The "whole of country" approach uses an "end-to-end" collaborative effort to leverage the combined expertise, capacity, and resources of government, industry, and academia to ensure national security.

There are several examples of this in different areas and contexts. For instance, DARPA fosters collaboration between government, academia, and industry to develop cutting-edge technologies for national security, in areas ranging from AI and robotics to advanced materials. In a similar fashion, Australia has established the *Comprehensive Defence Handbook*, which outlines a whole-of-government approach to national security, emphasizing the importance of collaboration across

various government departments and agencies. It also provides guidance and addresses key issues such as integrating defense planning with other national priorities, including economic development and sustainability. The Ministry of Defence (MoD) in the United Kingdom has launched the Defence Innovation Initiative, which aims to harness the collective expertise of the defense industry, academia, and the wider innovation community to deliver cutting-edge technology and capabilities to the armed forces. To quote from their site, "The plan will transform how defence deals with the challenges of tomorrow, to gain critical advantage for our defence and security forces."[33] All these examples in western countries require a win-win scenario of operation and contracting among the DoD/MoD, the legislature, industry (and, in some case, academia) and, as such, becomes a bit more complex to institutionalize.

Far more concerning is the approach by adversarial, mainly autocratic nations. They do not need a win-win set of scenarios to marshalling a "whole of country" approach. China has implemented initiatives such as its MCF strategy, which aims to leverage the country's entire industrial and technological base to support defense modernization, and drives collaboration between the military, civilian industries, and research institutions. Their current efforts involve a very close integration, flexible operation and exchange of ideas and capabilities between the PLA or CCP and industry. Russia has a long history of integrating defense manufacturing and technology development across various sectors of the economy. Many companies are involved in both defense and non-defense production. This approach has enabled Russia to recover quickly and maintain a strong defense industrial base despite economic challenges from the West. The "Make in India" initiative promotes domestic manufacturing and technology development in various sectors, including defense. This initiative encourages collaboration between the government, industry, and academia to develop advanced defense technologies and promote self-reliance in defense production.

While many of these instances involve the development and manufacture of defense equipment, they do not seem to overtly involve the surge capacity and ramp capability needed by the U.S. today and in the future. The lessons learned, however, are very applicable to the surge situation and include:

- Central planning
- Non-adversarial relationships
- Flexible ways of doing business
- Common objectives
- Win-win scenarios
- End-to-end collaboration
- And, in certain countries, sourcing guidelines

The main take-away is that speed, response, risk management, and efficiency can best be achieved in a "whole of country" approach that emphasizes these characteristics.

4.3 DoD budget as a % of GDP has declined over time and is unlikely to return to WW II, Vietnam, or Cold War Era levels.

The fiscal 2024 defense budget request was $842 billion dollars. It was the largest in history and represented a 3.2% increase from the prior year—almost three times the annual budget during the Cold War.[34] It rivals what all of NATO spends per year and is greater than Chinese ($232 billion) and Russian ($109 billion) spending combined (at least what their governments are willing to disclose).[35][36]

However, as a percentage of GDP, the 2024 budget request was near-record-low at 3%. Budget allocation as a percentage of the total economy has steadily declined over time. During the Vietnam War, defense spending equaled 9.27% GDP. During the Cold War it was at 6.45%.[37]

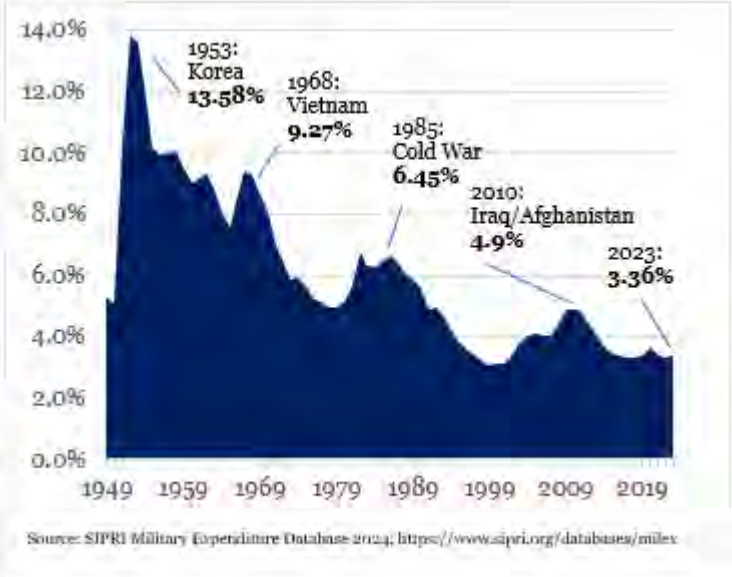

Figure 1: U.S. Defense Spending as a percent of GDP over time.

Over time, U.S. defense strategy has been adjusted to account for new budget realities with respect to the challenges of great power competition. After the Cold War, the force-planning construct was based on the capabilities needed to *defeat* two regional adversaries simultaneously—assuming those adversaries were inferior rogue states or non-peer competitors. After budget control measures began in 2011, PRC posturing, and the Russian annexation of Crimea in 2014, U.S. planners realized the two-war strategy would be extremely difficult in the current budget environment if the adversaries were peer challengers. Based on these events and fiscal realism, the U.S grand strategy was altered to state that the fully mobilized military would be capable of defeating a threat in one theater while *deterring* aggression in another. The debate around great power competition has raised questions about whether defense resource levels should be reconsidered based on this change in philosophy.[38]

Critics argue that national defense appropriations are bloated and costs nearing the trillion-dollar mark threaten the nation's ability to afford other priorities, including entitlement programs like Social Security, Medicare, and Medicaid. Others contend that large defense bills put pressure on the ballooning national deficit or that Allies should contribute a greater share to the cost of protecting western interests. As of July 2024, 23 of 32 NATO allies met the 2% target for military spending per GDP, a notable increase since Russia invaded Ukraine.[39]

Passing the annual budget has become increasingly contentious over the last 25 years. Appropriations have not been enacted on time since 1997 and have resulted in a government shutdown three times in the last decade. Continuing resolutions are commonplace now, last on average for five months, deny new starts of critically needed system acquisitions, and cap spending at prior year levels, complicating the financing for major systems. Considering the strain required to pass a budget at 3% GDP, it is unlikely to believe that defense funding proportions will consistently return to Cold War levels any time soon.[40] It is more likely, that supplemental measures will continue to be used to resource sudden crises and surges.

4.4 Capacity exists in the private sector that cannot be easily or affordably maintained organically.

As mentioned above, the U.S. currently enjoys a truly historic economy. In July 2024, the value of the total goods and services it produced exceeded $28 trillion, representing over a quarter of the world's GDP.[41] Six in ten of the world's largest public companies are U.S.-owned.[42] Clearly, the private sector has capacity that the DoD cannot match.

For instance, the U.S. commercial aviation industry operates over 7,000 aircraft, about twice the number of transport aircraft (cargo and personnel) as the DoD.[43][44] There are 6,120 hospitals in the U.S. versus the 45 in the DoD.[45] SpaceX's rockets can carry more satellites into orbit then anyone else's. U.S. automakers produced over 320,000 heavy trucks in 2022, about one tenth of all trucks produced worldwide.[46] And that's just end items. The capital, talent, equipment, facilities, and supply chains used to produce goods and services at scale vastly exceeds DoD's ability to organically develop and maintain capacity on its own. It is imperative therefore, that the Department orchestrate ways to reduce sourcing risk and leverage this capability.

On the downside, the U.S. has lost some of its capacity to manufacture and supply critical products such as pharmaceuticals, microelectronics, electro-mechanical components, and given Boeing's offshoring and management issues, perhaps large aircraft.

4.5 Multiple and unplanned-for events that require surge capacity are likely to be the environment of the future.

We live, and will continue to live, in an era where the risk environment is variable, uncertain, complex, and ambiguous (VUCA) with fast-moving, complex, and unpredictable trends. Unlike previous years, this environment has been made even more risky with a series of unplanned and unexpected events with global impacts and scale.

The trends include:

- Rapid technological advancements and propagation across nations;

- Increased digitalization across companies, countries, and societies with global mobility and connectedness;
- Heightened risk of cyber-crime and cyber-warfare as the "attack surface" of digitalization expands; and
- Global trade, offshoring, supply, and production, leading to fragile supply chains.

The risk events, on the other hand, are increasing in frequency, scope, and impact, and encompass wars, sudden escalations of conflict and other geo-political problems, trade disputes, climate change events, and public health crises that can disrupt global supply. More importantly, these events are often occurring simultaneously, where the impacts are compounded and difficult to predict and manage.

These multiple and unplanned-for events and trends constitute a changed, uncertain environment that is likely to be the "new normal" we live and operate in and can generate a series of surges in demand. These surges take the form of:

- Surges generated by planned and predictable events;
- Surges generated by unplanned and unexpected events;
- Surges caused by several simultaneous events (compound impacts); and
- Short- and long-term surges.

Traditionally, the DoD has planned for weapons systems, munitions, and materiel in a deterministic, somewhat uncoordinated fashion driven by a linear approach to risk, traditional contracting, and financing methods. As the U.S. has discovered during the last few years, this is not the best approach.

The DoD needs a "holistic" demand-supply planning, risk management, financing, contracting, and execution set of processes and structure to retain its position and competitiveness. A framework to identify, develop, and implement strategies designed to segregate products by complexity of manufacturing and speed of ramp-up, as shown below.

	Low (Fast) Ramp-Up Time	High (Long) Ramp-Up Time
Product Manufacturing – Integrated, Complex		
Product Manufacturing – Simple, Standardized, Modular		

The Subcommittee addresses these in recommendations later in this report.

4.6 It's becoming increasingly difficult to sustain the federal workforce.

Employee recruitment and retention has become a concern across most business sectors in recent years. Rising wages, work-life balance, low unemployment, and

technical talent shortages have kept people managers busy. These challenges are amplified within the DoD, where compensation limits and mission requirements make talent management particularly difficult. The upshot has been a lot of tough choices for the Military Departments.

For instance, amidst a personnel shortage for its logistics support ships, the Navy is contemplating a plan to sideline some vessels to free up its civilian mariners to crew the remaining fleet at a more sustainable operational tempo. The Navy fell short of its recruiting goals in 2023 and, today, has only 27 mariners to replace every 100 at sea.[47]

The Air Force has experienced similar challenges producing pilots, carrying a shortage of aviators over the last several years. Commercial competition as well as simulator, training aircraft, and instructor availability have all contributed to the continuing shortfall. The Air Force has chosen to leave support staff positions vacant to fill cockpits, at the expense of long-term mentorship and leadership development.[48]

Overall, only two of five of the Services met their recruiting goals in 2023 despite attractive bonuses, education incentives, and revised policies; with the Army and Navy missing their objective by nearly 20%.[49] Labor challenges persist within the DoD's civilian workforce as well, with nearly 9,000 unfilled positions and an overwhelming 30% of workers retirement eligible.[5051] The confluence of these factors results in a dearth of skills and manpower the DoD cannot overcome alone during times of crises. Additionally, a slow and cumbersome Federal employee hiring process has further exacerbated hiring DoD civilians to meet workforce demands.

5. Findings

Below are the key findings the subcommittee identified during the study that warrant particular attention as either best practices or challenges to improving the Department's partnerships with industry.

5.1 The Civil Reserve Air Fleet (CRAF) and partnerships like it are the gold standard for mechanisms to ensure capacity in a crisis.

Over the course of the subcommittee's interviews, one DoD partnership came up repeatedly: the U.S. Transportation Command's (USTRANSCOM's) Civil Reserve Air Fleet (CRAF). The CRAF is a cooperative disaster preparedness program created under the 1951 Defense Production Act (DPA) to enlist the help of commercial aircraft to supplement military airlift capacity during crises.

The CRAF works for a variety of reasons:

First, the CRAF works because it provides real value to all members of the partnership, during and between crises. The program affords DoD access to an enormous amount of latent airlift capacity it doesn't have to procure or sustain. The commercial companies purchase their own equipment, train their own aircrews, and perform their own maintenance. The carriers benefit because CRAF membership comes with exclusive access to over $5 billion in other DoD charters during peacetime operations. Every day, CRAF carriers provide airlift for nearly 90% of all DoD passenger travel and 40% of bulk cargo movement.

Second, demand exists in the civilian market to supplement DoD business. This addresses one of the major concerns in private industry—the stability and duration of demand for planning, investment, working capital, and budgeting purposes. Although the DoD is a significant source of revenue for its providers, it is by far not the largest. In fiscal 2019, CRAF business was just over 2% of the total revenue garnered by all carriers. The DoD cannot provide the demand needed to sustain 25 commercial carriers alone. Fortunately, the U.S. airline industry provides approximately $225 billion in other opportunity annually to keep the pool of CRAF providers viable.[52]

Third, commercial capabilities can be applied to the DoD mission with minimal modification. In this way, the CRAF is a true "dual use" technology. While there are some missions that commercial providers cannot undertake (e.g., outsized cargo, austere airfields, hostile landing zones), commercial aircraft are capable to operate on most routes and can be accounted for in planning. For instance, during the evacuation of Afghanistan, military C-17s were used to evacuate civilians out of the heighted threat environment at Kabul Airport, and were then transferred to commercial aircraft for the rest of the route to the U.S.

Lastly, the CRAF works because the participation incentives are meaningful for all parties. Even as a small share of the total market, DoD business is still worthwhile, especially for some of the smaller airline/transport companies that

struggle to survive in a competitive industry. Patriotism is still a driver as well. Participation in CRAF is a way for companies to offer a means for employees to serve their country or recruit veterans, interested in continued participation in the defense community.

The success of the CRAF has spawned many prospective analogs, including the Voluntary Intermodal Sealift Agreement (VISA) forged in the late 1990s for maritime transportation capacity and more recently, with the Space Force's Commercial Augmentation Space Reserve (CASR). These follow-on programs are a testament to the value and effectiveness of this partnership model for the DoD, they should not be the last.

One interviewee expressed concern that DoD appears to focus solely on surge sourcing of hardware and other materiel needs, ignoring a significant surge requirement: rapid/surge software modification.

The need to modify and configure software over the life cycle of systems is well known in DoD. Government contracts for software systems, both embedded and stand-alone, have for years included contract line items or other provisions for software "maintenance." But the subcommittee saw no evidence that provisions were made to provide for crisis surge of *software talent* when it may well be most needed.

Accordingly, the subcommittee recognizes that there may be opportunity here for DoD to investigate the costs and benefits associated with constructing a CRAF-like program for software. Such a capability could provide a contractual vehicle for rapid access to software-modification talent who would maintain competency in major DoD software-intensive systems to be "activated" to make changes to those systems when appropriate in a crisis. DoD's organic software factories may be a source of talent for the partnership as well. Given the wide array of legacy coding languages embedded within DoD systems—from drones to radar to missiles—a deep bench of software development expertise may provide significant value and flexibility, especially at the point of use.

What works for the CRAF will not be possible for all partnerships.

Not all DoD product and capability needs lend themselves to partnerships exactly like the CRAF. Not all goods have a sizeable commercial market to supplement demand. Some requirements will be episodic while others may require modification of the product to provide military utility.

Some lessons, however, are very relevant and critical.

Key lessons such as demand stability, long range forecasting, commercial demand to sustain capacity, "dual use" or easily modified technologies, and the patriotism that drives collaboration and response are those that DoD can apply to other efforts and are critical to improve its partnerships and increase capacity in crisis.

Best Practice:

The Civil Reserve Air Fleet

The CRAF is a cooperative disaster preparedness program created under the 1951 Defense Production Act (DPA) to enlist the help of commercial aircraft to supplement military airlift capacity during crises. Currently, 25 commercial carriers participate in the program through a contract with USTRANSCOM. With CRAF help, the Department can quickly flex from 275 transport aircraft to over 500. While participation in the program is voluntary, the President or a designee can direct performance under the DPA's allocation authority when military airlift is insufficient, and the program doesn't receive enough commercial bidders. Directed performance, known as activation, has only been required three times since the formulation of the CRAF, most recently in 2021 to support the evacuation from Afghanistan. During that event, the CRAF helped move 124,000 Americans and Afghan refugees in just twelve days.

Photo Credit: (U.S. Air Force photo by Tech. Sgt. Donald Barnec). The appearance of DoD visual information does not imply or constitute DoD endorsement.

Figure 2: The Civil Reserve Air Fleet

5.2 Companies need signed contracts and profitable financial results to remain in business with the DoD.

This involves consistent and profitable margins, return on investment, and the ability to obtain working capital and capital investment financing at a reasonable rate. Manufacturing companies also require tax incentives to maintain capacity, on-shoring, and near-shoring. They require consistent demand patterns over the product life cycle, including the services/spares life cycle. Companies that bid on certain volumes cannot be expected to maintain their price and margins if volumes drop or are unstable over relatively short periods of time. These imperatives are a function of profitability, return on invested capital, and "design for surge":

Profitability is a function of:

- Cost of Goods Sold – dependent on volume, product design and requirements (particularly for those products that are custom, must be re-designed, or modified from commercial use), direct product and manufacturing expenses.
- Logistics Costs – transportation from suppliers to the manufacturing plants, in-company transit, warehouse, and storage costs, specified packaging, and delivery. This depends on distance and mode of transportation.
- Working Capital and Capital Investment Financing and Interest Costs – the working capital aspect includes Days Payable (to the contractors' suppliers), Days Inventory Outstanding (in the end-to-end supply chain pipeline), Days Receivables (payments from the DoD) and ongoing operating expenses.
- Corporate taxes and investment tax credits may play a crucial role in moving manufacturing on-shore or near-shore and local mining for critical elements, thereby increasing quality and design control, securing critical elements, creating U.S. jobs, and shortening supply chains.

As can be seen, these vary with volume, sourcing decisions and demand stability.

Return on invested capital requires optimal efficiency in the use of production and storage assets, while financing for working capital and capital equipment (capacity) demands low-cost financing and loans to finance the cash-cash conversion cycle, operating costs, and other expenses. In some instances, this may require government funding for capacity acquisition and maintenance.

"Design for Surge (DfS)" is another critical aspect of business success that drives the cost, supply chain agility, and response to surges rests on another critical aspect of business success. This includes:

- Commonality of components, munitions, and products across weapons systems and departments;
- Design of components and products that can be used in other systems and this, coupled with inventory stocking and capacity maintenance,

can prevent the costs and time issues associated with products that must be stopped and re-started owing to lack of demand, design changes or end-of-service-life considerations;

- Discipline in the requirements definition, design and manufacturing phases of the product or weapons systems to guard against "nice to have" and unique features that can have significant cost, time, and wastage implications;
- Design for reuse across munitions and weapons systems' lives and generations; and
- Contracts that measure and incentivize DfS.

If DoD acquisition and demand management practices do not consider these private sector business imperatives, building up an expand-on-demand surge capacity with supply chain resilience will prove difficult. Like any business, defense companies must be profitable in a sustained way over the longer term, and they are incentivized to use dollars and assets efficiently. That often means adapting their operations (inventory, labor, facilities) and pricing to meet the forecasted demand of their customer (the DoD).

> *"We've made a policy choice to completely outsource to the private sector. Unsurprisingly, the private sector optimized to just-in-time delivery, maximum profits, and best price. Left to its own devices, it will always do that. We need some middle ground to preserve surge capacity."*
>
> - DoD Official

For instance, the initial procurement quantity for the Joint Air to Surface Standoff Munition (JASSM) was 2,400 when the program was approved for full rate production in 2003. Based on affordability projections within an estimated top line budget, the DoD forecasted an annual procurement quantity of 100-400 missiles a year over the first decade of the program.[53]

Therefore, the contractor built one production line with associated tooling and labor to support delivery of up to 480 missiles per year. As demand for the missile increased over time (the Australian Government placed an order in 2006), technology innovation spurred capability improvements (the missile's range was extended in 2008) and threats evolved, additional orders were placed. The total procurement quantity that was once 2,400 was revised to 7,200, then to nearly 9,000 missiles in the fiscal 2025 budget request. With each increase, the contractor added production lines, facilities, tooling, and workers to improve production capacity to over 1,300 missiles a month by the end of fiscal 2022.[54][55]

The JASSM program is typical of most DoD production efforts, just-in-time and budget-sensitive. The contractor right-sized capacity to the customer's stated requirement, keeping only a modest amount of excess capacity in any given year for

foreign military sales. Had U.S. or Allied demand spiked drastically, the program would have had difficulty responding. Construction of the program's latest production facility took over three years to build and certify.[56] This is the reality production programs face within the current demand management process, which is deterministic and does not consider risks and variability in providing demand quantities over a period of time to contractors.

Inconsistent or unpredictable and short-term demand stifles **industry's** ability to react, invest, plan, reduce cost, and improve delivery timelines.

JASSM has been a highly successful effort for the DoD and provides Combatant Commanders many options to generate effects on the battlefield. Even so, it is not immune to the annual budget vacillations and demand fluctuation all programs experience. From industry's point of view, the instability is perceived as a lack of understanding for the business imperatives of private industry—leading to a misalignment of acquisition and operational practices.

Since 2018, JASSM has only once maintained a consistent buy profile across the five years of the Future Years Defense Program (FYDP)—and it's not the only program so characterized. During two decades of counterinsurgency war in Iraq, Afghanistan, and Syria, many precision munitions and artillery programs fell victim to near-term priorities at the expense of industrial base stability.

Demand inconsistency was the top challenge identified by nearly all interviewees, both in production and maintenance. One official interviewed said that defense contractors must be mindful of how much capacity and inventory they keep. "They must be careful not to get stuck with a bunch of expensive parts should the Service decide to abruptly change its mind and divest of the system. It's hurting supply chain resiliency, especially for legacy weapon systems," he said.

More broadly, in a consolidated defense market, publicly traded defense companies are weary of "going at risk" to innovate, establish long-term contracts with suppliers, or to invest in production improvements without a contract in hand. The situation is exacerbated when the cost of money is high. "Borrowing money at 7% for a potential order only forecasted at 12% profit is a tough sell," an interviewee told the subcommittee.

What's worse, is when the order quantity doesn't come in as forecasted, or at all. Another employee told the subcommittee about a time his company procured $7 million of inventory in advance of an urgent DoD requirement that never materialized. Ten years later, they were still disposing of the material and seldom got management approval to lean forward again. The risk wasn't worth the reward.

Best Practice:

Collaborative Planning, Forecasting, and Replenishment (CPFR)

Collaborative Planning, Forecasting, and Replenishment (CPFR) is a business practice adopted in part or full by several companies in the consumer-packaged goods and retail industries. The practice was pioneered by companies such as Walmart and Procter & Gamble to increase supply chain efficiency by institutionalizing close collaboration among various parties within the supply chain, primarily between suppliers and retailers. CPFR is a structured process where all parties work together to match supply and demand, optimize, and integrate various stages of the end-to-end supply chain. It involves defining a process and set of agreements, working across organizational silos, leveraging and sharing technological solutions, data, and analysis to respond rapidly and cost-effectively to changes in demand, maintain customer service levels, and reduce costs.

Figure 3: Collaborative Planning, Forecasting, and Replenishment (CPFR)

Sustained and predictable minimum sustaining rate order quantities incentivizes just-in-time supply chain and production efficiency, minimizing hedge inventory, while disincentivizing excess capacity across the supply chain.

When DoD demand for a military-unique asset slows, there is no incentive for private companies to maintain production or support for an item. The DoD recently experienced this challenge while backfilling inventory sent to support Ukraine. When the Army placed an order in May 2022 to replace 2,000 shoulder-fired Stinger missiles, out of production for 20 years, it was told it would have to wait until 2026 for delivery.[57]

The story was similar across other munitions that had dropped to near-minimum sustaining rate order quantities—just enough to keep the lights on. Months were needed to ramp up production of the High Mobility Artillery Rocket System (HIMARS) system from five to just eight units a month.[58] Goals to double Guided Multiple Launch Rocket Systems (GMLRS) production were projected to take as long as three years.[59]

"Over time, the industrial base has prioritized efficiency over resiliency. We've allowed production lines to go cold, watched as parts became obsolete, and seen sub-tier suppliers consolidate or go out of business entirely."

- Dr. William LaPlante
Under Secretary of Defense for Acquisition & Sustainment
DoD News

Research conducted by the Center for Strategic & International Studies (CSIS) found that concerns over delivery timelines were not confined to U.S. Army programs alone. Their analysis showed production lead times of at least eighteen months for eight of the top DoD missiles across multiple Services, with the majority stretching twenty-four months or longer.[60]

The DoD, with the help of Congress, has done a lot of work in response to the industrial base challenges exposed by America's support to the conflict in Ukraine. One of the largest efforts is happening within the Joint Program Executive Office for Armaments and Ammunition where the Army has pledged to increase monthly production of munitions. With supplemental budget, including a $6 billion dollar contract in 2023 to open an advanced metal parts facility in Mesquite, Texas, and another for $218 million to modernize the explosive packing facility in Camden, Arkansas, the DoD is making the investment necessary to drive demand.[61]

More strategically, in 2023, the Department published its first-ever *National Defense Industrial Strategy* to communicate its plans to transform the industrial base for the future. In terms of purchase order reaction, one of its top priorities is movement towards "dynamic production," where capacity adjusts to meet the changing demands of warfighters, allies, and partners at speed and scale. The strategy recognizes that encouraging defense suppliers to build substantial spare capacity beyond just-in-time production will require a coordinated effort by industry, Congress, DoD, and others. Above all, it will take investment. The strategy suggests a combination of Congressional appropriations, tax incentives, regulatory relief, or long term-contracts could be used to make financial assistance available.

In October 2024, the DoD supplemented the strategy with the *National Defense Industrial Strategy Implementation Plan* to provide greater detail on the distinct lines of effort it will employ to realize its vision. The plan includes various resource investments submitted within the 2025 budget request as well as outcome metrics to measure progress.[62]

The DoD also established the Joint Production Accelerator Cell (JPAC) within the Office of the Under Secretary of Defense for Acquisition and Sustainment. The JPAC team is focused on using data, existing authorities, and enterprise coordination to proactively support a more responsive DoD production community, including building surge capacity. One of the authorities the JPAC advocates for and has been used increasingly in the Department over the last few years to stabilize demand, is multiyear procurement (MYP).

MYP is a special authority Congress granted to allow the DoD to establish a contract for deliveries of an item up to five years, eliminating the uncertainty of annual delivery orders. Multiyear contracts come with economic order quantity authority included, which allows programs to buy subcomponents needed for total contract quantities vice lot by lot. For these reasons, MYP saves money through economies of scale, provides a more consistent demand signal to industry partners, encourages innovation, and can mitigate long lead item delays.[63]

MYP is a powerful tool for minimizing the demand fluctuation that has stifled defense production over the years. Since 1990, MYP has been used only sporadically, but has become more popular recently. The 2024 defense budget included MYP for seven munitions programs. The DoD is hopeful that six more will be approved in 2025. It is critical for national security in dealing with multiple conflicts and government commitments to other countries that usage continues to increase and expand to other commodities purchased in large quantities, like drones, as well.

Lessons Learned: Ukraine Security Assistance

Many analysts have criticized the timelines announced to replace the arms drawn down from U.S. stocks deployed in support of Ukraine. Industry experts closer to the issue, however, say they were not surprised by the months and dollars necessary to get industry to a pace needed to support the war.

The arsenals and ammunitions plants that remain in the U.S were built to support a WWII surge and have garnered little modernization funding since. "We haven't invested in our facilities in decades," one interviewee told the subcommittee. "It's been very episodic—especially for our industry partners and it correlates to when we are in conflict," he continued. "Conflict breaks out, there is a surge, it takes 18-24 months, it ends, and everyone wants a peace dividend. Then we are back to nothing."

As of January 2024, billions of dollars have flowed into the U.S. defense industrial base for critical munitions, including $746 million from the Defense Production Act and $3.3 billion in Ukraine supplemental funding. Industry experts hope this time, the U.S. will incorporate what it has learned to find better balance between environmental policy and national security, near- and long-term priorities, and domestic and global sourcing of critical materials to stabilize replenishment times in the future.

Photo Credit: (U.S. Army photo by Henry Villarama). The appearance of DoD visual information does not imply or constitute DoD endorsement.

Figure 4: Lessons Learned Ukraine Security Assistance

5.3 Foreign military sales and commercial sales are opportunities to level demand curves for some systems/supplies.

Allies and partners are mentioned over 200 times within the National and Industrial Defense Strategies. The frequency underscores the Department's awareness of the vital role friendly nations play in both defending Western ideals and supporting the industrial base that makes defense possible. One tool the Department uses to foster both imperatives is Foreign Military Sales (FMS).

FMS is a security assistance program that helps foreign governments purchase U.S. defense articles, services, and training through agreements documented in a Letter of Offer and Acceptance (LOA). Unlike direct commercial sales, in FMS cases, a DoD program office manages the foreign customer's requirements through a contract between the U.S. Government and industry. The foreign government is responsible for all costs associated with the sale; a no-profit, no-loss basis for the U.S. taxpayer. Although co-development is possible, purchases are typically made for equipment the DoD has already fielded for its own use.

Allied participation in FMS has increased substantially following the Russian invasion of Ukraine, with volume surpassing $80 billion through August of 2024, up from $34.8 billion in 2021.[64] FMS is a win-win for all parties, what the Arms Export Control Act refers to as a "mutually beneficially defense relationship."[65] Through FMS, Allies and partners get access to the world's top defense technology and in return, the DoD mitigates some of the pitfalls of being the monopsonist for most products within an entire sector.

For instance, after completing its final delivery of the F-15E aircraft in 2004, the Air Force was able to return to place new orders of the newest model seventeen years later because foreign partners supplemented demand and upgrades for the airframe in the interim.[66] It's a similar story for the Patriot air defense system where eighteen foreign partners share in sustainment of the overall production line, including NATO's pledge to buy 1,000 missiles in the coming years.[67]

These examples illustrate the profound impact FMS can have on the domestic supply base. Should foreign demand for U.S. weapons continue at fiscal 2024 levels, or more, DoD officials hope that sustained FMS buys can help to smooth the edges off some of the episodic buying cycles that have kept industry from taking risk to expand their production margins in the past.

Foreign demand is especially important for niche defense equipment, like fighter aircraft, artillery, and tanks, where a commercial market does not exist. In some supply categories, like munitions, FMS demand is the only buyer beyond the limited quantities the DoD acquires for its training units. By buying common equipment, FMS also ensures greater interoperability among platforms and weapons employed by allies and partners, a benefit during coalition operations.

Coproduction agreements, where foreign partners are permitted to manufacture all or part of a U.S. defense article themselves, have very positive implications for

capacity growth as well. Coproduction is a tool the DoD has used in the past and per its strategy, looks to strengthen in the future. Most recently, the DoD has fostered deals with Australia to produce GMLRS and in Germany for Patriot missiles. Discussions are underway to explore production of artillery ammunition in South Korea and armored strike vehicles by India too.[6869]

And then there is AUKUS, the collaborative partnership between Australia, the United Kingdom, and the U.S., with plans to co-develop, co-produce, and co-sustain a collection of technologies, including nuclear submarines. Pillar one alone is supported by a massive FMS case that will span nine years on a contract with ceiling up to $2 billion.[70] The vision is to expand the capacity of defense industry in all countries, to include production capabilities in the Indo-Pacific.[71]

Despite its benefits, successfully navigating the FMS process from need to delivery can be long and arduous, teeming with government bureaucracy. Because of its implication on foreign policy, and the evolving geopolitical landscape over time, scores of additional stakeholders are involved to assure alignment with U.S. interests. External participation includes multiple offices across OMB, the State Department, and Congress. Within DoD, approval for FMS programs and activities are delegated to the Under Secretary of Defense for Policy, supported by the Defense Security Cooperation Agency, adding complexity beyond traditional program reporting chains usually confined to the Office of the Under Secretary of Defense for Acquisition and Sustainment (OUSD(A&S)).

The additional bureaucracy has historically meant longer timelines and frustration; a reason the DoD has attempted to revamp the process over a dozen times in the last 20 years. Time to deliver has been the source of ongoing GAO scrutiny, yielding modest improvements to the DoD pieces of the process over time.[72]

More recently, defense industrial base throughput challenges have taken over the spotlight. In July 2024, the FMS backlog of weapons for Taiwan swelled to $20.5 billion, including orders for F-16s, Harpoon Coastal Defense Systems, and Abrams Tanks.[73] The extent of the delays considering the seriousness of the geopolitical issues in the Indo-Pacific have many lawmakers calling for coproduction in Taiwan to alleviate domestic supply bottlenecks.[74]

The pace of commercial technology adoption across DoD has affected FMS cases as well. Many foreign partners want access to the innovative technologies that non-traditional defense companies offer but unless they've already been procured under a DoD program of record, no pathway exist to provide them. There may be capability capacity here, but without a standard process, it's a nonstarter for FMS case managers.[75]

During the recent uptick in FMS interest, the Department tasked another "tiger team" to look at the process again. The group recommended new ways to improve requirements understanding, additional training for stakeholders, and better methods for incorporating customer orders into existing production buys. The

group is also working with OUSD(A&S) on pathways to access commercial solutions. It's too early to tell if their recommendations to improve the overall experience of FMS partnerships will bear fruit over the long run.[76] Analysts caution against using Ukraine as a progress indicator, as this is a unique situation and the equipment items transferred in response to the conflict are not foreign military sales. Sustained FMS improvement is still a goal whose success remains to be seen.[77]

5.4 The requirements and design processes used in DoD acquisition are not optimized for partnerships with the broader commercial sector.

Defense acquisition has been in a continual state of reform since the 1970s, with over 50 revisions since that time. More recently, Congress passed legislation in 2016 that mandated the creation of a simpler, more expedient prototyping and production process. In 2021, it directed an investigation on how the DoD develops its requirements and in 2022 stood up a commission to overhaul how it builds its budget proposals.[78] While it's too early to measure impacts of the latest initiatives, it is clear from the professionals the subcommittee talked to that the requirements and design processes, as currently constituted, are not optimal for partnering with industry to surge capability.

In their current state, both processes force program requirements to adopt a set of rigid key performance parameters (KPP), supported by detailed specifications that too often overly constrain the trade space and stifle innovation—leading to novel development efforts. Because development programs are inherently producing something new, systems engineers are left with tough choices while conducting their manufacturing readiness assessments (MRAs) throughout the development and test phase of the program.

While the MRA process forces DoD program offices to assess the capacity of their production facilities, vulnerabilities in their supply chains (including foreign ownership, control, and influence), impacts from long-leads, and availability of critical materials, it doesn't press them to think in terms of surge (variable timeframes and quantities).[79] Further, while many programs can identify the risks associated in manufacturing, mitigating producibility challenges are a different story, especially if mitigation means a costly redesign late in the development phase to enable use of a more accessible material or subcomponent. As one interviewee put it, "Some of our capacity constraints are baked into the design. A lot is in the way the production process is laid out, in the way the system is designed, and the way production is designed—it's very out of date."

Recent events have caused acquisition officials to rethink manufacturing readiness, however. One leader told the subcommittee about how one of his important new projects is now asking industry to think about the ability to rapidly scale as part of the initial design effort. "For every design choice," he said, "we are asking the contractor to tell us how that will enable or disable our ability to rapidly scale." Other projects are beginning to follow suit.

Aside from surge, the current requirements and design process is not optimal for expanding the partnerships DoD will need in the future either; to non-traditional or commercial businesses for products where design producibility has already been stress tested.

In 1994, President Clinton signed the Federal Acquisition Streamlining Act (FASA), establishing the Government's preference for commercial products. In government acquisition, commercial items are those with a customer base greater than just the U.S. Government. Buying commercial provides substantial benefit to the Government, including better prices, technologies, competition, acquisition lead times, and shared demand. Despite codification in law however, the DoD continues to prefer to make and not buy much of the equipment it needs, often citing the uniqueness of its requirements. Since 2000, defense contract awards for goods categorized as commercial accounted for less than 25% of all obligations made each year.[80]

Military-unique requirements are warranted for end items like missiles and fighter jets, but it is unclear how hard the Department has challenged itself to adhere to the underlying provisions of the statute in pursuit of non-developmental items, even for traditional military wares. For instance, FASA requires that prime contractors and subcontractors incorporate commercial subcomponents into the architecture of their development systems where appropriate. Also, the law compels agencies to modify requirements to ensure they can be met by commercial services or products to the greatest extent possible.

But JCIDS, the lengthy, heavily bureaucratic requirements process, has too often restricted programs from satisfying these provisions to maximize non-developmental products. With little feedback from the commercial sector on the art of the possible or alternate solutions, JCIDS has unwittingly tilted the playing field in favor of the large defense primes, hampering the ability of small and non-traditional businesses to work with the DoD. Whether it's requirements narrowly written for predetermined solutions, or the addition of onerous certification processes or federal cybersecurity controls, the inflexible JCIDS has been a barrier for better procurement outcomes for decades.

One consequence has been the default to cost type contracts in the development phase. In these arrangements, the Government accepts all cost risk, often the only way major system integrators will take of novel requirements. Regrettably, with imperfect requirements and unforeseen challenges, cost contracts have contributed to a significant amount of growth over the years. A 2008 Naval Postgraduate School study found that cost contracts attributed to 54% greater cost change then fixed price models that year, illustrating why many reformers have advocated for the latter.[81] The Air Force's Sentinel program is the latest victim of bespoke requirements on a cost vehicle.

On January 18, 2024, the Air Force notified Congress that the program had grown in cost by 37% and breached the Nunn McCurdy reporting threshold.[82]

Program officials attributed the growth to unforeseen infrastructure costs associated with revamping the Air Force's vast network of missile silos.[83] While Sentinel has observably less options to inject commercial technology into the architecture, its recent experience should prompt other programs to take a harder look at solutions available off-the-shelf.

Recognizing the opportunity afforded by greater commercial adoption, various DoD components have pursued novel acquisition and contracting practices to sidestep JCIDS and its pitfalls. For instance, the Space Development Agency, under middle tier acquisition rules, plans to leverage commercial companies to provide the ground services for its second tranche of low-cost satellites rather than developing and maintaining its own equipment.[84] Similarly, the Replicator Initiative, a Defense Innovation Unit project to field thousands of attritable autonomous drones, is using a commercial solutions opening contractual mechanism to access production-ready maritime systems from non-traditional firms.[85] Both projects have made significant progress in the last year through modern procurement techniques, neither of which bound by the shortcomings of traditional processes, like JCIDS.

5.5 For other supplies and systems where there is neither FMS nor commercial demand existing to level demand, direct investment may be necessary.

There are products and materials needed by the DoD that simply don't elicit the commercial demand to ensure sufficient availability. Items like nerve agent antidote injectors, for instance, don't have a large market beyond the battlefield.[86]

There are other items available globally but that are so critical that they warrant domestic supply to ensure priority and availability, immune to geopolitical pressures or embargoes. These might include subcomponents or critical minerals used in advanced munitions—such as antimony or other rare earth elements (REEs). In August 2024, China announced export restrictions on antimony, citing its obligation to fulfil international non-proliferation agreements. The ban will greatly impact the U.S., which doesn't operate its own mines and sources 63% of its supply from China.[87] There are plenty of other similar examples.

For raw materials, especially REEs, macro-level investment might be required to seed the industrial base with the infrastructure, workforce, and special tooling needed to establish sufficient supply. For niche military equipment, like the nerve therapy injectors mentioned above, targeted procurements to a single company might be necessary. In either case, direct investment is crucial to ensure capacity for times of crises and is happening in various ways across the Department today.

One way the Department is addressing this is through a series of portfolios managed by the Office of the Deputy Assistant Secretary of Defense for Industrial Base Policy including the Defense Production Act Investment (DPAI) and Industrial Base Analysis and Sustainment (IBAS) programs. In 2024, Industrial Base Policy programs will distribute over $1.9 billion in DPA funding to struggling industries

within the defense industrial base, stimulating growth in what it sees as critical lines of effort for national defense.[88]

The DPAI program is executed under Title III of the DPA which empowers the President to bolster industrial production through loans, purchases, or grants. Through July 2024, DPAI obligated $381 million across 18 awards in multiple areas to expand manufacturing capacity within the industrial base.[89] Most recently, the program awarded a $23 million grant to boost capacity in the U.S. aluminum casting industry, struggling amid a declining domestic labor market. Aluminum is a key material used in many defense systems, foreign and domestic, from flight control surfaces to light-weight armor for ground vehicles.[90]

IBAS is executed under the authorities of the Industrial Base Fund established under Title 10 to, among other uses, expand and address supply chain vulnerabilities. In fiscal 2023, IBAS awarded more than $700 million to advance manufacturing capabilities across defense and commercial markets in areas including semiconductor packaging.[91]

Another source of DoD direct investment is through the Defense Logistics Agency's (DLA's) Warstopper program. Warstopper was created in the wake of Operation Desert Storm in the 1990s in response to a Congressional report that recommended the DoD take the necessary steps to ensure the availability of mission critical items during wartime surge if peacetime requirements were insufficient to maintain an industrial capability. Initially, the program focused on chemical warfare protective items but has since expanded to other supply chains.[92]

Unlike other DLA procurements that are purchased through working capital funds that set stock levels based on current year requirements, Warstopper uses appropriated funds, enabling it the flexibility to provide Combatant Commanders go-to-war coverage during unexpected events. In this way, Warstopper provides margin where working capital funds seek optimization between supply and demand.

Unlike the DPAI and IBAS programs that focus on cross-cutting industrial challenges at the macro level, the Warstopper program is focused on Service-specific tactical issues. It partners with the Joint Staff and Service leads to identify at-risk commodities within the DoD inventory and then takes action to mitigate delays to surge. These actions include many of the major risk mitigation strategies used by the private sector, including buffer inventory of raw materials, partially built long-lead time items, or redundancy and additional peacetime orders to keep the production line "warm."

Warstopper has been a vital "insurance plan" for the DoD and has provided the warfighter significant benefits. In the case of nerve agent antidote, the program secured access to excess plant capacity with great success. According to a DoD Inspector General Report, without Warstopper investment, it would take the Services two years to build and stock their wartime requirement.[93] The same report found that the program was able to secure access to excess inventory at costs

significantly below Service estimates. It cited two examples, including a savings of $1.8 billion in medical supplies and an 8 to 1 return on investment for Bradley fighting vehicle long lead parts.

Unfortunately, Warstopper has not received the same budget allocation as the other DPA-affiliated programs. In fiscal 2023, the program received just $45 million, less than 1% of all obligations made by DLA's working capital fund that year. The modest investment in Warstopper relative to other DoD projects is reflective of the conversative approach many DoD officials take towards spares. Too often, spare capacity has a negative connotation, suggestive of idle waste and an abuse of funds. But that mindset must be recalibrated to consider the value of buffer stock in terms of risk mitigation—whether those items are eventually utilized or not. Given the current state of surge, delivery, and capacity in the supply base, the Warstopper program budget is disproportionate to DoD needs.

5.6 Adversarial tensions often pervade contractual relationships between DoD and industry, to the detriment of supply, cost, response, and surge capacity.

DoD's relationships with private companies across the spectrum of weapons systems, munitions, and materials are not always as cohesive as they could be. Furthermore, there is often a lack of trust. Frequently, adversarial tensions arise because of unaligned objectives, a lack of transparency, and an unawareness of the constraints faced by the other parties involved. This is especially true for "traditional" DoD contracts with major defense companies, which have been consistently described by interviewees as adversarial. "There is still a very anti-industry tone by some in government, which feel for some reason that it's not okay for industry to make a profit," one DoD official told the subcommittee. "But businesses have to—and reasonable profits should be something everyone can agree on." Other interviewees characterized the DoD as "business-acumen deficient," which inhibits its understanding of project risk and clouds its vision on profit reasonability.

In response, the DoD has launched several programs to improve experience across the defense industrial base team. The Secretary of Defense Executive Fellowship Program, the DoD Centralized Intern Program, and the Public-Private Talent Experience Program are just a few of the dozens of ways the DoD attempts to foster the permeation of ideas and perspectives from private industry. Despite these efforts however, tension between DoD and private contractors persists. The discord is rooted in several factors:

- The Government's need to control costs within its allocated budget.
- The challenges of operating within a "traditional and sometimes antiquated" model of acquisition and contracting within the "iron triangle" of the DoD, Congress, and selected large private industry players.

- The award of lucrative contracts to private contractors with a great deal of burdensome input, activity, and reporting. This is often a function of insufficient government contract management expertise, engagement and access, coordination and communication, and the use of misaligned incentive payments and sanctions. Rigid processes and artificial milestone goals result in contractors having low incentives for closer engagement and collaboration.
- The DoD's heavy reliance on contractors to provide a wide range of critical services, munitions and consumables manufacturing, weapons development, logistics, and support that sometimes creates a situation where contractors have significant leverage over the Government because of insufficient competition and the specialized nature of the products and services needed.
- The private sector's obligation to manage cash flow, fund their business life cycle, make profit, and enhance stockholder equity is divergent from the Government's contract management goals.
- Private industry's need for long-term demand forecasts as a prerequisite to effectively invest in manufacturing and development equipment and automation. It also needs accurate demand projections to acquire critical long-lead-time materials and allocate its resources to support government objectives.

Adjudicating these elements will be critical to improving the partnerships needed for crises.

Unclear/misunderstood legal and contractual boundaries, coupled with a fear of revealing confidential information, often dissuade DoD personnel from communicating roadmaps and requirements with industry.

Aside from a lack of business acumen, the general risk-averse nature of many DoD organizations prevents public-private partnerships from achieving their full potential. Misinformation around contractual boundaries contributes to this as well. Program offices often shy away from discussion over program requirements without a contracting officer present. Operators are dissuaded from talking to industry about future capability needs in fear of adding unfunded requirements or inadvertently obligating the Government. "Conversations are not contracts," one DoD leader told the subcommittee. "But not all federal workers understand that and it's hurting progress," he said.

Without an open dialog, communication of plans and some transparency, the DoD is going to be hard pressed to encourage industry to take greater risk with respect to investment and production capacity. Multiyear contracts must become the norm. Giving industry partners greater access to demand projections, threat data, force design, and platform roadmaps is imperative to building the trust needed

to enable the working and fixed capital investment that rapid expansion to surge will require.

One senior official interviewed by the subcommittee summarized, "For us to have a viable industrial base, we have to telegraph more effectively what we are doing—more than one year at a time. If it's only one year at a time, they [industry] will have to be more conservative. They aren't going to go out and do big facility changes, if they have to recover that in one year and it'll be extremely expensive."

Strong business relationships are built on communication, collaboration, transparency, and trust.

As mentioned earlier, the CRAF is a model partnership that has fostered positive relationships where others have faltered. The major enablers of this successful and growing program are communication, collaboration, transparency, and trust. While access to DoD business is a CRAF benefit, the private carriers can remain profitable on commercial business alone; DoD is not a monopsonist in the relationship. That reality motivates DoD to be a better partner.

To foster communication and collaboration, the CRAF chairs quarterly and annual working groups to discuss the pertinent topics important to different echelons of business leadership. The meetings serve as a forum for carriers to bring issues to decision-makers to find common solutions. DoD personnel conduct annual site visits on a rotating basis as well to ensure equipment meets requirements and carrier-specific problems can be resolved face-to-face.

Perhaps most importantly, is the emphasis the CRAF places on ensuring its carriers have the latest information ahead of any major contingency operation. The program goes above and beyond to ensure demand planning and forecasting are transparent and predictable. To provide the most detail, the program supplies each carrier with their own tablets. Because its carriers have a commercial presence in day-to-day worldwide operations, the program prioritizes information sharing on operational risk to ensure capacity is accessible in times of need.

Communication and transparency have helped CRAF build trust among its commercial partners. The respect the program shows for each of the businesses that choose to participate has helped as well. Although provisions of the DPA allow the President to direct performance under CRAF, the program has made it a point to make activation a last resort. CRAF leaders see commercial carriers as equal partners, not state-owned entities it controls. If an activation cannot be avoided, DoD officials do their best to limit the duration to the greatest extent possible. During the rapid Afghanistan evacuation, CRAF limited carrier-mandated participation to just twelve days.

5.7 Regulations and statutes need to adjust to account for the changing environment of the defense industrial base.

The CRAF program once had a rule that required 60% of a company's business to come from a non-DoD source. The spirit of the rule was to encourage a healthy commercial air transportation industry to ensure that carriers would not become overly reliant on DoD business. But as the commercial aviation sector changed over the years, the program modified, then dropped the requirement altogether in favor of its operational goals.

It is important to note that this change was made in concert with the carriers, who had become frustrated with the limitation and viewed the restriction as paternalistic. They wanted to make their own business decisions.[94] As in the case with CRAF, the DoD must change and push back against policies that provide barriers with very little benefit. Over the course of subcommittee interviews, two policy barriers were brought up most often: bona fide need and new start rules.

Improper implementation of the Bona Fide Need rule has prohibited the stock levels needed for crises.

The Bona Fide Need rule, sometimes referred to as the "time statute," is a provision codified in Title 31 U.S.C., Section 1502(a). It states that a fiscal year appropriation may be obligated only to meet a legitimate need arising in the fiscal year for which the appropriation was made. The spirit of law encourages the most efficient use of taxpayer dollars; it ensures that no current need goes unfunded because a future requirement was paid ahead of time—a misuse of funds.[95]

Over time, exceptions to the rule have been added to promote positive outcomes for national defense. Multiyear procurement, described above, is one. Advanced procurement, an exception to the full funding policy that allows programs to buy subcomponents with long delivery timelines in advance of an order for the end item itself, is another.

There is also an exception for supplies. This provision allows managers to procure items during a current fiscal year to maintain a reasonable level of inventory, even if that inventory will not be used until future years. But overly conservative interpretations of this exception have artificially deflated the demand signal to industry and have led to less-than-optimal outcomes for national defense.[96]

In some DoD organizations, appropriations managers interpret stock levels based on peacetime operations isolated from wartime capacity. This is a result of bureaucracy, the lack of business acumen and risk management. Deviating from current utilization often requires additional management intervention, justification, and work. As one DoD leader told the subcommittee, "One of the restrictions that we have, is with bona fide need. That might seem really tactical but it's problem with the GS-11s and 12s that are doing the work. Based on the Federal Acquisition Regulation, they don't see a need for 75 if you are only consuming 50. And so, we are basing our consumption levels on training missions and a little bit of work in the Middle East. We've got to develop the conflict requirement—that's the bona fide need."

New contracting tools and pathways may be needed for building capacity.

Conservative interpretations of statutes and acquisition regulation make implementation of the creative strategies needed to curb the capacity dilemma seem impossible within the Department. But it must try. One such strategy, described by several interview participants, was some form of "capacity-as-a-service." In this context, "capacity-as-a-service" is defined as a contractual relationship with a dynamic order quantity and atypical deliverable turn time due to some form of long lead item mitigation.

Under this approach, the Government would place a production order for a modest number of units with the ability flex to a surge output quantity to be delivered within a reasonable timeframe (e.g., ramped up deliveries in 6 months versus 2 years because excess long lead items are available and on hand). In this arrangement, the Government might share in the contractor's cost of holding excess inventory or provide tax breaks to companies that carry a certain level of inventory on their shelves. Unlike other surge mitigation strategies, like stockpiling, these latent production arrangements help offset government storage, maintenance, and disposal costs because the item isn't delivered until the time of need. In this way, holding additional inventory could prove mutually beneficial.

Obviously, there are affordability concerns to contend with for these strategies, but for critical, select weapon systems with long lead times needed in high quantity—like missiles, drones, and other FMS offerings—capacity assurance strategies could be warranted. Short of buying capacity potential, interviewees offered other smart techniques the Department can use more broadly to better position itself to contract for capacity in crises.

Establishing Indefinite Delivery, Indefinite Quantity (IDIQ) contracts for mission critical supplies ahead of time is one best practice. Through these vehicles, contracting offices can establish pricing tables for various quantities needed in both peacetime and during a contingency. Not only does the activity alleviate rushed estimates and imperfect price agreements during a crisis, but it forces production planners to consider sources, supplier capability, workforce, risk, and infrastructure requirements ahead of a surge or an emergency.

Recent agreements for support to U.S. Navy vessels in the Pacific are a good example, where the cost of reliable resources have risen in unison with the growing tension there. In October 2024, a government contract for U.S.-flagged tanker support in the Indo-Pacific theater was signed for nearly double the average market rate. The development underlines both the premium the DoD is willing to pay for supply chain resiliency as well as the impact of demand urgency on price.[97]

Beyond contracting, continued evolution of the acquisition process is foundational to support the type of rapid capability iteration the next crisis will demand. The war in Ukraine, which progressed from trench warfare to software-

enabled drone strikes in a matter of months, is a prime example. As it iterates feverishly to counter the next technological escalation, the Ukrainian military cannot afford to wait years for program offices to analyze, test, and certify the commercial satellite, AI, and drone technology it relies on. Crises require agile processes that are responsive to a continuously changing battlefield to deliver innovation now.

The DoD has made progress towards this goal over the last decade. At the urging of Congress, OSD(A&S) split the "one-size-fits-all" traditional acquisition approach into six pathways in 2020, under an effort known as the Adaptive Acquisition Framework (AAF). The revised policy recognizes that different procurements strategies, with varying levels of process, review, and paperwork, are necessary to match the characteristics [risks] of the capability being acquired.[98]

Under the new construct, program managers are empowered to use streamlined procedures if their capability meets an urgent need, is a rapid prototype, or provides agile software. Initial feedback on the AAF has been positive, but further refinement is warranted, especially in terms of commercial software adaptation and the use of AI at the point of use.

One DoD official lamented to the Subcommittee about the push-back his organization has experienced when trying to integrate commercial software applications in the field, work traditionally left to acquisition programs. "We need to embrace the fact that you can go to Chat GPT, and it can do coding for you. We built a very simple app in two weeks. It was fine until people found out we were doing the work, instead of an acquisition program. There are hundreds of these grass-roots projects, developed by users to make decisions and correlate data—not everything is an acquisition program and impeding this activity is significantly slowing us down." Technology is moving faster today than DoD's procurement processes can accommodate. The AAF was a good first step, but the Department must continue to evolve its policies to foster the innovators that keep its systems relevant.

Continuing resolutions threaten to delay the start of production lines in first year of new production programs.

Implementation of "new start" fiscal policy has also plagued production programs in the past. A new start is defined as any effort that was not justified by an agency in prior year budget documentation. Even if a development program has been initiated and funded for years, in its first year of production, it is considered a new start because it is funded by a new appropriation.

Under CRs, used to provide funding to the Government to operate between annual budgets, new start restrictions typically include language that prohibits the "new production of items not funded for production in previous fiscal years." The restriction has often curtailed production plans for DoD programs, including seven Navy projects during the CR issued for fiscal 2018. While there is a process for requesting exceptions to the rule for "new start anomalies," the process is often unsuccessful. In 2018, DoD requested approval for 75 new start exceptions inclusive

of the Navy efforts. However, none of the requests were approved and included in the text of the enacted CR. [99]

Inflexible budget structures hurt crisis response.

Once Congress passes the annual federal budget, there are still challenges to executing funds in pursuit of national security objectives. One obstacle is working within a rigid accounting structure to match resources to needs, which may evolve faster than the process used to reallocate them. Currently, the defense budget is divided by appropriations categories based on the type of work (RDT&E, Procurement, Operations & Maintenance, etc.) and by line items (e.g. JASSM, Long Range Anti-Ship Missile (LRASM)).

In the year of execution, if a Service needs to move funds between phases of a project (from R&D to Procurement) or from line item to line item (JASSM to LRASM), it cannot do so without Congressional approval through a reprogramming process that can take months.[100] Should an unforeseen surge require a reprioritization of supplies, like the production of more LRASM assets versus JASSMs, Congress must be involved, despite the fact that both systems are part of the tactical missile portfolio.

For these reasons, some organizations, including the Space Force and Navy, have partnered with Congress to begin piloting capability-based approaches where budget line items are consolidated into mission areas or portfolios, not singular programs. Similarly, beginning in 2020, Congress approved an initial pilot for a single appropriation for software, alleviating the perplexing delineation between RDT&E and O&M for software coding.[101] The 2024 Planning, Programming, Budget, and Execution (PPB&E) Commission applauded these efforts and advocated for greater adoption because of the agility it affords the DoD to respond to threats and incorporate emerging technologies.[102]

Best Practice:

Acquisition Planning and Risk Management using Option Theory

Option theory is used by large companies in several industries (technology and automotive are examples) in the supply chain planning and acquisition processes to deal with uncertainties in demand, market conditions, supply prices, and operational disruptions. Such an approach provides supply chain flexibility, where companies can negotiate terms where suppliers agree to hold capacity or inventory for potential future orders.

The process consists of several key elements:

Single points of demand aggregation to ensure consistency in demand planning and forecasting.

Assessment of the likelihoods of different demand levels, starting from the certain, moving to those with a lower probability, and ranging to planning for unexpected surges and spikes. Simulations could be used to find out the financial impacts of these different scenarios.

Fixed Price Contracts for certain demand levels (usually those with high likelihoods)

Flexible Contracts that allow for the maintenance of capacity or inventory for less likely or future demand levels at certain prices within specific time frames without the obligation to buy. This usually requires upfront payments to allow suppliers to maintain the capacity or hedge. A variant of this could be commitments to buy over a period, accompanied by agreed-upon ongoing payments to suppliers to cover some or all the required Capex or Working Capital.

Figure 5: Acquisition Planning and Risk Management using Option Theory

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6. Recommendations

Based on the findings observed during this Study, documented in Section 5 above, the subcommittee offers the following recommendation to improve DoD's partnerships with industry to better prepare for crises:

6.1. **Assess developing a "Software Surge" program, modeled after** CRAF – Patterning after materiel surge processes, investigate the costs and benefits associated with building a pool of software developers on a multiple award IDIQ contract who would maintain competency in major DoD software-intensive systems so that they could be "activated" to make changes to those systems when dictated in a crisis.

Proposed Action Owner: OUSD(A&S)
Implementation timeline: 1 year

6.2. Adopt an acquisition policy that specifies as part of the contract and rewards primes/subs who meet established surge preparedness metrics – Consider developing a set of metrics to accurately assesses the "surge health" of contractor-provided systems. Potential indices include on-hand stocks of components, dual-use products, flexible production and handling equipment, capacity, talent, assured access to critical materials, assured deliverability of systems, etc. Apply the metrics to establish a "surge readiness score" and consider awarding a bonus or some set of restricted business opportunities to the firms scoring highest (per the CRAF model).

Proposed Action Owner: OUSD(A&S)
Implementation timeline: 1 year

6.3. Negotiate capacity ahead of time – Establish variable pricing agreements/pricing tables on select weapon systems procured in high quantity (100 or more per year). Include consumables, spares, and maintenance supplies from the current inventory. This practice could help insulate contracting timelines from the unpredictability of the budgeting process and expedite awards should budget be made available by Congress through out-of-cycle supplemental appropriations.

Proposed Action Owner: OUSD(A&S)
Implementation timeline: 1 year

6.4. **Establish a "capacity**-as-a-**service" pilot program to negate the** effects of long lead item delays on capacity for critical weapon systems – Establish contractual vehicles with mechanisms to share fixed costs/holding costs of long lead components to ensure latent production capacity on select critical capabilities. (e.g., The Government pays a stipend on production contracts to guarantee materiel on hand to eliminate lead time delays, enabling a rapid production ramp up to quantity x% over and above

current demand during crisis.) It is preferrable if this were across more than a single supplier to increase redundancy and mitigate risk.

Proposed Action Owner: OUSD(A&S)
Implementation timeline: 18 months (budget cycle + 6 months)

6.5. Stabilize demand across the Department – Implement a collaborative planning, forecasting, and replenishment-type process, including probabilistic forecasting and Option Theory, leveraging technology, driven by the DoD, and encompassing its major munitions and material suppliers. This is a critical process that will provide both long-term demand plans and firm commitments to enable the defense industrial base to respond rapidly and cost-effectively to changes in demand and unplanned surges.

Several key characteristics must be included:

- A structured process where all parties collaborate and work together, tailored to the specific needs of the DoD, contractor, and the products being sourced, planned for, ordered, and replenished.
- Leverage technologies and methods (such as planning, analytics, simulation, and collaboration tools) shared with the different parties to standardize and accelerate communications and status. These can include:
  - Planning and analysis, using real time analytics, artificial intelligence, machine learning, simulation, and digital twins to forecast and plan demand, conduct multiple and varied scenarios, predict, and detect anomalies that could indicate supply chain disruption. Equally important would be their use to model and simulate the impact of disruptions or new strategies before implementation.
  - Data Management – ensure common nomenclature, standardization, accuracy, and security.
  - Visibility in the end-to-end supply chain, using technologies such as the internet of things, RFID and common data management and nomenclature to manage inventory, risks, status, and design for surge in terms of product and components. This could include automated inventory management to automatically manage inventory levels – a critical feature during surge capacity management to avoid stockouts or overstocking.
  - Collaboration, using collaboration tools to enhance communication and collaboration with suppliers, logistics partners, and customers in real time.
- Transparency and sharing of information, demand requirements, supply and capacity positions, and costs. This should include joint problem solving, single points of demand aggregation that includes time-phased committed

orders and commitments to buy. This will allow for the necessary planning of capacity and inventory to manage surge and reduce risk.

- The use of Option Theory, fixed-price, and flexible contracts to manage and plan for supply and capacity under different scenarios. Option Theory in the context of purchasing and contracts refers to the use of options as a strategic tool to manage risks, optimize costs, and provide flexibility in procurement processes. These scenarios must include different payment and incentive methods that consider both the DoD and private company business imperatives, such as volume flexibility contracts, long-term agreements with options, and modular contracts.
- Escalation processes in the event of emergencies.
- A pilot program with selected supplies to confirm, surface, and asses those issues specific to the DoD and contractor acquisition process. We believe the DBB can assist the DoD in assembling an industry-DoD team to design and implement this critical initiative in an expedited fashion.

Proposed Action Owner: Chief Data & Artificial Intelligence Officer (CDAO)
Implementation timeline: 18-24 months

6.6. Expand the Warstopper program to make annual investments with companies to ensure capacity is maintained in order to respond to a sudden surge. To start with, increase the budget for DLA's Warstopper program by 10x to identify and invest in additional national security-critical businesses to safeguard capacity during crisis. Require DLA to submit a budget estimate for Warstopper on the annual Defense Unfunded Priorities List. (Current Warstopper budget is $45M of DLA's $50B budget.)

Proposed Action Owner: OUSD(A&S) / OSD Comptroller
Implementation timeline: 1 year (1 budget cycle)

6.7. Map the critical weapons and materiel supply chains (sources and points of origin) to ascertain chokepoints and vulnerabilities in terms of surge capacity and response.

Proposed Action Owner: OUSD(A&S) / CDAO
Implementation timeline: 18-24 months

6.8. Develop and hire the necessary talent at the central DoD level who understand private sector business imperatives: demand management, demand-supply matching, forecasting, options planning, and the common and advanced technologies available. These skills could be developed at the Defense Acquisition University and through focused education programs and assist in implementation of recommendations 6.6 and 6.8 above.

Proposed Action Owner: OUSD(A&S)/DoD Chief Talent Management Officer (CTMO)
Implementation timeline: 12 months

6.9. Revise bona fide need rule exemptions to allow for critical long-lead parts and components to be stocked at "surge" or wartime consumption rates (in excess of system quantities currently purchased for peacetime training and operational usage). These can also be justified on the bases of time and cost to ramp-up, working capital spend, shelf-life, risk of supply, and the catastrophic failures of running short.

Proposed Action Owner: OSD Comptroller
Implementation timeline: 1 year (1 budget cycle)

6.10. **Revise "new start"** provisions included in continuing resolutions. Work with Congress to exempt existing acquisition programs transitioning from the development to the procurement phase from being considered "new starts" to avoid unnecessary cost increases and program delays during CRs.

Proposed Action Owner: OSD Comptroller
Implementation timeline: 1 year (1 budget cycle)

6.11. Transition to capability-based budgeting. The DoD should work with Congress to, where reasonable, transition its budget structure from individual program line items to portfolios based on common capabilities. Capability-based budgeting will allow the Department greater flexibility to direct funding to urgent needs that arise from crises in the year of execution.

Proposed Action Owner: OSD Comptroller
Implementation timeline: 5 budget cycles

7. Conclusion

Since WWII, the DoD has not faced a crisis without leveraging its many partnerships with industry. For their ingenuity, adaptability, and innovation, American businesses have been foundational to U.S. military dominance over the last century and key to its continued standing on the global stage. Leveraging the talent and capabilities of the defense industrial base is the only way the Department can yield the capacity necessary to meet its evolving challenges and outsized strategic objectives. With global competitors waxing, the next crises may arrive sooner than predicted.

To maintain its position in the world, the DoD must move quickly to improve its business acumen and resource allocation efficacy to synergize the powers across the industrial partnerships it relies on. To do so, the DoD should look no further than its own CRAF partnership and the ways it maximizes shared demand, presents meaningful incentives, pursues transparency, and when necessary, subsidizes demand with direct investment.

Appendix A: Terms of Reference

DEPUTY SECRETARY OF DEFENSE
1010 DEFENSE PENTAGON
WASHINGTON, DC 20301-1010

MAY 16 2024

MEMORANDUM FOR DEFENSE BUSINESS BOARD

SUBJECT: Terms of Reference – Industry Partnerships for Crises

Ensuring our military's ability to respond rapidly during a crisis enhances our ability to deter, and if necessary, defeat aggression. Given this national security imperative, the Department of Defense ("DoD" or "the Department") is focused on strengthening our defense industrial base and partnerships with industry. This study will examine the policy, infrastructure, contracting, and workforce elements that might be improved to boost and expand the Department's ability to partner with industry to surge capability.

Therefore, I direct the Defense Business Board ("the Board"), through its Business Operations Advisory Subcommittee ("the Subcommittee"), to examine the current state of contingency readiness in the Department specifically related to private sector dependencies. Based on its findings, the Board should make recommendations on ways the Department can build better partnerships with the private sector for a reliable and rapid "expand-on-demand" capacity in a series of crises or unexpected events. The Subcommittee should consider the following elements as part of its study:

1. How the Department defines, identifies the need for, categorizes, and prioritizes its public/private partnerships in the context of surge capacity needs.

2. Opportunities, programs, processes, and incentives available to help facilitate partnerships and enable rapid expansion of production capacity.

3. Industry best practices in production innovation and efficiency, to include corporate incentives and investment.

4. What authorities and financing are available within the Department to reinforce and assist corporate best-practices and foster similar industry-wide efforts.

5. Any other related matters the Subcommittee determines relevant to this task.

I direct the Subcommittee to submit its findings to the full Board for its thorough consideration and deliberation at a properly noticed and open meeting, unless the meeting must be closed pursuant to one or more of the exceptions found in title 5, U.S. Code, section 552b(c). The Board will submit its independent recommendations to the Secretary of Defense or the Deputy Secretary of Defense no later than November 29, 2024.

In conducting its work, the Subcommittee and the Board have my full support to meet with Department leaders. The Board staff, on behalf of the Board and the Subcommittee, may request the Office of the Secretary of Defense and DoD Component Heads to timely furnish any required information, assistance, or access to personnel to the Board and the Subcommittee. All

requests shall be consistent with applicable laws; applicable security classifications; DoD Instruction 5105.04, "Department of Defense Federal Advisory Committee Management Program;" and this Terms of Reference.

Material provided to the Board becomes a permanent part of the Board's record. Components are reminded that all data/information provided is subject to public inspection unless the originating Component office properly marks the data/information with the appropriate security classification markings and Freedom of Information Act exemption categories before the data/information is released to the Board. The Board has physical storage capability and electronic storage and communications capability on both unclassified and classified networks to support receipt of material up to the Secret level. Each Component should remember that Board and Subcommittee members, as special government employee members of a DoD federal advisory committee, will not be given any access to DoD networks, to include DoD email systems.

The Board and the Subcommittee will operate in conformity with and pursuant to the Board's charter, title 5, U.S. Code, chapter 10 (commonly known as "the Federal Advisory Committee Act"); title 5, U.S. Code, section 552b; and other applicable federal statutes, regulations, and policy. The Subcommittee and individual Board members do not have the authority to make decisions or provide recommendations on behalf of the Board nor report directly to any federal representative. The members of the Subcommittee and the Board are subject to specific Federal ethics laws, including title 18, U.S. Code, section 208, governing conflicts of interest, and the Standards of Ethical Conduct regulations in 5 C.F.R., Part 2635.

Thank you in advance for your cooperation in this critical undertaking and your contributions in support of the nation's defense.

cc:
Senior Pentagon Leadership
Defense Agency and DoD Field Activities Directors
Advisory Committee Management Officer, DA&M

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Appendix B: Presentation Slides

DBB FY25-01

Defense Business Board
Industry Partnerships for Crises

AN INDEPENDENT REPORT –
References to specific companies, commercial products, processes, or services do not constitute endorsement or recommendation by the Department of Defense or the U.S. Government. The appearance of DoD visual information does not imply or constitute DoD endorsement.

12 November 2024

The Subcommittee

Business Operations Advisory Subcommittee

Secretary Deborah James

DBB Chair

Co-Chair **Co-Chair**

Dr. Christopher Gopal

Brig Gen Bernie Skoch USAF (Ret.)

David Beitel

Sally Donnelly

Linnie Haynesworth

Joshua Malcolm

Sarah Mineiro

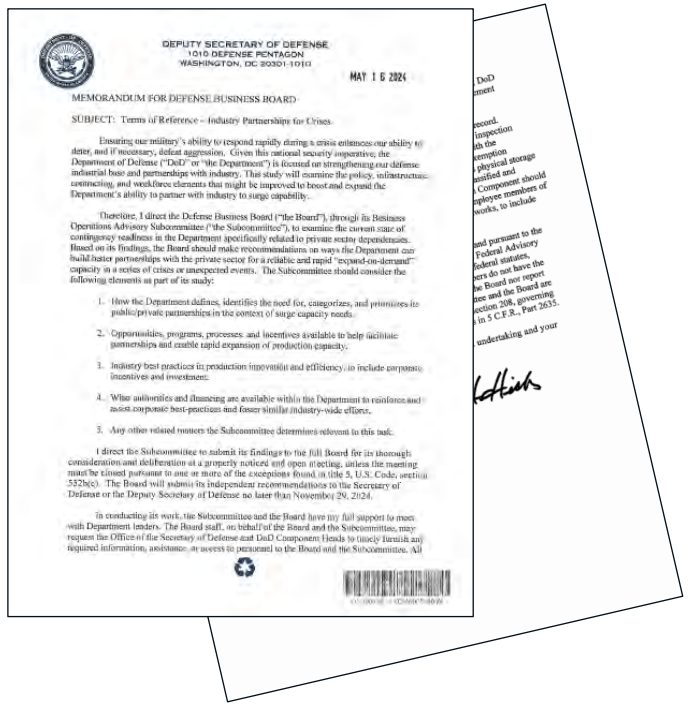
Dr. David Van Slyke

Pat Zarodkiewicz

Task

The Deputy Secretary of Defense directed the Defense Business Board to:

- Make recommendations on ways the Department can build better partnerships with the private sector for a reliable and rapid “expand-on-demand” capacity in a series of crises, unplanned or unexpected events.



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Surge Capacity

A Working Definition

surge capacity

1. The ability to quickly expand supply, production, and delivery of materials and services in response to unplanned or sudden upticks in demand.
2. Facilities and equipment that are unutilized or underutilized during normal peacetime operations.
3. The ability to leverage output potential from allies and partners.
4. Inclusive of the point of first supply to the “last mile” to the warfighter.

Industry Partnerships for Crises

Situation

DoD & Industry have partnered to respond to crises throughout history.

- **Lessons learned:**
  - Industry innovation / capabilities are crucial to national security
  - Developing and ramping up manufacturing and supply capacity takes planning, time and coordination
  - Defense supply, production and delivery cannot be easily “turned on and off” as threats change
  - It is costly to be a monopsonist, shared demand and risk is optimal

https://histclo.com/essay/war/ww2/cou/us/us-aode.html

The climate for defense partnerships has become more difficult over time…

↓ System Quantity, ↑ Complexity

- Since 1980, DoD weapons systems and munitions have increased in capability but decreased in order size & quantity:
  - Navy – 50% fewer battle ships
  - Army – 30% fewer tanks
  - Air Force – 60% fewer fighter aircraft
- Most systems & munitions now consists of both hardware & software

↑ DoD Dependency on Industry

- Vastly capable - 1.1 million U.S. workers, 60k companies
- Majority of DoD industrial facilities are GOCO
- DoD is no longer the leader in R&D spending
- Issues with end-to-end value chain management of DoD acquisition and production processes have resulted in many systems, munitions, and material being short, late, or over-budget

↑ Industry Consolidation

- Major system integrators reduced, 51 to 5
- 90% of all munitions from 3 sources
- Defense workers down 66% since 1985
- 17,000 suppliers have left defense in last 5 years

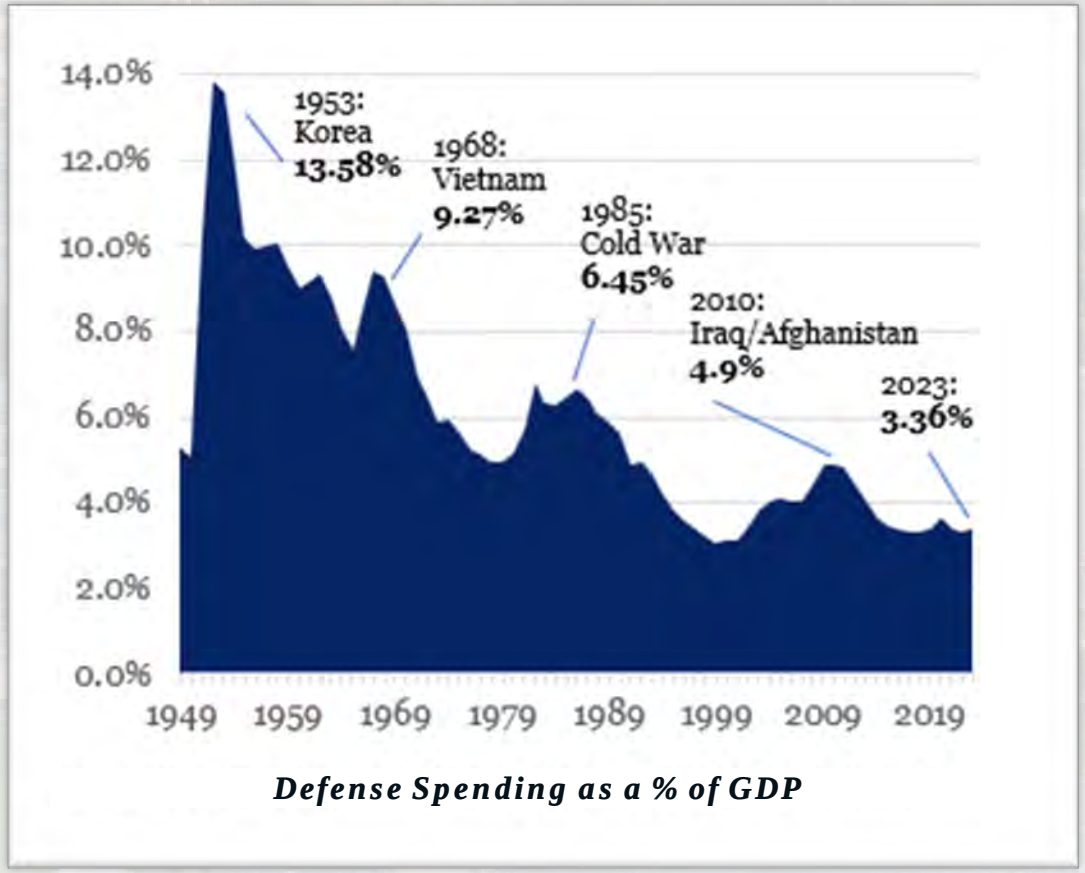
↑ Globalization

- 90% of businesses have relocated a portion of their operation overseas
- U.S. manufacturing jobs fell from 20 to 13 million from 1979 to 2018
- China controls 60% of the world's rare earth element (REE) supply, most of EV batteries and antibiotics supply
- Significant corporate offshoring driven by "short-termism" financialization & pre-2017 corporate tax policy

Result: A challenging environment for surge.

...but the need for partnership has intensified.

- Great Power Competition, proliferation, and rise of new adversaries
- "Whole of country" to expand military might
- Reduction of DoD Budget as % of GDP
- Private sector ability to scale for capacity
- Persistence of unplanned events/crises
- DoD technical and value chain management talent retention challenges



Defense Spending as a % of GDP

DoD must continue to grow & cultivate industry partnerships: (For example)

Civil Reserve Air Fleet

- Created in 1951
- 25 commercial carriers
- Executes $5 billion in annual DoD business
- Everyday airlift for 90% of DoD passenger / 40% bulk cargo movement
- Activated 3x in its history for crises

Commercial Augmentation Space Reserve

- Starts in 2025
- A CRAF-like partnership with space companies
- Managed by the Commercial Space Office—provides a single "front door" to streamline access to government business

Warstopper Program

- Created in 1992 by Defense Logistics Agency
- Disaster preparedness program
- Ensures availability of critical go-to-war supplies & suppliers
- $45 million annual budget, <1% of DLA's work

U.S. Army Joint Program Office for Armament & Ammunition

- Leading the DoD effort to replenish munitions stocks
- With industry partner, surged 155mm production from 14k to 36k a month since February 2022

Burning platform in the national spotlight…

"…reluctant to invest in expansion without knowing that the Pentagon is committing to buying at increased levels…"

"…difficulty of ramping up production…"

"…The more sophisticated the missile, the harder to produce …"

"…drawing on newer companies to help increase production…"

"…production capacity can't keep up…"

"…production isn't all for the Pentagon, 14 allies also buy…"

(*Wall Street Journal*, 10/29/2024)

Industry Partnerships for Crises

Solutions:
Findings & Recommendations

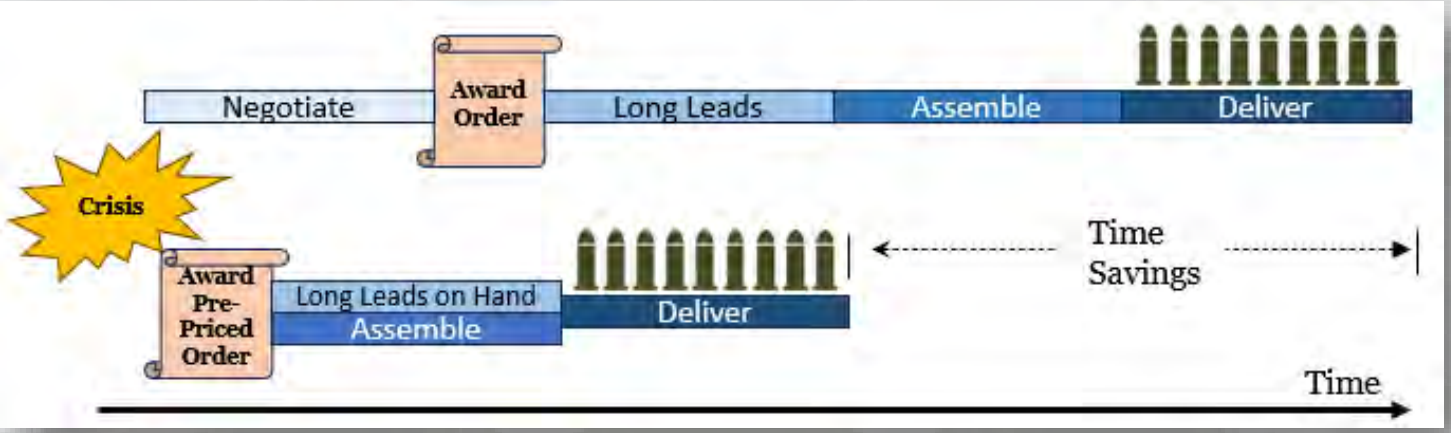
Solutions

Finding	Recommendation(s)
(1) The Civil Reserve Air Fleet (CRAF) and partnerships like it are the gold standard for mechanisms to ensure capacity in a crisis.	(1) **Assess developing a "Software Surge" program**, modeled after CRAF (2) Adopt an acquisition policy that specifies as part of the contract and **rewards primes/subs who meet established surge preparedness metrics**

(#) – Report finding/recommendation number
(*) – Denotes requirement/potential for statutory changes or Congressional assistance.

Solutions

Finding	Recommendation(s)
(2) Companies need signed contracts and profitable financial results to remain in business with the DoD.	(3) **Negotiate capacity ahead of time.** Establish variable pricing agreements/pricing tables on select weapon systems to expedite awards. (4) **Establish a "capacity-as-a-service" pilot program** to negate the effects of long lead item delays on capacity for critical weapon systems. Establish contractual vehicles with mechanisms to share costs of long lead components.



(#) – Report finding/recommendation number
(*) – Denotes requirement/potential for statutory changes or Congressional assistance.

Solutions

Finding(s)	Recommendation
(3) Foreign military sales and commercial sales are opportunities to level demand curves for some systems/supplies. (4) The requirements and design processes used in DoD acquisition are not optimized for partnerships with the broader commercial sector.	(5) **Implement a collaborative planning, forecasting, and replenishment-type process**, including probabilistic forecasting, contracting using portfolio and Option Theory, leveraging technology, driven by the DoD, and encompassing its major munitions and material suppliers.

(#) – Report finding/recommendation number
(*) – Denotes requirement/potential for statutory changes or Congressional assistance.

Solutions

Finding	Recommendation(s)
(5) For other supplies and systems where there is neither FMS nor commercial demand existing to level demand, direct investment may be necessary.	(6) **Expand the Warstopper program** to make annual investments with companies to ensure capacity is maintained to respond to a sudden surge. To start with, increase the budget for DLA's Warstopper program by 10x as a proof of concept; require an annual budget estimate thereafter. (7) **Map the critical weapons and materiel supply chains** (sources and points of origin) to ascertain chokepoints and vulnerabilities in terms of surge capacity and response.

(#) – Report finding/recommendation number
(*) – Denotes requirement/potential for statutory changes or Congressional assistance.

Solutions

Finding	Recommendation
(6) Adversarial tensions often pervade contractual relationships between DoD and industry, to the detriment of supply, cost, response, and surge capacity.	(8) **Develop and hire the necessary talent** at the central DoD level who understand private sector business imperatives: demand management, demand-supply matching, forecasting, options planning, and the common and advanced technologies available.

(#) – Report finding/recommendation number
(*) – Denotes requirement/potential for statutory changes or Congressional assistance.

Solutions

Finding	Recommendation
(7) Regulations and statutes need to adjust to account for the changing environment of the defense industrial base.	(9*) **Revise bona fide need rule exemptions** to allow for critical long-lead parts and components to be stocked at "surge" or wartime consumption rates (in excess of system quantities currently purchased for peacetime training and operational usage). (10*) **Revise "new start" provisions.** Work with Congress to exempt existing acquisition programs transitioning from development to procurement from being considered "new starts" to avoid cost increases & program delays during continuing resolutions. (11) **Transition to capability-based budgeting.** Work with Congress to, where reasonable, transition from budget line items to capability portfolios to provide greater resource agility in crisis response.

(#) – Report finding/recommendation number
(*) – Denotes requirement/potential for statutory changes or Congressional assistance.

Conclusion

DoD should continue to find ways to advance and strengthen its relationship with private industry by focusing on:

- Stabilizing demand, coupled with longer-term forecasting and supply planning
- Leveraging the CRAF model for other applications
- Increasing resource priority for preparedness programs like DLA's Warstopper
- Establishing strategies, new contracting methods, risk analysis processes, and technologies to manage risk and eliminate lengthy contract negotiations
- Developing / hiring talent for demand-supply matching, forecasting, risk management and options planning

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Appendix C: Subcommittee Biographies

DEFENSE BUSINESS BOARD

DR. CHRISTOPHER S. GOPAL, PhD

EXECUTIVE, CONSULTANT, AUTHOR & EDUCATOR
GLOBAL SUPPLY CHAIN & OPERATIONS

Dr. Gopal has more than 40 years of experience consulting and providing industry executive management in global supply chain and operations strategy, execution, and technology. His expertise has focused on innovating, structuring, improving, and managing supply chain operations, business processes, services, and technology-use for leading global companies.

For products companies, this has included developing innovative supply chain, customer life cycle experience, and information strategies on a global basis, cost reduction, risk mitigation, stabilizing and improving operational efficiency, and executing for world-class results. In the services arena, he has built and run world-class professional services and consulting practices for major companies, consulted in supply chain strategy, management, and technology with leading global companies, and developed technology solutions, innovative new services in accelerated strategy and process design, and executive education programs.

Dr. Gopal has held executive positions at leading companies, including VP in World-Wide Operations, Dell Computer; Partner & Director of Global Supply Chain & Operations services, Ernst & Young Consulting; and executive VP positions at Unisys, Overland Storage, and SAIC. Currently, he is a member of the Private Sector Advisory Board of the Global Fund in Geneva, a public-private sector health organization focused on HIV, TB, and Malaria.

Dr. Gopal is a recognized thought leader in the field of global supply chain & operations. He is the co-author of four books, the latest being *Breakthrough Supply Chains: How Companies and Nations Can Thrive and Prosper in an Uncertain World* (endorsed by the Council for Supply Chain Management Professionals and accepted into the Pentagon Library). Dr. Gopal has authored several articles and is an invited speaker and panelist at numerous international business conferences for *Business Week, Defense Logistics Agency, the Harvard Business Review, the Milken Institute Global Forum,* and *the OECD*, among others. He has testified before the Congressional US-China Committee and served as an Advisor and Board member to leading–edge technology companies. Dr. Gopal served as an Advisor to a prominent think tank project in Washington on Industrial Competitiveness, and on a White House sub-committee on Manufacturing Technologies.

Currently, Dr. Gopal is a strategic advisor to several small companies in the field of technology, supply chain, and customer experience. He consults with companies in supply chain & operations, risk mitigation, technology, and solutions development. He teaches at the University of California San Diego and University of Southern California (USC). Dr. Gopal serves on the Advisory Board of the Global Supply Chain Management Center at USC. He holds a PhD in Business from the University of Southern California; an MBA from the Cranfield School of Management, UK; and a B.Sc. from Bangalore University, India.

DEFENSE BUSINESS BOARD

BRIG. GEN. BERNARD SKOCH, US AIR FORCE (RET)

CHAIR OF THE BOARD
AIR & SPACE FORCES ASSOCIATION

Brigadier General Bernie Skoch (USAF, Ret.) graduated from the University of Arkansas with a Bachelor's in Industrial Engineering. Upon graduation he was commissioned as a second lieutenant in the Air Force. His 29-year Air Force career took him throughout the United States, Europe, Asia, the Pacific, and the Middle East on permanent and temporary duty until retiring at the rank of brigadier general.

Skoch has more than 25 years of experience in leadership positions developing, managing, and implementing communications and information systems at the wing, major command, and Air Staff levels of the United States Air Force as well as at the Defense Information Systems Agency (DISA). During his time at DISA, he served as the Principal Director for Customer Advocacy and as the Principal Director for Network Services. At Headquarters USAF, he served as Director of Mission Systems, Director of Communications Operations, and Director of Chief Information Officer Support where he was responsible for aligning information technology systems with business process improvements. He has developed policies for global voice, video, radio, data, and satellite systems. While on the Joint Staff, Skoch led transformation of the mainframe-based DoD-wide Worldwide Military Command and Control System to the distributed Global Command and Control System, substantially improving system support to Combatant Commands.

As Director of Communications at Pacific Air Forces, he led the creation of the COPE SPARK family of initiatives which significantly improved warfighter communications and data support throughout the Pacific.

Upon retirement from active duty, Skoch was a consultant to numerous IT-sector companies and to the federal government. In 2010, following an unsuccessful run for the U.S. House of Representatives, Skoch was appointed National Commissioner of the National Youth Cyber Education Program, CyberPatriot, a program operated by the not-for-profit Air and Space Forces Association. Skoch oversaw the planning and implementation of CyberPatriot and provided leadership and support for the program's development. Under his leadership the program grew into the largest cyber defense STEM education competition in the world, reaching over 250,000 K-12 students, stimulating their interest in science, technology, engineering, and mathematics related studies, as well as increasing their awareness of cybersecurity threats.

Skoch is a graduate of Air Command and Staff College, Air War College, and the Program for Senior Officials in National Security at Syracuse University and Johns Hopkins University. He holds a Master's in Management and Supervision from Central Michigan University. Bernie is a certificated Commercial Pilot, FAA-certificated drone pilot, an amateur astronomer, and a ham radio operator. Bernie and Debbie, his wife of 52 years, have six children, twenty-two grandchildren, and one great grandchild.

DEFENSE BUSINESS BOARD

DAVID BEITEL

CHIEF TECHNOLOGY OFFICER
ZILLOW GROUP

As Chief Technology Officer of Zillow Group, David Beitel oversees the internal and external technical engineering, product development, and technology operations teams. David joined Zillow in 2005 as a member of the founding team and is one of the company's first executive leaders.

In addition to his role as CTO, David helped develop and build Zillow from a small startup to a household name and was named the region's Most Innovative CTO by the *Puget Sound Business Journal* in 2012. He also received the Large Enterprise Seattle CIO ORBIE Award for 2021.

Prior to Zillow, David was CTO of Expedia, where he joined as one of its earliest team members and spent 12 years contributing to its success. David started his career at Microsoft in the Handheld Computing group.

David earned a Bachelor of Science in Computer Science and Master of Engineering in Computer Science from Cornell University. He is a Board Trustee and Advisor with a number of advocacy, education, and charitable organizations, including Cornell University CIS; University Prep; and T4A.org.

DEFENSE BUSINESS BOARD

SALLY DONNELLY

FOUNDING PARTNER
PALLAS ADVISORS

Sally Donnelly is a Founding Partner of Pallas, a strategic advisory firm specializing in navigating complex national and international security dynamics. Her public service included roles as Senior Advisor to the Secretary of Defense; Director of the Washington Office for the Commander of U.S. Central Command; and Special Assistant to the Chairman of the Joint Chiefs of Staff.

In the private sector, Ms. Donnelly was the Founder and Chief Executive Officer of SBD Advisors, a Washington, D.C.-based consulting firm, advising technology and corporate clients as well as non-governmental organizations on strategic positioning, communications, and policy issues.

Previously, she spent more than 20 years at *Time Magazine* serving as the magazine's correspondent for the Iraq War, the Moscow bureau, and on the aviation and airline beat. She was the head researcher of the 1988 book *Mikhail S. Gorbachev: An Intimate Biography* and worked on the 1989 book *Massacre in Beijing*.

Ms. Donnelly serves on the Board of the Quincy Institute for Responsible Statecraft. Additionally, she is a non-resident Senior Fellow at the Rockefeller Brothers Fund and on the Leadership Council for the Bob Woodruff Foundation. Ms. Donnelly holds a Bachelor of Arts in History from Hollins College and a Master's in Russian politics from London School of Economics.

DEFENSE BUSINESS BOARD

LINNIE M. HAYNESWORTH

CO-CHAIR, DEFENSE BUSINESS BOARD;
FORMER VICE PRESIDENT, NORTHROP GRUMMAN; and
INDEPENDENT BOARD DIRECTOR

Ms. Haynesworth serves as a Board Director on four public company boards where she sits on the Audit, Technology, and Governance and Sustainability committees.

Linnie also serves on non-profit Boards, including the USC Viterbi School of Engineering Board of Councilors, Fairfax County Economic Development Authority (FCEDA) Commission, and the Flint Hill School Trustees and has served on the Boards of the Northern VA Technology Council and the Intelligence & National Security Alliance (Audit Committee).

Ms. Haynesworth is a highly regarded operational leader with an extensive background in technology integration, cybersecurity risk management, strategic planning, and large complex software-intensive system development, delivery, and deployment to U.S. government and international customers. With P&L operational responsibility for multiple $1B-plus divisions, she retired in 2019 as the Sector Vice President and General Manager of the Cyber and Intelligence Mission Solutions Division for Northrop Grumman Corporation's (NGC) Mission Systems Sector. Linnie also led Engineering, Supply Chain, and Product Development functions for the NGC Space sector.

Ms. Haynesworth received her BS in Electrical Engineering from the University of Southern California (USC) and is the 2019 recipient of the USC Viterbi School of Engineering Mark A. Stevens Distinguished Alumni Award. Linnie also earned the National Association of Corporate Directors (NACD) Cybersecurity Oversight Certification from Carnegie Mellon University Software Engineering Institute (2022).

DEFENSE BUSINESS BOARD

JOSHUA D. MALCOLM

CHIEF EXECUTIVE OFFICER
LUMBEE TRIBE HOLDINGS, INC.

Joshua D. Malcolm is the Chief Executive Officer (CEO) of the Lumbee Holdings, Inc. (LH) family of tribally owned companies. Malcolm is an enrolled member of the Lumbee Tribe of North Carolina and previously served as General Counsel and Corporate Secretary for LH and its subsidiaries.

As an active citizen of the Lumbee Tribe, in various roles during the years, Malcolm's most prominent contribution was serving as Chief Justice of the Lumbee Tribe Supreme Court. He has served as General Counsel and Chief of Staff for the University of North Carolina at Pembroke and as Associate General Counsel for Fayetteville State University, both of which are a part of the University of North Carolina System.

In North Carolina, Malcolm serves on the State Bar Council, Lottery Commission, and Medical Board.

Malcolm was a Distinguished Graduate of the University of North Carolina at Pembroke's Air Force ROTC program. A combat veteran, he served on active duty as a warranted Contracting Officer and an Aviator with the U.S. Air Force. After serving our Great Nation, he earned his law degree from the North Carolina Central University School of Law.

A novice runner, Malcolm completed his first marathon in early 2024. He is married and has four children.

DEFENSE BUSINESS BOARD

SARAH MINEIRO

FOUNDER & CEO
TANAGRA ENTERPRISES

Sarah Mineiro is the Founder and CEO of Tanagra Enterprises, a defense, intelligence, space, science, and technology research and consulting firm based in Washington, D.C. Sarah has worked within the national security and defense sector for more than 20 years. Over her career, Sarah has worked in private industry and the Executive and Legislative Branches of government.

Previously, Sarah was the Senior Director of Space Strategy for Anduril Industries, a hypergrowth VC-backed defense unicorn specializing in AI/ML-enabled defense technologies. Sarah was the Staff Lead for the Strategic Force Subcommittee for the House Armed Service Committee (HASC). She led the Subcommittee's legislative and oversight activities of all Department of Defense and Military Intelligence Program space programs, U.S. nuclear weapons, missile defense, directed energy, and hypersonic systems. In this role, she was the primary drafter and negotiator of the Space Force and Space Command legislation for the House Republicans.

Prior to joining the HASC, Sarah served in the Office of the Under Secretary of Defense for Policy (OSDP) and the Under Secretary of the Air Force for International Affairs (SAF/IA), and she started her career as an intelligence analyst for the National Air and Space Intelligence Center. Sarah is an angel investor and is a member of several corporate boards, the Defense Business Board, and the Defense Innovation Board as well as a Board member of the Space Force Association and National Defense University Foundation. She serves as a non-resident Fellow with CSIS and on the Board of Advisors for several space start-ups. She has been awarded the Secretary of Defense Medal for Exceptional Civil Service. She is an Executive Mentor with the Zed Factor Fellowship, a newly established nonprofit seeking to increase participation of underrepresented communities, including women of color and LGBTQ+ individuals, in the space ecosystem. Sarah is also a Senior Fellow with the Potomac Institute for Policy Studies as well as an adjunct Senior Fellow with the Aerospace Security Project at CSIS.

DEFENSE BUSINESS BOARD

DR. DAVID VAN SLYKE, PhD

DEAN, THE MAXWELL SCHOOL OF CITIZENSHIP & PUBLIC AFFAIRS, SYRACUSE UNIVERSITY

David M. Van Slyke is Dean of the Maxwell School of Citizenship and Public Affairs at Syracuse University and is the Louis A. Bantle Chair in Business-Government Policy. Prior to becoming Dean in July 2016, Van Slyke was Associate Dean and Chair of Maxwell's Department of Public Administration and International Affairs. He is a tenured, full professor at the Maxwell School and a two-time recipient of the Birkhead-Burkhead Award and Professorship for Teaching Excellence.

Van Slyke is a leading international expert on public-private partnerships, public-sector contracting and contract management, public and nonprofit management, and policy implementation. He was a Director (2016- 2021) and is a Fellow (2010-Present) of the National Academy of Public Administration (NAPA) and has been a member of NAPA's Expert Advisory teams for the Office of the Inspector General at the Department of Homeland Security and U.S. Postal Service. He is a former co-editor of the *Journal of Public Administration Research and Theory* and the *Journal of Strategic Contracting and Negotiation*. He is actively engaged in the Network of Schools of Public Policy, Affairs, and Administration; the Association of Professional Schools of International Affairs; the Volcker Alliance; and the University Leadership Council on Diversity and Inclusion in International Affairs Education. He also sits on the Editorial Boards of several top-ranked public affairs and nonprofit management journal.

He has provided expert guidance to the Office of Management and Budget, Government Accountability Office, U.S. Coast Guard, Department of Defense, World Bank, and a range of philanthropic foundations. As part of his executive education teaching and research, he has worked extensively with senior leaders in government, nonprofit, and business organizations in China, India, Russia, Singapore, and Thailand. He has been interviewed on, and his work cited in, *CNN, Washington Post, Bloomberg Tax, National Public Radio's Morning Edition, National Public Radio/American Public Media's MarketPlace, CBS News, US News & World Report, Governing, the Capital Pressroom, Washington Times, Government Executive, InsideDefense, Xinhua Global Times in China, Federal Computer Week, Washington Technology, Defense Industry Daily, Federal News Radio,* and *GovLoop*.

Van Slyke's book, *Complex Contracting: Government Purchasing in the Wake of the U.S. Coast Guard's Deepwater Program* (Cambridge University Press, 2013) is the recipient of the American Society for Public Administration Section on Research Best Book Award for 2014 and honorable mention for the Public and Nonprofit Section of the Academy of Management best book award for 2016. He is winner of the 2015 Distinguished Alumnus in Public Administration and Policy award from the Rockefeller College of Public Affairs and Policy at the University at Albany and of the 2007 Best Article Award published in the *Journal of Public Administration Research and Theory*. Van Slyke earned a PhD. in Public Administration and Policy from the Rockefeller College of Public Affairs and Policy at the University at Albany, State University of NY.

DEFENSE BUSINESS BOARD

PATRICIA J. ZARODKIEWICZ

PRESIDENT
PATZ CONSULTING, LLC

Pat Zarodkiewicz, President of PatZ Consulting, LLC, provides national security, organizational dynamics, and leadership consulting to private and federal markets.

In addition to her consulting, she currently serves on the Aerospace Corporation's Board of Trustees and Board of Advisors for the Intelligence & Security Academy LLC, and she is an Advisor to Core4ce, LLC. She is a retired Senior Executive with nearly 34 years of experience in the Department of the Air Force. In her final USAF position as the Administrative Assistant to the Secretary of the Air Force (SAF/AA), she provided advice to the Secretary of the Air Force and Chief of Staff on executive personnel and Headquarters management; led an organization responsible for over $5.6 billion annually; and supported 37,000 people. As the Air Force's Senior Security Official, she led the Air Force's insider threat program, information, personnel, and industrial security policy and provided oversight of Special Access Programs. Pat served as the Acting Under Secretary for five months in 2017 and was the Senior Transition Official for the Air Force. She served as the Chair of the Strategic Planning Committee for the $6 million DoD Concessions Committee and was the Chair and Board member of the Air Force Board of Military Corrections.

Prior to her SAF/AA role, Pat served as the Deputy Administrative Assistant to the SECAF and was the Principal Deputy Financial Management and Comptroller for two years. She served as the Deputy Director of the Headquarters Staff. Her previous positions include Deputy for Budget, Assistant Secretary of the Air Force for Financial Management and Comptroller (SAF/FMB); the Deputy Comptroller and Comptroller, HQ Air Force Materiel Command; and the Director of Budget Investment, SAF/FMBI. Her career includes 20 years of experience in financial management at base, Major Command, and Headquarters.

Pat was a Distinguished Graduate in 1995 from the Industrial College of the Armed Forces, graduating with a MS in National Resource Strategy, and her studies focused on space programs. Pat has a MA in International Affairs from American University and a BA in Economics and Political Science from the University of Rochester. She attended the Seminar XXI program at Massachusetts Institute of Technology. Pat's leadership was recognized with two Meritorious Presidential Rank Awards; one Distinguished Presidential Rank Award; the Air Force Exceptional Service award; the Navy Superior Public Service Award; and the Army Meritorious Public Service Award.

Appendix D: Acronym List

AAF – Agile Acquisition Framework
AUKUS – A partnership between Australia, the United Kingdom, and the US
CASR – Commercial Augmentation Space Reserve
CDAO – Chief Data & Artificial Intelligence Officer
C4ISR – Command, Control, Communications, Computers, Intelligence, Surveillance, & Reconnaissance
CCP – Chinese Communist Party
CRAF – Civil Reserve Air Fleet
CR – Continuing Resolution
CSIS – Center for Strategic & International Studies
DARPA – Defense Advanced Research Projects Agency
DBB – Defense Business Board
DLA – Defense Logistics Agency
DPA – Defense Production Act
DPAI – Defense Production Act Investment program
FASA – Federal Acquisition Streamlining Act
FMS – Foreign Military Sales
GDP – Gross Domestic Product
GMLRS – Guided Multiple Launch Rocket Systems
GWOT – Global War on Terrorism
HIMARS – High Mobility Artillery Rocket System
IBAS - Industrial Base Analysis and Sustainment programs
JCIDS - Joint Capabilities Integration and Development System
JASSM - Joint Air to Surface Standoff Munition
JPAC - Joint Production Accelerator Cell
LCS - Littoral Combat Ship
LOA - Letter of Offer and Acceptance
MCF - Military-Civil Fusion
MYP - Multiyear Procurement
MoD - Ministry of Defence
NATO - North Atlantic Treaty Organization
NDS - Nation Defense Strategy
NFE - Non-federal entities
NGJ - Next Generation Jammer program
OMB - Office of Management and Budget
OSD - Office of the Secretary of Defense
OUSD(A&S) - Office of the Under Secretary of Defense for Acquisition and Sustainment
PLA - People's Liberation Army, China's military force
QDR - Quadrennial Defense Review
REEs - Rare Earth Elements
S&P 500 - Standard & Poor's 500
U.S.S.R – Union of Soviet Socialist Republics
USTRANSCOM - United States Transportation Command
VC - Venture Capitalist
VISA - Voluntary Intermodal Sealift Agreement
VUCA - **V**olatile, **u**ncertain, **c**omplex, and **a**mbiguous
WWI - **W**orld **W**ar **I**
WWII - **W**orld **W**ar **II**

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Appendix E: Disclosures

This Study, DBB FY25-01, *Industry Partnerships for Crises*, is a product of the Defense Business Board (DBB). The board's recommendations herein are offered as advice and do not represent DoD policy.

The Secretary of Defense established the DBB in 2002 to provide the Secretary and Deputy Secretary of Defense with independent advice and recommendations on how "best business practices" might apply to the overall management of the DoD. DBB's members, appointed by the Secretary of Defense, are senior corporate leaders with demonstrated executive-level management and governance expertise.

DBB members possess a proven record of sound judgment in leading or governing large, complex organizations and are experienced in creating reliable and actionable solutions to complex management issues guided by proven best business practices. All DBB members volunteer their time to this mission.

Authorized by the Federal Advisory Committee Act of 1972 (Chapter 10 of Title 5, U.S. Code) and governed by the Government in the Sunshine Act of 1976 (Section 552b of Title 5, U.S. Code), 41 CFR 102-3.140, and other appropriate federal and DoD regulations, the DBB is a federal advisory committee whose members volunteer their time to examine issues and develop recommendations and effective solutions to improve DoD management and business processes.

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Appendix F: Public Comments

An open meeting was held on November 12, 2024, during the Defense Business Board Quarterly Board Meeting. No comments were submitted from the public.

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Appendix G: Study Definitions

The following definitions are provided for further context to the subcommittee's findings and recommendations pertaining to this task. Where possible, the subcommittee adhered to the "official DoD" definition of terms, as documented in Joint Staff Publication 1-02.

Partnership – a mutually beneficial relationship during a specific amount of time or for a specific circumstance. Includes:

- 1: Public-Private-Partnerships - Voluntary, non-contractual collaborations between DoD and non-federal entities (NFE) through which both parties leverage the expertise, resources, and incentives of the other to achieve mutually agreed goals.
- 2: Contracts
- 3: Strategic Partnerships – less formal than alliances documented by treaties but help build relationships between nations or organizations like militaries.[103]

Expand-on-demand capacity (or surge capacity) –

- 1: The ability to quickly expand supply, production, and delivery of materials and services in response to unplanned or sudden upticks in demand.
- 2: Facilities and equipment that are unutilized or underutilized during normal peacetime operations.[104]
- 3: The ability to leverage output potential from allies and partners.
- 4: Inclusive of the point of first supply to the "last mile" to the warfighter.

Crises or unexpected events – An incident or situation involving a threat to the United States, its citizens, military forces, or vital interests that develops rapidly and creates a condition of such diplomatic, economic, or military importance that commitment of military forces and resources is contemplated to achieve national objectives.[105]

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Appendix H: Study Findings & Recommendations Matrix

Finding	Recommendation	ToR Section	Legislation Needed?
1. The Civil Reserve Air Fleet (CRAF) and partnerships like it are the gold standard for mechanisms to ensure capacity in a crisis.	1. Assess developing a "software surge program," modeled after CRAF. 2. Adopt an acquisition policy that specifies as part of the contract and rewards primes/subs who meet established surge metrics.	1., 2., 4.	No
2. Companies need signed contracts and profitable financial results to remain in business with the DoD.	3. Establish a "capacity-as-a-service" pilot program. 4. Negotiate capacity ahead of time.	1., 3.	No
3. Foreign military sales and commercial sales are opportunities to level demand curves for some systems/supplies.	5. Stabilize demand across the Department.	1., 2.	No
4. The requirements and design process used in DoD acquisition are not optimized for partnerships with the broader commercial sector.	5. Stabilize demand across the Department.	2.	No
5. For other supplies and systems where there is neither FMS nor commercial demand existing to level demand, direct investment may be necessary.	6. Expand the Warstopper program. 7. Map the critical weapons and materiel supply chains.	1., 2., 3., 4.	No
6. Adversarial tensions often pervade contractual relationships between DoD and industry, to the detriment of supply, cost, response, and surge capacity.	8. Develop and hire the necessary talent.	3.	No
7. Regulations and statutes need to adjust to account for the changing environment of the defense industrial base.	9. Revise bona fide need rule exemptions. 10. Revise "new start" provisions. 11. Transition to capability-based budgeting.	2., 4.	Potentially, Title 31 U.S.C., Section 1502(a) (Bona Fide Need) & Continuing Resolution provisions (New Starts).

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Appendix I: Brief History of the Defense Industrial Base

Americans have long recognized the inextricable linkage between industry and national security. George Washington's 1790 state of the union address emphasized the vital ties between safety and the essential production of the tools of national defense. The following year, Alexander Hamilton wrote to Congress on ways to encourage manufactures to produce essential military supplies.[106] In later writings, he advocated for government-owned arms factories, a thoughtful exception to his free market stance.[107]

While recognition came early, the transformation of the country's colonial economy into the producer of today's military-industrial complex took a lot longer. Over the first century of its existence, the U.S. maintained only modest armed forces, to avoid, as Washington reasoned, stressing the finances of the young republic.[108]

By the late 1800s, the U.S. economy produced twice as much as Great Britain but was still not a great military power, despite a century of conflict to include its own civil war.[109] Into the 20th century, the U.S. was forced to reckon with the imbalance between its industrial and military might as global threats continued to advance on U.S. interests; first against its foreign allies, then its own overseas commerce, and finally within its own hemisphere as well.

> *"American airplanes did not arrive at the front lines in sufficient numbers. American guns in certain essential calibers did not appear at all. American gas shells were not fired at the enemy. American troops fought with French and British machine guns."*
>
> - America's Munitions 1917-1918, Report of Benedict Crowell, Assistant Secretary of War, Director of Munitions

Upon the U.S.'s entry into WWI in 1917, there were roughly twenty companies producing artillery, big guns, rifles, machine guns, and other supplies. This was an increase from two prior to 1914. However, the Great War ended before the output of America's great industrial mobilization could bear fruit, leaving its troops to fight much of the war with foreign equipment. Although the U.S. had managed to raise and train a fighting force of nearly one million men in the first nineteen months, its manufacturing and transportation capacity lagged. Nonetheless, WWI motivated U.S. commerce to get more involved in the Nation's defense, involving over 8,000 companies on ordinance contracts alone.

But the progress made to encourage businesses to enter the defense space eroded during the 1930s, despite the increased attention on defense industrial planning in the wake of WWI. During the Great Depression, industrial production fell by one-third, unemployment rose to 25% and many of the WWI weapons manufactures faced a backlash of anti-war sentiments, reduced budgets, and in-turn, reduced demand. In 1940, looking out across a depleted military that had one-fifth the planes and one-twentieth the number of tanks Hitler did, President Roosevelt asked Congress to

increase Army appropriations from $24 to $700 million. Roosevelt knew that defeating the Axis Powers would require the capacity of America's industrial base—with a goal to increase aircraft production from 50 to 50,000 per month.[110]

From America's entry into WWII in 1941 until 1945, it steadily mobilized its economy to stock the materiel needed for a long war against a major peer adversary. Although difficult and at times disorganized, the nation eventually coalesced the government and business sectors to build the "arsenal of democracy." At the time of Japan's surrender, the U.S. had produced over 88,000 tanks, 257,000 artillery pieces, 41 billion rounds of ammunition, and 324,000 aircraft—supplying some $50 billion of raw materials and two-thirds of all equipment to its allies all the while.[111]

Despite programs like the *Lend-Lease Act*, established to share some military equipment costs with foreign allies, the U.S. Government bore much of the cost of the demand spike alone. All told, WWII proved to be America's most expensive war, costing over $4 trillion. Through its transformation into a production marvel, the U.S. learned several lessons that propelled it to "super-power" status in the latter half of the 1900s:[112]

1. The innovation of American businesses was both crucial to the success of the war effort as well as the health of the economy during peacetime.
2. Capacity takes time and coordination that must be accounted for in planning.
3. National defense is not a light switch, turned on and off as threats changed.

America emerged from WWII determined to maintain the military industrial progress it lost at the beginning of the century. It preserved a fighting force larger than 1% of the total population and steadily increased its annual defense budget year over year.[113] Companies no longer had to divest the defense manufacturing segments of their business during peacetime. Conflicts in Korea, Vietnam, and fears of a Cold War with the Union of Soviet Socialist Republics (U.S.S.R) turning "hot" provided delivery orders as well. Concurrently, U.S. technology advanced and the economy grew. By the 1980s, the aerospace and defense sector, cultivated by the DoD and Congress, supported over 50 suppliers.[114] The nation finally realized President Eisenhower's "Defense Industrial Complex," created out of the "imperative" to preserve U.S. interests. In Eisenhower's estimation, the ecosystem was essential; the U.S. "could no longer risk emergency improvisation of national defense; (it was) compelled to create a permanent armament industry of vast proportions."[115]

With the dissolution of the U.S.S.R. in 1991, the U.S. became as the world's lone superpower. U.S. leaders and their allies sought to capitalize on their global advantage by extracting a "peace dividend" through a redistribution of funds away from defense spending to other domestic priorities. This led to consolidation of the defense sector, personified by a 1993 dinner meeting held at the Pentagon to inform defense executives that it could no longer sustain demand to keep all their companies in business. The meeting, known colloquially as the "Last Supper," spelled the merger and end of many of the world's largest arms producers, resulting in a highly concentrated defense and

supply industry.[116] The impacts, both intended and unintended, did not take long to manifest.

The 1997 Quadrennial Defense Review (QDR), the DoD's principal strategy document and precursor to the Nation Defense Strategy (NDS), was pointed in its assessment of the nation's defense posture at the time. It noted that operating with 38 percent less budget, 33 percent less people, and reliant on a defense industry employing 3.7 million less workers than it had in the previous decade, the peace dividend was taking a toll. "It was clear," the QDR summarized, that the Department was "failing to acquire the modern technology and systems essential for its forces to successfully protect the security of its nation in the future."

With only modest budget increases expected into the twenty-first century, the QDR plan sought to maximize investments in industry to modernize the force for future threats. It prioritized programs to leverage technological advances in C4ISR and munitions capacity, especially for precision missiles. The QDR postulated that between 1997 and 2015, it was reasonable to assume that more than one aspiring regional power would have the desire and means to challenge U.S. interests militarily.

But the attacks on September 11, 2001, altered the trajectory of the type of defense modernization the 1997 QDR hoped for. The counterinsurgency operations in Iraq and Afghanistan that followed came with high manpower and construction costs. Defense planners siphoned remaining funds to large, exquisite systems, like the ones that overwhelmed the Iraqi Army in just a few days.[117] Little progress was made to expand the pool of major weapons producers and integrators since the "Last Supper" consolidation.[118]

The Global War on Terrorism subsided in the early 2020s. Fiscal 2020 was the final year of the GWOT supplemental budget. The U.S. withdrew from Afghanistan in 2021 and focused its attention on other threats. The "aspiring regional powers" the 1997 QDR forewarned came into focus in the 2022 NDS, namely, the People's Republic of China (the pacing challenge) and Russia (an acute threat). [119] Equally concerning is the success of China in becoming the "manufacturing and supply hub" of the world with U.S. industry dependent on Chinese supplies and material.

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