EXIGER | SPECIAL COMPETITIVE STUDIES PROJECT

WHITE PAPER · NOVEMBER 2026

Modernizing the United States Defense Industrial Base



About the Collaborating Organizations

ABOUT EXIGER

Exiger transforms supply chain management from a complex challenge into a strategic advantage—driving savings and operational excellence in today's volatile market. Exiger's single, intuitive 1Exiger platform provides instant visibility into vast supplier ecosystems through a single pane of glass. Leveraging proprietary data and advanced agentic AI, 1Exiger proactively surfaces risks, automates compliance, accelerates procurement, and reveals opportunities to gain efficiencies and reduce costs to strengthen long-term resilience. With a mission to make the world a safe and transparent place to succeed, Exiger empowers 550+ global customers, including 150 Fortune 500 and 60+ government and Defense Industrial Base organizations, with supply chain AI. Exiger is FedRAMP® authorized and the largest provider of supply chain technology to the U.S. Federal Government. Named a Leader in the Gartner® Magic Quadrant™ for Supplier Risk Management, twice selected as one of Fast Company's 'Brands That Matter,' and recipient of the Third Party Risk Association's Innovator Award, Exiger's technology has been recognized by leading analyst evaluations and 50+ awards. Learn more at Exiger.com and follow Exiger on LinkedIn.

ABOUT SCSP

The Special Competitive Studies Project (SCSP) is a non-partisan, non-profit initiative with a mission to make recommendations to strengthen America's long-term competitiveness as emerging technologies reshape our national security, economy, and society.

Executive Summary

The Trump administration's USD 1.5 trillion defense budget request, the largest in U.S. history, reflects a national commitment to rebuilding American military capability in an increasingly contested global environment. Yet sustained defense readiness depends not only on the scale of investment, but on the industrial capacity to deliver it. Exiger analyzed billions of data points across defense supply chains, mapping vulnerabilities at the individual part and material level, to identify precisely where the U.S. defense industrial base's (DIB) risks are most acute and where targeted investment and reform can yield the greatest impact.

Exiger's analysis reveals six interconnected vulnerabilities that budget alone cannot resolve: critical mineral deficiencies, manufacturing process bottlenecks, foreign reliance in the supply chain, regulatory roadblocks, workforce, and the economics of manufacturing. Thousands of components across major weapon systems, including the F-35 fighter aircraft, B-2 bomber, and Virginia-class submarine, require critical minerals such as gallium, germanium, antimony, and tungsten that are primarily sourced or refined in China, creating supply chain chokepoints vulnerable to foreign export controls. Underlying those mineral dependencies are equally serious manufacturing gaps: persistent bottlenecks in casting, forging, and extrusion have pushed lead times on critical parts beyond nine months, driven by decades of facility closures and workforce erosion in the United States. The U.S. no longer produces titanium sponge, the feedstock for the titanium in jet engines, airframes, and naval systems, leaving the defense base reliant on imports concentrated in a few allied suppliers and a global market increasingly dominated by China. Lengthy qualification processes and legacy military specifications compound the problem, deterring new suppliers from entering the market and limiting competition. Financial pressures have accelerated the damage: inflation, high interest rates, and fixed-price contracting have eroded margins across the supply chain.

Addressing these vulnerabilities—spanning critical mineral dependence, manufacturing capacity, supplier access, and contracting structure—will be essential to ensuring the U.S. can translate a record defense budget into real, deployable military capability. Exiger's part- and material-level data identifies where those gaps are deepest and where intervention is most likely to drive meaningful results.



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SECTION 01

A Global Surge in Defense Spending

Amid escalating global tensions, nations are ramping up their military spending at an accelerating pace, reflecting a shift in priorities and growing security concerns. In 2024, global defense spending hit a record USD 2.718 trillion, a 9.4% increase over 2023, which was the steepest year-on-year rise in decades. This increase continued the trend since 2022, when Russia's invasion of Ukraine jolted many countries into boosting their defense budgets. At the June 2025 NATO summit, most alliance members adopted an increased defense spending target of 5% of GDP by 2035. Projections indicate that defense spending growth will persist; one analysis estimates world defense expenditures will expand to roughly USD 3.3 trillion by 2030, driven by funding for emerging technologies like AI and space capabilities as well as by growing manufacturing to support traditional warfighting capabilities. Preparation for future potential conflicts related to Taiwan, the South China Sea, and the Middle East may also drive increased defense spending. As allied nations increase their own defense capabilities, the demand for shared inputs will cause additional constraint on supplies, increasing competition for the same capacity.

United States

The U.S. is the global leader in defense spending, and the trajectory is accelerating. On July 4, 2025, President Trump signed into law a landmark budget reconciliation package, passed by the House on May 22, which included over USD 150 billion in new military investment as part of a USD 1 trillion defense topline. Building on that momentum, the Trump administration's FY2027 budget request pushes further still, proposing a record USD 1.5 trillion for defense, a 42% increase over current levels and the largest such request in U.S. history. The funding will support a broad range of defense initiatives, shipbuilding, missile defense systems such as Golden Dome, nuclear deterrence, and AI-enabled capabilities, reflecting the Pentagon's strategic pivot toward high-tech competition with near-peer rivals China and Russia. It also aims to replenish stockpiles of munitions and equipment drawn down through support to Ukraine and operations in the Iran conflict, including missile interceptors.

USD 2.718T

RECORD GLOBAL DEFENSE SPENDING IN 2024, UP 9.4% OVER 2023

USD 1.5T

FY2027 U.S. DEFENSE BUDGET REQUEST, THE LARGEST IN U.S. HISTORY

+42%

INCREASE OVER CURRENT U.S. DEFENSE SPENDING LEVELS

European Union and United Kingdom

EU defense spending is expanding rapidly in response to Russia's invasion of Ukraine. EU member states already collectively spent EUR 392 billion (~USD 459 billion) in 2025, surpassing the 2% GDP threshold for the first time, with the ReArm Europe Plan mobilizing up to an additional EUR 800 billion (~USD 936 billion) through 2030. Germany's draft 2027 budget alone earmarks nearly EUR 145 billion (~USD 170 billion) for defense, rising toward EUR 180 billion (~USD 211 billion) by 2030, underscoring the scale of Europe's rearmament. The UK has, for similar reasons, committed to substantially expanding its defense funding, which is projected to reach 2.5% of gross domestic product (over USD 100 billion) by 2030. The war in Ukraine has highlighted critical gaps in Europe's defense readiness, especially regarding procurement of weapons, munitions, and modern equipment, and the ability to ramp production to backfill arms sent to Ukraine. Accordingly, the EU intends to expand its DIB to increase production capacity for equipment like steel armor and ships, improve procurement efficiency, and foster tech innovation, particularly in AI, quantum computing, and space defense, in an effort to ensure Europe can compete globally and respond effectively to emerging security risks. Procurement and industrial policy will need to be coordinated to reduce supply bottlenecks for DIB inputs shared with allied nations.

EUR 800B

MOBILIZED BY THE REARM EUROPE PLAN THROUGH 2030

2% of GDP

EU SPENDING THRESHOLD SURPASSED FOR THE FIRST TIME IN 2025

2.5% of GDP

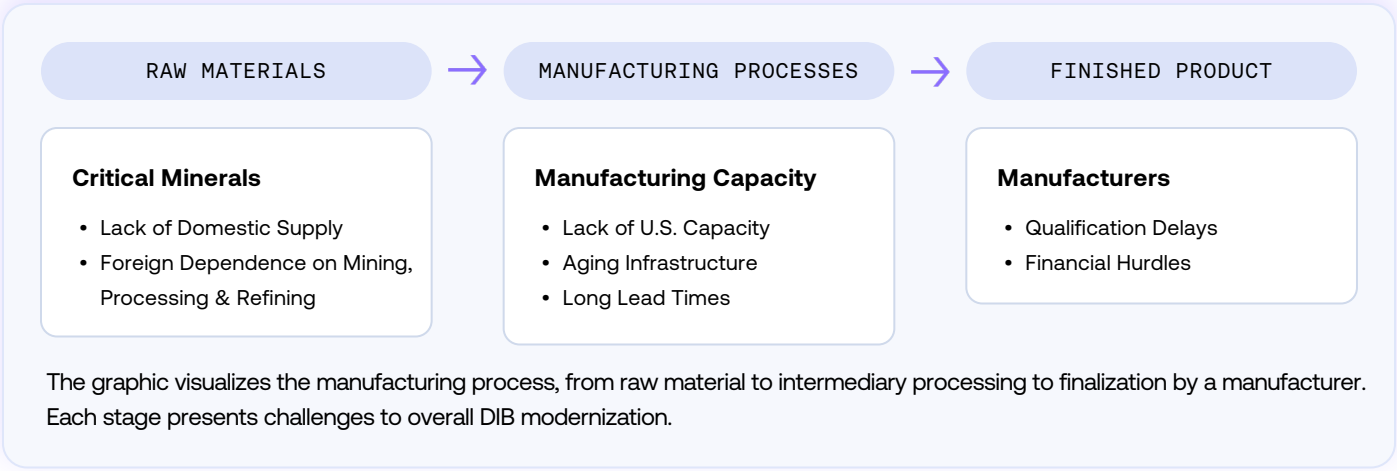
UK DEFENSE FUNDING TARGET – OVER USD 100 BILLION BY 2030

SECTION 02

Major Challenges in Modernizing the DIB

Converting the increase in defense funding into military capability depends on the health and agility of the global allied DIB, with the U.S. and its allies facing significant challenges in expanding and modernizing defense production to meet the new demand. Each stage of the defense value chain faces obstacles, such as dependence on adversaries for critical minerals, bottlenecks in manufacturing processes, regulatory concerns, and the volatile economics of manufacturing.





The graphic visualizes the manufacturing process, from raw material to intermediary processing to finalization by a manufacturer. Each stage presents challenges to overall DIB modernization.

Challenges at each stage of the value chain include:

Critical Minerals	Insufficient domestic production of critical minerals and rare-earth elements, which are used in thousands of critical parts in weapon systems, due to offshoring has resulted in foreign reliance, exposing the U.S. to risk of supply chain disruptions that could stall production and inhibit operability of key weapon systems.
Manufacturing Capacity	Limited capacity and workforce to produce products using certain manufacturing processes, such as castings, forgings, and extrusions, can make defense systems vulnerable to long lead times and foreign-sourced parts.
Manufacturers	Compliance requirements related to military specifications ("mil-specs") and manufacturing operations, as well as unfavorable economic conditions, can burden manufacturers, contributing to longer lead times and disincentivizing development and adoption of new technology.

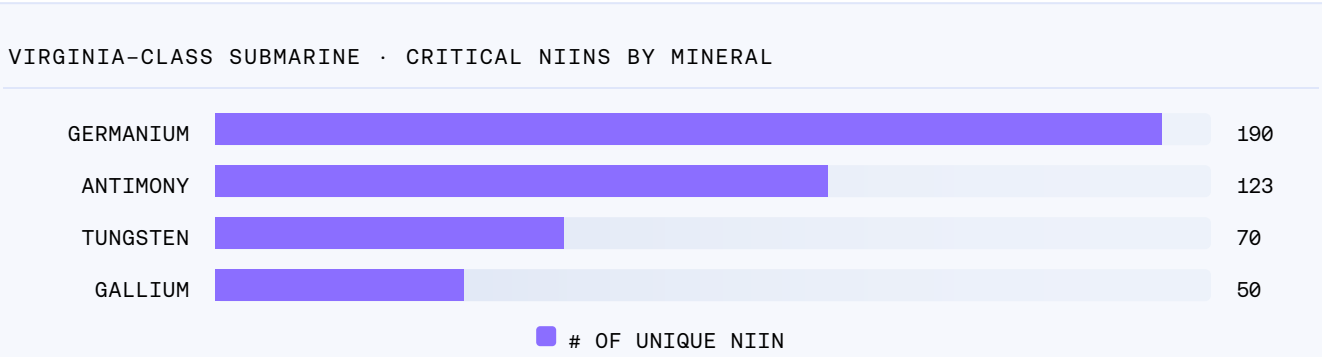
Each of these areas is further detailed in the ensuing sections.



Critical Minerals Deficiencies

The U.S. depends on China for strategic minerals vital to weapon systems, making the U.S. vulnerable to China's weaponization of minerals through export controls and market manipulation. By subsidizing and incentivizing Chinese companies to develop mines and processing facilities, the Chinese Communist Party controls the majority of global supply and processing capacity for many minerals. These include gallium, germanium, and antimony, which are essential for semiconductors, night-vision systems, alloys, and munitions, and currently have limited to no production in the U.S. In December 2024, China formally banned exports of these three critical minerals to the U.S. In February and April 2025, China imposed further restrictions on a wide range of critical and rare-earth minerals, including tungsten, samarium, gadolinium, terbium, dysprosium, lutetium, scandium, and yttrium, as well as rare-earth magnets, all of which are critical to defense systems.

PinPoint, Exiger's part-level data tool, contains data on nearly 9 million parts and 3,000 weapon systems. Of these, Exiger identified over 28,000 unique parts in nearly 1,400 weapon systems that contain antimony, gallium, germanium, or tungsten.



The Virginia-class submarine uses over 300 critical NIINs containing germanium, antimony, tungsten or gallium, highlighting the need for investment in domestic production of these critical minerals.



THE WALL STREET JOURNAL.

WORLD • CHINA

China's Rare-Earth Escalation Threatens Trade Talks—and the Global Economy

President Trump says Washington is weighing a response

By Amrith Ramkumar and Lingling Wei
Oct. 9, 2025 9:00 pm ET

China under leader Xi Jinping has used its dominance of the rare-earths market to seek an edge in trade talks. QILAI SHEN/BLOOMBERG NEWS



Most recently, on October 9, 2025, China required foreign suppliers to secure approval from Beijing to export some products with certain rare-earth materials originating from China if they account for only 0.1% or more of the good's total value, a restriction that applies to products manufactured outside of China and extends beyond the U.S. to all foreign buyers. The Chinese government announced that export applications for products with military uses generally will not be approved, that licenses related to semiconductors or AI will be granted on a case-by-case basis, and that licenses would be required for exports of certain lithium batteries and some equipment and materials used to make them, expanding extant restrictions on technology used in EVs and consumer electronics. In November 2025, following a meeting between Presidents Trump and Xi, China suspended both the gallium/germanium/antimony ban and the October extraterritorial measures through November 2026, though licensing requirements and military end-user restrictions remain in force. China's exploitation of its supremacy over critical mineral mining and processing underscores the urgent need for the U.S. to expand domestic production.

China's requirement that some of its mineral exporters provide evidence that their products are not being used for defense-related purposes is choking off supply and increasing lead times for components in defense platforms, and these problems are poised to worsen in November 2026 when China is scheduled to reinstate harsher export controls it had postponed following a bilateral summit with President Trump. A shortage of antimony, gallium, germanium, or tungsten could degrade America's ability to defend against threats.

The fielding of key weapon systems could be disrupted from dependence on China-sourced minerals. Using PinPoint, Exiger identified that the B-2 Stealth Bomber, a long-range bomber aircraft developed by Northrop Grumman, contains 782 parts with antimony, gallium, germanium, or tungsten. The U.S. Air Force currently operates 19 B-2 Stealth Bombers, which have been deployed as recently as June 2025 to target underground nuclear facilities in Iran. Other examples include the nuclear-powered fast attack Virginia-class submarine and F-35 fighter aircraft, which reportedly contain nearly 9,200 and 900 pounds of rare-earth elements, respectively. With export controls on critical minerals, the operational readiness and sustainment of these systems are at risk.

B-2 STEALTH BOMBER · CRITICAL-MINERAL EXPOSURE — SOURCE: PINPOINT



782

PARTS CONTAINING ANTIMONY, GALLIUM, GERMANIUM, OR TUNGSTEN

51 Sb	31 Ga
ANTIMONY	GALLIUM
32 Ge	**74 W**
GERMANIUM	TUNGSTEN

19 B-2S IN THE U.S. AIR FORCE FLEET, DEPLOYED AS RECENTLY AS JUNE 2025

Using PinPoint, Exiger identified 782 parts in the Northrop Grumman B-2 Stealth Bomber that contain antimony, gallium, germanium, or tungsten — minerals primarily sourced or refined in China.

This risk could manifest in prolonged lead times for critical parts, delaying production, assembly, and maintenance of military assets and impacting America's military posture. Exiger identified several part categories where critical mineral content is associated with longer lead times. For example, within federal supply class 5315, which covers hardware such as nails, machine keys, and pins, tungsten-containing parts have an average production lead time of 213 days, compared with an average of 172-day lead times for parts not containing tungsten.

Gallium can be sourced from outside of China, but scaling up production would require investment and could take years to reach China's current output levels. Two U.S.-based gallium refiners, Merelex Corp. and Indium Corp., have said they intend to increase gallium production. Both companies operate U.S.- and non-U.S.-based gallium production sites; no public documentation is available so far of heightened domestic production.

Outside the U.S., initiatives such as the U.S.-Ukraine Reconstruction Investment Fund, the Minerals Security Partnership with European and East Asian allies, and an agreement with Australia, each seek to develop alternative sources of rare earths and critical minerals. But opening new mines and refining facilities takes decades, with an average timeline of 29 years in the U.S. and 10 to 20 years in Europe, due to complex permitting processes and typical bureaucratic delays. To help address this issue, in March 2025, President Trump issued an Executive Order to streamline mine development by removing certain regulations, coordinating interagency efforts to identify and approve land for mining, and providing capital.

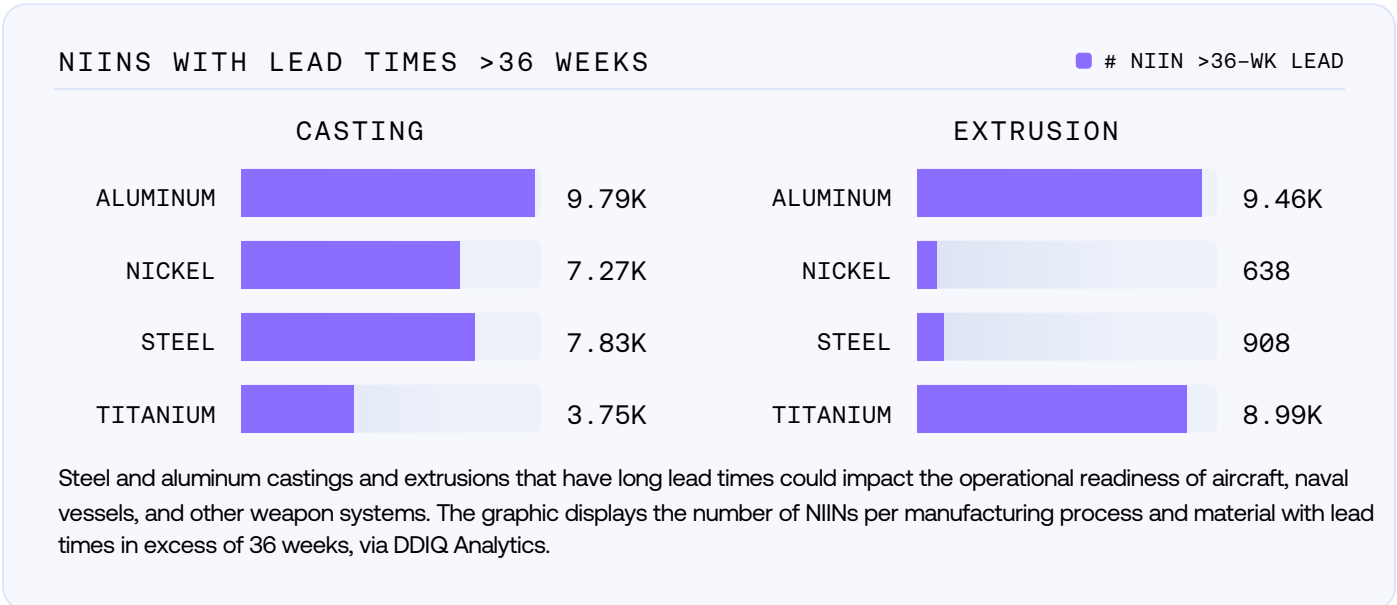


Manufacturing Process Bottlenecks

Constraints in manufacturing capacity are an impediment to DIB expansion and modernization. This white paper highlights the impacts that domestic shortcomings in three key manufacturing capabilities associated with extended part lead times (casting, forging, and extruding) could have on defense systems. For U.S. DIB modernization, these three areas stand out as high-priority areas for investment to shore up domestic capacity.

Issues with casting and forging are emblematic of the challenges the U.S. faces in translating intent to reality for modernizing defense-related manufacturing. Over the past two decades, more than 240 U.S. forging plants have closed, leaving only 152 in operation. Of that remaining population, only a single domestic foundry (Hodge Foundry Inc.) can produce iron castings over 100 tons, and large submarine castings remain a chokepoint after the Navy's sole qualified private supplier paid USD 11 million in 2020 to settle a decades-long casting fraud case, leaving the Navy's in-house Philadelphia foundry as a key remaining capability. This limitation affects large-scale metal castings and forgings, which are essential for structural components such as naval vessel hulls, propeller blades, and rudders. Insufficient foundry and forging capabilities threaten to stall the defense procurement pipeline, particularly as China produces almost 50% of the world's total casting output and is often the sole option for large castings. In 2024, DoW launched a USD 2 billion initiative to revitalize the U.S. casting-and-forging industry, and is urging faster qualification of new suppliers. Even so, in a recent war-game simulation, analysts found that the U.S. industrial base could not replace losses of ships, missiles, and aircraft due to shortfalls in castings and forgings, among other key inputs.

Another manufacturing process vital to production of critical parts used in the defense sector is aluminum extrusion. Created by forcing heated aluminum through a die to form beams, tubes, and complex profiles, aluminum extrusion is essential for some aircraft structures, missile bodies, and vehicle components. In the aerospace sector specifically, demand for large, high-strength extrusions cannot be met as most small and medium-sized U.S. facilities lack the requisite high-tonnage extrusion presses. Limited domestic capacity for handling large cross-sections, along with long lead times for specialty alloys, have led to production bottlenecks. For instance, complex or specialty alloy shapes, such as large, high-strength components for aerospace, reached lead times of up to 85 weeks at the 2022–2023 peak. Domestic capacity is beginning to respond. Recent examples include Taber Extrusions' 10,000-ton press (largest in North America), over USD 250 million in aerospace/defense aluminum expansions by Arconic, Kaiser Aluminum, Vista Metals, and Hydro since 2022, and construction of the first new U.S. primary aluminum smelter in 45 years in Oklahoma.



Steel and aluminum castings and extrusions that have long lead times could impact the operational readiness of aircraft, naval vessels, and other weapon systems. The graphic displays the number of NIINs per manufacturing process and material with lead times in excess of 36 weeks, via DDIQ Analytics.

In Exiger data, the high percentage of parts with long lead times that undergo casting, forging, or extruding points to the potential impact of the domestic capacity limitations described above. Specifically, 52% (nearly 8,000) of National Item Identification Numbers (NIINs), unique codes for cataloging items of supply, that contain steel and undergo casting have lead times over 36 weeks, and 47% of NIINs (over 9,400) that contain aluminum and undergo extrusion have lead times over 36 weeks.

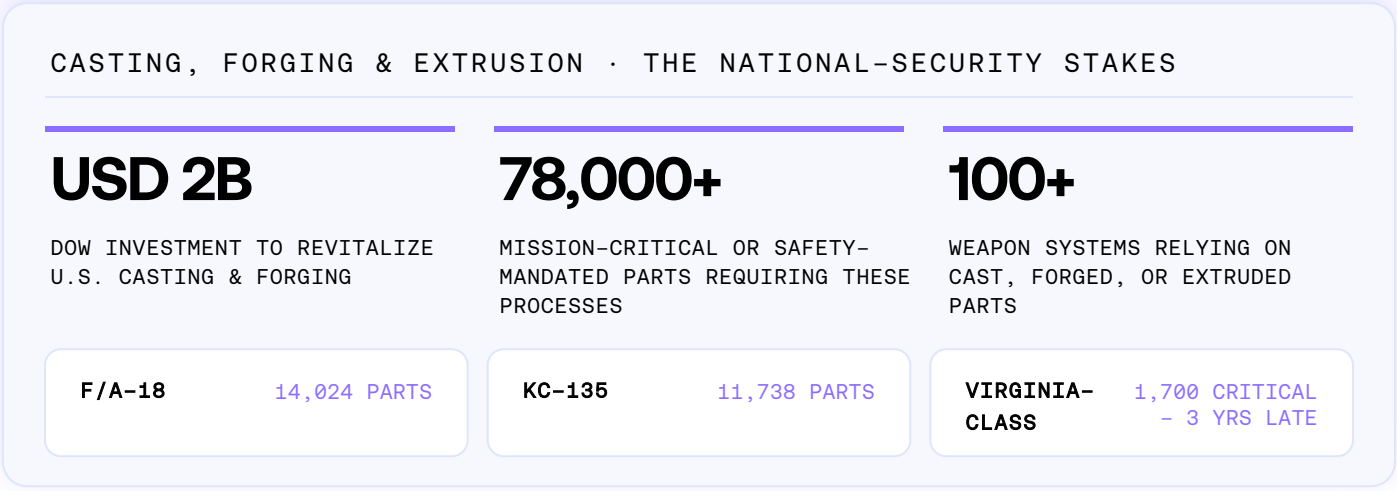


Aircraft may be the most affected by insufficient domestic casting, forging, and extruding capacity. The graphic shows the 10 systems, all of which are aircraft, that contain the greatest number of steel castings, via DDIQ Analytics.

Because the U.S. produces or imports from Canada most of its steel and aluminum, the cause of long lead times for these parts is less likely to be supply constraints for raw materials and more likely to be limited manufacturing capacity. Targeted investment in domestic capacity for these manufacturing processes, such as DoW's USD 2 billion investment in casting and forging, could therefore enhance U.S. DIB production and modernization. But supply side investment may not be sufficient if demand for those manufacturing processes is inconsistent. One headwind could be the impact of tariffs on prices of raw materials, especially from Canada, which can make existing fixed-price contracts that require those materials less profitable. This can throttle raw material demand and have knock-on economic effects, such as impacting workforce size.

Insufficient casting, forging, and extruding capacity could also significantly impact national security. More than 78,000 mission-critical or safety-mandated parts across over 100 weapon systems require one of these manufacturing processes. Vulnerable systems, by virtue of including many critical parts that undergo casting, forging, or extruding, include the F/A-18 Super Hornet (14,024 unique parts) and the KC-135 Stratotanker (11,738 unique parts). Virginia-class submarines, already threatened by U.S. reliance on China for critical minerals, are reportedly also three years behind schedule, potentially due in part to the lack of domestic large-scale casting capacity. These submarines contain at least 1,700 mission- or safety-critical castings, forgings, or extruded parts, the failure of any of which would take the vessel out of commission.

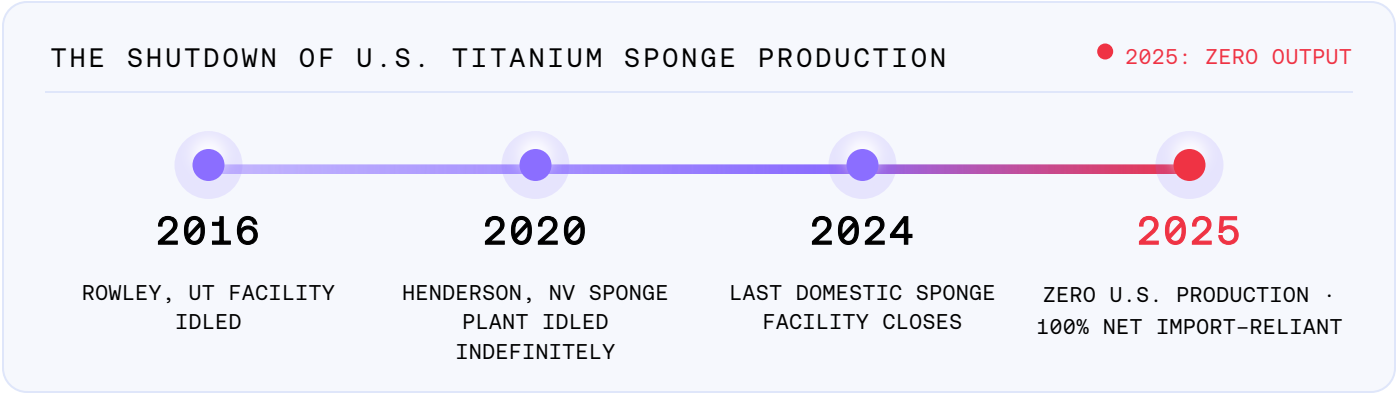
These examples of critical castings, forgings, and extrusions in major aircraft and submarines underscore the need for investment in U.S. DIB manufacturing capacity. This will support defense supply chains and enable the ramping of production in times of need, equipping U.S. warfighters to respond to threats.



Barriers to Manufacturing

Manufacturers serving DoW encounter numerous challenges, including managing foreign presence in the sub-tier supply chain of parts used in U.S. weapon systems, regulatory issues related to mil-specs and manufacturing facilities, rising costs from inflation and high interest rates, and qualified labor shortages. These obstacles not only complicate operations but also necessitate a reevaluation of strategies to enhance resilience and innovation in the defense sector.

Foreign Reliance in the Supply Chain



The U.S. no longer produces titanium sponge, the purified feedstock that is melted and alloyed into finished titanium parts, and that gap now propagates directly into the defense supply chain. Titanium is central to the systems where substitution is hardest: the majority of U.S. titanium metal goes to aerospace, with the remainder in armor, marine hardware, and power generation, meaning jet-engine rotating parts, airframe structures, missiles, and naval components. Domestic sponge production ceased in stages: Titanium Metals Corporation's Henderson, Nevada plant, then the country's sole titanium sponge producer, idled its sponge plant indefinitely as of 2020 amid a pandemic-driven collapse in sales, and the last remaining domestic sponge facility, a small Utah electronics-grade plant, closed in 2024. USGS reports the U.S. produced no titanium sponge in 2025 and is now 100% net import-reliant, up from over 95% in prior years, importing a record 44,000 metric tons. Substantial domestic sponge capacity still exists on paper but sits cold: the Henderson plant and a third facility in Rowley, Utah, idled since 2016, together represent more than 23,000 metric tons per year of dormant capacity kept offline by market economics rather than any physical inability to produce.

That dependence has already produced real supply-chain stress. When Boeing and Airbus curtailed purchases of Russian aerospace-grade sponge after the 2022 invasion of Ukraine, the shift away from a major supplier drove titanium lead times as much as five times longer than pre-2020 levels. Aerospace titanium lead times remained elevated well beyond their pre-pandemic norms as supply constraints became a durable condition, and because defense components must pass long qualification cycles, often 6 to 18 months before a new supplier's material can enter a certified assembly, buyers cannot quickly substitute their way around a disruption. ITAR restrictions further narrow the field of usable foreign suppliers, so the defense base draws on an even smaller pool than the commercial market. The result is that qualified titanium availability, not just price, has become a program-planning variable for defense manufacturers.

The concentration of remaining supply compounds the risk. U.S. melters now source titanium sponge overwhelmingly from Japan, Saudi Arabia, and Kazakhstan, with Japan alone supplying roughly 77% over 2021–2024, principally through Toho Titanium and Osaka Titanium Technologies. These are partner nations, but concentration in a few foreign sources leaves defense production exposed to disruption from disaster, conflict, or shipping interruption, while the broader market tilts toward strategic competitors: USGS estimates China produced about 67% of world sponge output in 2023 on rapidly expanding capacity. DoW has treated the gap as a DIB problem in its own right. In 2023, DoW awarded a contract to IperionX, which began scrap-based titanium-powder production at its Virginia campus in late 2024. Its output is titanium metal made from scrap rather than sponge from ore, so it represents a new production pathway rather than a restoration of the lost sponge capacity, and it remains years from the scale needed to displace imports, leaving the defense base reliant on foreign sponge in the interim.

U.S. TITANIUM SPONGE DEPENDENCE

100%
NET IMPORT-RELIANT; NO U.S. SPONGE PRODUCED IN 2025

~77%
OF SPONGE IMPORTS FROM JAPAN, 2021–2024

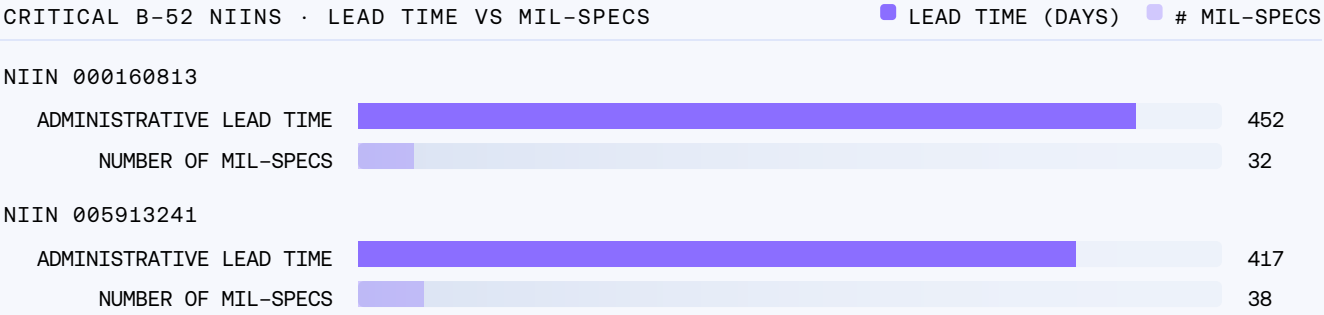
~67%
OF WORLD SPONGE OUTPUT PRODUCED BY CHINA, 2023

The U.S. imported a record 44,000 metric tons of titanium sponge while more than 23,000 metric tons per year of domestic capacity sits idle, per USGS figures cited in this report.

Regulatory Roadblocks

Removing administrative hurdles is also a key part of DIB modernization. One example is mil-spec qualification requirements, which have not kept pace with modern commercial practices and sometimes result in lengthy timelines to certify new parts, materials, and suppliers, decreasing the economic viability of developing new technology. Defense contractors often must use legacy mil-spec components even when superior alternatives exist because approval for new items can take years.

For example, the Army began establishing a new facility to produce nitrocellulose, the energetic material used in artillery propellant, in 2012. However, at the time of writing, the "prove out" process for the nitrocellulose to meet mil-specs could still take multiple years before full-rate output is achieved. Non-traditional suppliers are especially affected as their ability to bid on DoD contracts may be contingent on approval and inclusion of their products on the Qualified Products List, effectively requiring the company to complete development and testing processes ahead of any procurement opportunities. To be sure, rigorous standards are important to ensure safety and reliability of systems. But responsibly streamlining military certification would help more rapidly field cutting-edge technology and encourage competition from new suppliers.

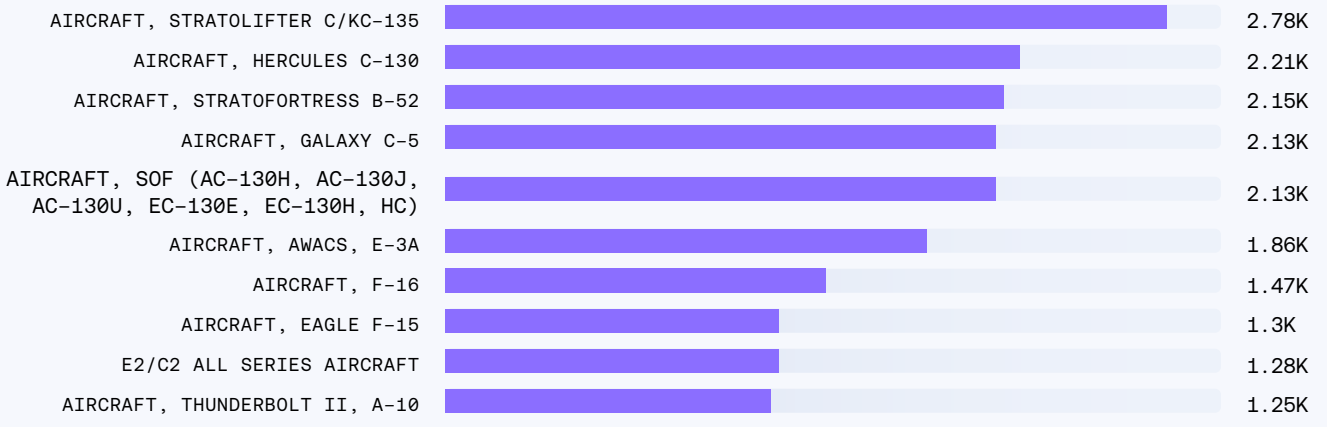


Requirements to meet many mil-specs could delay production. The graphic shows the lead times and number of associated mil-specs for two critical B-52 NIINs, via DDIQ Analytics.

Mil-spec requirements may also result in longer lead times that complicate sustainment efforts. For example, the B-52 Stratofortress bomber (B-52)'s rib's airfoil and fuel vent valve (NIINs 000160813 and 005913241) are critical components and have lead times of over 400 days, which may be due partly to their association with dozens of mil-specs each. The requirement for a part to meet so many mil-specs, if not reasonably necessary, may limit the number of possible suppliers of that part, potentially increasing its lead time and bottlenecking production. For the B-52, this could inhibit current modernization efforts intended to keep the airplane operational through the 2050s.

Staying with the B-52 example, the dozens of mil-specs to which those two NIINs are subject include time-intensive qualification requirements, which could contribute to lengthy lead times. The aerospace heat treatment standard governing metal hardening and tempering (SAE-AMS2770), for example, requires Nadcap-accredited processors with regularly certified furnace equipment, strict time-at-temperature and quench delay controls, and detailed traceability documentation for every heat treat cycle. MIL-PRF-8625, which governs the anodizing of aluminum, requires several quality control tests to be performed monthly or even bi-weekly. For parts that meet multiple mil-specs, failure of a single test for any of the mil-specs could extend lead times and delay the availability of the part. This could be especially problematic for legacy systems that use parts requiring requalification due to obsolescence or loss of previously qualified suppliers. Again, the need for rigorous standards, especially for manned systems, is essential for safety and mission readiness. Qualified authorities could carefully review and, if possible, without compromising safety or effectiveness, streamline certain specs.

EPA regulations on facilities performing cadmium plating that improve corrosion resistance on aerospace materials illustrate how non-defense regulatory requirements can contribute to long lead times, even when those requirements exist for legitimate environmental and safety reasons. The EPA put limitations on the release of cadmium in 2008 due to its carcinogenic properties and began requiring compliance with certain cadmium management and reporting practices. Non-compliance risks fines and remediation costs, potentially leading to business closure. Using Pinpoint data, Exiger identified that two-thirds of castings or forgings that also undergo cadmium plating have lead times of at least six months, which may be due to the shrinking cadmium plating supplier base.



The shrinking number of domestic companies performing cadmium plating could be contributing to long lead times for parts that require such plating. The graphic shows the top 10 weapon systems by number of NIINs that undergo cadmium plating, via DDIQ Analytics.

The legal framework for military contracts includes national and international regulations designed to reduce environmental damage, sometimes including regulations derived from the National Environmental Policy Act ("NEPA") in the U.S. Under NEPA, new government sites or federally funded non-government sites may require an environmental impact statement, which in 2024 took a median of 2.2 years to complete, with more complicated reviews taking significantly longer. In 2025, the Trump administration rescinded Council on Environmental Quality's (CEQ) NEPA implementing regulations and directed agencies to issue their own streamlined procedures, though it remains to be seen whether these changes will materially shorten review timelines. Military contracts may also include DoD directives that integrate environmental standards and sustainability practices. Together, mil-spec and manufacturing site regulatory requirements could delay production by contributing to long part lead times.

Economics of Manufacturing

Revitalizing and modernizing the DIB requires a competitive landscape of suppliers and technology. But, due in part to the disadvantages that new companies and technologies face compared to incumbent suppliers, the supplier base has been shrinking. The Pentagon's slow acquisition processes and the notorious "valley of death," the gap where innovative technologies fail to transition from R&D prototypes to full production contracts, have driven many smaller firms out of the defense market, resulting in a 43% decline in the number of small defense contractors over the last decade. This attrition leaves primes with fewer qualified sub-suppliers and stifles competition and innovation. DoD strategies like the National Defense Industrial Strategy of 2023 acknowledged that the government must do more to bridge the gap for new entrants and fund critical lower-tier production lines.

The broader economic environment is also straining the DIB as post-pandemic inflation has driven up costs for labor, materials, and energy, making defense contracts more expensive to execute. Defense firms initially acted as a "shock absorber" for inflation, absorbing cost increases on fixed-price contracts. As inflation persisted, though, companies warned that they could not continue to eat rising costs. For example, The Boeing Co. ("Boeing") has faced significant financial challenges due to fixed-price contracts that have resulted in billions of dollars in cost overruns, particularly in programs like the KC-46A aerial refueling tanker (overrun of >USD 7 billion) and the 747-8 (overrun of >USD 3 billion).

-43%

DECLINE IN SMALL DEFENSE CONTRACTORS OVER THE LAST DECADE

>USD 7B

BOEING COST OVERRUN ON THE KC-46A AERIAL REFUELING TANKER

>USD 3B

BOEING COST OVERRUN ON THE 747-8 PROGRAM

High interest rates compound the challenges of inflation by raising the cost of capital, making it more expensive for manufacturers to finance new factories, equipment, and inventory. Smaller suppliers and new tech startups are again disproportionately affected as their profit margins are thinner. This environment has also placed particular strain on highly leveraged companies, often referred to as " zombie companies," which rely on low interest payments as they cannot repay their debt through revenue. Highly leveraged companies in the DIB include TransDigm Group Inc. and Boeing. The result is that necessary investments in production capacity may be deferred or passed on to the government via higher contract prices.

In addition to financial headwinds, deindustrialization and the shift to service industries in the U.S. have weakened the long-term competitiveness of the DIB. The wider manufacturing sector spent most of the past three years in contraction: the Institute for Supply Management's PMI showed U.S. manufacturing activity declining in 36 of the 38 months from November 2022 through December 2025, with the initial 26-month streak being the longest on record. Contributing factors include supply chain disruptions, labor shortages, and increased competition from foreign manufacturers that operate with lower costs and sometimes significant government subsidies.

Affected companies in the DIB are both small and large, such as aircraft engine parts maker AeroCision LLC ("AeroCision") and steel company Cleveland-Cliffs Inc. ("Cleveland-Cliffs"). AeroCision filed for Chapter 11 bankruptcy in July 2023 and subsequently liquidated in early 2024 with its assets sold at auction. Cleveland-Cliffs idled six facilities between March and May 2025, laying off approximately 2,000 workers across Michigan, Illinois, Minnesota, and Pennsylvania, as a result of decreased demand from cheaper foreign-made products.

Workforce Shortages

The U.S. depends on a defense industrial workforce it can no longer reliably staff, making production capacity, sustainment, and readiness vulnerable to a shortage that now spans the entire talent pipeline. In skilled trades alone, industry leaders identify a current shortfall of roughly 500,000 manufacturing jobs, and forecast more than 2 million unfilled manufacturing jobs within the next five years. The existing workforce is also aging out: as of 2023, roughly 29% of aerospace and defense employees were over 55. The problem is severe relative to the base itself, which a November 2024 Defense Business Board assessment put at roughly 1.1 million workers across 60,000 companies, with annual attrition running near 15%. These departures drain not only headcount but the specialized institutional knowledge that cannot be quickly rebuilt.



The engineering and cleared-workforce dimensions are equally acute, and clearances are uniquely resistant to conventional fixes. Demand for AI/ML engineers, cybersecurity analysts, and autonomous and space systems talent has surged alongside elevated budgets, yet the cleared workforce, estimated at roughly 2.8 million active holders, is not keeping pace. More than 70,000 cleared positions sat unfilled as of 2023, and the bottleneck is structural: the clearance pipeline is government-controlled, ITAR limits who can be considered, and Top Secret investigations run a 150-to-200-day median. NDIA's 2026 survey found the strain broad-based, with 56% of respondents reporting difficulty hiring across cleared personnel, skilled trades, and STEM alike. Because a cleared worker can take a year or more to replace, every departure carries outsized operational cost.

The shortage persists despite rising appropriations because of interlocking structural drivers. For three consecutive years, defense companies have named a lack of qualified candidates and competition from commercial employers as their leading barriers to filling vacancies. The national pipeline is under the same pressure, with roughly 45,000 welder and 200,000 assembler and fabricator openings projected each year through 2033, while citizenship and clearance requirements further narrow the available pool. Wages compound the problem: some shipyard welders have earned pay comparable to fast-food workers, and roughly 8 in 10 organizations lost leading candidates due to salary concerns, even after 88% raised compensation the prior year. Finally, year-to-year appropriations tie employment to procurement, producing a self-reinforcing cycle in which demand rises, shortages slow execution, and schedules extend even as investment grows.

The consequences are sharpest in submarine shipbuilding, where the Navy estimates the industrial base will need roughly 140,000 skilled workers over the next decade to deliver, beginning in 2028, one Columbia-class and two Virginia-class submarines per year, roughly five times the 2015 build rate. Workforce availability must therefore be treated as a core element of industrial capacity, on equal footing with facilities, materials, and supply-chain resilience. The exploitation of a single choke point can inhibit U.S. weapon production, and a workforce the nation cannot staff is a constraint of the same order; closing it will require predictable multiyear demand, expanded apprenticeships and technical education, stronger retention, efficient clearance processing, and sustained investment in automation and digital manufacturing.

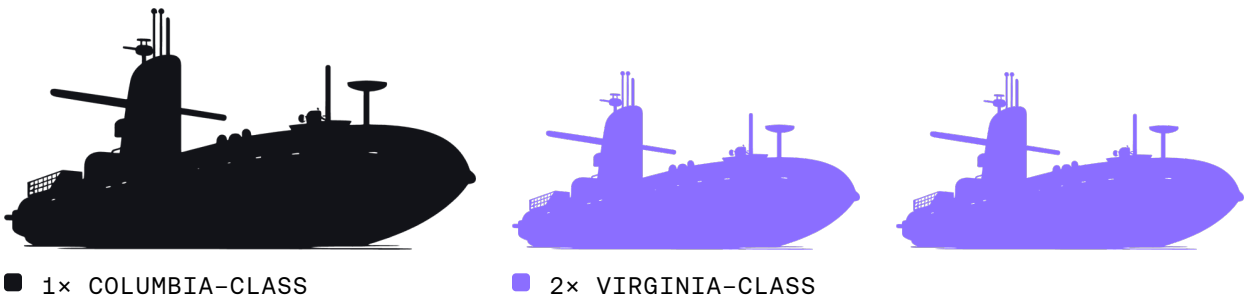
SUBMARINE SHIPBUILDING · THE COMING WORKFORCE DEMAND — U.S. NAVY ESTIMATE

140,000

SKILLED WORKERS NEEDED OVER THE NEXT DECADE

~5×

THE 2028 DELIVERY CADENCE VS THE 2015 BUILD RATE

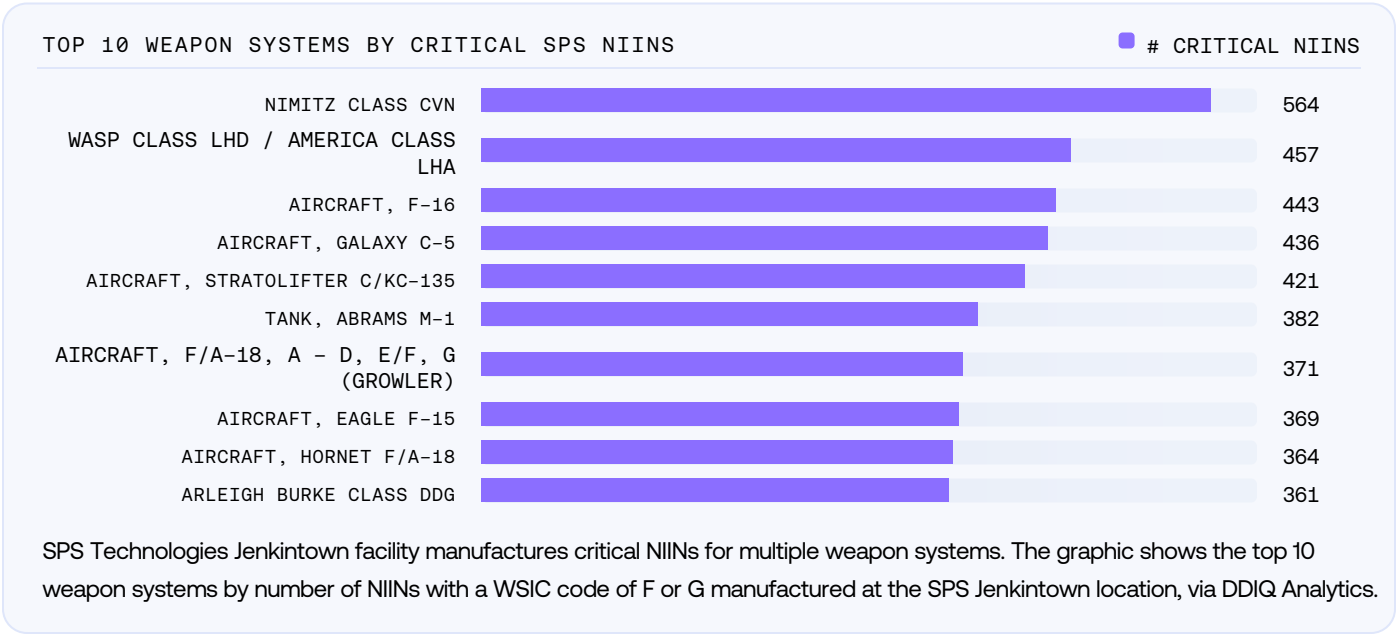


Beginning in 2028, the industrial base must deliver one Columbia-class and two Virginia-class submarines per year — roughly five times the 2015 build rate, per Navy estimates cited in this report.

Single-Source Risks: SPS Technologies Case Study

On February 17, 2025, a fire broke out in SPS Technologies LLC's Jenkintown, Pennsylvania facility, a site responsible for the supply of tens of thousands of fasteners for more than 1,000 weapon systems. SPS Technologies is the single source for high-strength fasteners for several key systems, including the Tomahawk missile and the Black Hawk helicopter. The closure of its Jenkintown operations through at least 2028, at which point the company intends to open its new facility at the same location, indicates that fastener supplies for U.S. defense systems, including 90 systems where at least one SPS Technologies fastener is deemed critical, are actively disrupted. This case underscores the risk of single sourcing in the defense industrial base and the need to qualify alternate sources to avoid such significant chokepoints.





SPS Technologies Jenkintown facility manufactures critical NIINs for multiple weapon systems. The graphic shows the top 10 weapon systems by number of NIINs with a WSIC code of F or G manufactured at the SPS Jenkintown location, via DDIQ Analytics.

By the numbers

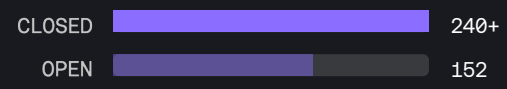
28,000+

UNIQUE PARTS IN NEARLY 1,400 WEAPON SYSTEMS CONTAIN ANTIMONY, GALLIUM, GERMANIUM, OR TUNGSTEN

Sb Ga Ge W

240+

U.S. FORGING PLANTS CLOSED OVER THE PAST TWO DECADES, LEAVING ONLY 152 IN OPERATION



100%

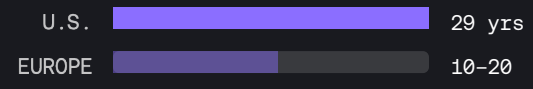
U.S. NET IMPORT RELIANCE FOR TITANIUM SPONGE IN 2025



44,000 METRIC TONS IMPORTED · ZERO DOMESTIC OUTPUT

29 years

AVERAGE TIMELINE TO OPEN A NEW MINE AND REFINING FACILITY IN THE US



43%

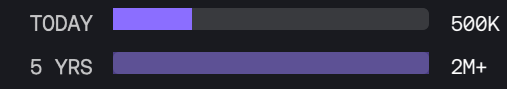
DECLINE IN THE NUMBER OF SMALL DEFENSE CONTRACTORS OVER THE LAST DECADE



FEWER QUALIFIED SUB-SUPPLIERS FOR PRIMES

2M+

UNFILLED MANUFACTURING JOBS FORECAST WITHIN THE NEXT FIVE YEARS



SECTION 03

Potential Solutions for DIB Modernization

Modernizing the DIB requires not only identifying vulnerabilities but also making strategic investments and policy changes. From critical mineral sourcing to manufacturing processes to the standards manufacturers and parts must meet, clear areas exist on which to focus in reinforcing the industrial foundation for national defense.

Critical Minerals

To address critical mineral dependencies, the U.S. is exploring alternative domestic and allied sources, recycling initiatives, and streamlining permit processing. Rare-earth production from the Mountain Pass Mine in California, which contains almost two million metric tons of rare earths, has steadily increased since its resumption of operations in 2017. DoD's recent investment in MP Materials, which operates the Mountain Pass Mine and has built an accompanying mineral processing and magnet production plant in Texas, will also advance critical mineral production reshoring efforts. In October 2025, moreover, development of the critical mineral-containing Ambler Road Project in Alaska received approval. Other measures include the Department of Energy's investment in programs to extract germanium from coal ash and zinc smelter residues, aiming to reduce reliance on foreign imports, and recycling efforts to recover minerals, such as gallium, from electronic waste and industrial byproducts. These initiatives not only enhance supply chain resilience but also contribute to environmental sustainability by reducing the need for new mining operations. On their own, however, they are unlikely to produce enough critical minerals to make the U.S. self-reliant.

Another initiative to help secure U.S. mineral independence is through streamlining permits. In May 2025, the Federal Permitting Improvement Steering Council announced that five new critical mineral production projects will be streamlined under Title 41 of the Fixing America's Surface Transportation Act ("FAST-41"), aiming to simplify environmental reviews and authorizations. This stems from President Trump's Executive Order on "Immediate Measures to Increase American Mineral Production," enhancing supply chain resilience by strengthening the domestic mining industry for critical minerals.



Other options to increase domestic production of rare earths include streamlining development of additional domestic deposits, such as those in Bear Lodge, WY and Bokan, AK, and building processing capacity for recycling and extracting rare-earth elements. China controls nearly two-thirds of the refinement of critical minerals like lithium, graphite, cobalt, nickel, and copper, and over 90% for rare-earth elements. Reducing dependence on China will require investment across multiple streams of effort.

Manufacturing Processes

Investments in manufacturing process capacity are needed to overcome existing constraints in the DIB. Upgrading casting facilities, particularly for large-scale steel and aluminum components, can alleviate production constraints. Encouragingly, in 2024, Constellium Muscle Shoals LLC received a USD 23 million grant from DoD under the Defense Production Act Investment program to significantly increase domestic aluminum casting capacity. The project is expected to add up to 300 million pounds of annual output starting in H2 2026.

The modernization of aluminum extrusion capabilities is also vital for supporting production of complex systems such as aircraft and missile bodies. In 2024, Taber Extrusions LLC announced a USD 70 million expansion of its Russellville facility planned to open in 2026, introducing the largest direct-extrusion press in North America. This investment will help the company produce more advanced aluminum extrusions for the aerospace and defense sectors.

An April 2025 Executive Order explicitly targeted revitalization of the U.S. shipbuilding industry, noting that the U.S. currently accounts for less than 1% of commercial ship production; execution of this order will mean substantial investment in steel casting capacity. Such upgrades require capital-intensive outlays, and public-private partnerships will help spur investment in modern furnace equipment, mold-making, and high-tonnage presses, which are important to meet growing defense production demands and restore domestic capacity.

More broadly, robotics and advanced automation are key to modernizing U.S. manufacturing processes. Adoption of these tools not only increases factory throughput but also improves quality and enables production processes that cannot be done by humans. The gains are already measurable across the industrial base: General Dynamics Electric Boat reported that one Columbia-class outfitting process fell from 180 days to 65 after it adopted collaborative robots for cutting and welding at its Quonset Point submarine facility. Northrop Grumman similarly credited its progressive, robot-enabled manufacturing line with increasing national-security space payload output to more than ten times its former level. Newer entrants are pushing further still: Hadrian, which the Navy backed with a $900 million contract in March 2026, is building submarine-component facilities designed to automate as much as 80% of the work. Together these cases show that automation is not a speculative fix but a proven lever for the throughput, quality, and scale the defense mission now demands.



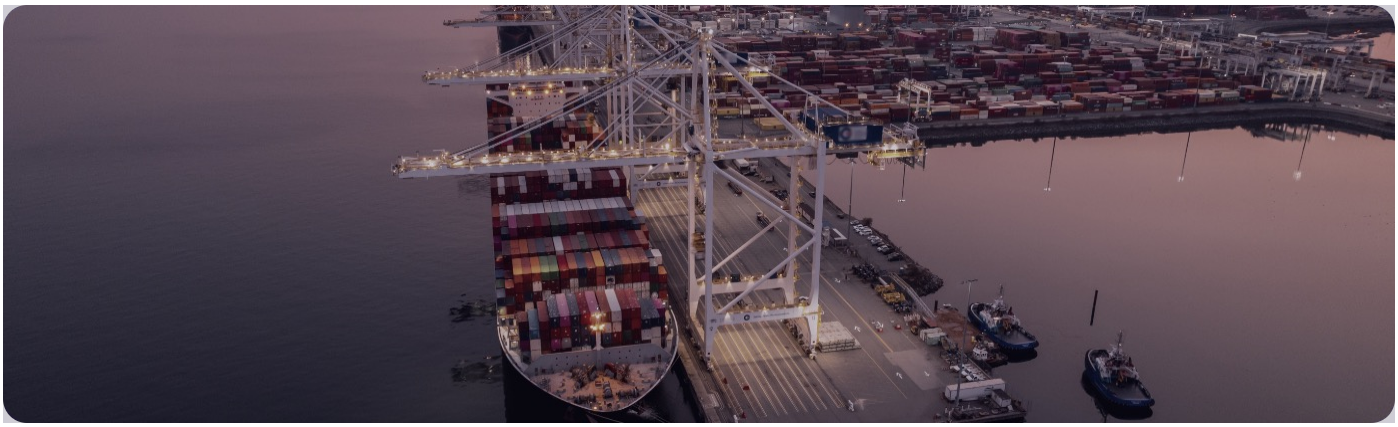
Manufacturing Ecosystem

Other changes that can revitalize the U.S. DIB include tariffs, efforts to streamline regulations, and shifts in government contracting practices.

As part of an industrial policy that began in President Trump's first term and continued through the Biden administration into the second Trump term, tariffs are now front and center in how the U.S. approaches its economy and geopolitics. Though higher prices are hurting the current business performance of some DIB suppliers, targeted tariffs on imports can stimulate growth in DIB production in the long term by creating a "price umbrella" that narrows the cost disadvantage of domestic producers, making investments in new capacity more economically viable. This nudges firms to expand or reshore production of critical inputs. In strategic sectors, tariffs may encourage onshoring of supply chains that DoD depends on, reinforcing resilience against foreign reliance.

While tariffs incentivize the U.S. base to develop a stronger domestic vertical supply chain, the high interest rates mentioned previously may still discourage industrial expansion.

One example is in heavy steel plate, used for armor, naval hulls, and structural components. After the Trump administration's Section 232 steel tariffs in 2018, domestic plate producers saw a clearer market signal to expand. Nucor in turn invested USD 1.7B in its Brandenburg, KY plate mill, capable of 1.2M tons per year, adding capacity to supply defense, infrastructure, and industrial users. That facility is one of the few U.S. mills able to produce thick plate products at scale.



A second example is ship-to-shore ("STS") port crane manufacturing, which is important to defense logistics and port security. The Biden administration introduced a 25% tariff on Chinese-made STS cranes, accompanied by a USD 20B port infrastructure investment package and cybersecurity directives to phase out foreign crane systems. In response, PACECO (a U.S. subsidiary of Japan's Mitsui E&S) announced plans to reestablish domestic crane manufacturing for the first time in three decades. That shift was directly catalyzed by the tariff signal (raising the cost of competitive imports) plus government incentives. The Trump administration has since reinforced this direction; its April 2025 "Restoring America's Maritime Dominance" executive order directed the U.S. Trade Representative to pursue additional tariffs on PRC-origin cranes and established a new Maritime and Industrial Capacity Directorate at the National Security Council to oversee domestic manufacturing development.

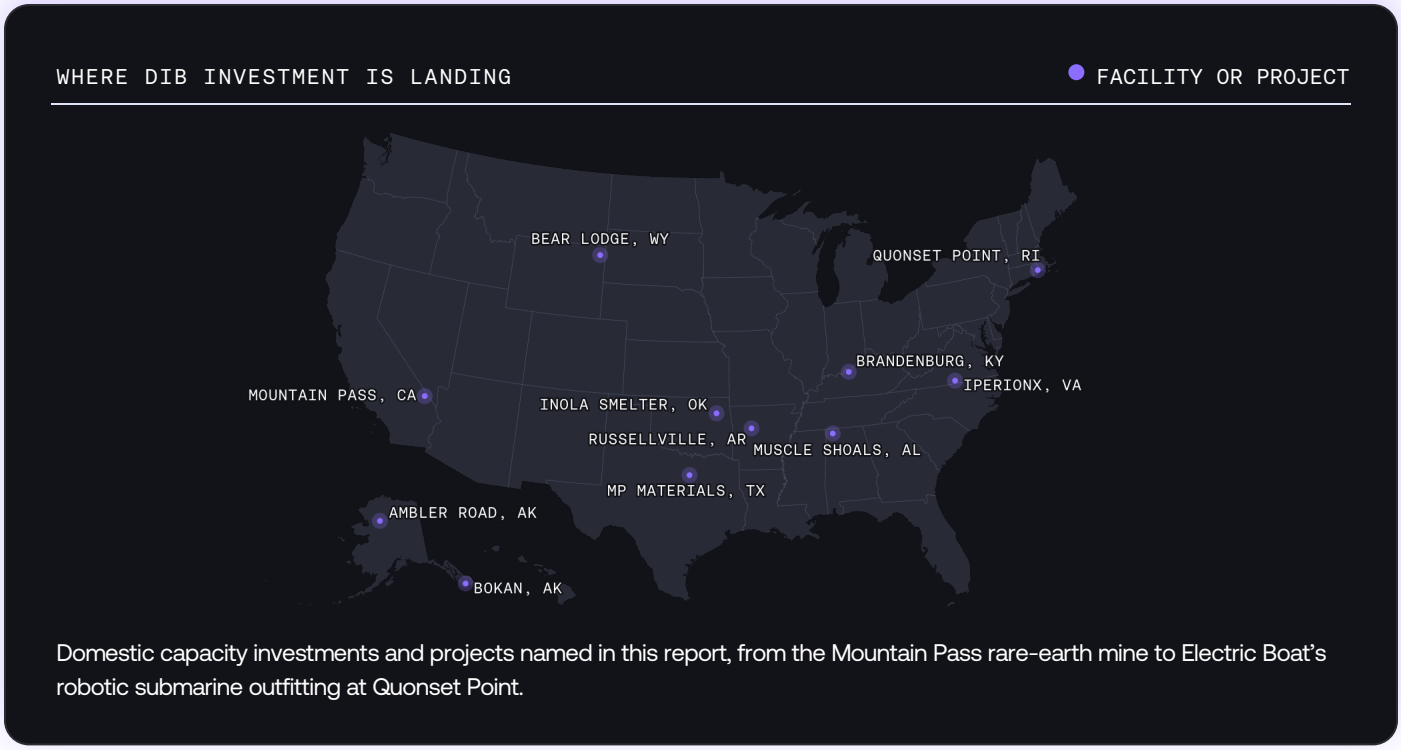
A third and more recent case involves tungsten, a critical mineral. Earlier in 2025, the U.S. hiked Section 301 tariffs on certain Chinese tungsten imports to 25%, bolstering the cost case for domestic tungsten suppliers. American Tungsten Corp. has cited the tariff environment as improving the economics of its U.S. assets because it expects increased demand for domestic tungsten from government and industrial buyers.

The above is just a sampling of how targeted tariffs may help when paired with procurement and investment signals, but can hurt when they raise input costs without demand certainty.

Streamlining regulations can also encourage DIB modernization. In an effort to shrink construction timelines on new manufacturing facilities, President Biden signed legislation in 2024 that exempts certain semiconductor manufacturing facilities, particularly those receiving CHIPS Act funding, from potentially onerous NEPA review.

Contracting policies that help ensure profitability can also incentivize companies to develop novel technology and qualify products for military use. As noted above, adding economic price-adjustment clauses in multi-year, fixed-price contracts can help defense contractors offset financial risk from inflation. At least one major defense prime, L3Harris, has publicly said that it will limit bidding on fixed-price DoW contracts, a practice that could cascade to lower tiers of the DIB.

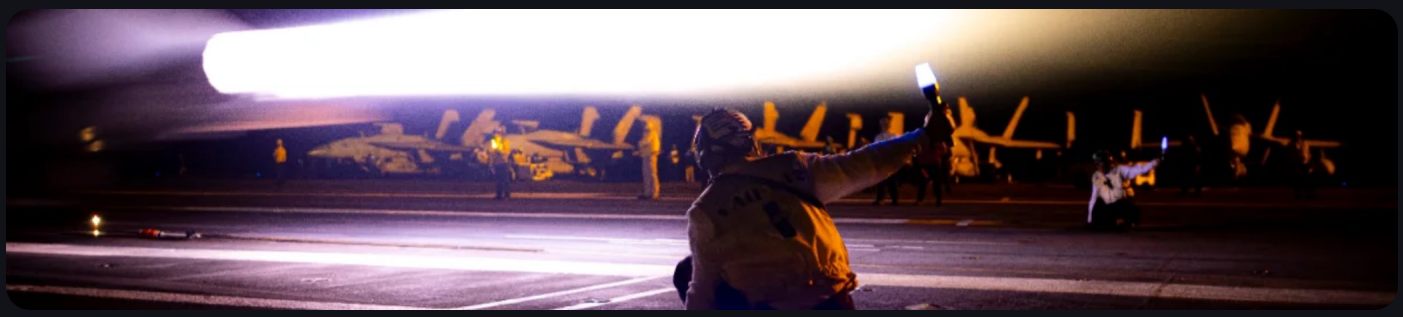
Lastly, supporting a robust talent pipeline for the manufacturing sector is vital to maintaining the sector's long-term vitality. A national push to improve both the perception and quality of manufacturing jobs could help overcome the growing workforce shortage in the industry. As the industry modernizes, upskilling and credentialing for workers to support robotic systems must be expanded.



Domestic capacity investments and projects named in this report, from the Mountain Pass rare-earth mine to Electric Boat's robotic submarine outfitting at Quonset Point.

Conclusion

A healthy DIB, one that has enough skilled labor, production capacity, suppliers, and innovation, is essential to operationalize (i.e., turn into real, usable outcomes) increased defense budgets. Through targeted investment in, and reform to, certain raw material production, manufacturing processes, and regulations, the U.S. DIB can better support weapon system maintenance, repair, and operation as well as spur the development and adoption of more cutting-edge technology.



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