READY TO DEFEND

How Automation Restores Manufacturing Power

EXECUTIVE SUMMARY

In August 2025, the U.S. Army announced it would miss its target of 100,000 155 mm rounds per month. At best, it now aims to hit that number in mid-2026. (1) The problem? National defense spending is surging, but there simply aren't enough skilled factory workers to keep pace.

The U.S. isn't alone. Across NATO nations, defense orders are surging faster than factories can fulfill them. Production lines meant for peacetime output are being asked to run at wartime speed with a fraction of the skilled labor they once had. At the same time, welders, machinists and toolmakers are becoming increasingly scarce, along with maintenance technicians, CNC programmers, die setters, millwrights, and industrial electricians. These are the quiet experts who keep presses calibrated, lines moving, and complex systems running day and night.

This widening labor gap has become a chokepoint in defense manufacturing, threatening readiness just as geopolitical instability intensifies. And while funding and technology abound, one resource remains in short supply: people.

In fact, in 2025 alone, an estimated 73 percent of manufacturers reported struggles to recruit and retain the talent needed for mission-critical projects. (2)

Across U.S. manufacturing broadly, 2.1 million jobs could go unfilled by 2030 if the skills gap continues to worsen. (3) Even more stark: by 2033, one study warns of a shortfall of 1.9 million manufacturing workers in the U.S. alone, as 3.8 million new positions open and nearly half may remain unfilled. (4)

It's no better in Europe. There, defense firms are scrambling to hire engineers, welders, AI specialists, and mechanics to match increased military spending. (5)

This means a real-world brake on production, one that's already slowing programs and delaying deliveries. The question for the decade ahead is not whether this crisis deepens, but how severely defense output will be compromised if nothing changes.

Something has to give. And across factories in North America and Europe, that change has begun.

Walk into a modern defense plant today, and the contrast is striking. The hum of automation is beginning to fill the gaps left by a disappearing workforce. It's early proof that the next era of defense manufacturing is already taking shape.

These glimpses of modernization hint at a path forward, but to understand why automation matters so much, we first need to look at how deep the workforce crisis really runs.

THE GROWING WORKFORCE CRISIS IN DEFENSE MANUFACTURING

The defense industrial base is facing a labor challenge decades in the making.

For years, the warning signs were there: an aging workforce, declining interest in skilled trades and underinvestment in vocational education.

In the U.S., nearly one in four manufacturing workers is aged 55 or older (6), and half are already over 45 (7).

Meanwhile, only 14 percent of Gen Z workers say they'd consider a career in industrial work, underscoring how difficult it's become to attract new talent into manufacturing. (8)

In Europe, the picture isn't much brighter. Roughly 44 percent of upper-secondary students pursue vocational education, yet fewer than half of those programs include hands-on, work-based learning. (9)

That gap between classroom instruction and real-world production experience has left many defense firms struggling to fill technical roles, even as demand for skilled labor hits record highs.

Younger generations are entering the workforce with a very different relationship to manufacturing, because they've grown up in the digital era.

While their parents and grandparents built their livelihoods through grit, calloused hands and long shifts on the shop floor, they're drawn to fields like software, renewable energy or design, and often see factory work as outdated or monotonous, despite how advanced it's become.

It's an ironic mismatch, because the very things that make manufacturing seem outdated are the ones most transformed by technology.

Today, modern defense manufacturing increasingly relies on advanced robotics, automation and data-driven systems, technologies that align perfectly with the skills and interests of younger talent.

Still, the disconnect persists. So, until the image of manufacturing catches up with its reality, the industry risks losing another generation of potential builders and innovators.

The result: labor shortages are now delaying projects, inflating costs and straining national defense readiness. In fact, one article pointed out that many of today's procurement estimates, which often extend beyond 900 days, are based on pre-pandemic times. Across the Defense Industrial Base, lead times have expanded significantly not only because of limited access to critical materials and alloys, but also because of capacity bottlenecks, aging infrastructure, and a decline in skilled labor. (10)

The workforce crisis is not confined to the factory floor.

Across the defense supply chain, small and midsize contractors are struggling to keep pace as retirements, clearance delays, and training bottlenecks slow production. With each departure, decades of tacit knowledge disappear, leaving new hires to learn on compressed timelines while programs slip further behind schedule.

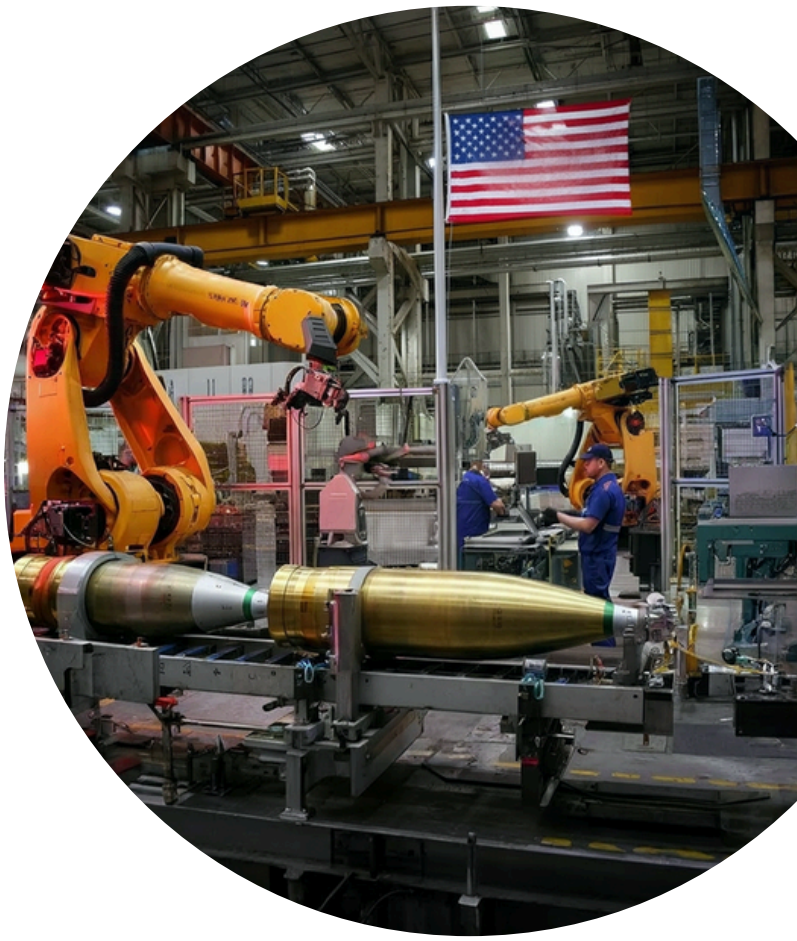
Even when materials are available, capacity and expertise often are not. Taken together, these forces have created a fragile industrial ecosystem.

The question now is how to rebuild that capacity at scale. For many in the industry, the answer lies not in replacing workers but in amplifying them through automation, robotics and intelligent manufacturing systems designed to do more with fewer hands.

A report in *Air & Space Forces* references the National Defense Industrial Association (NDIA) warning that the industrial base is shrinking, less able to surge production, and facing a worsening shortage of workers, which implies that workforce shortfalls are affecting readiness and capacity. (11)

AUTOMATION AND THE RETURN TO READINESS AND RESILIENCE

The U.S. Government Accountability Office reported in 2022 that most military depots are operating with equipment well past its intended service life, while maintenance backlogs and aging infrastructure continue to undermine production. (12)



The human challenge is just as severe. When Raytheon restarted production of the Stinger missile, which was dormant for decades, it had to rehire retired engineers in their seventies to teach new employees how to build from old blueprints. (13)

Few examples better illustrate how fragile the defense manufacturing knowledge base has become.

As traditional labor pipelines shrink and production demands surge, automation offers a way to sustain, even expand, capacity without waiting decades for workforce renewal. Processes that once depended on scarce specialists can now be programmed, monitored and replicated with precision.

By retooling domestic facilities with automation, nations can regain manufacturing independence and agility.

Smaller, distributed factories can now achieve outputs once reserved for massive plants, strengthening resilience against global disruptions. Automation also provides a decisive wartime advantage: when skilled labor is scarce, it enables surge production at the speed national security demands.

CORE TECHNOLOGIES DRIVING THE SHIFT

After years of capacity constraints and workforce strain, defense manufacturers are finding new momentum.

Automation, robotics and AI are giving the defense industrial base the ability to produce more, produce faster prodce and with greater precision than ever before.
For decades, production volume rose and fell with labor availability. Today, that link is breaking. The next generation of defense manufacturing is no longer limited by who's on the shop floor. It's powered by intelligent systems that extend human capability, ensure consistency and unlock capacity once thought impossible.

ROBOTS

Robotic systems are redefining what's possible in defense manufacturing. Once a niche investment, it's now the backbone of modern production lines, delivering the consistency, precision and endurance that human labor alone just can't sustain.

Across factories in North America and Europe, robotic systems are taking on the heavy lifting of forging, machining, assembly, and inspection, keeping critical programs on schedule, even as the skilled workforce shrinks.

On modern defense production lines, robotic arms load and unload artillery shells from forging presses with unerring precision. Automated welding systems deliver uniform seams on armored vehicle hulls, while vision-guided inspection robots scan aircraft components for micrometer-level deviations invisible to the human eye. Autonomous guided vehicles (AGVs) weave through the plant floor with flawless timing, moving materials in sync with AI-managed production schedules.

The results are striking. Robotic cells have been shown to cut cycle times, improve uptime and reduce defect rates.

Collaborative robots — or cobots — take this even further, safely working alongside operators to handle repetitive or hazardous work while freeing skilled technicians to focus on oversight and optimization.

Far from replacing human expertise, robotics amplifies it. It takes the repetitive, the dangerous and the physically demanding out of the equation, allowing people to focus on what they do best: problem-solving, process improvement and innovation. In doing so, it restores the one resource that's been missing from the defense industrial base: capacity.

The global military robots market size was estimated at USD 19.68 billion in 2024 and is projected to reach USD 32.50 billion by 2030, growing at a CAGR of 8.7% from 2025 to 2030. (14)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

When robots provide the limbs, AI provides the intellect. In the next wave of defense industry transformation, Artificial Intelligence (AI) and Machine Learning (ML) are doing more than automating tasks. They're making factories smarter, more predictive, more adaptive and more resilient. If robotics do the work, AI ensures that work is optimized, error-free and anticipatory.

One of AI's earliest and most high-impact roles in manufacturing is predictive maintenance by using sensor data and algorithms to forecast when a machine will fail and intervening before it does.

Many manufacturers report measurable gains with the use of Predictive Maintenance. In fact, manufacturing plants using AI-driven predictive maintenance have stated 20 to 50% reductions in downtime compared to reactive or purely scheduled maintenance regimes. (15)

In defense contexts, Predictive Maintenance is critical. The ability to forecast failure in aircraft engines, armored vehicle subsystems, or munitions assembly lines means fewer surprises, higher uptime, and better resource allocation.

One forward-looking article suggests that AI-powered predictive maintenance could extend the lifespan of defense equipment by around 27%, by intervening before degradation accelerates. (16)

When tolerances are measured in micrometers, AI-driven inspection becomes indispensable. Machine vision systems, powered by deep learning and neural networks, are spotting defects that human inspectors would miss (one study found that human inspectors can miss 20 to 30 % of defects in standard inspection tasks) (17) and doing it continuously.

This shift means fewer rejects, less rework, tighter delivery reliability, and much stronger traceability, which are all vital in defense manufacturing's zero-defect expectations.

Beyond just maintenance and inspection, AI is now stepping in to optimize entire production flows, orchestrating how machines, robots and humans work together in real time.

- Algorithms can adjust machine parameters on the fly (feed rates, cutting speeds, tool paths) based on sensor feedback to optimize throughput and reduce wear.
- AI-driven scheduling can dynamically reallocate work when bottlenecks emerge: for example, if a machine is trending toward wear, shift jobs elsewhere proactively rather than waiting for a failure.
- Over time, these systems learn. The more data they consume, the better they become at preempting variation, anticipating problems and self-optimizing.

One academic study on fault-prediction models showed that the adoption of advanced transformer-based models increased product yield from ~78.4% to ~89.6% in a real-world manufacturing trial. (19) Another research project in predictive maintenance circuits showed that AI models helped reduce machine downtime by ~50% in test environments. (20)

In short, AI doesn't just make factories smarter. It helps defense industry catch up to new demands, close the gap created by labor constraints and build resilience into manufacturing.

AI systems in manufacturing are being trained to detect surface defects, dimensional shifts, and material anomalies in real time, often outperforming manual inspection speeds and consistency. (18)

CASE STUDY

Automated Artillery Shell Production — UNION's Factory of the Future

The war in Ukraine laid bare a painful truth: Western defense producers lacked the surge capacity and agile manufacturing infrastructure to sustain protracted conflict. The U.S. Army's ambition to reach 100,000 155 mm shells per month has repeatedly slid, hampered by aging plants, fragmented supply chains and acute shortages in skilled labor.

Enter automation.

UNION Technologies emerged with a bold solution: a highly automated, software-driven munitions plant in Carrollton, Texas, designed not merely to produce shells, but to reimagine what a defense factory could be. Dubbed the "Factory of the Future," the site represents a radical shift toward digital-first, human-light manufacturing for mission-critical defense production.

By the end of 2026, UNION plans to operate two identical production lines with a combined monthly capacity of 60,000 155 mm shells. The first line will be staffed by just 50 to 75 people, a lean workforce compared to traditional shell plants. (21)

At the heart of the facility are two fully automated Macrodyne press lines, purpose-built for high-output, repeatable shell forming and forging operations.

The plant is projected to become the largest large-caliber shell forge in the United States, setting a new benchmark for domestic munitions production.

But UNION's ambitions extend far beyond throughput. Its leadership envisions a manufacturing ecosystem in which every component — machines, software, data streams, and operators — functions as part of an interconnected neural network. (22) In this model, each factory is a self-learning organism capable of autonomous reconfiguration, scaling, and optimization in real time.

And it's not about replacing people. "For UNION, it's about preserving skill at scale," says one rep. "Our software layers codify best practices so that what one great operator knows becomes institutional knowledge across every factory. Our FactoryOS allows changes to propagate globally; our robotics layer ties every machine's behavior to compliance and safety envelopes. That lets us multiply expert labor instead of dilute it. UNION is left with: predictable takt time, near-zero requalification downtime, and a dramatically smaller skilled labor footprint per line."

The implications are profound. Producing tens of thousands of shells with only a few dozen operators fundamentally reshapes the economics of munitions manufacturing. The plant's modular, software-driven architecture allows for rapid pivoting between production priorities, ensuring surge readiness when global events demand it. Equally important, this approach strengthens sovereign capacity, defending nations not only with weapons, but with the industrial agility to produce them at will.

If successful, UNION's "Factory of the Future" may serve as a blueprint for how allied nations modernize their defense manufacturing base: a scalable "factory-as-a-stockpile" model that can be exported, duplicated, or even deployed in forward locations.

"The West can't afford single points of failure or multi-year qualification cycles," states UNION. "UNION's model— Factories-as-a-Stockpile™ — treats throughput, traceability, and replication as strategic weapons. The wider industry should take note: deterrence now depends less on how many shells (or any war component) are stored, and more on how many factories can produce them on demand."

EMPOWERING PEOPLE IN THE AGE OF AUTOMATION

Automation still makes many people uneasy, but the fear is understandable. Headlines about "machines replacing humans" have fueled anxiety for years, and for some, the word automation still conjures images of empty factory floors and jobs disappearing overnight.

But in defense manufacturing, that story doesn't hold. The reality is far more hopeful: automation isn't erasing human work. It's redefining it.

Modern automation succeeds only when paired with a skilled, empowered workforce. Rather than eliminating jobs, it's transforming them. A technician who once operated a press may now program a robotic cell. An inspector might oversee advanced vision systems instead of examining parts by hand. The work still relies on human judgment, just with different tools.

Governments and defense companies alike are recognizing this shift. The U.S. Department of Defense has labeled workforce supply a "critical supply chain issue" and is funding programs focused on robotics, mechatronics, and digital manufacturing. Across Europe, the European Defence Fund is backing similar initiatives to reskill and upskill workers for next-generation production environments.

Automation is also helping to rebrand manufacturing for younger generations. Smart factories filled with robotics, data-driven systems, and AI controls project a modern, high-tech image—exactly the kind of workplace that attracts new talent.

Ultimately, automation doesn't replace skilled workers. It empowers them. Robots and AI systems take on the repetitive, hazardous and precision-dependent tasks, allowing people to focus on oversight, optimization, and innovation. It's a new kind of collaboration, one that's redefining what efficiency looks like on the defense production line.

U.S. PROGRAMS RESHAPING MANUFACTURING SKILLS

As automation accelerates across defense manufacturing, a growing network of U.S. training programs is stepping up to prepare the next generation of technicians, engineers and system specialists.

From national initiatives led by the Department of Defense to hands-on community college programs, these efforts are redefining what a manufacturing career looks like in the age of robotics and digital production.

Advanced Robotics for Manufacturing (ARM) Institute

Based in Pittsburgh and part of the DoD's Manufacturing Innovation Institutes, ARM funds educational partnerships, apprenticeships and training in robotics, automation and AI to help workers transition into future-ready roles.

Robotics Careers

A national platform tied to ARM that connects job seekers, training providers, and manufacturers. It curates vetted robotics/automation programs and helps individuals map education to career paths.

UTI – Robotics & Automation Technician Program

A vocational program (12–18 months) covering PLCs, mechatronics, control systems, and robotics. Graduates are prepared for technician roles on the factory floor.

Arapahoe Community College – Robotics & Automation / Mechatronics

Based in Colorado, this program emphasizes hands-on training with industrial automation, robotics, and control systems.

Hennepin Technical College – Automation Robotics Engineering Technology

Minnesota's program offers practical training in PLCs, robotics, sensors, and automation controls geared toward advanced manufacturing roles.

PREPARING FOR WHAT'S NEXT

THE ROAD AHEAD

The defense manufacturing base stands at a turning point. Automation is no longer an experiment. It's the new foundation for industrial readiness. But reaching its full potential will depend on balance: pairing the precision of machines with the ingenuity of people.

The factories of the next decade will be hybrid by design: human intelligence directing machine precision.

AI-driven systems will optimize production in real time; robotics will take on the dangerous and monotonous; and skilled operators will guide the process, interpreting data, solving problems and driving innovation.

This isn't the end of human work. It's the evolution of it. Automation doesn't displace the defense workforce; it protects it. It safeguards knowledge, accelerates production and ensures that national defense will never again hinge on outdated equipment or an empty factory floor.

If readiness is the measure of strength, then automation is its engine. The nations that master it first won't just be more efficient. They'll be more secure.

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