

Before the

**White House Office of
Science and Technology Policy (OSTP)**

*In Response to the
Request for Information:*

**National Strategic Plan for Advanced Manufacturing
Questions 6a and 6b**

Docket ID. NIST-2025-0004

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March 30, 2026

Executive Summary

The United States faces a critical shortage of skilled workers that is limiting the growth of advanced manufacturing and constraining efforts to reshore production. Workforce availability—not trade policy, taxation, or regulation—has emerged as the primary barrier to expanding domestic manufacturing capacity.

Addressing this challenge requires a coordinated national strategy to expand the pipeline of skilled workers, modernize training systems, and scale proven workforce development models. Current systems do not fully reflect the value of industry certifications, apprenticeships, and other technical training pathways, limiting their adoption and impact.

To strengthen the advanced manufacturing workforce, federal agencies should prioritize the following actions:

- Elevate manufacturing workforce development as a national priority aligned with industrial and supply chain strategy
- Modernize federal workforce data systems to distinguish outcomes for individuals with certifications, apprenticeships, and technical credentials
- Expand adoption of industry-recognized certifications across federal workforce and education programs
- Scale registered apprenticeships and pre-apprenticeships aligned with advanced manufacturing careers
- Invest in hands-on training infrastructure to support Industry 4.0 skill development
- Strengthen national awareness of manufacturing careers as high-tech, high-wage pathways

These actions will help build a larger, more highly skilled workforce capable of supporting long-term U.S. manufacturing competitiveness.

These recommendations reflect direct input from Harry Moser, Founder and President of the Reshoring Initiative and several of the Manufacturing Skill Standards Council’s Board of Directors, which includes leaders from across the manufacturing and workforce development ecosystem:

Jan Bray, President, Bray Strategies

Josh Gonzalez, Director of Technical Training Centers, Target Corporation

Phil Jones, Senior Engineer Safety, Enterprise Risk Management, Target Corporation

Matt Kennedy, Vice President, Capabilities & Innovation, Rockwell Automation

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Introduction

America’s ability to maintain global leadership in advanced manufacturing depends fundamentally on the availability of a skilled workforce. While technological innovation, supply chain resilience, and capital investment are essential elements of industrial competitiveness, the most decisive factor influencing the growth of domestic manufacturing is the availability of qualified workers.

Industry research consistently confirms that workforce availability now surpasses trade policy, taxation, or regulation as the leading constraint on domestic manufacturing expansion. Surveys of U.S. manufacturers indicate

that companies would reshore substantially more production if a sufficient quantity and quality of skilled employees were available.

[The Manufacturing Skill Standards Council \(MSSC\)](#) is a nationally recognized, industry-led nonprofit organization that develops and certifies the foundational technical competencies of front-line technicians in advanced manufacturing and logistics. Through a nationwide network of 3,900+ training providers and 2,300 testing centers in all 50 states, MSSC has issued hundreds of thousands of industry-recognized credentials aligned with employer needs.

From this perspective, strengthening the advanced manufacturing workforce requires coordinated action in three areas:

1. **Growing and expanding a “Skilled” pipeline of workers entering manufacturing careers**
2. **Strengthening training and national industry certification pathways**
3. **Scaling proven workforce development models nationwide**

The following comments address the major workforce challenges facing the advanced manufacturing sector and propose strategies for federal agencies and federally funded R&D centers to strengthen training, certification, and apprenticeship systems.

6a. What are the main challenges in attracting, training, and retaining a skilled workforce for advanced manufacturing, and how can they be addressed?

Workforce Availability as the Primary Constraint on Manufacturing Growth

Across the United States, the shortage of skilled manufacturing workers has become the single greatest barrier to expanding domestic production capacity. Companies considering reshoring or expanding U.S. operations frequently identify workforce availability as the most critical factor in site selection and investment decisions¹.

Economic projections reinforce this concern. Industry forecasts indicate that millions of manufacturing positions will open in the coming decade, yet a substantial portion of those roles may remain unfilled without targeted workforce development initiatives².

Addressing this workforce gap will require expanding the number of Americans entering technical career pathways while simultaneously improving training systems that prepare workers for advanced manufacturing environments.

Furthermore, the workforce challenges and training frameworks described in this response apply not only to advanced manufacturing, but also related to supply chain and logistics operations, which increasingly rely on the same advanced technologies, automation systems, and digitally integrated processes. Recognizing supply chain as a critical component of the advanced industrial ecosystem will ensure that workforce development strategies are aligned with the full scope of modern production and distribution systems.

¹ Harry Moser, “2025 Reshoring Survey: 59% of Shops Reshored or Are Quoting,” *Association for Manufacturing Technology (AMT)*, August 14, 2025, <https://www.amtonline.org/article/2025-reshoring-survey-59-of-shops-reshored-or-are-quoting>

² John Coykendall, Kate Hardin, John Morehouse, Victor Reyes, and Gardner Carrick, “Supporting US Manufacturing Growth Amid Workforce Challenges,” *Deloitte Insights*, April 3, 2024, [<Supporting US Manufacturing Growth Amid Workforce Challenges>](#).

Cultural Bias Toward Four-Year Degrees

One of the most significant structural challenges in workforce development is the long-standing cultural bias favoring four-year academic degrees as the default pathway after high school.

For decades, education systems and career counseling frameworks have emphasized a “college-for-all” approach. While traditional higher education remains valuable for many students, this emphasis has unintentionally discouraged interest in technical careers and skilled trades that are critical to the manufacturing economy.

Many students and families remain unaware that modern manufacturing careers frequently offer:

- Competitive starting wages
- Opportunities for rapid advancement
- Paid training and apprenticeships
- Minimal or no student debt

While there is no single solution to this challenge, it is critical that these career benefits are more clearly communicated to students, families, and educators. Shifting perceptions will require consistent messaging, stronger career counseling, and greater exposure to real-world opportunities in modern manufacturing. By elevating awareness of these pathways, we can help align workforce development efforts with the evolving needs of the industry.

Additionally, greater alignment is needed between job requirements and the actual skill demands of modern manufacturing roles. Many positions continue to list four-year degree requirements by default, despite being primarily competency-based. Moving toward more standardized, skills-focused job profiles would help expand the talent pool, improve hiring consistency, and reinforce the value of industry-recognized credentials and technical training pathways.

An additional proactive measure would be to strengthen how federal agencies report workforce and earnings data. Current data systems—such as those [published by NCES](#) and other federal entities—often group individuals with industry certifications, apprenticeships, and other technical training into the broad category of “high school graduates.” This aggregation obscures the outcomes of individuals who have completed rigorous, skills-based training pathways. Doing so would provide a more accurate representation of workforce pathways, better inform policy decisions, and help students and employers understand the true economic value of technical training.

Negative Public Perceptions of Manufacturing Careers

Public perceptions of manufacturing have not kept pace with the transformation of modern production environments. Many Americans still associate factory work with outdated stereotypes of “dirty, dull, and dangerous” workplaces.

In reality, modern advanced manufacturing environments are highly automated, technologically sophisticated, and increasingly dependent on digital tools, robotics, and data analytics.

To attract the next generation of workers, national efforts should focus on repositioning manufacturing as a high-tech, high-wage career pathway. Possible initiatives include:

- National awareness campaigns highlighting modern manufacturing careers.
- Expanded participation in [Manufacturing Day activities](#)
- Factory tours and workplace visits for students
- Direct engagement by industry leaders in schools and community events

Improving the public image of manufacturing will play a critical role in strengthening the long-term workforce pipeline.

Limited Career Awareness in K–12 Education

Many students reach graduation without ever having been exposed to manufacturing career opportunities.

Career awareness often begins too late in the education process, after students have already selected academic pathways that limit their ability to pursue technical training.

Introducing manufacturing career awareness earlier, particularly during middle school, can significantly expand the number of students considering technical career options. A national analysis found that 73% of states explicitly identify middle school career exploration as an important component of a student’s education, with most also dedicating funding and policy support to these activities.³

Effective strategies include:

- Fun and engaging learning tools i.e., hands-on, multi-media e-learning, VR.
- Highlight earning potential for students
- Articulation agreements, where training earns college credits.
- Career days featuring industry speakers.
- School advisory boards with manufacturing participation
- Training for career counselors on manufacturing career pathways
- Structured factory visits and industry tours

Early exposure helps students understand the range of opportunities available in advanced manufacturing and allows them to select appropriate coursework during high school.

³ Britebound and Education Strategy Group, *Extending the Runway: A National Analysis of Middle School Career Exploration* (March 2024). <https://www.britebound.org/insights/extending-the-runway>

Insufficient Preparation in Foundational STEM Skills

Modern manufacturing increasingly requires workers who possess strong foundational academic skills.

Technicians and production workers must be able to interpret technical documentation, operate advanced equipment, analyze data, and troubleshoot complex systems. These competencies rely heavily on strong preparation in:

- “Applied” Mfg. Mathematics, particularly geometry and trigonometry.
- “Applied” English, reading retention and application.
- Technical and science literacy
- Problem-solving and analytical reasoning
- Workplace ethics

However, many students entering postsecondary training programs require remediation in these subjects before they can begin advanced coursework.

Strengthening STEM preparation in middle and high school curricula will therefore be essential to building a future-ready manufacturing workforce.

Need to Keep Pace with Technological Change

Manufacturing technologies are advancing at an unprecedented pace, transforming production environments and increasing the technical sophistication required of front-line workers. A nationwide commitment is required to accelerate the training and credentialing of front-line technicians on emerging process technologies so that the workforce can keep pace with these changes.

Such a commitment is particularly important to ensure that the productivity gains associated with artificial intelligence can be fully realized on the factory floor. AI-enabled manufacturing systems rely on front-line technicians who can operate advanced equipment, interpret data generated by digital systems, and troubleshoot increasingly automated production processes.

In addition, front-line technicians in advanced manufacturing environments are increasingly responsible for maintaining and troubleshooting highly integrated systems that combine mechanical equipment, automation controls, robotics, and digital monitoring technologies. This evolution represents a significant shift from traditional single-trade roles toward cross-disciplinary technical responsibilities.

At the same time, the workforce must be prepared to work with a broad range of Industry 4.0 technologies that are reshaping modern manufacturing, including autonomous robotics, the Industrial Internet of Things, additive manufacturing, augmented reality, data analytics, nanomanufacturing and advanced materials. Preparing technicians to operate and maintain these technologies will require continuous updating of training programs, stronger industry-

led standards, and scalable credentialing systems that can rapidly translate technological innovation into workforce competencies.

Without a coordinated national effort to align workforce training with these technological developments, the United States risks slowing the adoption of advanced manufacturing technologies and losing opportunities for productivity growth and global competitiveness.

Limited Access to Hands-On Training Tools and Equipment

Manufacturing skills cannot be learned through classroom instruction alone. Workers must develop practical competencies through hands-on training using equipment and systems similar to those used in industry.

Access to such training tools remains uneven across the country. Many schools and training providers lack the resources required to offer realistic manufacturing simulations and hands-on experiences.

Expanding access to modern training equipment and advanced manufacturing training systems would allow more students to develop practical skills before entering the workforce. In doing so, emphasis should be placed on strengthening system-level, cross-disciplinary training within these hands-on environments—not only to expand the manufacturing workforce, but also to ensure technicians are prepared to operate and sustain increasingly automated and digitally integrated production systems.

Lack of Clear Career Pathways

Retention challenges within the manufacturing workforce often stem from the absence of clearly defined career progression pathways.

Workers are more likely to remain in the industry when they can see a structured progression from entry-level roles to higher-skilled and higher-wage positions.

Effective workforce systems provide visible pathways such as:

- Internships (Academic-year and Summer)
- Pre-apprenticeships
- Entry-level certifications—embed into internships and apprenticeships.
- Registered apprenticeships
- Advanced technical certifications
- Supervisory and engineering career tracks

Creating transparent career ladders encourages long-term engagement in the manufacturing sector.

6b. How can Federal agencies and federally funded R&D centers develop, align, and strengthen all levels of advanced manufacturing training, certification, registered

apprenticeships, and credentialing programs?

Addressing the manufacturing workforce challenge requires coordinated national strategies to strengthen training systems and align education with employer needs.

Federal agencies and federally funded R&D centers can support these efforts through several key initiatives.

Expanding National Industry Certifications

Industry-recognized certifications play a critical role in verifying worker competencies and aligning training programs with employer needs.

High-quality certifications should meet rigorous standards for quality assurance that ensure consistency, transparency, and employer confidence in credentialing programs.

Federal agencies can support certification adoption by:

- Encouraging integration of industry certifications into federal workforce programs i.e., apprenticeships
- Recognizing nationally portable credentials in federal funding initiatives
- Supporting quality assurance frameworks such as the [Quality Assurance Guidelines for National Industry Certification Bodies](#) developed by [the Coalition for Career Development \(CCD\) Center](#).

Nationally portable certifications help employers identify qualified workers while providing individuals with credentials that are recognized across industries and regions.

Supporting Stackable Credential Pathways

A modern workforce development system should allow individuals to progressively build their skills through stackable credentials.

Under this model, workers can begin with entry-level certifications and continue advancing through additional training and credentials over time.

This approach allows individuals to:

- Enter the workforce with “skill-ready” efficiency.
- Continue developing new skills throughout their careers.
- Progress into higher-level technical or supervisory roles

Stackable credential frameworks support lifelong learning while ensuring that training systems remain aligned with evolving technological needs.

Expanding Registered Apprenticeships

Registered apprenticeship programs represent one of the most effective models for developing skilled manufacturing workers.

These programs combine:

- Paid on-the-job training.
- Industry-recognized credentials
- Classroom instruction
- Structured mentorship
- Wage progression

Successful advanced manufacturing apprenticeships typically span two to four years, providing apprentices with both technical expertise and practical workplace experience.

Federal agencies can expand apprenticeships by supporting program development, providing incentives for employer participation, and encouraging integration with community college and technical training programs.

Scaling Proven Apprenticeship and Workforce Models

Several existing programs provide strong models for national workforce development and could be expanded through federal support.

Examples include:

- [Industrial Manufacturing Technician \(IMT\) Apprenticeship](#)
- [FAME \(Federation for Advanced Manufacturing Education\)](#)

The IMT Apprenticeship combines extensive on-the-job training with classroom instruction and industry certifications, preparing workers for roles across multiple manufacturing sectors.

Programs such as FAME demonstrate the effectiveness of employer-driven workforce models that integrate education, technical training, and industry participation.

Scaling these programs nationally would significantly strengthen the manufacturing workforce pipeline.

Expanding Pre-Apprenticeship Programs

Pre-apprenticeships serve as an important entry point into the manufacturing workforce.

These programs prepare participants for full apprenticeships through:

- Industry-recognized credentials
- Foundational technical training
- Career readiness skills

- Exposure to manufacturing environments

Pre-apprenticeships are particularly valuable for high school students, community college learners, and individuals transitioning from other industries.

Expanding Financial Support for Short-Term Workforce Training

Many manufacturing certifications and training programs are shorter than traditional degree programs, yet they often fall outside existing federal financial aid systems.

Expanding support for short-term training—such as **Workforce Pell Grants**—will allow more financially-challenged individuals to pursue certification programs that lead directly to employment.

This policy change will significantly increase access to workforce training while aligning education funding with labor market needs.

Strengthening Industry–Education Partnerships

Successful workforce development systems depend on strong collaboration among manufacturers, educators, and workforce organizations.

Federal agencies can support these partnerships by encouraging regional workforce initiatives that bring together:

- Manufacturing companies
- Community colleges
- Technical high schools
- Workforce development boards
- Industry associations
- Community “Action” organizations i.e., Goodwill, charities

These partnerships ensure that training programs remain aligned with employer demand and evolving industry technologies. Federal support for these partnerships can help scale successful regional models that create clear pathways from education to employment in manufacturing.

Supporting Small and Medium-Sized Manufacturer Participation

Small and medium-sized manufacturers often face resource constraints that limit their ability to participate in workforce training programs.

Policies that support small and medium-sized enterprise participation could include:

- Apprenticeship incentives
- Regional training consortia

- Loan guarantees tied to workforce development commitments

Such initiatives would expand training opportunities while strengthening regional manufacturing ecosystems.

Building Employer–Student Connection Networks Through Verifiable Credentials

One emerging opportunity to strengthen the manufacturing workforce pipeline is the development of digital networks that connect credentialed individuals directly with employers through verifiable industry credentials.

As industry-recognized certifications increasingly move toward secure digital credential formats, they create new possibilities for linking training completion directly with employment opportunities. Digital credentials can contain verified information about an individual’s competencies, training provider, and assessment outcomes, allowing employers to identify qualified candidates with greater confidence and efficiency.

Federal agencies and federally funded research centers could support the development of credential-based talent connection networks that allow:

- Students and workers to share verified digital credentials with employers
- Manufacturers to identify candidates with specific technical competencies
- Training providers to track employment outcomes for credential holders
- Workforce agencies to better understand regional skill supply and demand

Such systems would function as a trusted skills marketplace, where verified credentials serve as the common language connecting education, training programs, and employment.

Proven Models Demonstrating Impact

The following examples demonstrate how MSSC-aligned models are already delivering measurable outcomes by integrating education, industry engagement, and credential attainment in ways that directly reflect this vision. These programs show how scalable, employer-driven approaches can successfully connect training to career pathways and workforce needs.

Expand “Proven Models”:

- **GPS Education Partners:** The GPS Education Partners (GPS Ed) program is a youth apprenticeship model that blends classroom instruction with paid, hands-on work experience to help high school students earn their diplomas while gaining industry-recognized credentials. Students attend GPS Ed learning centers located within partnering businesses, where they complete core academic subjects alongside technical training in fields such as manufacturing, construction, and automotive. The program’s design features small class sizes, personalized learning plans, and multiple job rotations—from exposure to credentialed roles—allowing students to earn MSSC CPT certifications and a Youth Apprenticeship Certificate while developing leadership, professionalism, and employability skills. This model supports strong credential attainment and prepares students for both college and immediate career entry.
- **Alamo Academies:** The Alamo Academies program, an educational partnership among the Alamo Colleges, area high schools, local industry, and regional workforce organizations, integrates Manufacturing Skill

Standards Council (MSSC) courses and credentials into both for-credit and non-credit curricula at the secondary and postsecondary levels. The program includes paid summer internships with employers such as Toyota, Toyotetsu, and Pressure Systems International, and requires students to earn MSSC CPT Safety and Quality credentials before advancing to additional CPT modules in Manufacturing Processes and Maintenance Awareness. This structured pathway ensures students gain both academic credit and industry-recognized credentials aligned with employer expectations.

- **North Carolina Manufacturing Institute**: The North Carolina Manufacturing Institute (NCMI) was designed as a collaborative, multi-county partnership connecting employers, community colleges, workforce boards, and economic development organizations to close the manufacturing skills gap. The program features an 8- or 16-week MSSC CPT training model that combines classroom instruction with hands-on learning, fully funded through scholarships for qualified job seekers. Manufacturers are directly involved in the process, interviewing each graduating class to recruit certified candidates with the skills and knowledge they need, ensuring a seamless connection between training and employment and accelerating job placement outcomes.
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Conclusion

The United States cannot sustain leadership in advanced manufacturing without a workforce development strategy that is equal in scale to the technological transformation of the industry. Addressing the current labor shortage will require expanding the pipeline of workers entering technical careers, strengthening training and credential systems, and ensuring that workforce programs are aligned with the evolving skill demands of modern manufacturing. Earlier career awareness, stronger STEM preparation, expanded hands-on training opportunities, and clear career pathways can help attract and retain the next generation of skilled manufacturing professionals.

Federal agencies and federally funded research centers have an important role to play in scaling proven workforce development models. Expanding industry-recognized certifications, supporting stackable credential systems, strengthening registered apprenticeships, and improving collaboration between manufacturers and educational institutions will help create a more responsive and efficient training ecosystem. By investing in these strategies and supporting innovative tools such as digital credential networks, the United States can build a larger, more highly skilled manufacturing workforce capable of supporting long-term industrial growth and global competitiveness.