TALENT SOLUTIONS FOR THE NEW ECONOMY



TRAINING TO WIN



MANUFACTURING Institute



Industry 4.0 refers to the disruptive wave of innovation due to digital technology. It follows three earlier revolutions:[1]

- Steam, water and mechanical production equipment
- Division of labor, electricity and mass production
- Electronics, IT and automated production

The hallmarks of this fourth revolution include the following:[2]

- Virtually unlimited data capacity, and with it, the means to connect all elements of supply, production and distribution seamlessly
- Analytics that are achieving ever-greater efficiencies in manufacturing
- New forms of human-machine interaction, made possible by technology such as augmented reality
- Rapid production from digital models, including 3-D printing and advanced robotics

Manufacturing is a vibrant and growing sector of the American economy, representing 11.7 percent of our nation's GDP.[3] It is also at the forefront of innovation: 90 percent of patents cover manufacturing processes.[4]

We stand at the precipice of greater growth and prosperity. In a recent survey, more than 90 percent of manufacturers are positive about their own company's outlook.[5] A new wave of innovation will usher in new opportunities and greater efficiencies in manufacturing processes and operations. These trends hold the promise of new prosperity—benefiting our global competitiveness, economic growth and communities across the country.

Yet, our progress toward shared prosperity stands in jeopardy. Even as manufacturing becomes more productive, our nation's education and workforce development systems are stuck in neutral. Best estimates are that more than 350,000 manufacturing jobs are unfilled today.[6] Through 2025, that number is expected to total 2 million unfilled positions.[7]

We must act now to meet the demands of today and to prepare for the job needs of future generations.

Trends That Are Remaking the Manufacturing Workforce

Standing still is not an option. Manufacturing is modernizing across the globe. To win in the international marketplace, American manufacturing must outcompete for talent and innovation.

Trend 1: A "fourth wave" of manufacturing innovation is upon us, with a dizzying pace of change redefining how we work, shop and produce. Consider the following:

- The annual output per manufacturing worker rose to $149,299 in 2012, 90 percent higher than in 1998. The productivity and ingenuity of American manufacturers have helped to accelerate an industrial resurgence.[8]
- The wall separating engineering and production is coming down. More companies are expecting engineers to come with hands-on experience—or put engineers on the production floor as a part of their onboarding. Likewise, production workers increasingly need more applied math and problem-solving skills to succeed.
- Critical skills in manufacturing are rapidly changing to meet the needs of the automated and digital economy. Occupations such as industrial maintenance and process technology—the ability to develop and operate complex systems—are two of the most sought-after jobs in the modern factory.

Trend 2: Skill needs are increasing. More than 80 percent of manufacturers report skill shortages in production jobs, from entry level, to middle skills, to engineers and managers.[9] Whereas these jobs at one time required little more than physical labor, requirements more common today are math skills, teamwork and advanced problem solving. The impacts are being felt across the economy:

- Increasingly, machining operations are computer controlled. This not only entails a large growth in productivity but also means a greater need for programmers, operators and maintenance workers.
- The percentage of manufacturing workers with postsecondary training after high school is 54.4 percent and climbing.[10]

The skill required to operate, program and maintain modern high-technology equipment is evident in wages for demand occupations. Industrial maintenance workers, for example, average more than $50,000 per year, and highly skilled maintenance technicians can earn more than $100,000 per year.[11]

Trend 3: Public–private partnerships are driving new training models. Most students do not complete a two-year degree in two years or a four-year degree in four years. The "typical" education path—high school diploma, college degree and career—is now the exception, not the rule. Far more commonly, individuals are receiving certificates, earning certifications and working—sometimes in different orders or all at once. Manufacturers are hiring and promoting based on skills and competencies. That trend will only accelerate in the new economy.

Increasingly, earn-and-learn models are filling the void. Demand-driven training ensures that students in career and technical programs are learning high-demand skills. Internships and apprenticeships are giving opportunities for students to build job skills and prepare for manufacturing careers. Once employed in manufacturing, workers are able to apply tuition reimbursement, continuing education and incumbent worker training programs to continue on a path of lifelong learning.

This roadmap lays out recommendations to ensure the competitiveness of manufacturing and to help more Americans benefit from the industrial resurgence. Its aim is to provide specific recommendations for action and spotlights examples of success in which manufacturers and communities have built effective models.





Underlying these recommendations are important principles:

- **Career and technical education needs to be flexible and adaptable in preparing the workforce of today and tomorrow.** Short-term training, part-time learning and a blend of credit and noncredit programs are all in wide use by the industry, yet often run afoul of funding and incentives that have a bias toward full-time education and four-year degrees.
- **More needs to be done to modernize apprenticeship and other incumbent worker training.** The long legacy of apprenticeship is a testament to the strengths of structured, on-the-job training. However, the apprenticeship system needs to grow with modern manufacturing. That includes greater flexibility, true competency-based apprenticeships and a full range of opportunities for companies in registered and unregistered models.
- **Worker training is a public–private imperative.** Manufacturers overall are investing more in training for their incumbent workers as they work to meet skill needs and address the coming baby-boomer retirements. Even with that trend, it is essential that workforce preparatory programs, including high schools, community colleges and four-year institutions, meet industry standards and mesh seamlessly with corporate training. In addition, the system must be resilient and designed to evolve continuously to meet industry demands across the coming decades.
- **Manufacturing is driven by data.** Our education and training system should be, too. Information on enrollment is scattered across multiple agencies, making it virtually impossible to compare education and training programs. Our modern economy demands a comprehensive data system that tracks enrollments with outcomes that matter to employers, such as industry-recognized credentials and job placement in a related occupation.
- **Women, veterans and underrepresented populations are a priority and an opportunity for growth.** In an era of unfilled positions, it is especially important to ensure as many skilled workers as possible are entering manufacturing and secure that talent pool in leadership and manufacturing roles. Women are underrepresented, even as companies have proven they can do much more when they remove hidden barriers and value women's contributions. Veterans and youth need every opportunity to learn about manufacturing and ways to enter a career in the industry.


SSEMBLY

1. REDEFINING APPRENTICESHIP: THE AMERICAN MODEL FOR EARNING AND LEARNING

Structured, on-the-job training tied to skills and career paths is a proven strategy for growing a skilled and productive workforce. Registered and unregistered apprenticeships, structured internships and other solutions within companies will only grow in significance as we replace retirees and grow the workforce for 21st-century skills.

REGISTERED APPRENTICESHIPS

Registered apprenticeships—approved and documented by state or federal agencies—work well for many companies. The U.S. Department of Labor has taken important steps to address the needs of modern manufacturing, including competency-based—as opposed to time-based—apprenticeships. Nevertheless, too often, manufacturers still report barriers to executing these government-driven models.

Modernizing and reforming the registered apprenticeship system would allow more companies to participate.

Spotlight: Dow

The Dow U.S. Apprenticeship Program[12] provides a pipeline of talent to support business growth and advance skill development in manufacturing and engineering.

The fully paid Dow U.S. Apprenticeship Program offers three-plus years of world-class training and on-the-job experience in some of the most sought after and highest-earning technical specialties in the industry. While working for Dow, apprentices earn a two-year college degree and gain in-depth, specialized training.

Apprentices earn competitive wages and full college tuition while gaining in-depth knowledge and enhancing their marketability for today's lucrative manufacturing roles:

- Chemical Process Technician
- Instrument Electrical Technician
- Millwright

Through partnerships between Dow and local community colleges, this program combines classroom training and hands-on learning to build in-depth skills and experience. Upon successful completion of the program, apprentices will be evaluated for full-time employment opportunities at Dow.

INTERNSHIPS

Far more companies choose internships and other structured on-the-job training as opposed to officially registered apprenticeships. These models can be as robust as apprenticeships and are often more flexible in meeting the modern needs of the workplace for both employers and employees.

Innovative workforce boards and other training organizations have built highly effective partnerships that organize paid internships with companies in their region. For companies, these programs represent an opportunity to attract talent, reduce recruitment expenses and "try out" candidates prior to full-time hire. Some internships are managed relatively informally. Others, such as Toyota's Advanced Manufacturing Technician (AMT) program, have become full-fledged organizations that are effectively narrowing the skills gap for critical positions in communities.

Manufacturers increasingly are recognizing the power of on-the-job training to grow the pipeline of talent for today's and future careers. The diverse models employed by companies—from job shadowing and internships all the way to structured apprenticeship—have value and provide important on-ramps to manufacturing careers.

Spotlight: Toyota's AMT Program

To remain internationally competitive in the manufacturing sector, America needs a reliable, on-time pipeline of new technical talent that is as good as, or better than, the best in the world. The shortage of technical workers to keep factories running and producing is becoming an economic crisis. The AMT program, originally envisioned, developed and implemented by Toyota, addresses this critical need.

AMT is a dual-track, five-semester program that matches education with continuous real-world working experience through a leading manufacturer. The AMT program combines proven workplace components of apprenticeship with the earn-and-learn model in subjects including electricity, fluid power, mechanics, fabrication and robotics. The result is paid work experience that includes hands-on application and the best practices of a world-class manufacturer. Students who complete this program receive the AMT certification as well as an associate degree in applied science.

Through an employer collaborative known as Federation for Advanced Manufacturing Education (FAME), manufacturers partner to support each local AMT program at an area college. Local employers form a FAME group. A local college will then implement the AMT program, and employers will sponsor students who will attend school two days per week and work at the sponsoring employer three days per week. This model successfully prepares students for a career in manufacturing and ensures students are also earning college credits.

An Apprenticeship Agenda for the Future Must:

- Provide incentives for on-the-job training, irrespective of formal registered apprenticeship status. Some states, such as Tennessee, Ohio and Florida, employ incumbent worker training funds that companies can use to grow their workforce.
- Stitch together internships, pre-apprenticeships and other work-based learning in ways that help fill the pipeline of workers into manufacturing and related industries.

Actions for Leaders to Take:

- Streamline the registered apprenticeship system to be more consistent across all 50 states. The patchwork of state apprenticeship councils and duplicative federal programs make it difficult for manufacturers to engage successfully.
- Be flexible and supportive of competency-based and shorter apprenticeships.
- Remove regulatory hurdles. Well-meaning regulations on apprenticeships nevertheless require additional paperwork to execute. There should be a close review of regulations that have had the effect of steering companies away from registering their otherwise eligible programs.



2. BETTER WORKFORCE DEVELOPMENT AND TRAINING

Fully 76 percent of Americans believe the United States should further invest in manufacturing, and 69 percent believe it should be a national priority.[13] Our workforce system spends billions of dollars each year to prepare individuals for jobs and link them to employment. Now is the time to examine that system and ensure investments match up with national priorities and the demonstrated need for manufacturing skills.

At its best, our federal workforce development system can be an important bridge for jobseekers to gain high-demand skills and for companies to access qualified workers. The essential element in this system is training to standards set by the industry based on accurate labor market information. Our current system falls far short of its potential. Instead, we find too many boards, too much bureaucracy and too few actual training outcomes.

We need a new paradigm equal to the demands of the modern economy and modern manufacturing.

PUBLIC–PRIVATE PARTNERSHIPS

The Workforce Innovation and Opportunity Act (WIOA) made important strides toward accountability and increased the importance of employers in workforce decisions. A number of state and local workforce development boards have moved further toward a demand-driven system. That initiative should be applauded and serve as a foundation for true public–private partnerships.

It is critical that training be aligned to nationally portable, third-party certifications based on industry-defined competencies.

The Manufacturing Institute has identified the Manufacturing Skills Certification System to guide industry, education institutions and policymakers. More than 500,000 certifications were issued in five years, representing a quantum change in skills for American workers.



FLEXIBLE SPENDING PARAMETERS

States and regions are hamstrung by rigid funding formulas and set-asides. These regulations may be well intentioned, but they tend to prevent regional and sector-based strategies working in concert with industry and economic development. True reform will lead to the following:

- More flexibility for states to develop training solutions
- Greater coordination with economic development agencies to achieve common outcomes

DISCRETIONARY SPENDING

A variety of discretionary programs—including those in the Department of Labor, Department of Commerce and Department of Education—have been used to fund demonstration projects that are not subject to rigid rules and formulas. These projects have tended to target high-growth sectors, such as advanced manufacturing, or go directly to community colleges and, in ideal circumstances, involved a series of partners, including area industries. These programs have demonstrated ways to change the workforce system for the better.

A Workforce Agenda for the Future Must:

- Be industry-led and tied to fulfilling the workforce aims of economic development strategies.
- Be data-driven and required to meet performance outcomes.
- Ensure that grant-funded activities are sustainable and have articulated plans for longevity after the conclusion of funding.

Actions for Leaders to Take:

- Redirect existing funds within the public workforce system in ways that support public–private training solutions that have been proven to be effective.
- Support innovative training solutions in addition to traditional brick-and-mortar training facilities.
- Provide incentives to find and embrace new training methods and technologies.



3. EDUCATION

Increasingly, jobs require some form of postsecondary education, but even when students earn a degree, they often find a disconnect between their studies and the demands of the labor market. Half of recent college graduates report they are not using skills they learned in college at work, and 86 percent say they are learning new skills outside of college.[14] Community and technical colleges are playing an important role in upskilling, and 54 percent of working adults now believe it is essential to get training to update skills throughout their working lives. Yet, the current higher education system places too strong a priority on four-year institutions.[15]

The education system needs to change and adapt to reflect the reality of lifelong learning. Opportunities for hands-on or experiential learning are critical. Engaging early ensures interest and access to STEM (science, technology, engineering and math) and career and technical education.

An Education Agenda for the Future Must:

- Provide multiple on- and off-ramps and include emerging forms of learning, including credit and noncredit programs, work-based learning and new forms of training, such as distance learning.
- Consider alternative measures of completion, recognizing that more and more students will enroll in short-term training and achieve industry-recognized credentials that have market value.
- Recognize prior learning where it happens, not necessarily just in the classroom.
- Provide alternative ways for industry experts to become teachers, recognizing the value of their practical expertise and credentials as opposed to traditional routes to a teaching certification.

Actions for Leaders to Take:

- Ensure that financial aid programs serve students' best interests, not educational bureaucracies. Many individuals benefit from year-round learning, for example, but are stymied by outdated financial aid policies tied to academic calendars.
- Create clear pathways in and through education, incorporating elementary, secondary and postsecondary systems and from education to employment—acknowledging that the future of higher education will likely include lifelong engagement with education and training.
- Focus on STEM and technical learning at early ages, starting as early as elementary school, to ensure that a large talent pipeline will be ready and adaptable to the changing needs of employers across the country.

4. DATA

Data analysis is revolutionizing manufacturing, helping companies to optimize their supply chains, production processes and distribution channels. Yet, when it comes to the supply chain for talent, manufacturers—and our country as a whole—are largely in the dark.

There is virtually no transparent, comprehensive data on education and training providers. Key measures, such as student movement and credential attainment, are absent. In part, this is because the federal government only reports on first-time, full-time enrolled students in courses that provide academic credit. That represents fewer than 15 percent of all students.[16]

We need data on all students for all types of programs—credit and noncredit, full-time and part-time and short-term training—that lead to a credential. Employers and educators alike also need more reliable data on the value of industry-recognized credentials, on which programs are preparing students to pass industry assessments, and how they are supporting employment and retention. A new, comprehensive dataset will help target financial aid to programs that best prepare students for the labor market.

Spotlight: NAM Data Matching System for Education Outcomes

The National Association of Manufacturers (NAM) and the Institute, in partnership with the National Student Clearinghouse and the U.S. Census Bureau, are pioneering a national education data infrastructure to identify, analyze and report outcomes from education and training programs at community colleges. This data infrastructure will include records from community colleges (credit and noncredit courses) and third-party credential providers, match those combined records with IRS employment and earnings information and aggregate the results to determine labor market outcomes at the program level and across company and population characteristics. The data will be displayed on a public website where interested audiences can learn the education and labor market outcomes of academic programs, the employment and earnings impact of third-party credentials and the industries employing former students.

A Data-Driven Agenda for the Future Must:

- Track outcomes across a variety of student learning, including non-credit or nontraditional academic or training programs.
- Evaluate alternative measures for student completion, such as awarding of industry-recognized credentials and employment placement in related field of study.
- Allow access to financial aid for nontraditional institutions that are providing the best outcomes for students, which may include credentials issued, labor market placement and retention.

Actions for Leaders to Take:

- Replicate innovative state-based programs, such as pay-for-success models that allow for performance-based funding.
- Expand models to align education and training data systems across K-12 and postsecondary institutions, inclusive of industry-recognized credentials, to better understand the strongest academic pathways leading to the best labor market outcomes.

5. SUPPORTING UNDERREPRESENTED POPULATIONS

With manufacturers reporting growing skills shortages, there are still large underrepresented populations that are a potential source of skilled workers. Growing and diversifying the pipeline into manufacturing careers will do more than increase the number of workers; it will also broaden the experience and expertise of our workforce and ensure an inclusive work environment.

Manufacturers are recognizing the importance of outreach and inclusion of underrepresented populations and have developed successful models for replication.

YOUTH

Manufacturing represents a wide array of occupations, the chance to work literally on the cutting edge of technology and opportunities to build a career while simultaneously achieving education goals. Awareness of these assets has begun to change, with more Americans recognizing the industry's pay, benefits, work environment and high-tech jobs. Yet, consistently, only one-third of parents say they would recommend a manufacturing career to their child.[17] This disconnect hampers the further growth of the industry as older workers retire from manufacturing.

Much of the problem stems from a lack of awareness. Interest in manufacturing careers doubles when people are familiar with manufacturing.[18]

The NAM and the Institute co-produce Manufacturing Day, when companies open their plants for tours, visit schools and participate in events to raise the profile of manufacturing. Initially reserved for the first Friday in October, Manufacturing Day has grown to Manufacturing Week or Manufacturing Month in many regions.

Career and technical education is an essential bridge to careers and has been shown to improve high school graduation rates for at-risk populations.[19] Students and parents must receive realistic information about the range of careers and available education and training pathways. Manufacturers themselves are an important link to providing authentic experiences about the industry. More of them are engaging directly with schools and students and identifying early-career "ambassadors" to be their voice in classrooms and community organizations.



WOMEN

Women represent a vast pool of untapped talent, comprising just 29 percent of the manufacturing workforce. We can and must bring women more fully into production, design, engineering and management. In fact, companies with women on their leadership team demonstrate better management practices, innovative and creative approaches and solutions and likely improved financial performance.

Companies of all sizes have begun to respond. In a recent survey, 58 percent of women noted positive change in their industry's attitude toward female professionals over the past five years.[20]

Spotlight: STEP Ahead

The Institute's STEP Ahead Awards recognize women in science, technology, engineering and production. Since 2013, 500 women leaders and 120 emerging leaders (under 30 years old) have received the honor and participated in intensive workshops, leadership training and networking. The program has had unexpected benefits, not only for honorees but also for their companies and communities. Over five years, the program has reached—directly and indirectly—more than 300,000 individuals, from peers in the industry to school-age children.[21]

Based on this success, the Institute has launched STEP Forward, a series of regional events to bring the benefits of the program to communities.

VETERANS

There are more than 19 million veterans in the United States, and more than 200,000 service members transition from active duty each year. Many of them have military experience and training in manufacturing-related fields. Companies see this as an ideal source of talent, yet often report having difficulty locating veterans interested in manufacturing.

Helping veterans enter into civilian manufacturing occupations is a national imperative. Companies are increasing their presence on military bases. Pilot projects are embedding industry certifications into programs such as the Army's Soldier for Life.

As with other federally managed programs, veterans' services must prioritize public–private partnerships and meet industry demand. Streamlining services—currently spread across multiple departments—will be crucial in maximizing effectiveness and reducing needless unemployment of our nation's heroes.

EX-OFFENDERS

Every company is different and has a unique set of requirements when it comes to background checks and security clearances. Some manufacturers are finding that they can actively recruit prior offenders as a source of talent. In some cases, manufacturers have voluntarily "banned the box" in their screening prior to making a job offer.

An Agenda Supporting Underrepresented Populations for the Future Must:

- Recognize the contributions of a diverse workforce in productivity and growth.
- Consciously include all populations in hiring and promotion.
- Make it easier for companies to bring minors in as interns.

Actions for Leaders to Take:

- Support and participate in Manufacturing Day to celebrate the industry and raise awareness about manufacturing careers.
- Maximize participation in extracurricular projects, such as Project Lead the Way, SkillsUSA and FIRST Robotics.
- Identify ambassadors to be the industry's voice among youth and underserved populations.



LOOKING AHEAD

Immediate action must be taken to ensure that modern manufacturing has the talent it needs to compete and succeed in the 21st century. To be successful, leaders must do the following:

- Organize manufacturers to speak with one voice on workforce policies needed to sustain and grow manufacturing.
- Engage and align key stakeholders—including community leaders, education institutions, public officials—to take action and build momentum around policy priorities at the state and federal levels.
- Together, build a policy framework that delivers a sustainable pipeline of strong, skilled manufacturing talent.

NOTES

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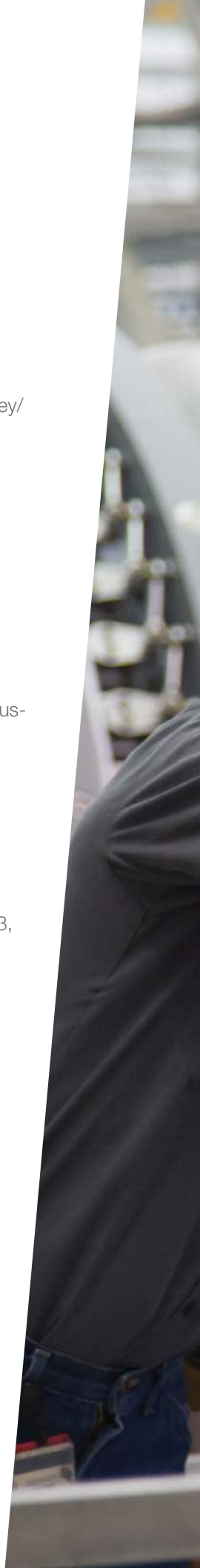


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