

THE EQUIPMENT INDUSTRY TECHNICIAN SHORTAGE:

REASSESSING CAUSES, IMPACTS AND POLICY RECOMMENDATIONS – 2020

A Research Study Conducted at
the College of William & Mary,
Commissioned by The AED Foundation



DEAR AED MEMBER,

On behalf of The AED Foundation Board of Directors, I encourage you to examine The Equipment Industry Technician Shortage: Reassessing Causes, Impacts and Policy Recommendations research report prepared by the College of William & Mary for The AED Foundation. This report provides an updated look at the impact the skills gap is having on our industry, estimates how many technician positions will need to be filled over the next five years, and provides recommendations for addressing the technician shortage.

In addition to the current report, The AED Foundation continuously funds research that backs up its claims on the importance of workforce development and shares data with legislators, educators, the media and other industry stakeholders.

The AED Foundation, through its Vision 2024 initiative, is creating a steady and robust pipeline of technicians for the future of the equipment distribution industry. By 2024, the Foundation is aiming to reach the following goals; 100 accredited college programs, 50 recognized high school programs, 10,000 skilled technicians entering the workforce, 500 certified managers, 10,000 tests administered, and 5,000 certified technicians. The Foundation works to provide tools for dealers to recruit technicians, including its careers in construction equipment and distribution brochure, technician videos, and other workforce events. In addition, The AED Foundation’s Dealer Learning Center is filled with many industry-specific learning opportunities, including online courses, on-demand webinars, and certified management programs in parts, service, rental, sales and branch management.

However, without the generous support from our investors, The AED Foundation would not be able to continue to deliver research reports or the services that AED members need to improve their companies and stay up to date with new business trends.

I encourage you to join me in supporting The AED Foundation by visiting bit.ly/2020aedfcampaign and making a tax-deductible contribution to ensure that The AED Foundation can continue to provide this valuable information now and in the future.

Sincerely,



Jeff Scott
The AED Foundation
Chairman
Intermountain Bobcat

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1 | EXECUTIVE SUMMARY

A skills gap refers to a mismatch between the skills that businesses are looking for in employees and the skills present in the workforce, a mismatch that makes it difficult for businesses to hire and expand. This report focuses on the shortage of technically skilled workers in the heavy equipment distribution industry. Businesses in this industry distribute, rent and support heavy equipment that is used in construction, mining, power generation and other sectors. This report will update the analysis done in 2016 with several additions, such as in the recommendations and case studies sections, and discussion of the Perkins Act reauthorization.

Analyses of economic trends and of a survey of AED distributor members conducted in the spring of 2019 confirm the continued existence of a skills gap. AED members who responded to the survey overwhelmingly report that they cannot recruit enough skilled technicians; 95% agree that there is a skills gap in the industry and 89% report a shortage of workers in their own company or shop.¹ A similar trend persists in the broader economy.²

The multitude of factors included in the survey and wider economic literature indicate a significant mismatch in skills that hampers businesses' ability to hire, grow and serve customers. However, there are several differences from the last report to now. First, the causes have somewhat shifted in terms of what is getting the most impact and attention. For example, the retirement of baby boomers, heavily emphasized in 2016 literature, seems to be less of an immediate concern than that of industry perceptions and a school system inadequate for the needs of vocational careers. Furthermore, a more recent shift toward artificial intelligence (AI) and programming provides a new avenue of exploration relevant to the industry skills gap. This points to preparation for a future rooted in software skills as well as the hardware skills typically associated with the technical skills gap. Overall, despite wider literature and national trends indicating a worsening skills gap, for the heavy equipment industry and AED membership in particular, the survey data shows that such predictions seem to be less extreme than anticipated, or at the very least seem to be holding steady.

The skills gap has significant negative effects on companies' bottom lines and on their ability to grow. Studies of the manufacturing industry predict that around USD\$454 billion, or around 17% of the total projected U.S. manufacturing GDP, could be at risk if qualified workers are not recruited to take over the open jobs.³ Among AED members, the top three leading effects of the skills gap are an inability to meet customer demand, hindered growth, and an inability to seize new opportunities. **Extrapolating from the survey results, AED distributor members collectively are seeking to fill approximately 3,300 technician positions annually. We estimate, when including non-AED member dealers, the range could be anywhere from 9,000 to 14,700 unfilled technician positions annually.**

Several notable causes have contributed to the technical skills gap. The survey focused on a few of them, such as a perceived lack of attractiveness of the industry and inadequacies of the school system. The current structure of the educational system is skewed in favor of a traditional four-year college education. A side effect of this bias is a lack of attention to the economic reality of a need for technical-based skills and a lack of consideration for the students who could potentially excel in the vocational field. Studies show that less than 33% of surveyed Americans would encourage their child to pursue a manufacturing career. This percentage went down slightly from 37% only a few years ago in 2016.⁴ This is related to the school system that often frames technical jobs as fallbacks for those who cannot succeed in the traditional college setting, rather than as legitimate professions that provide an excellent standard of living. About 61% of AED members don't believe that local educational institutions understand their company's workforce needs, with the 10% who responded "Other" usually expressing a degree of understanding or communication in progress, but not enough. And as noted in an earlier skills gap report, the baby boomer generation contains relatively more technically trained workers than the rising

millennial generation. As these baby boomers begin to retire, there are not enough trained workers to fill the technician job openings.⁵

The overall proven status of the technical skills gap on a national level builds on cases that occur on the micro level. Disaggregating the data to closely analyze the input of all the stakeholders helps to track changes and to evaluate the effectiveness of policy initiatives. On a higher level, the Perkins Act exemplifies federal support for career and technical education services through funding, research and credential programs. Recent reauthorization of Perkins increases funding for technical programs in secondary and postsecondary education. The Work-to-School Opportunity Act is another measure helping to provide political support for combining education and workforce development and serves as support for the recommendation of bringing high school students into the physical areas of work. Finally, we show how the skills gap extends to other industries such as science, technology, engineering and math (STEM) and information technology (IT), revealing that training and education is a concern shared across industries.

The report concludes with several recommendations. It combines old and new ideas for how to strengthen the recruitment strategy, such as further educational development and initiatives, data collection to increase recruiting effectiveness, and creation of new roles for older workers in order to leverage valuable knowledge. This section also generates the key conclusions about AED and skills gap case studies and policy aimed at workforce development, demonstrating the variety of measures that exist for workforce aid and funding. At the very end is a summary of some potential areas of exploration for the future and for the continuation of this report, and some other ideas mentioned but not fully examined.

¹ AED survey data.

² Craig Giffi, Paul Wellener, Ben Dollar, Heather Ashton Manolian, Luke Monck, and Chad Moutray, "2018 Deloitte and the Manufacturing Institute skills gap and the future of work study," 2018, Deloitte and the Manufacturing Institute.

³ Ibid.

⁴ Craig Giffi, Michelle Rodriguez, Sandeepan Mondal, "A look ahead: How modern manufacturers can create positive perceptions with the US public," 2017, Deloitte and the Manufacturing Institute.

⁵ Bethany Bostron, Jesse Jordan, and Timothy Planert, "The Equipment Industry Technical Workforce: Addressing the Technician Shortage," 2018, the College of William & Mary and The AED Foundation.

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2 | INTRODUCTION

The skills gap refers to a mismatch between the skills that businesses are looking for in new employees and the skills present in the workforce. This makes it difficult for businesses to hire and expand. Of specific concern is a skills gap in jobs that require vocational skills, namely a shortage of technically skilled workers in the heavy equipment distribution industry, which is represented by Associated Equipment Distributors (AED). The businesses in this industry require skilled technicians to repair and maintain equipment that member businesses rent or sell to consumers.

Interested parties have researched the skills gap in recent years, and this report will draw heavily on studies done by Deloitte, the Manufacturing Institute, and previous William & Mary researchers. The topic is especially relevant in the context of strong economic recovery after the Great Recession. This report will follow up over the four-year timespan since the 2015 data to discover any changes in AED distributors specifically. We will use the updated versions of expert economic and industry analyses to examine the technical skills gap, workforce development policies, and a redistributed survey to AED equipment distributor members.

Consistent with the 2016 report, manufacturing was chosen as an analogous technical industry in the broader economy. An important portion of this analysis is comparing and connecting trends found in AED members with the experiences of wider sectors of the economy. Manufacturing is an industry that faces a shortage of technical workers and that makes up a large portion of the American and Canadian economies. These common features provide the opportunity to identify trends, causes and effects of the skills gap that might not be revealed by the AED survey alone.⁶ The response rate in the 2019 member survey was 29%, up from 24% in the 2016 study.

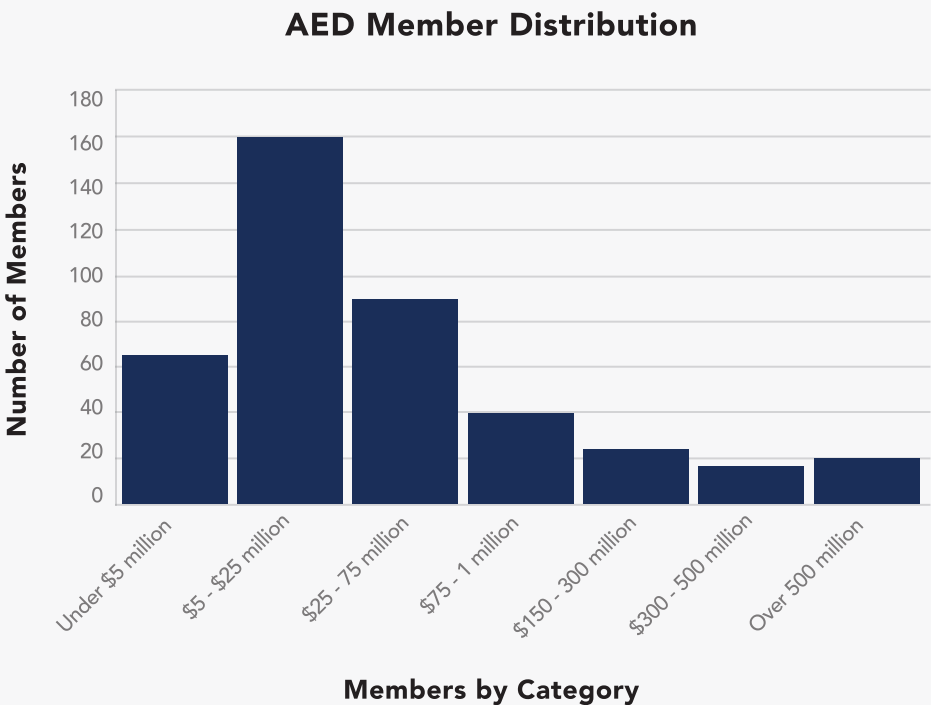
2.1 | The Client

Established in 1919, Associated Equipment Distributors (AED) is an international trade association based in Schaumburg, Illinois, representing companies involved in the distribution, rental and support of equipment used in construction, mining, forestry, power generation, agriculture and industrial applications. AED serves independent distributors, construction manufacturers and relevant business service suppliers, maintaining 450 distributor member companies in the U.S. and Canada. Other areas of interest to AED include public policy advocacy, industry education and career development, economic and business research, public relations, and networking events.⁷

⁶ Danny Berg, Josh Klein, and Will Nisbet, "The Equipment Industry Technician Shortage: Causes, Impacts and Policy Recommendations," 2016, the College of William & Mary and The AED Foundation.

⁷ About AED - <http://aednet.org/about-aed/>

The AED Foundation (AEDF) is the section of the association which addresses professional education and workforce development in the equipment industry. AEDF promotes employee success via educational opportunities in both availability and quality. Some of its activities encompass providing insight into the technical career path, accrediting diesel-equipment technology college programs, and offering online learning resources.⁸ According to AED member data, total membership is skewed right, with most members categorized as relatively smaller-scale companies within the \$5-\$25 million revenue range.



2.2 | Survey Methodology

Building on the AED survey developed in the summer of 2015, small changes and additions were made and the 2019 version was administered to the dealership members. The survey collected data on each respondent's company profile, their recruiting habits, and their perceptions of the skills gap. This data provided insight into the experiences of AED members in relation to broader national trends, as well as helping to identify any notable changes in perceptions over time.

The survey was created with Qualtrics Survey Software and released in an online format to the AED distributor members in the United States and Canada. A total of 131 members completed it, representing 29% of total dealership members. Of the respondents, 23% were "small" (under \$25 million), 34% "medium" (\$25-75 million), and 42% "large" (over \$75 million). The actual membership distribution is 54% small, 21% medium, and 25% large. It is possible that this discrepancy could be due to the larger members having better staffing, making it easier for them to complete the survey. Based on this comparison and attached to the earlier disclaimers about membership response percentage, the survey somewhat overrepresents the experiences of large companies.

⁸ Mission - <http://aedfoundation.org/mission/>

3 | THE SKILLS GAP

A skills gap exists in jobs that require technical skills, with a shortage of technically skilled workers in the heavy equipment distribution industry, which is represented by AED. The businesses in this industry require skilled technicians to repair and maintain equipment that they rent or sell to consumers. While this industry is the focus of the present study, a large amount of the research draws from the overarching manufacturing industry. It provides the best analogue to AED's membership in a larger sector of the economy because, despite the differences, both the manufacturing and the equipment distribution industries are experiencing the skills gap and all the problems it creates for their workforces.

Manufacturing represents about 11.6% of the United States' yearly gross domestic product, and in just the first quarter of 2018 manufacturers contributed \$2.33 trillion to the economy. For all its significant contributions, the next decade predicts that nearly 3.5 million manufacturing jobs will be needed, yet 2 million of those positions are expected to go unfilled due to the skills gap.⁹ This industry situates the technical skills gap into concrete consequences in terms of national economic causes and effects; these insights may be applicable to AED's industry, which is situated on a more specialized level that is, in some ways, more useful on a case study scale. Taking it a step further, it is also important to consider the indirect impact on the industries linked to those directly affected by the skills gap in heavy equipment and manufacturing.

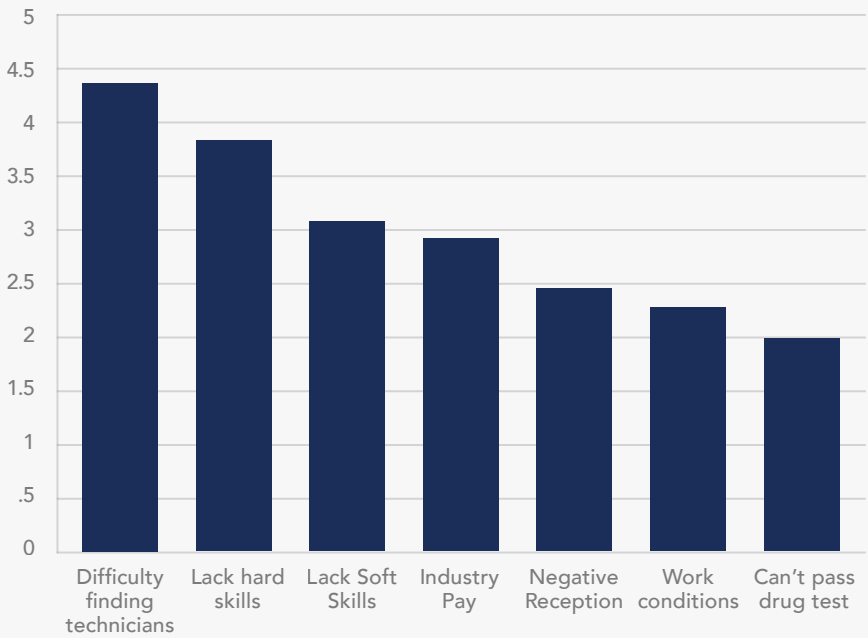
The following parts in Section 3 will summarize several key findings of the survey: factors affecting hiring; ratings of factors affecting hiring; quantitative categories such as job opening rate, average length of job openings, and number of technician positions companies are looking to fill; and effects of the skills gap. Overall, despite wider literature and national trends indicating a worsening skills gap, for the heavy equipment industry and AED membership in particular, the survey data shows that such predictions seem to be less extreme than anticipated, or at the very least seem to be holding steady.

3.1 | Perceptions of the Skills Gap

The Deloitte and Manufacturing Institute Report from 2014 confirmed that 84% of executives think there is a skills gap in the manufacturing industry; however, the focus of the 2018 follow-up report was on proving the projections that the skills gap seemed to be worsening.¹⁰ Wider literature is focused on this idea, but for the heavy equipment industry and AED members specifically, the situation doesn't seem as dire as previously anticipated.

The results from the Deloitte and Manufacturing Institute Report are very much in line with the survey of AED members. In the survey, respondents were asked to rate on a 1-5 scale, with 1 indicating no

FIGURE 1: RATINGS OF FACTORS AED MEMBERS LISTED AS AFFECTING HIRING

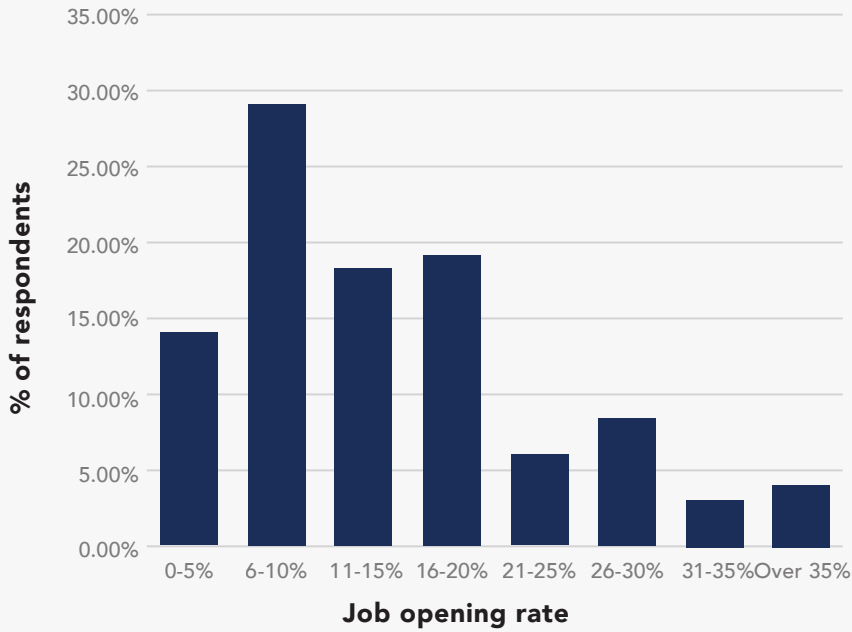


FROM THE SURVEY OF AED MEMBERS, ON A SCALE OF 1-5, 1 INDICATING "NO DIFFICULTY" AND 5 REPRESENTING "GREAT DIFFICULTY"

difficulty and 5 indicating great difficulty, how much trouble they had in finding technicians. Then they were asked to rate on a 1-5 scale, with 1 indicating not significant and 5 being very significant, how a variety of factors (lacking hard skills, inability to pass drug test, etc.) contributed to that recruiting difficulty. The first column in Figure 1 shows the overall difficulty AED members reported in finding technicians. The other columns break down reasons for the difficulty. **Figure 1** shows that the vast majority of AED dealerships indicate difficulty in recruiting technicians, with 50% indicating that they have "great difficulty." The mean response is 4.36 on a scale of 1 to 5. The most important reason for this difficulty is a lack of hard (technical) skills among applicants. A lack of soft skills is the second most important. Industry pay was reported to be the third most important factor. This is consistent with findings among AED members in 2016.

Along with qualitative perceptions, the survey was aimed at leveraging several metrics to analyze the shortage of qualified technicians in the workforce. The first metric is job opening rate (JOR), which is calculated by taking the number of unfilled positions and dividing it by the total number of positions, filled and unfilled, in the job market. A second metric is the amount of time that an advertised position remains open before being filled. An additional metric in the survey was the number of technician positions the company was looking to fill. Taking these variables into consideration, and based on the data from the respondents, the skills gap in AED's industry has generally stayed consistent with larger trends.

FIGURE 2: JOB OPENING RATES



FROM THE SURVEY OF AED MEMBERS

Figure 2 shows a bar graph of the job opening rate for survey respondents. The Bureau of Labor Statistics estimated a nationwide job opening rate of 4.8% at the time the survey was launched.¹¹ The data show that almost 90% of AED dealerships have a JOR above the national average. Nearly 7% of respondents had a JOR above 30%. Given the reported difficulty in finding qualified technicians, this job opening rate is likely not a sign of an industry ready to boom, but of a mature industry that cannot hire the skilled workers it needs. This talent shortage leads to low industry growth as businesses are unable to meet customer demand or take advantage of new opportunities.

9 "Top Facts About Manufacturing," National Association of Manufacturers, Accessed April 1, 2019.

10 Supra, Note 2

11 The Bureau of Labor Statistics, "Job Openings and Labor Turnover Summary," 2019, United States Department of Labor.

Further evidence of the skills gap in the equipment distribution industry is presented in **Figure 3**. The graph shows the average number of days that a job remains open, with several categories for survey response ease. The national mean vacancy duration in the manufacturing industry, from January 2001 to June 2017, was 30.5 days.¹² Jobs in the equipment industry remain open for considerably longer. About 33% of respondents reported a mean job opening duration in the 31-60 days category, and 49% reported that their openings remain vacant for 60 days or more. Almost 7% of respondents reported jobs left open for over 150 days. A future consideration for this particular factor would be specifying the average job opening duration for technicians, as opposed to openings for managerial or other positions that are not the focus of the report.

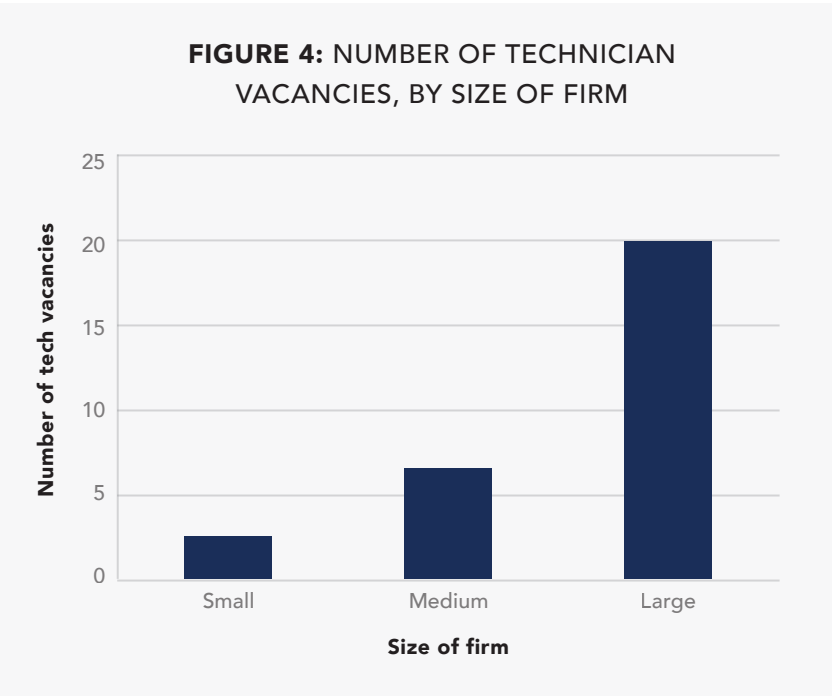
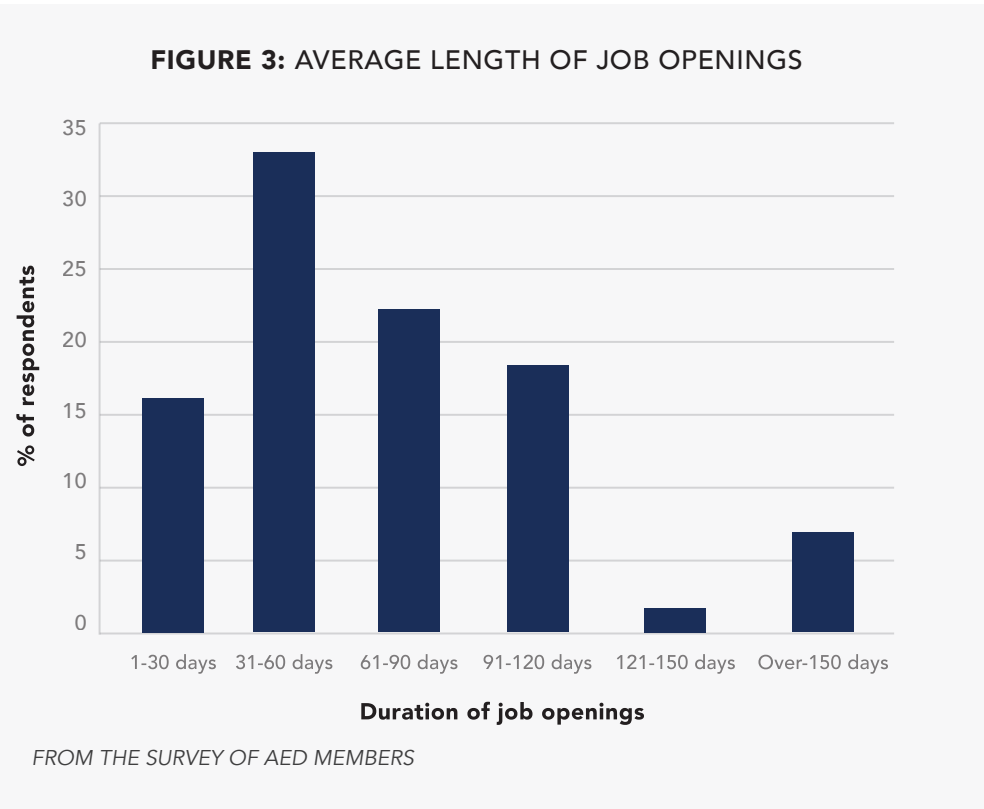
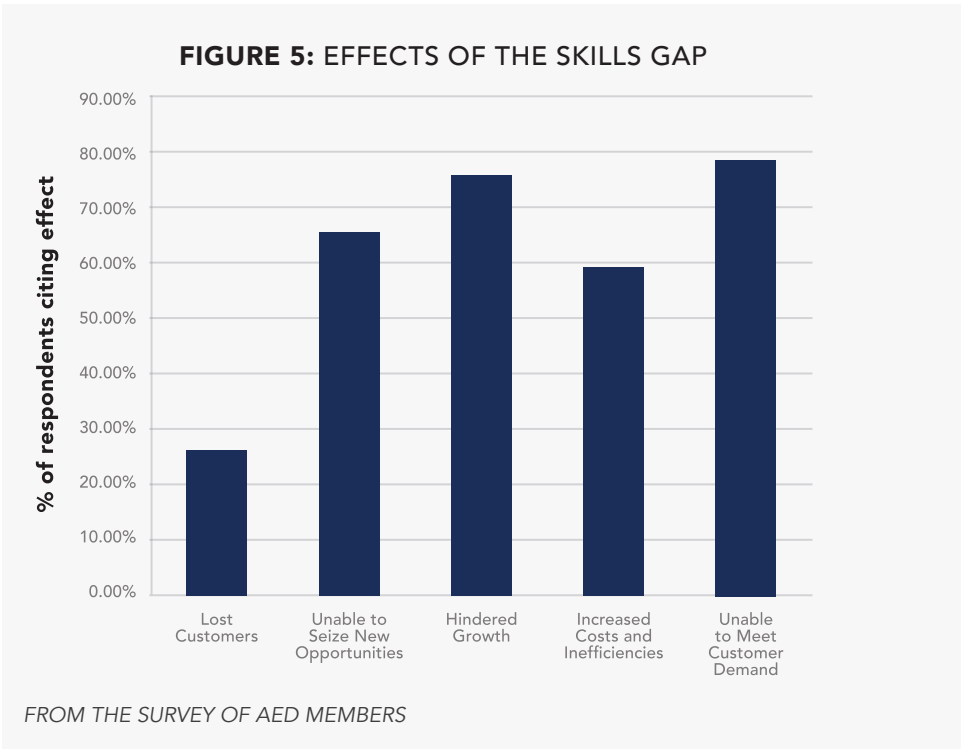


Figure 4 shows the number of technician positions that AED member companies are looking to fill, broken down by the size of the company. The average number of vacancies across all respondents is 10.9, but the number varies greatly depending on the size of the company, with the larger AED members looking to fill about 20 positions, on average. Extrapolating from the survey results, AED distributor members collectively are seeking to fill approximately 3,300 technician positions annually, or about 16,500 technician positions over the next five years. Based on estimates of unfilled positions, dealers who are not members of AED, could experience a shortage between 5,700 to 11,400 annually. Combining these approximate results there could be anywhere from 9,000 to 14,700 unfilled technician positions annually.

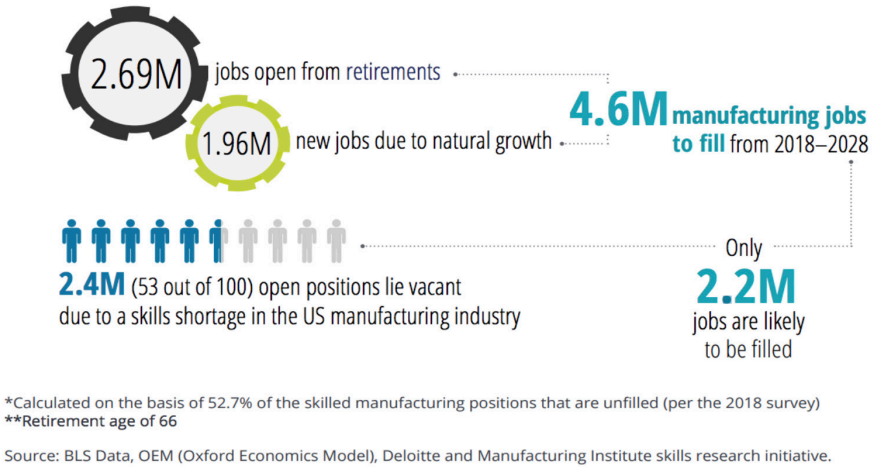
Figure 5 examines effects of the skills gap on AED member companies. AED members were asked to indicate all applicable options describing how difficulty in finding technicians has affected the company. The top three effects were Unable to Meet Customer Demand, Hindered Growth, and Unable to Seize New Opportunities. This makes sense, since if companies are unable to meet current customer demand, they are unable to grow and seize new opportunities. Reflected in the survey question, almost 96% of surveyed organizations agreed with the general statement that the skills gap hinders their ability to meet demand or increases costs and inefficiencies for the company.¹³ An inability to meet customer demand was also the leading effect in the 2016 report.



The skills gap hurts manufacturers in many of the same ways as it does AED members. Some estimates put the impact of the skills gap on manufacturers at up to 11% in reduced earnings annually due to increased production costs and revenue losses.¹⁴ In 2016, the College of William & Mary research study commissioned by The AED Foundation highlighted that the skills gap could be costing the full AED membership approximately \$2.4 billion each year.

4 | EXPLAINING THE SKILLS GAP

The skills gap may leave an estimated 2.4 million positions unfilled between 2018 and 2028



The existence of the skills gap is supported by evidence from both the manufacturing industry and AED membership, and it is abundantly clear that the skills gap is hurting businesses in need of technically skilled workers. For further insight into the skills gap, it is important to take a closer look at some of the factors that may be contributing to its existence. Here are the main reasons that AED organizations believe the skills gap persists, in order from most frequently mentioned to least frequently mentioned: attractiveness of industry, the school system, access to talent, visibility of industry, baby boomers retiring, and “other.”

12 DHI Hiring Indicators, “DHI-DFH Measure of National Mean Vacancy Duration, January 2001 to June 2017,” 2018, DHI Group Inc.

13 AED survey data.
14 Jonathan Little, Breck Marshall, Matt Reilly, James Robbins, Thomas Walsh, and Gardner Carrick, “Accenture 2014 Manufacturing Skills and Training Study,” 2014, Accenture and the Manufacturing Institute

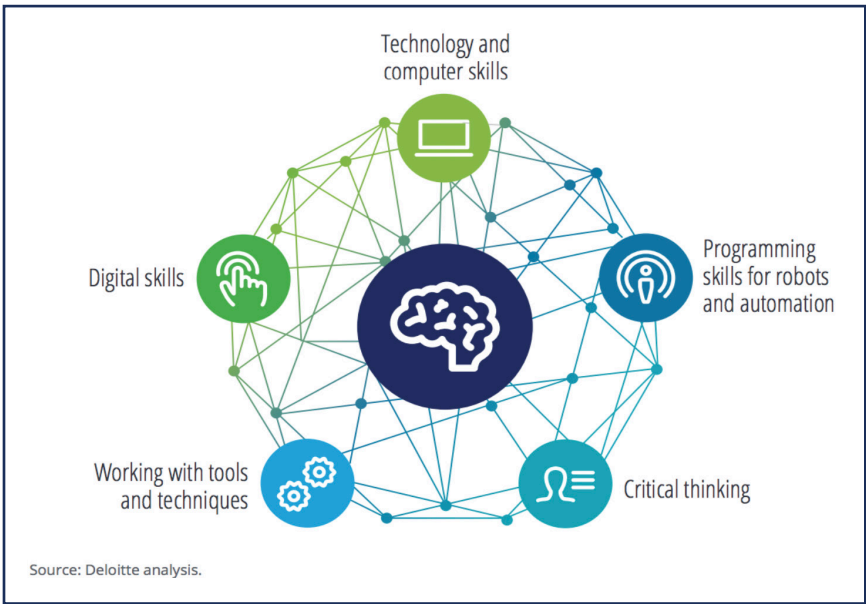
A notable shift has occurred in the past three years in what manufacturers see contributing to the current talent shortage. In 2015, the retirement of baby boomers topped the list, followed by strength of the economy. However, Deloitte’s current study reveals that most manufacturers believe that the leading cause of the skills shortage is “shifting skill set due to the introduction of new advanced technology and automation,” followed by “negative perception of students/their parents toward the manufacturing industry.” Baby boomer retirement is the third cause of today’s skills shortages, according to manufacturing executives.¹⁵ Shifting skills tops the list, with manufacturers finding themselves in an industrial period defined by its use of advanced technology to transform work throughout an organization. Half of the manufacturers in the Deloitte study noted that they have already adopted technologies such as robots, cobots, machine learning and artificial intelligence (AI). In the increase of human-machine teaming and access to insights via the “internet of things” (IoT), the types of skills that employees need to possess are rapidly evolving. It is increasingly difficult for the workforce to keep pace, thus highlighting the skills gaps currently present in the industry.

4.1 | Shifting Skills

According to the Deloitte and Manufacturing Institute study, the early stages of digital transformation are creating a mismatch between the available workers and the skills necessary to fill open jobs. Production workers no longer solely need STEM degrees (science, technology, engineering, math) as qualifications within the industry, but also the ability to program machines on the plant floor. Employers are looking for extensive computer skills that enable core production workers to understand and utilize engineering and manufacturing software, including tasks such as programming a computer numerical control (CNC) machine for a new job, or interacting with computer-aided design/computer-aided manufacturing (CAD/CAM).

Manufacturing executives listed the top five skill sets that could increase significantly in the coming three years in response to the influx of automation and advanced technologies:

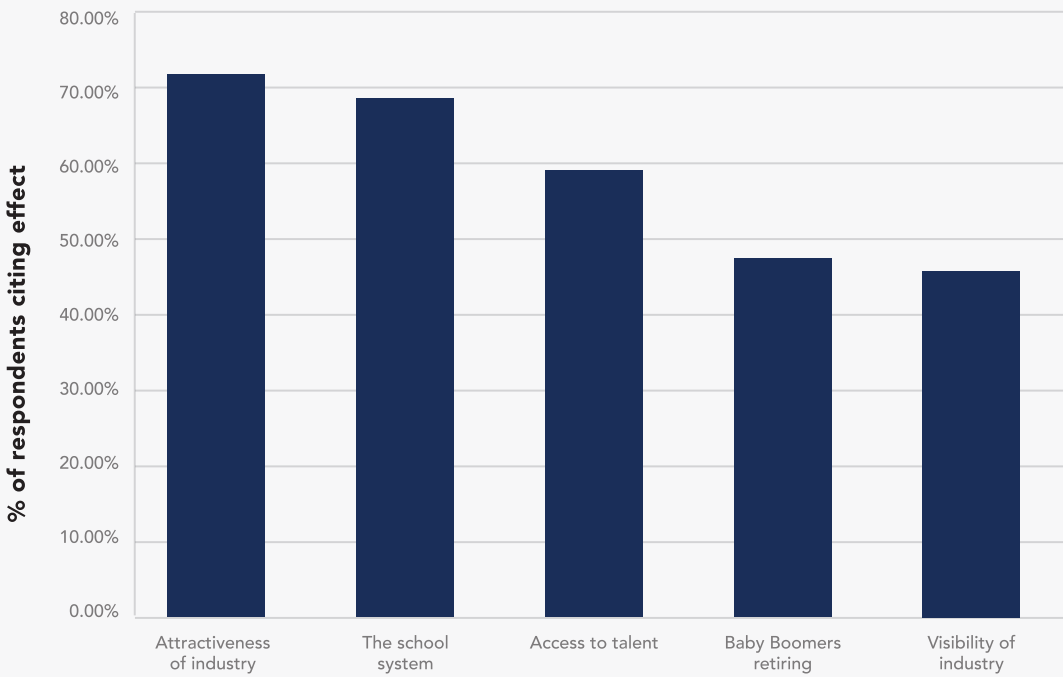
- 1. Technology/computer skills
- 2. Digital skills
- 3. Programming skills for robots/automation
- 4. Working with tools and technology
- 5. Critical thinking skills



15 Supra, Note 2

In addition to technical skills, critical thinking is noteworthy, signifying an emphasis on “human” skills in the face of technology transformation. As technology replaces many manual or repetitive tasks in the industry, uniquely human soft skills will become even more important. A World Economic Forum study found that human skills – including critical thinking, creativity and originality, attention to detail, problem-solving, and people management – are expected to see an outsized increase in demand compared to their current importance.¹⁶ Organizations need workers with demonstrated proficiency in the digital space in automation as well as these soft skills. In manufacturing, this generally translates to solving problems in production, which is to become increasingly important as automation is added to production lines in the form of robots and cobots. Deloitte’s 2018 Global Human Capital Trends report notes that many organizations are working to use humans to transform business. The broader aim of this is not merely to eliminate routine tasks and cut costs, but to create value for customers and meaningful work for teams. Delivering value will now come in the form of human-machine pairing.¹⁷

FIGURE 6: ISSUES CONTRIBUTING TO THE SKILLS GAP



FROM THE SURVEY OF AED MEMBERS

4.2 | Issues Contributing to the Skills Gap

Another connection between the experiences of AED members and those of the wider manufacturing industry is represented in **Figure 6**, causes of the skills gap. This encompasses a more general line of questioning than that in Figure 1 because it expands the scope to gauge structural factors like industry perceptions overall, the school system, and even population patterns such as the anticipated retirement of baby boomers. AED members were to indicate all applicable options regarding which issues were thought to have contributed to the skills gap. The top three results were Attractiveness of Industry, the School System, and Access to Talent. Baby boomer retirement dropped to being one of the less impactful factors, reaffirming the deviation from 2016. A future consideration for this section in particular would be including shifting skills toward programming/software knowledge as an option, now that recent literature has highlighted it as having growing importance.

16 Supra, Note 2

17 Anthony Abbatiello, Dimple Agarwal, Josh Bersin, Gaurav Lahiri, Jeff Schwartz, and Erica Volini, “The rise of the social enterprise,” 2018, Deloitte Global Human Capital Trends.

4.3 | Low Social Perceptions and Visibility of Technical Jobs

Although more than 8 in 10 Americans surveyed believe the U.S. manufacturing industry is vital to maintaining the average American’s living standards, less than 5 in 10 Americans surveyed believe manufacturing jobs to be more interesting and rewarding, clean and safe, and stable and secure than in the past. Less than 30% of Americans surveyed would encourage their children to pursue a manufacturing career. Yet respondents familiar with the industry are nearly two times more likely to encourage children to pursue a manufacturing career than others.¹⁸ This signifies a divide between those who are familiar with the industry and those who aren’t, demonstrating a need to bridge the gap to those who do not have existing information about manufacturing. Given the seemingly broad support for manufacturing in the United States, one might expect more support for people entering the industry. A major factor causing this friction between perception of the industry and support for working in the industry is the visibility of technical work in society and, specifically, in school. Only 28.36% of AED respondents said that they believe local educational institutions in their area (high schools, community colleges, other technical schools) understand their company’s workforce needs and align their curricula and train students to meet those needs.¹⁹

This is also paralleled in 2016 survey data in which respondents say that if they can get parental approval of the industry and the company, they have a good chance of recruiting young technicians. Without this approval, students are pushed into four-year schools and aren’t likely to view technical work as a viable option. This highlights the importance of visibility of technical careers. Public awareness of advanced technologies in manufacturing is growing, but a willingness to follow it with work in the industry appears to be slow. When asked what future jobs in manufacturing will look like, Americans said future manufacturing jobs will require high-tech skills (88%), will be clean and safe (81%), and will be more innovative (77%).²⁰ Given these optimistic views, manufacturers could benefit from uplifting current perceptions and tapping into the future vision to aid in the attraction of talent.

Some actions manufacturers can take to improve perception of the industry include investing in skill development programs; raising awareness about the benefits of a manufacturing career, such as through support of events like Manufacturing Day; and tapping into more pro-manufacturing groups (such as females, Generation X Americans, and American parents who have a positive perception of the industry) to use as recruiting targets and brand ambassadors of manufacturing.

4.4 | Baby Boomers Retiring

Most recent data shows the retirement age rising to an average of 66 years; even so, the volume of retirements in the decade to come could pose threats to the industry. The potential impact a wave of retirements could have on manufacturers’ organizations could prompt the need to find innovative solutions for retaining their committed and experienced workforce and using them as competitive leverage. The Deloitte 2018 Global Human Capital Trends study found that manufacturing companies in the United States are unprepared to leverage the aging workforce, as only 9.2% of these companies are creating targeted roles for older workers.²¹ Only some manufacturers have launched specific programs to retain the value of their oldest employees. Nearly half (47%) of AED respondents said that baby boomer retirement is a leading cause of the skills gap (Figure 6), so this is clearly a continuing concern for the industry.

18 Supra, Note 4
19 AED survey data.
20 Supra, Note 4
21 Supra, Note 2

4.5 | Social Momentum Toward Four-Year Degrees

According to the U.S. Department of Education, college entry has risen by 3.4% since 2000, with 63.3% of recent high school completers enrolling in college (both two-year and four-year colleges or universities) in 2000, compared to 66.7% in 2017.²² Among surveyed AED members, 61.54% say local educational institutions in their area (high schools, community colleges, other technical schools) do not understand the company’s workforce needs and don’t align their curricula and train students to meet those needs.²³ AED’s partnerships with educational institutions and certification programs have greatly improved the relationship between local communities and manufacturing organizations and work to address this factor.

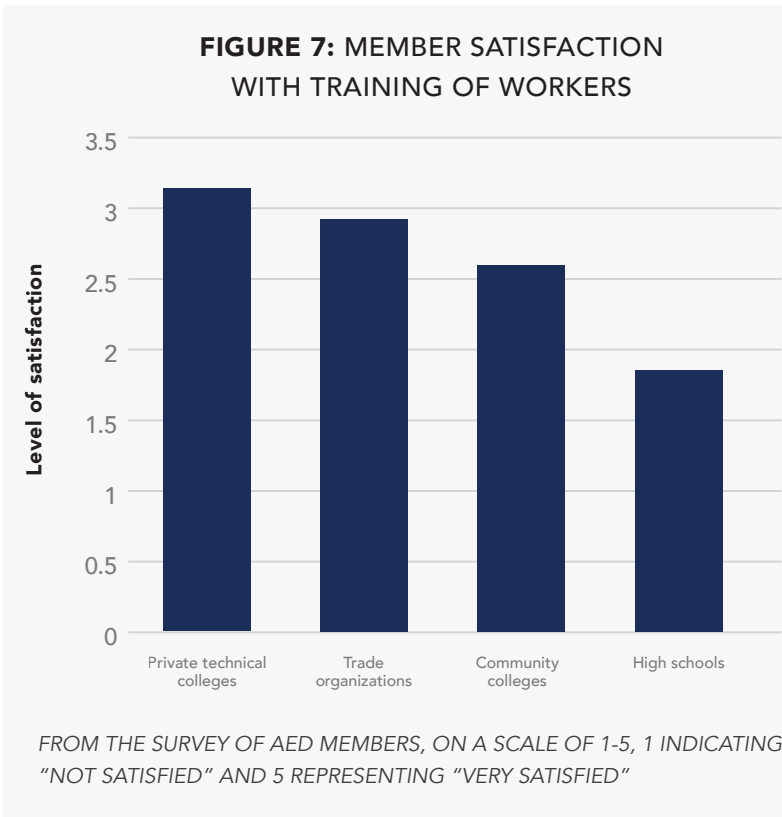
4.6 | Misalignment of Labor Market Needs and School System

At the root of the technical workforce crisis is an education system that provides limited opportunities to explore technical careers and that produces graduates without the requisite skills to fill labor openings. Surveyed AED members report a general dissatisfaction with local educational institutions, which encompasses high schools, community colleges, other technical schools and trade organizations. When asked the question, “Do you believe that local educational institutions in your area (high schools, community colleges, other technical schools) understand your company’s workforce needs and align their curricula and train students to meet those needs?” only 28.36% of respondents said yes. This actually increased from 15% in 2016 and could be attributed to either the conscious effort to partner with the educational community or information collection limitations. This problem is not unique to AED, as studies show that less than 33% of surveyed Americans would encourage their child to pursue a manufacturing career. This percentage went down slightly from 37% in 2016.²⁴

Figure 7 presents average ratings of local high schools, community colleges, trade organizations, and private technical schools by AED members on a 1-5 scale. Ratings for the technical schools and trade organizations are on the higher end of the scale, and high schools and community colleges are significantly behind. The highest rating, at a little over 3, is for private technical colleges, but even that is not particularly high given that the scale goes up to 5. The overall poor ratings, especially for high schools, are indicative of a technical education system that has largely neglected secondary school students and other young adults. This lack of focus pushes students away from technical careers at an early age. These figures are comparable to the 2016 report results.²⁵

One way to bridge the gap between labor market needs and school systems is through apprenticeships. Exposure to a skilled trade through an apprenticeship has shown to be a promising pathway for filling many of the skilled jobs that lie open in the manufacturing industry. The government and manufacturers together can fund such education and apprenticeship programs to develop a job-ready stream of qualified workers.

22 National Center for Education Statistics, “Most Current Digest Tables,” DHI-DFH Measure of National Mean Vacancy Duration, January 2001 to June 2017,” 2017, U.S. Department of Education.
23 AED survey data.
24 Supra, Note 4
25 Supra, Note 6



5 | POLICY ANALYSIS AND CASE STUDIES

The community-based recruitment strategy is intended to initiate dialogue and partnership between individual members of AED and the stakeholders in local areas. In collaborating with members to establish educational and professional standards of development, The AED Foundation accredits diesel-technology equipment programs that meet standards developed by the industry with representation from equipment dealers, manufacturers, and technical colleges. The overall success of this program and strategy depends on the stakeholders' recognition of the mutually beneficial incentives that it provides.

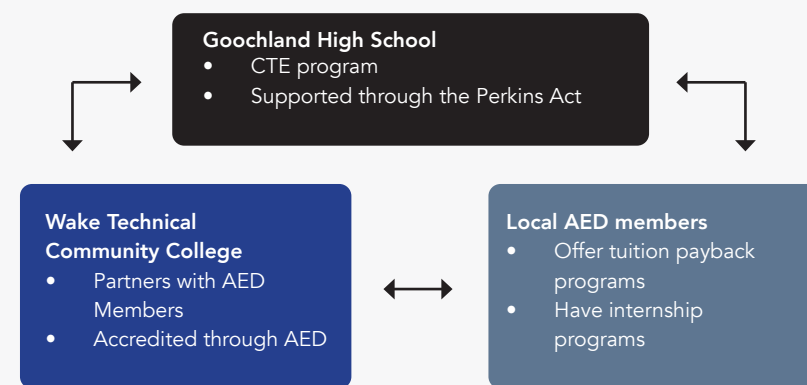
5.1.1 | AED Foundation Recruitment Strategy and the Virginia CTE Model

Any consideration of the extent to which public policies can help AED address the skills gap in its technical workforce must be done in the context of The AED Foundation's community-based recruitment strategy. This strategy is intended to facilitate dialogue and partnerships between individual AED members and key stakeholders in their local area, including other AED members, high schools and technical colleges.²⁶ This approach is designed to increase the visibility of the technician profession and its benefits among high school students, while providing guidance on the pathways to pursuing these careers and on opportunities to financially support their transition to a technical college. The AED Foundation has worked with its members to establish educational and professional development standards for technical colleges to incorporate within the curricula of their technician-oriented degree programs, and awards an industry-recognized accreditation to schools that adopt these standards. The success of this strategy relies on stakeholders' recognition of the mutually beneficial incentives it provides.

The 2016 report notes that AEDF's community-based recruitment strategy shares many similarities with the approach of organizations representing industries with comparable workforces that are also experiencing challenges with skills gaps. It references the Center for Energy Workforce Development (CEWS) and its recruitment process. The report emphasizes that the CEWD has established a multilayered consortia of key stakeholders across the nation, soliciting the participation of employers, educators and worker groups to develop targeted strategies that build sustainable pipelines for developing skilled workers to meet the industry's future needs. The strategy reflects an inclusive approach by opening participation to all education stakeholders, regardless of whether their school offers academic programs or coursework specifically geared toward utility technician career preparation. This report concurs with this approach, but the AED community can further take advantage of this strategy by expanding its high school recognition program.

Figure 8: The AED Foundation Model in Virginia

A demonstration of how the AED community-based recruitment strategy works in practice in southern Virginia is the collaboration between the career & technical education (CTE) program at Goochland High School, Richmond-area AED members, and the regional college that holds AED accreditation, Wake Tech. Goochland High School hosts AED members for on-campus marketing and career events, and AED members donate equipment to the school's CTE program as well as provide access to their facilities for site visits. Goochland students interested in pursuing a technical degree at Wake Tech are provided with internship and post-graduation employment opportunities with AED members as well as participation in a tuition reimbursement program upon starting their technician career. The AED Foundation works with Wake Tech to ensure that its curriculum for AED technician-oriented degree programs aligns with the skills and competencies students need to transition into careers as AED technicians.



Source: Danny Berg, Josh Klein, and Will Nisbet. "The Equipment Industry Technician Shortage: Causes, Impacts and Policy Recommendations," 2016, The College of William & Mary and The AED Foundation.

The 2019 team from William & Mary working on this report specifically observed this Virginia model via a visit to James River Equipment, which is one of the largest shops among AED members in terms of gross annual revenue. The AED team recognizes that James River Equipment used a similar recruitment strategy as that shown above on the graph.²⁷ The company donated equipment and provided technical support to local high school programs that target students interested in a technical career with the heavy equipment industry. However, the actual outcome of this partnership was not ideal, meaning that not enough students joined the industry after their completion of the program. Since the financial burden of donating equipment to local schools is high, James River Equipment had to end the partnership. During an interview, James River's vice president implied that the failure was due to social misperception of the industry. Nevertheless, he shared his potential strategy for a future recruitment process: a shadow program. In the shadow program, interested students will be invited into the shop to shadow technicians. In doing so, students will not only gain hands-on experience but will also understand the environment of the workplace. This method will benefit the students and lower the financial burden of the shops.

5.1.2 | AED Foundation Canada College Affiliate Program

The AED Foundation recognizes the importance of building relationships among college diesel-equipment technology programs in the U.S. and Canada. Toward that end, the Foundation launched The AED Foundation Canada College Affiliate initiative. This initiative, combined with The AED Foundation's Accreditation program, creates an AED Foundation umbrella group of North American diesel-equipment technology college programs which provides for networking opportunities, sharing of best practices, and student scholarships. This program helps in the promotion and spread of the goals of The AED Foundation throughout North America.²⁸

5.1.3 | AED Self-Study Program

The self-study courses of the Dealer Learning Center program assist in providing information and training to improve the performance of managers, employees and departments as a whole. Self-study participants learn at their own pace through interactive and accessible learning materials. All content is delivered in a well-organized, industry-specific fashion, with graphics, charts and data. Travel cost is eliminated, as the course can be taken from any location. Examples of courses that have been recently added to this program are Sales Leadership 101–Sales Management Skills and Sales Leadership 102–Coaching, Not Telling. Sales Leadership 101 is designed to help sales leaders master essential skills, improve team productivity, and create an inspiring mindset in order to encourages positive behaviors and long-term revenue and profitability. Sales Leadership 102 approaches selling as a skill, framing every conversation as a teaching moment. The class gives leaders and other people-managers the skills they need to be effective coaches in every appropriate setting. These Sales Leadership courses can be taken separately or together as part of the new Sales Manager Certification program, which includes AED certification. However, these courses are not just for leadership, as anyone can benefit from gaining awareness of how mindset and behavior can affect the sales process.²⁹

5.1.4 | AED Foundation-Recognized High School Diesel Technician Program

In order for a secondary or high school technical program to become AED Foundation-recognized, the school must meet technical standards that are locally developed and mutually agreed on by AED and the school. The standards are derived from a subset of AED Foundation national technical college standards and provide a rational and seamless progression from secondary technical education. There are currently five AED Foundation-recognized high school programs in the United States.

²⁷ Supra, Note 6

²⁸ AED Foundation Canada College Affiliate Program - <http://aedfoundation.org/accredited-programs/accredited-programs-canada/>

²⁹ Mattingly-Arthur, Megan, "New AED Self-Study Sales Management Courses," 2018, Construction Equipment Distribution.

²⁶ Steven A. Johnson, "Recruitment Guidebook for AED Member Dealers: Recruiting Young People for Careers in the Construction Equipment Industry," (3rd Ed., March 2017), The AED Foundation.

5.2 | School-to-Work Opportunities Act (STWO)

The most important action on skills in the 1990s was arguably the school-to-work movement, which asserted that the way to improve student skills and increase employability was to bring school and employers closer together in an effort to smooth the transition from school to work. In practice, that meant apprenticeships, co-op programs, internships and other arrangements that would help students see the practical value of classroom lessons, first by using more business and workplace examples in the classroom and then by seeing how those examples could be applied at work.

The School-to-Work Opportunities Act (STWO) provided administrative and financial support to help build those connections. The STWO was signed into law by President Clinton on May 4, 1994.³⁰ Jointly administered by the Departments of Labor and Education, this act was a new approach to education and workforce development that sought to better prepare all American youth for careers in high-skill, high-wage jobs and to strengthen the linkages between work and what is learned in school. Under the act, venture capital grants are provided to states and local communities to undertake systemic reform to increase the likelihood that youth will successfully transition from school into careers or postsecondary institutions. Grants are for a limited duration, with federal investment declining over time. These investments are intended to support the one-time costs of states and local communities to restructure learning experiences for all students. Currently all 50 states, the District of Columbia and Puerto Rico are receiving STW implementation funds. The act also provides funds for national activities to support STW system-building efforts nationwide. These funds are used for technical assistance and capacity building, outreach and research, and evaluation.

Students learn most effectively if they are taught skills in the context in which they will use them.³¹ School-to-work programs are very beneficial for students, schools and businesses. Students learn firsthand how to behave in the workforce and what it takes to be successful while achieving an education. School-to-work programs also give them the opportunity to try new things and find the tech career they’re searching for. The school benefits through recognition from the community for all the opportunities they offer to the students and the local businesses. Participating businesses’ benefits include (1) the value of student labor, (2) reduced training and recruitment costs, (3) higher productivity of students hired as regular employees relative to other entry-level employees, (4) improved community relations, (5) higher productivity and morale of employees, and (6) increased diversity in the workplace.³² As stated previously, social misperception is strong and sometimes negative toward the heavy equipment industry. School-to-work programs can strength the connection between the community and local businesses, giving community members insight into the industry and contributing to a more positive attitude toward the industry in general.

5.3 | Reauthorization of the Perkins Act

In the summer of 2018, Congress passed the Strengthening Career and Technical Education for the 21st Century Act (a reauthorization of the Carl D. Perkins Career and Technical Education Act of 2006, commonly known as the Perkins Act). This law lays out statutory requirements governing federal support for career and technical education services that are offered in secondary and postsecondary schools in the United States.

Furthermore, the Perkins Act assists in preparing immigrants for employment. It provides funds under three main programs:³³

- 1. Basic State Grant Programs (Title I): States distribute money to high schools, colleges and universities that offer programs integrating academic, career and technical education.
- 2. National Programs: Allows certain research organizations to conduct and disseminate national research on best practices in order to improve career and technical programs.
- 3. Tech Prep Programs (Title II): Allows educational institutions to combine at least two years of high school education followed by at least two years of education at a college or university, resulting in an industry-recognized credential, certificate or degree. Since May 2011, the U.S. Department of Education no longer provides states with funds for tech prep programs.

The current 2019 funding under Perkins is about \$1.3 billion. The overall funding appropriated for Perkins career and technical education (CTE) programs has generally decreased over time until 2018. In fiscal year 2004, the funding level was \$1.3 billion, and the fiscal year 2017 level was \$1.1 billion. The cuts have resulted in the elimination of funds under Title II, the Tech Prep Programs, which provide grants to secondary schools and certain nonprofits offering a two-year associate degree or apprenticeship program. Title I spending has decreased slightly over time as well, and the National Programs saw a big drop in funding, falling from \$11.9 million in fiscal year 2004 to \$7.4 million in fiscal year 2017.

FIGURE 9: PERKINS BASIC STATE GRANT (TITLE I) FEDERAL INVESTMENT: FISCAL YEARS 2004–2019³⁴

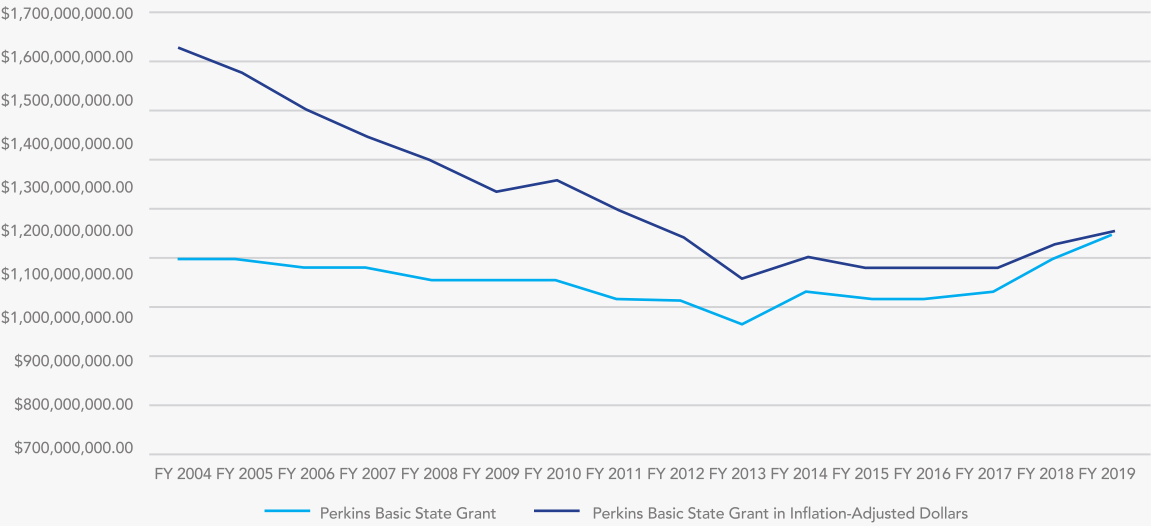


FIGURE 10: STATE FORMULA ALLOCATION FOR PERKINS IV³⁵

The base formula for determining state allocations is designed to favor states with larger populations that are of high school age and two years thereafter and states with a lower than average per capita income. Population is based on the sum of the number of individuals in three age groups and the combined number of individuals in these age groups. Each of these groups is weighted. The largest weight (0.5) is assigned to the age group of persons aged 15 to 19, inclusive—the Perkins IV priority population group. The age group of persons aged 20 to 24, inclusive, is assigned a weight of 0.2, while the age group of persons aged 25 to 65, inclusive, is assigned a weight of 0.15. The final age group included in the calculation is all individuals aged 15 to 65, inclusive, and it is assigned a weight of 0.15. Thus, among states with a similar number of people aged 15 to 65, states with relatively younger populations will have a higher weighted population count than states whose populations are relatively older.

$$ARatio = 1 - 0.5 * \left(\frac{pci - s}{pci - n} \right)$$

The weighted population count is further weighted by the state’s allotment ratio. The state’s allotment ratio is calculated by dividing the per capita income (pci) for the state by the pci for the 50 states and the District of Columbia combined. The result is multiplied by 0.5 and subtracted from one.

The distribution of Perkins CTE funding is entirely based on state population. The Basic State Grants Programs (Title I) are allotted to states through a formula based on populations in certain age groups and earning certain levels of per-capita income. States are required to distribute at least 85% of Title I funds to local education agencies, vocational and technical schools, community colleges, and other public or private nonprofit institutions offering CTE programs. Each state may decide how much money will be distributed to recipients at the secondary and postsecondary levels. Generally, about 64% of the funds go to secondary and 36% to postsecondary education programs.

30 Employment and Training Administration, “School-to-Work Opportunities Act: Industry Association/Business Consortium Solicitation,” 2009, United States Department of Labor.
31 H.R.D. Gordon, “The History and Growth of Vocational Education in America,” 2003, Waveland Press.
32 Thomas Bailey, Katherine Hughes, and Tavis Barr, “Achieving Scale and Quality in School-to-Work Internships: Findings From Two Employer Surveys,” 2000, Educational Evaluation and Policy Analysis.
33 “Fact Sheet: What is the Perkins CTE, and How Does it Serve Immigrants?” 2018, National Immigration Forum.

34 Advance CTE, “FY 2004-2019 Perkins Funding Levels,” May 2019.
35 Cassandra Dortch, “Carl D. Perkins Career and Technical Education Act of 2006: Background and Performance,” December 5, 2012, Congressional Research Service.

6 | THE SKILLS GAP IN OTHER INDUSTRIES

Concerns about the short supply of skills, especially education-related skills, in the U.S. labor force have exploded in recent years with a series of reports from employer-associated organizations, with independent and even government sources making similar claims.³⁶ This evidence suggests that not only the manufacturing industry, but also the entire U.S. labor market, is facing skilled labor shortages. The degree of shortage varies from industry to industry.

The rise of the skills gap in the U.S. labor market is especially surprising as it appears to have increased since the 2008 Great Recession when the flood of unemployed job seekers – most of them recently employed – far exceeded available job opportunities.³⁷ Like AED’s industry, engineering and information technology, which both require high-skilled labor, are also experiencing a skills gap. Studies show that occupations requiring more advanced training have gaps that have endured the recession, while the market for middle-skill jobs has tightened. Engineers show 15% more openings than available workers. As with IT workers, the number of labor shortages had grown 14-fold as of 2015. Though the data suggests otherwise, manufacturing employers consistently cite a deep shortage of production workers with the skills and qualifications they need.³⁸

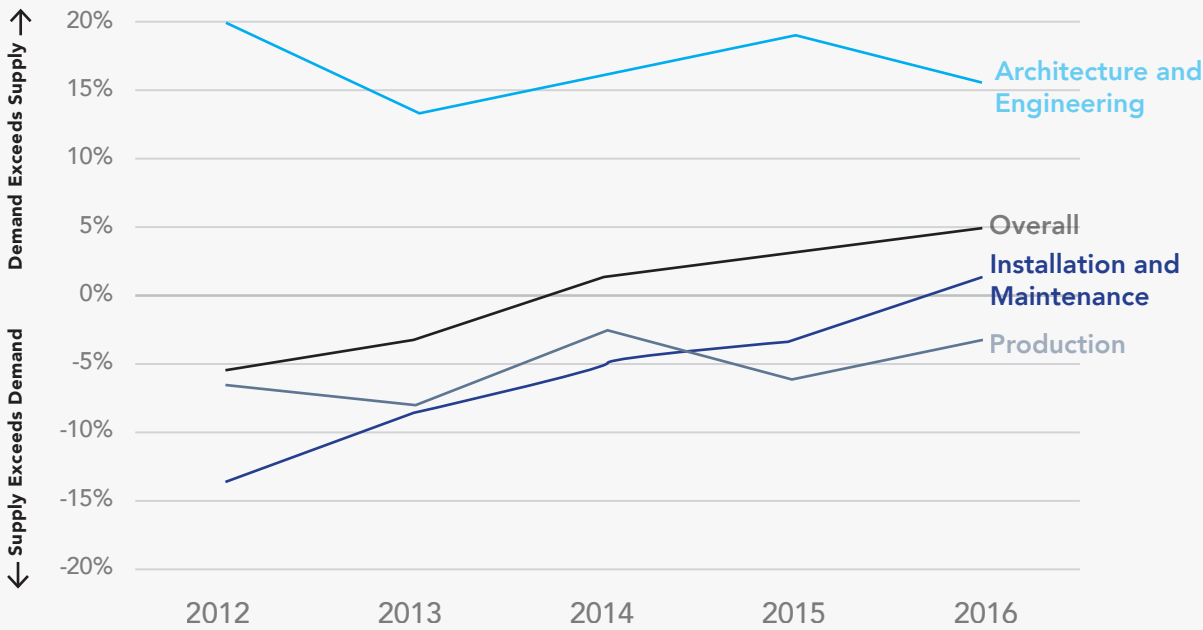
6.1| Science, Technology, Engineering and Math (STEM)

The STEM workforce also experiences the shortfall in skills. The 2012 report of the American Society for Training and Development (ASTD) notes that what most members saw as causes were management actions internal to the organization. Other reports argue that there will be a shortage of skills associated with college education. The President’s Council on Jobs and Competitiveness, a business-led council (20 of its 24 members are from business), claims that the U.S. will have a shortfall of 1.5 million college graduates by 2020.³⁹ More studies point out that one fundamental problem with projections like these is the assumption that every job currently held by a college graduate requires the skills associated with that degree.⁴⁰

However, the Pew Research Center in 2018 made the claim that “while STEM workers tend to be highly educated, roughly a third have not completed a bachelor’s or higher-level degree.” Moreover, about half of workers with college training in a STEM field are working in a non-STEM job.⁴² This suggests that there is a general misperception about who works in STEM and the difference that having a STEM-related degree can make in workers’ pocketbooks.

36 Peter Cappelli, “Skill Gaps, Skill Shortages and Skill Mismatches: Evidence for the U.S. National Bureau of Economic Research,” 2014, Cambridge, MA.
37 Bureau of Labor Statistics (BLS), “Job Openings and Labor Turnover Survey,” 2014.
38 Burning Glass Technologies, “Different Skills, Different Gaps: Measurement & Closing the Skill Gap,” 2018, U.S. Chamber of Commerce Foundation.
39 President’s Council on Jobs and Competitiveness, “Road Map to Renewal,” 2012.
40 Paul E. Harrington and Andrew M. Sum, Forthcoming, “Recent Projections of Labor Shortages Through 2018: From Great Recession to Labor Shortages? A Critical Look at the Evidence,” Monthly Labor Review.

FIGURE 11: DEMAND AND SUPPLY OF ENGINEERING, MANUFACTURING OVER TIME⁴¹



6.2 | Information Technology (IT)

The Computing Technology Industry Association produced a detailed report based on a survey of employers in which 93% of employers responding said that they had a skills gap.⁴³ Yet 90% responded that they were at least “moderately close” to “where they want to be” with respect to skills. Only 15% said that a factor in their skill problem was insufficient focus on STEM education, and only 20% reported that the problem was a limited pool of skilled IT workers, the essence of the STEM skill shortages argument. A large part of their perceived skills gap had to do with soft skills – work ethic and motivation.

Although the skills gap in the information technology workforce is not as severe as that in the manufacturing industry, the gap is slowly expanding each year. The reason is the explosion of big data analysis and the growing demand for data scientists. In 2012, there were just 1,061 postings for data scientists. By 2016, the number had grown 14-fold, to 14,653. The supply of data scientists has not been able to keep up. In other research, data analytics was identified as a “disruptive skill” that shakes up job markets because of its crucial nature to business access, sourcing challenges, and the lack of an established training system.⁴⁴

41 Supra, Note 38
42 Nikki Graf, Richard Fry, and Cary Funk, “7 Facts about the STEM Workforce,” 2018, Pew Research Center.
43 Computing Technology Industry Association, “State of the IT Skills Gap,” 2012, CompTIA Properties LLC.
44 Supra, Note 38

7 | RECOMMENDATIONS

*Indicates new recommendations

7.1 | Strengthen the Recruitment Strategy

- ▶ Continue to increase targeted outreach efforts to secondary and presecondary students and raise awareness and understanding of the heavy equipment industry and the career opportunities associated with the technician profession.
 - Promote career and technical education and STEM programs
 - *Invite students into the facility to gain firsthand experience and understand the working environment.
 - *Emphasize hands-on learning; involve the motor-related areas of the brain (more “doing”).
- ▶ Identify and collect data on top sources of employee recruitment, including the effectiveness of each.⁴⁵
 - Word-of-mouth, staffing agencies, online job boards, external search firms, social media, job fairs, union outreach, etc.
 - Overlook years of experience to identify candidates with good attitudes and adaptability.
- ▶ *Promote the technological component of technician training to promote interest among students.
- ▶ *Target an experienced workforce by creating roles for older workers⁴⁶
 - Ex. In an off-boarding interview, inquire about post-retirement work for short-term projects or mentoring.

7.2 | The Skills Gap and Public Policy

- ▶ Promote state-level workforce development initiatives that facilitate coordination among educators and employers to develop partnerships that take advantage of public funding resources for specific programs, like apprenticeships.
- ▶ Continue to incentivize career and technical education programs at the high school and postsecondary school levels aimed at addressing labor market and local employment needs, especially in terms of easing the process for accessing workforce development funds for technically focused programs.
- ▶ Advocate for the adjustment of national workforce policies to incorporate an emphasis on individuals entering the labor market (broadly) and those seeking technical careers (specifically) to support their pursuit of education and training programs designed to prepare them to enter these industries, particularly those experiencing workforce shortages.
- ▶ *School-to-Work Opportunities Act (STWO)
 - Plan for effective grant usage and program sustainability in light of the STWO’s intended “one-time use” function.

7.3 | Future Studies and Implications

- ▶ Update and administer the existing survey that targets AED members with questions aimed specifically at *tracking the development of the skills gap (for better or worse) and its effects on business to observe any change in survey responses and analyze causes.
 - *Ex. Target questions toward change (the focus is no longer merely on proving it exists), ask questions to collect data more accurately without sacrificing quantity, and incorporate new options into survey questions based on updated literature.
- ▶ Continue evaluation of the performance of AED-accredited technical programs to assess the relative rates of participation, and attempt to determine career opportunities pursued by graduates upon degree completion.
- ▶ *Perform research on how immigration policies and AI affect the skills gap in the manufacturing industry and their significance in the contribution of labor shortages, and be aware of the mismatch of skills in immigrant workers.
- ▶ *Conduct data analysis on the distribution of Perkins Act funds through state and local governments in regard to the education of technicians.

⁴⁵ Giffi, C., Dollar, B., Drew, M., McNelly, J., Carrick, G. and Gangula, B., “The skills gap in U.S. manufacturing 2015 and beyond,” 2015, Deloitte and the Manufacturing Institute.

⁴⁶ Supra, Note 2

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