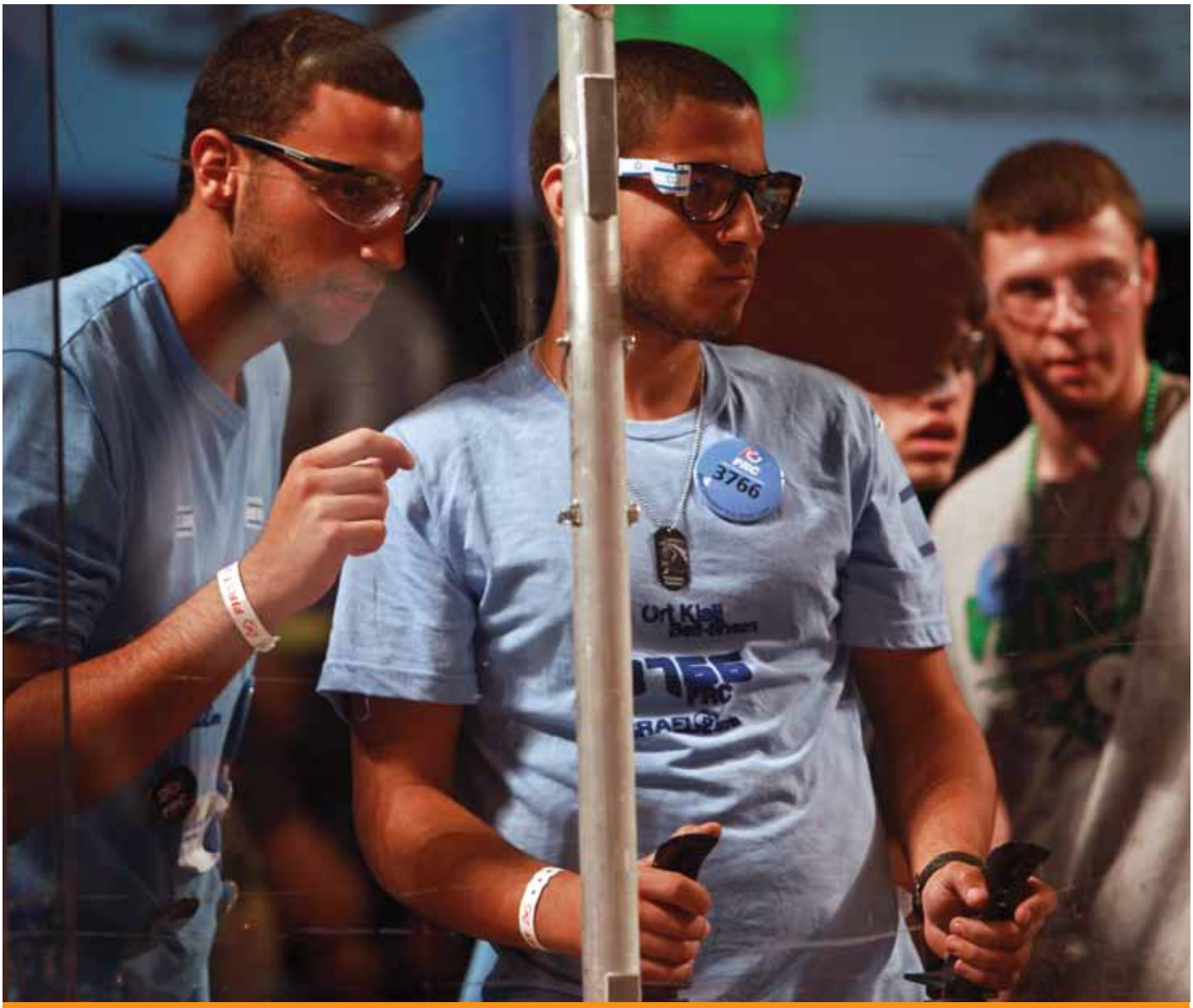
STEM Education and Workforce Development



Overview

Dow believes that the long-term viability of the manufacturing sector requires a workforce with advanced skills in the fields of science, technology, engineering and mathematics (STEM). However, the U.S. is far from being on track to fill the projected number of STEM jobs of the future. If the talent development system is not reinvented, it is estimated that by 2020 the U.S. will have 12-24 million jobs that will go unfilled across the entire U.S. economy.[1] In addition to a good high school education, these jobs may require specialized post-secondary career education, two- or four-year college degrees, one- or two-year college occupational certificates, or a two- to three-year apprenticeship education.[2]

The STEM talent gap is hurting domestic manufacturers now and will continue to do so over the coming years unless the underlying issues are tackled and negative trends are reversed. In fact, 75 percent of manufacturers report being impacted by the skills shortage and overall, U.S. manufacturers see up to an 11 percent reduction in earnings due to the shortage of skilled workers.[3] Machinists, operators, skilled tradesmen, distributors, and technician positions will be hardest hit by retirements in the upcoming years, but also the hardest to find in the job market.[4]

The STEM talent gap is multi-faceted, complex and is inextricably linked to social issues such as poverty, inequality and youth unemployment. Addressing this gap will take a concerted effort from all stakeholders and a comprehensive integrated approach, to ensure a steady stream of STEM talent to help build the future of advanced manufacturing and innovative solutions.

Issues

From weaknesses in K-12 education and post-secondary training to the unfavorable image of manufacturing jobs, several issues come into play essentially rendering the U.S. workforce less than competitive on a global level, which in turn threatens the success of an advanced manufacturing industry in the U.S.

Lower overall achievement in K-12 mathematics and science compared to other member countries of the Organization for Economic Cooperation and Development (OECD): OECD 2012 comparisons show that the U.S. performed below average in mathematics (ranking 27th out of 34 OECD countries) and performed close to average in science (ranking 20th out of 34 OECD countries).[5] This poor performance is attributed in part to poor K-12 standards for mathematics and science, shortages in qualified STEM teachers and large achievement gaps for minorities and students from low-income families. While many states have made progress over the last few years in adopting and implementing higher standards, given the scale and political nature of education reform, it will be a while before these efforts pay off.

Less than optimal high school graduation rate: High school graduates are more likely to be employed, make higher taxable income, and aid in job creation. However, far too many students are still dropping out of high school. Although the national high school graduation rate hit a record high of 81.4 percent in 2014, it remains to be seen whether the nation will achieve a goal of 90 percent on-time graduation by 2020. If the national graduation rate were to reach 90 percent, the additional graduates from a single class would earn an estimated $5.3 billion more in income, generate more than 37,000 jobs and increase the GDP by $6.6 billion per year.[6]

Low college readiness with the need for remediation before credit-earning college courses: Equally important to increasing the high school graduation rate is ensuring that graduates are ready for college or a career. Of the U.S. students that took the ACT test in 2014 (57 percent of all high school graduates), only 43 percent met the readiness benchmark for mathematics, while only 37 percent met the readiness benchmark for science.[7] Our own recruitment efforts for the Dow Apprenticeship Program have also revealed that in some cases, students lacked basic mathematics skills that are necessary for technical roles.

Not enough domestic STEM graduates: The President's Council of Advisors on Science and Technology (PCAST) found that the U.S. will need one million new STEM graduates over the next decade to meet expected demand.[8] But less than a third of our students are graduating with a degree in science or engineering, putting the U.S. at a pitiful 20th place globally. By comparison, more than 50 percent of students in China graduate with such a degree. Shortages of domestic students graduating with STEM degrees are linked to decreased interest in the pursuit of STEM degrees. Additionally, high tuition costs, which have risen at twice the rate of inflation over the last decade, and the fear of amassing graduate debt ($1 trillion nationwide and growing) are increasingly deterring many low-income students from pursuing a college education.

Reduced focus on vocational training: Reduced focus on apprenticeships and Career and Technical Education (CTE) over the last two decades has led to shortages in middle skill or trades workers. Despite prominent mentions by President Obama in several State of the Union addresses and bipartisan support in Congress, apprenticeship programs have struggled to gain a foothold among employers. Over the last dozen years, the number of U.S. apprenticeships has dropped 20 percent, to fewer than 400,000 or less than five percent of the workforce. In contrast, Germany, which is considered the model country for apprenticeships, trains over two thirds of its working population in the programs each year and thus has a low level of youth unemployment (7.1 percent in 2015).

Unfavorable image of manufacturing: The U.S. manufacturing sector is often perceived as offering little job security and advancement opportunities. However, the reality is quite different. Manufacturing jobs of today are high-wage and high-skilled. According to a congressional report by the Joint Economic Committee in 2013, hourly compensation is 17 percent higher in manufacturing than in other industries. As of 2013, the average U.S. manufacturing worker earned $77,506 annually, including pay and benefits.[9] It is critical to change inaccurate perceptions in the minds of children, parents and educators to ensure a sustainable talent pipeline into the future.

Recommendations

K-12 Education Reforms

- **Higher standards in K-12:** States should continue implementing higher state standards for Science and Mathematics in K-12 to create a 21st century workforce that is skilled in problem-solving, critical thinking and data-based argumentation.
- **STEM teacher development and training:** States must improve teachers' skills through mentoring and formal training to ensure all students have access to high-performing teachers, and hands-on STEM-based curricula. The private sector can further help in improving the quality of STEM curricula for K-12 by providing technical expertise and coaching to teachers on a volunteer basis, by contributing to the development of technical curricula, and by inviting teachers into private industries to personally experience STEM-related jobs.
- **Closing the achievement gap:** States must adopt policies that ensure schools are held accountable for the achievement of all students and enable intervention in the lowest performing schools.
- **Early exposure to college materials:** States should adopt policies that enable equitable access for high school students to early college credit opportunities including dual enrollment, advanced STEM courses and Advanced Placement.
- **Spark early interest in STEM:** States, districts and schools should include hands-on STEM learning in school curricula. A program such as First Robotics is a great example of hands on learning which piques the interest of students in STEM disciplines early on, and demonstrates the importance of an interdisciplinary approach for innovation. Additionally, schools and businesses should partner to both engage STEM professionals in the classrooms, and open businesses to teachers and students for visits, internships and job shadowing.

Education-to-Employment System Reforms

- **Demand-driven apprenticeships:** Partnerships among government, academia and industry are needed to focus on creating the workforce of the future with an emphasis on workforce training and retraining. This must include the development of partnerships and policies that support demand-driven apprenticeship programs. The recommendations made by the Advanced Manufacturing Partnership provide a blueprint for businesses to implement such programs.[10]
- **Reinvent CTE and increase pathways to college and careers:** States, districts and schools should seek policies that increase pathways to college and career by reinventing CTE programs. Ideally, every pathway should enroll a fairly representative cross-section of students from a school or a district. Programs should merge occupational course sequence, rigorous academic coursework, and career exploration opportunities, and as such, truly become pathways into post-secondary programs that link degrees and credentials to occupations. Programs should incorporate on-/off-ramps for students who need to move in and out of the job market and training programs to meet life demands.
- **Build a positive image of manufacturing jobs:** As efforts to increase pathways from K-12 to college and career take off, all stakeholders must design campaigns that build a positive image and perception of manufacturing as a dynamic, creative and rewarding profession. Manufacturing Day℠ has been successful in growing participation over the short time it has been running.
- **Restore college affordability:** Federal and state governments must pursue policies that restore the affordability of a college education, reduce graduate debt, and demonstrate the potential return on investment.
- **Higher Education suited to the needs of manufacturing:** U.S. graduate programs should be adapted to the specific skill sets, and areas of high interest and demand in manufacturing, including opportunities for the public and private funding of graduate fellowships.
- **Enable hiring and retention of STEM foreign talent:** The federal government should enhance U.S. immigration policies for foreign talent to enable U.S. businesses to hire and retain STEM graduates from U.S. universities.

STEM Skills Gap: Think Nationally, Act Locally
Visit Dow's website (www.dow.com) to learn about Dow's partnerships and activities to close the STEM talent gap.

STEM Teachers
In collaboration with the Smithsonian Science Education Center, Dow is providing teachers in Dow's communities with an inspirational experience and educational resources to help support their commitment to students. This, in turn, will help drive the creation of the next generation of the STEM workforce.

When the program ends, the teachers selected to join the program will receive continued support from other teacher-participants in their area and the Dow STEM Ambassador program.

Dow Apprenticeship Program
The Dow U.S. Apprenticeship Program supports a major initiative of the Advanced Manufacturing Partnership, a national effort to secure U.S. leadership in emerging technologies by creating high-quality manufacturing jobs and enhancing America's global competitiveness.

Through partnerships between Dow and local community colleges, the apprentices will receive three years of training and on-the-job experience in two of the most sought-after and highest-earning technical specialties in the industry: instrument electrical technicians and process technicians. During this time, the apprentices will have their tuition funded by Dow and receive a competitive salary that increases incrementally over their tenure in the program. Upon completion of the program, apprentices will be evaluated for possible employment opportunities at Dow.

Dow STEM Ambassadors
Dow has more than 1,000 trained STEM volunteers, known as STEM Ambassadors, who aim to support teachers and inspire students by providing real life examples that make challenging concepts easier to understand.

This Dow program also has a strong focus on sharing exciting opportunities available through pursuing STEM careers.

Sources:
[1]"The Global Talent Crisis," by Edward Gordon, The Futurist, September-October 2009

[2]"The Global Talent Crisis," by Edward Gordon, The Futurist, September-October 2009

[3]"Out of Inventory – Skills Shortage Threatens Growth for U.S. Manufacturing," 2014 Report from The Manufacturing Institute

[4]2011 Skills Gap Report from the Manufacturing Institute

[5]OECD, PISA, Key Findings, PISA 2012 Results U.S.

[6]Source: GradNation Report, 2014

[7]The Condition of College & Career Readiness 2014, www.act.org

[8]Source: PCAST Report to the President – Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics, February 2012

[9]National Manufacturers Association

[10]PCAST Report to the President, Accelerating U.S. Advanced Manufacturing, October 2014