

# Diversifying the Engineering Workforce: Start with Students



According to William A. Wulf in his annual report to the National Academy of Engineering in the early 2000s, “Diversity is strength in creativity, broadness of new ideas and embracing new perspectives to arrive at the most truly innovative, resource-smart solutions possible.”<sup>2</sup> When the overwhelming majority of the discipline consists of those with a common perspective, it becomes difficult to find the new ideas and innovation critical for engineering success.

Science & Engineering (S&E) fields have long been dominated by males, whites and Asians in particular. While the number of women and minorities in S&E fields has been increasing slightly over the last two decades, people in these groups still hold engineering degrees and jobs at much lower rates than their proportion of the U.S. population. To succeed, initiatives focused on increasing workforce diversity must also work to diversify the pathway to degrees and careers for all potential S&E students.

This paper offers an overview of the current state of diversity across the engineering discipline, as well as tactics for increasing student and faculty diversity in higher education.

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## THE STATE OF THE WORKFORCE

The National Science Foundation reported that in 2015, women constituted 50% of the college-educated workforce, 40% of employed individuals whose highest degree was in an S&E field and 28% of those in S&E occupations. While Hispanics, African Americans and American Indians or Alaska Natives together make up 27% of the U.S. population age 21 and older, they comprise just 15% of S&E highest degree holders and 11% of workers in S&E occupations. Asians and foreign-born individuals make up a much higher proportion of the S&E workforce than they do the population: Asians make up 6% of the U.S. population age 21 and older but account for 21% of S&E jobs.<sup>8</sup>

Noha El-Ghobashy, vice president of strategic initiatives at the Institute for Transformative Technologies (ITT) and former executive director of the Association of Mechanical Engineers (ASME), explained that both the industry and the private sector are increasing pressure on academia to get a more diverse pipeline into the workforce.

“If we’re going to design solutions that successfully address problems faced by the over seven billion people living on this earth, we can’t have 84% of the

engineering workforce represent only two demographic groups,” El-Ghobashy said. Diverse perspectives are crucial not just in *solving* problems but in fully *understanding* problems.

### Ways to improve workforce diversity

**Provide equal pay.** The most recent National Science Board report on S&E Indicators found pay gaps for women and racial and ethnic minority groups — even when average salaries were adjusted to compensate for fields of education and occupation, employment sector and experience.<sup>8</sup> “We are seeing a greater number of companies with a commitment to transparency and accountability across the organization,” said El-Ghobashy.

**Give diversity and inclusion officers a seat at the executive table.** For diversity and inclusion officers to make an impact, they need to be part of larger business and strategy-related conversations — not just human resources discussions.

**Examine your company policies and culture.** In February 2017, GE announced goals of having 20,000 women

fill STEM roles at the company by 2020 and obtaining 50:50 representation for all entry-level technical programs. Part of that initiative centers around implementing employee programs and benefits that foster a fair and inclusive culture where all employees can thrive.<sup>5</sup> El-Ghobashy pointed out that some underrepresented groups may require flexibility that has not traditionally been part of company culture.

**Assign sponsors who take active roles in paving career paths.** These sponsors should be more than mentors: They should function as advocates and allies for minorities, helping to create opportunities for advancement.



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## IMPROVING FACULTY DIVERSITY

Increasing faculty diversity is a key component in attracting more diverse students. “Faculty of color provide students with diverse role models and help provide more effective mentoring to students of color. Exposure in college to a diverse faculty, along with diversified curricula and teaching methods, produces students who are more complex thinkers, more confident in traversing cultural differences and more likely to seek to remedy inequities after graduation,” explained Tabbye M. Chavous, a professor of education and psychology and director of the National Center for Institutional Diversity at the University of Michigan — Ann Arbor.<sup>10</sup>

### Current state of faculty diversity

A 2015 study examined retention and promotion of women and underrepresented minority (URM) faculty in S&E at four large land grant institutions. The conclusion: “URM faculty representation is so low that it limits our understanding of faculty retention and success.”<sup>6</sup>

Stephanie Adams is the first woman and first minority to serve as Dean of Batten College of Engineering and Technology at Old Dominion University, and she is one of four African American women engineering deans nationwide. As a dean committed to hiring diverse faculty,

Dr. Adams pointed out that the small pool of women and minorities earning doctorates in STEM fields presents a challenge. “If you look at the number of Ph.D.s produced each year, and then consider that at least half don’t go into higher education, you’re working with a small pool. Consider that there are about 350 ABET-accredited schools. Now say there are 234 Ph.D.s awarded to African Americans in engineering — that leaves 117 candidates available for higher ed, which works out to each school potentially being able to hire one African American faculty member every three years.”

Dr. Adams explained that since these candidates are in demand, they may have

multiple job options available. Schools need to be more aggressive and move quickly to recruit faculty members from diverse backgrounds. “There’s a real void — we can’t use the same old practices to diversify faculty because the population isn’t there,” she said.

## Ways to attract more diverse faculty

**Fix the leaky Ph.D. pipeline.** About half the people who start the Ph.D. process don’t finish — and that number is higher in the engineering field and for people of color, said Dr. Adams. “People often get stuck in the writing,” she explained. Programs like the Dissertation Institute at the University of Houston provide support for underrepresented engineering doctoral students currently writing their dissertations or dissertation

proposals. At the Dissertation Institute, students learn to set writing goals, practice writing habits and learn new strategies. They also create a network of fellow doctoral students who can provide motivation and promote a sense of personal accountability.<sup>3</sup>

**Rethink systems and processes.** A recent Chronicle of Higher Education article encouraged colleges and universities to focus on fixing systems, not people. Providing workshops and programs on mentoring, climate and service are admirable efforts, but they focus on only one aspect of the issue: “When underrepresented faculty and staff leave campuses, they rarely complain about a lack of training or workshops; instead, they point to unchecked discrimination, harassment and unfairness that are often part of the day-to-day campus culture.”<sup>1</sup>

**Create a welcoming culture.** Rebecca Bates, professor of computer science and integrated engineering at Minnesota State University, Mankato, encourages schools to think about creating spaces where people want to stay. “Consider the policies and rewards that are affecting faculty as well as the training you’re offering graduate students who are often teaching undergraduates — they all need to understand inherent bias, micro-aggressions, etc. We have to think about how people are working together,” she said. In addition to developing more supportive environments for undergraduate students, Dr. Bates said, “We have to create faculty spaces where people want to be and then make those spaces visible to graduate students, not just in our research labs, but also as we navigate the university structures that affect tenure, promotion and overall career happiness.”

## INCREASING STUDENT DIVERSITY

According to a report on the future of graduate STEM education from the National Academies of Science, Engineering and Medicine, “Scientific excellence depends on diversity and inclusion. Ideally, students from all backgrounds would fully participate and achieve their greatest potential during their educational experience through transparent institutional action to enhance diversity and promote inclusive and equitable learning environments.”<sup>4</sup>

### Current state of student diversity

The National Science Foundation reports that Asians are more likely than whites and URMs to earn a college degree in an S&E field. Although whites’ share of S&E degrees has declined over the past two decades, they continue to earn the majority of degrees in all broad S&E fields.<sup>9</sup>

In the U.S., approximately 4,000 African American engineers graduate annually with bachelor’s degrees — 10,000

annual bachelor’s degrees would more accurately align with overall population density. Hispanics make up 16% of the U.S. population, but only earn 8% of all certifications and degrees awarded in STEM fields. Just 370 American Indians earn engineering degrees each year.<sup>7</sup>

To improve student diversity in STEM, the Society of Women Engineers (SWE), the National Society of Black Engineers (NSBE), the Society of Hispanic Professional Engineers (SHPE) and the American Indian Science and Engineering



Society (AISES) have come together to form the 50K Coalition, an organization dedicated to producing 50,000 women and URM engineering graduates by 2025.<sup>7</sup>

## Ways to increase student diversity

**Help students better understand what engineers do.** Dr. Adams said the engineering profession needs to do better at telling young people who engineers are and what they do, and work in tandem with K-12 teachers to bridge the connections between math, science and engineering. “I make the argument that engineering is in everything we see, do and touch every day, yet we’re somehow not articulating that to students,” she said.

**Extend your reach with a Centralized Application Service (CAS™).** Dr. Jerry Kernes, program chair at the University of La Verne, was interested in a CAS because of its potential to recruit beyond the University’s geographic area. Dr. Kernes explained: “As an accredited program, we have to show deliberate work towards diversifying our applicant pool. It’s not good enough to say that we have a diverse student body. We have to show how we’re working to attract applicants with unique perspectives.” In its first year using a CAS, the University of La Verne saw a 21% increase in out-

of-state applicants. With numbers like these, Dr. Kernes sees CAS as “changing admissions at University of La Verne for the better.”

Temple University offers another example of the benefits of a CAS: Before joining a CAS, the University’s manual admissions pipeline process was getting in the way of being able to serve students’ needs. “Having to do everything manually, including sending physical files out to faculty for review — and then hoping that faculty would return them — was a very tedious, long and cumbersome process,” shared Erin Brosious, an academic coordinator. Implementing a CAS not only helped Temple see a 2% increase in diversity of applicants, but it also reduced application review time by 75% and manual tasks associated with application processing by 50%. A CAS gave Temple’s admissions office time to focus on what really matters: building a better, more diverse class.

With the launch of EngineeringCAS™ in 2017, engineering programs now have access to a CAS specifically developed to offer their admissions offices — and prospective applicants — these benefits and more.

**Focus on retention, not just recruitment.** Dr. Bates said this involves recognizing differences and developing empathy for students. “We need to

recognize that when students have had really different experiences from us, as faculty, we need to learn more to help them be successful.”

Kevin L. Moore, dean and professor at the College of Engineering and Computational Sciences at the Colorado School of Mines, said in 2002 the school decided to focus on attracting women and recently directed those same efforts to URMs. Now, the School has created dedicated admissions counselors for women and for URMs. The school also has a full-time faculty director and a part-time faculty adviser who work with their campus branch of SWE — the country’s largest.<sup>11</sup> Developing partnerships with organizations like SWE, NSBE and Girls Who Code can help with student persistence.

**Start fostering diversity in STEM education at the K-12 level.** Karen Horting, CAE, SWE’s executive director and CEO, said she’d like to see less educational disparity in neighborhoods, particularly in African American ones. After all, some children in grades K-12 have no access to AP calculus and physics courses! “That’s the next piece — looking at the K-12 pipeline and asking, ‘How do we get more equity there?’” Horting said. “Are we doing the right things to make sure kids are prepared? You can’t be coming into college needing remedial training.”<sup>7</sup>



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## CONCLUSION

To effectively improve diversity the S&E workforce, we must first address a lack of diversity among students and faculty in STEM fields. Partnerships between industry, education, non-profits and government organizations are yielding results, though much work remains to be done. Rather than focusing solely on

people, employers and higher education institutions must re-evaluate and re-engineer structures, processes and policies that serve as barriers to education and employment for women and URM — particularly in S&E fields, where some of the greatest disparities exist.

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