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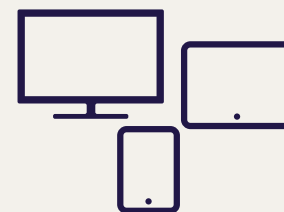
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Proceedings of a Workshop
IN BRIEF

December 2018

Engineering Societies' Activities in Promoting Diversity and Inclusion
Proceedings of a Workshop—in Brief

As part of a series of workshops on the role of engineering societies in engineering education in the United States, the National Academy of Engineering (NAE) held a workshop titled "Engineering Societies' Activities in Promoting Diversity and Inclusion" on June 4, 2018, at the University of Cincinnati. The goals were to explore how engineering societies can promote diversity and inclusion in engineering, provide an opportunity for societies to share promising practices, and investigate possible collaborative actions. The topic for the event grew out of concerns raised at a broader workshop in January 2017 on the relationship between engineering societies and engineering education.[1] Other follow-up workshops have explored the possibility of establishing a multidisciplinary and multisociety student competition focused on the NAE Grand Challenges for Engineering[2] and ways for the professional societies to influence measures of faculty impact.[3]

The Cincinnati workshop on diversity and inclusion took a broad view of the issue. It started with an overview of the topic, followed by a report on the preliminary findings of an NSF-sponsored study of members of professional engineering societies. Attendees then heard examples of activities by societies to promote diversity and inclusion. The workshop concluded with breakout sessions on key takeaways from the presentations, possible future actions, and challenges and opportunities.[4]

"NSF knows that professional societies have an important role to play in the professional formation of engineers," said Julie Martin, program director for engineering education at the National Science Foundation (NSF), in her welcoming remarks to the participants. "There's a real opportunity for you to contribute to solving the challenges that we're facing in broadening participation in engineering. I know that this often seems like an intractable problem, but we have a lot of smart, creative, hardworking, and dedicated people here."

DIVERSITY AND INCLUSION IN ENGINEERING: AN OVERVIEW

At the beginning of her overview of diversity issues in engineering, Erin Cech, assistant professor of sociology at the University of Michigan, pointed out that women, racial/ethnic minorities, and LGBTQ[5] individuals remain underrepresented in science- and engineering-related fields.

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[1] The Engagement of Engineering Societies in Undergraduate Engineering Education (https://www.nae.edu/Activities/Projects/126089.aspx)
[2] An Undergraduate Competition Based on the Grand Challenges for Engineering: Planning and Initial Steps (https://www.nae.edu/178121.aspx)
[3] Understanding Measures of Faculty Impact and the Role of Engineering Societies (https://www.nae.edu/186835.aspx)
[4] Workshop presentations are available at https://www.nae.edu/Activities/Projects/126089/167196/181467.aspx.
[5] LGBTQ = lesbian, gay, bisexual, transgender, queer

NATIONAL ACADEMY OF ENGINEERING

According to Cech, women make up only about 20 percent of undergraduate engineering students and just 9 percent of all engineering faculty. Among STEM faculty, women make up 36 percent of adjuncts, 28 percent of tenure track positions, and 16 percent of full professorships. In industry, they account for just 21 percent of science, technology, engineering, and math (STEM) professionals, 15 percent of STEM managers, and 6 percent of engineering managers.[6]

Similar underrepresentation and lack of inclusion characterize other groups in engineering. African Americans, Hispanics, and Native Americans make up less than 15 percent of bachelor's degree holders in science and engineering and less than 10 percent of PhDs.

In a nationally representative survey of STEM professionals, LGBTQ individuals said that they are more likely to have to work harder than colleagues to be seen as legitimate professionals, are less likely to have colleagues perceive them as equally skilled professionals, and are less likely to have their talents used well in the workplace.[7]

Barriers to advancement are no longer primarily a result of "bad apples" who resist the inclusion of underrepresented minorities, said Cech. Instead, subtle beliefs and practices, such as microaggressions, cognitive biases, and cultural processes, create disadvantages that progressively accumulate. Furthermore, she reported that a plateauing in the percentage of women receiving bachelor's degrees in science and engineering over the past two decades suggests that these beliefs and practices do not necessarily improve over time.

Three ideologies in the professional culture of engineering are particularly powerful in producing inequalities, according to Cech. First, schemas of scientific excellence, which call attention to the characteristics and skills that are assumed to be markers of professional competence, can be gendered, racialized, and heteronormative. As an example, she cited the ideological separation between technically and socially focused activities, with the former more highly valued than the latter. Yet social and technical skills cannot be fully separated from one another. Bias can thus be built into the yardstick of evaluation of STEM excellence, with consequences for diversity and inclusion.

The influence of this schema of scientific excellence led Cech to formulate a reflection question for the workshop participants:

- *How is excellence judged in your area of engineering? How might social stereotypes get folded into these definitions of excellence?*

The second factor she discussed is depoliticization, which she defined as the belief that STEM is a "pure" space that can and should be stripped of political and cultural concerns.[8] But what to study, how to define problems, and what to fund are inevitably cultural and political decisions, she explained. "Because we are human beings, we are inherently political and cultural and social. We can't ever fully remove that from the work we do."

The idea of depoliticization can shut down conversations about diversity and inequality in STEM.[9] For example, in a longitudinal study of engineering undergraduates from four US universities who entered engineering jobs, Cech found that their interest in issues of professional and ethical responsibility, the consequences of technology, and how people use machines declined during their undergraduate years and again 18 months after their entrance into the workforce.[10] About 40 percent of a nationally representative group of employed engineers agreed that social issues like inequality should be separated from science and engineering work, and about 20 percent thought that raising concerns about diversity undermines one's credibility as a scientist or engineer.

Cech posed the following reflection question in regard to depoliticization:

- *How might depoliticization silence conversations about diversity and inequality in your organization?*

Third, Cech discussed the meritocratic ideology, the belief that success is the result of individual talent, training, and motivation. The idea is that "if you work hard and you have enough drive you can achieve anything," she said. "But a century of social science research suggests that trying hard and having motivation are not enough to succeed.

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[6] Blair-Loy M, Pecenco L, Cech E. 2013. Persistence of male power and prestige in the professions: Report on the professions of law, medicine, and science & engineering. Center for Research on Gender in the Professions, University of California, San Diego.

[7] Cech EA, Pham MV. 2017. Queer in STEM organizations: Workplace disadvantages for LGBT employees in STEM related federal agencies. Social Sciences 6(3):1–22.

[8] Cech EA. 2014. Culture of disengagement in engineering education? Science, Technology & Human Values 39(1):34–63.

[9] Cech EA, Sherick HM. 2015. Chapter 9: Depoliticization and the structure of engineering education. In: International Perspectives on Engineering Education and Practice in Context, eds Christensen SH, Didier C, Jamison A, Meganck M, Mitcham C, Newberry B. New York: Springer.

[10] Cech (2014).

We know there are structural biases and structural sexism, racism, and heteronormativity. The world is not completely fair, and no matter how hard some people try they will never succeed at the same level as their more privileged peers because of the insurmountable barriers that they might have in their lives."

The meritocratic ideology frames inequalities in engineering as the fault of women and minorities, not the social system. In this way, it shifts attention away from the social and cultural processes that perpetuate inequalities in professions, Cech explained. For example, in a survey of science and engineering faculty at a large research institution, the faculty with the strongest beliefs in the meritocratic ideology were less likely to report seeing instances of discrimination in the past three years than were faculty members who had structural explanations for inequalities. The former group also was less likely to report that their departments had "chilly climates" for women and minorities.[11]

Cech suggested the following reflection question about the meritocratic ideology:

- *Who in your organization still needs to be convinced that unequal processes actually exist in engineering?*

These three ideologies are part of the professional cultures of STEM, said Cech. They are difficult to see and hard to change. Even if people do not display overt prejudice and discrimination, they can perpetuate inequality by adhering to and perpetuating these cultural ideologies.

The way to address these problems is not to somehow "fix" women or minorities to be more like White men, Cech continued. Rather, these cultural ideologies need to be addressed directly. For example, people need to be wary when discussing "fit," she said. "Any time the term *fit* is used, it has the potential for biases to be smuggled in. When you don't define the cultural yardstick used to judge competence and excellence, it can potentially include a host of biased assumptions." One useful approach is to carefully articulate the criteria used in a decision so that people can recognize and discuss biases that may exist.

People also need to legitimize discussion of diversity and equality, even in spaces used for "pure" science or "pure" engineering, such as laboratories or departmental meetings, Cech said. If discussions of diversity occur only in certain places, the implication is that the problem occurs only in some places. "If it feels awkward to talk about diversity and inclusion in a particular place in your workplace, that's probably the place that needs it the most."

Finally, if people believe that patterns of difference are the result of a fair and meritocratic process, Cech said that they need to be shown that a problem does exist. One way to do this is to bring the conversation into mainstream spaces—for example, by publishing articles on diversity and inclusion among "technical" articles.

Beliefs in engineering can change over time, Cech observed. For example, environmental engineering is now fully accepted in the field, whereas in the past it was viewed with skepticism as overtly political. Also, many examples demonstrate that incorporating diverse perspectives strengthens engineering, which strengthens the case for diversity and inclusion. "Just thinking about diversity and inclusion makes engineering better."

A SURVEY OF STEM PROFESSIONALS

Cech discussed preliminary results from a study that she is conducting with Tom Waidzunas, assistant professor of sociology at Temple University, on interactional, organizational, and professional mechanisms of disadvantage in the underrepresented and marginalized STEM workforce.[12] The study is based on a paradox, she pointed out: STEM professions are supposed to be objective and apolitical, yet persistent societal biases exist against women, people of color, LGBTQ individuals, and persons with disabilities. By comparing a large sample of diverse majority and nonmajority STEM professionals, the study has provided systematic documentation of whether and what types of inequalities emerge, net of other demographic variation. It also has provided the type of data that are compelling to administrators and policymakers.

The study, funded by the National Science Foundation, conducted a confidential survey with 16,046 full-time STEM professionals responding, working through partnerships with 14 professional organizations.[13] A survey link was distributed via email (accompanied by the endorsement of the organizations' leadership) to the full membership or to a random sample of the organizations' members. Cech observed that the support of an organization's leadership in

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[11] Cech EA, Blair-Loy M, Rogers LE. 2018. Recognizing chilliness: How schemas of inequality shape views of culture and climate in work environments. American Journal of Cultural Sociology 6(1):125–160.

[12] For more information on the study, see www.steminclusion.com/.

[13] At the time of the workshop, plans for the analysis were to survey five to seven additional organizations, explore intersectional processes of disadvantage, do interviews with a stratified random sample of survey respondents, and hold a best practices summit with the leadership of the participating organizations.

participating in the survey was a signal that they cared about diversity and inclusion. Results were controlled for variation by gender, race/ethnicity, age, disability status, education level, employment sector, STEM organization, and STEM discipline and returned to the organizations for their use in examining diversity and inclusion issues.

As an example of a marginalization question, Cech cited the following: "How frequently have you been harassed verbally or in writing on the job?" Analyzing the preliminary results by gender, race/ethnicity, LGBTQ status, and disability status, the researchers found that women reported instances of harassment more frequently than men; that Hispanics, Asians, and African Americans reported harassment more frequently than Whites; and that those with disabilities reported harassment more frequently than those without disabilities. These results were robust to differences by sector, age, and other controls.

When asked "In your workplace in the last three years, have you observed a person being treated differently because of their gender?" 27 percent of respondents reported that they had. Those in the for-profit and other sectors were less likely than those in the university/college sector to observe gender mistreatment. With regard to discipline, physical scientists and engineers were more likely to report gender mistreatment than those in computer science, mathematics, and other STEM-related fields.

The same question with regard to race/ethnicity rather than gender revealed that 17 percent of respondents had observed differential treatment in their workplace along the lines of race/ethnicity. The same pattern occurred across sectors as with gender, while engineers were more likely to report racial mistreatment than professionals in other STEM fields.

In response to a question about devaluation of work, the preliminary results indicated that women were less likely than men to say that their work is respected in their workplace. Hispanic, Asian, and African American respondents were also less likely than Whites to say that their work is respected, results that parallel those for LGBTQ individuals and people with disabilities.

Another question asked how often respondents had been bothered in the past year by minor health problems such as headaches, insomnia, and upset stomach. Cech reported that the preliminary results showed that health disparities can be explained in part by people's negative experiences in their workplace.

Survey Results from Five Societies

William Rothwell, a graduate student in sociology at the University of Michigan, presented more detailed results of the survey from five organizations at the workshop that agreed to have their data presented: an industry sector engineering organization (Organization 1), an engineering subfield-specific organization (Organization 2), an interdisciplinary sector-focused engineering organization (Organization 3), an interdisciplinary subfield-focused organization (Organization 4), and a racial/ethnic minority-oriented organization (Organization 5). At the request of the study director, the names of the organizations and the specific finds for each organization were redacted to protect confidentiality.

The survey included several questions about processes of inclusion and marginalization. First, it asked respondents about the frequency with which they heard or read comments in the workplace that they found offensive. Second, it asked how many times in the past year respondents overheard or observed a coworker making a negative comment or joke about racial/ethnic minorities, LGBTQ individuals, or people with disabilities. Responses were on a scale from 1 to 3: 1 indicated that respondents had never heard or read such comments, 2 that they had read or heard such comments at least once in the past year, and 3 that they had read or heard such comments at least once a month.

The survey also asked about processes of professional devaluation at work. First, it asked respondents whether they felt they were held to the same standard as others for promotion and advancement. Second, it asked whether they had to work harder than their colleagues to be perceived as a legitimate professional.

On the question of the frequency of hearing or reading offensive comments, responses were generally either once in the past year or once in the past month. For four of the five societies whose results were discussed at the workshop, women were significantly more likely than men, and Asians significantly more likely than Whites, to report reading or hearing such offensive comments. Preliminary data indicate a difference between White and Black respondents, but not enough responses had been collected at the time of the workshop to reach statistical significance.

On the question of whether respondents had heard negative comments about disadvantaged groups in the workplace, responses were generally either that they had not heard such comments in the past year or heard them at least once in the past year. However, women were more likely than men and LGBTQ respondents were more likely than non-LGBTQ respondents to report overhearing such comments in their workplace.

On measures of professional devaluation, responses ranged from 1 (strongly disagree) to 5 (strongly agree). In response to the statement "I am held to the same standard as others for promotion and advancement," responses were generally neutral or agree. However, women were significantly less likely than men to believe that they are held to the same standard as others for promotion. When asked whether "I have to work harder than my colleagues to be perceived as a legitimate professional," the differences along categorical lines were even more striking. Women were more likely than men, and Asian and Black respondents more likely than Whites, to report having to work harder to be seen as a legitimate professional.

Results were somewhat different for respondents from Organization 5 (the racial/ethnic minority-oriented organization), where there was no significant variation among groups about reading or hearing offensive comments. The overall incidence tended to be low, although LGBTQ respondents were significantly more likely than non-LGBTQ respondents to report overhearing such comments. Also in this organization, women were significantly less likely than men to report believing that they are held to the same standard for promotion and advancement. They also were significantly more likely than men to feel as though they had to work harder than their colleagues to be seen as a legitimate professional.

For all five societies, the results raise questions about the inclusion and retention of talented women, racial/ethnic minorities, and LGBTQ individuals in STEM fields, Rothwell concluded. He also stated that frequent experiences with marginalization and isolation can have detrimental impacts on underrepresented groups, contributing to high rates of turnover and exacerbating underrepresentation.

Reflections on the Survey

After Rothwell's presentation, representatives of four of the societies whose survey data were presented at the workshop reflected on the results. To protect the confidentiality of the responses, the names of the organizational representatives have been redacted in this account of the panel discussion.[14]

One representative noted that such data are valuable to present to people in an organization who do not think that a problem exists or do not see the need for change. That is especially the case in organizations representing people who are accustomed to working with data, she added.

Different communities have different needs, this representative continued, which may require different kinds of (or additional) data. For example, her organization does a salary survey every year to which about 20,000 individuals respond. The survey has added questions developed by a gender equity task force. In this way they are working with their industry partners to find out what respondents at companies feel needs to be done.

The chief executive officer of this organization has worked hard on this issue for almost two decades, the representative continued. The organization takes diversity into account when putting together a nominating slate for the board, when enlisting volunteers, and when organizing committees. "We don't tell people who to put on any committee, but we do a lot of assisting."

The organization understands that some people may give verbal support to the need for diversity and inclusion, but be less willing to take action. "Sometimes it's because people don't see what they can do to make the change."

A representative from the second organization observed that organizations of different sizes may have different issues. "We have a lot of small companies that are much less diverse than some of the bigger defense contractors or the government and research institutions, and programs for inclusivity at those places are vastly different." She praised the survey results because they point to actionable steps, and "we can't solve the problems in a vacuum…. We want to identify what kinds of challenges our members are facing and what [we] can do to be a partner and an educator in helping to create actionable steps toward solutions."

As a smaller association focused on technical matters, this organization has been experimenting with different programming, such as leadership training or networking events, to create more value for its members. These activities could be an opportunity to disseminate some of the information generated by the survey.

The representative from the third organization pointed out that quantitative results from the survey match the qualitative accounts heard in discussions. Knowing that these experiences are widespread and not just anecdotal can build support for change. In addition, the representative pointed out that it is important to recognize people belonging

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[14] General comments that were not specifically related to the data for an individual organization and were made later in the session are attributed to the speaker.

to more than one marginalized group and to try to understand their experiences. "We're trying to address this, but we know there's not a lot of data on it."

The respondent from the fourth organization observed that the data reveal the need to create safe spaces for discussions of diversity and equity. For example, this organization has had conference panels of members who have discussed their experiences and how they have overcome barriers.

This respondent noted that the survey results can give people the tools they need to make changes in their organizations. Her organization brings together about 50 industry partners quarterly for discussions about diversity and inclusion and is always trying to increase that number.

As the discussion was opened up to general comments among the workshop participants, several people mentioned the widespread belief that new people in an organization need to undergo "a rite of passage" before being accepted. Lisa Black, senior manager for diversity and inclusion programs at the American Society of Civil Engineers (ASCE), noted that this kind of thinking can be a problem for underrepresented groups. Michelle Tubb, director of marketing, membership, and education at the Society for the Advancement of Material and Process Engineering (SAMPE), agreed: such thinking is "something we have to work against," she said.

The group also discussed the recruitment of younger and more diverse members to their organizations. Some workshop participants noted that younger and more diverse members are well represented in their organizations; others said the opposite. Sometimes a tension exists for young members between becoming involved in technically oriented or socially oriented societies. However, everyone who commented agreed that it is important to get young and more diverse people, including students, involved in their organizations and to keep them involved after they graduate.

Penny Wirsing, president of the Society of Women Engineers (SWE), observed that the organization starts each board meeting with a diversity and inclusion moment, similar to the safety moments with which many industry groups begin and end their meetings. SWE also has created card decks with information on diversity and inclusion that it makes available to its sections and member companies and that can be used to start discussions about the issue.

DIVERSITY AND INCLUSION AT THE AMERICAN GEOPHYSICAL UNION: A CASE STUDY

Billy Williams, vice president for ethics, diversity, and inclusion at the American Geophysical Union (AGU; https://sites.agu.org), described the organization's diversity and inclusion activities. With 60,000 members in 144 countries, AGU publishes journals, convenes meetings, honors and recognizes accomplished members, advocates for funding and other support for science, and communicates the value of science to the public and to policymakers. It also advances a code of conduct for ethical and professional behavior.

AGU has been devoting special attention to diversity and inclusion in recent years, and at the time of the workshop was conducting a broad review of its policies affecting diversity and inclusion, "looking at opportunities to more proactively address diversity and make it part of everything we do," said Williams.

A key juncture for ethics, diversity, and inclusion at AGU was a September 2016 workshop on sexual harassment in the sciences, with 65 participants representing academic leaders, scientific society leaders, and government officials. "We started to dialogue about our responsibility," said Williams. "Do we allow it just to be managed within the individual home institutions, or do we have a role?" The discussions led AGU to conclude that "any professional society has not only a role but a unique opportunity and obligation to help address and establish the culture they want. The academic institutions can't do this. The government agencies can't do this. The private employers can't do this. There's a unique opportunity for professional societies to step into this and embrace establishing the cultural norms that you expect."

As a result, in September 2017 AGU updated its code of conduct to include harassment as scientific misconduct. As part of this change, it has worked on ensuring that members receiving AGU awards and honors are not only great scientists but also adhere to AGU's code of conduct. "It helps set the tone and send a message across our organization about what our standards are."

This conflicts, Williams acknowledged, with the federal definition of scientific misconduct, which currently includes only fabrication, falsification, and plagiarism. But separating social issues from technical aspects "discounts the potential impact that we as a professional society can have on these issues."

AGU does not want to be known as the ethics police, Williams clarified. Rather, its role is to promote and codify standards for professional behavior and policy while also enforcing sanctions tied to its code of conduct. "We see our major role being to educate and support members," he said.

As part of its overall activities, AGU holds ethics- and harassment-related sessions at scientific meetings and maintains a Stop Harassment website. It also sponsors workshops on bystander intervention and implicit bias and has a program called Safe AGU, which provides support for members.

In addition to its workshops, training, and web-based resources, AGU draws on its databases of publications and meetings to conduct studies—for example, on the impact of peer review on gender-related issues across the sciences. "We're seeing some major studies evolve from our databases, including some that are not favorable to AGU," Williams acknowledged; he cited a paper on the lack of women among invited lecturers and session leaders at AGU meetings.

A current focus of the AGU ethics program is to implement updated policies and expand member resources, with additional workshop offerings.

Most recently, AGU has been establishing program metrics and plans for a longer-term Ethics and Equity Resource Center to educate and promote best practices to address harassment, diversity, inclusion, and related work-climate issues in the sciences, integrated with traditional scientific ethics training. The center would be sustained through partnerships with the National Center for Professional Research Ethics and other science organizations. Among the issues it could address are workplace climate assessment tools, diversity and inclusion measurements, unconscious bias and bystander interventions, online ethics education, safe-place counseling, scholarly research, classroom teaching tools, data resources, and best practice awards and recognition for organizations, departments, and individuals in advancing STEM equity.

Models for one element of the center, Williams noted, are Athena SWAN[15] and SEA (STEM Equity Achievement) Change. The former focuses on advancing equity and diversity in colleges in the United Kingdom and has had more than 12 years of operational success. It grew from 10 institutions in 2005 to 143 in 2017 through an evidence-based approach built on quantitative and qualitative research. The SEA Change program is a North American initiative modeled after Athena SWAN and hosted by the American Association for the Advancement of Science. With 12 institutions in the pilot program, it is building on the experiences of the NSF program for Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE). Institutions collect data, set goals, and develop a plan for improving their metrics. Departments, colleges, and institutions are recognized with bronze, silver, and gold awards. The program also offers opportunities for professional societies to sponsor departmental awards.

SNAPSHOTS FROM ENGINEERING SOCIETIES

During a lightning round after Williams' presentation, representatives of nine professional societies provided short descriptions of their activities related to diversity and inclusion.

American Society for Engineering Education (ASEE; https://www.asee.org). ASEE's vision is to create widespread, inclusive, and equitable environments—for engineering in academia and industry—"that embrace individual differences and leverage diversity for a better engineered tomorrow," said Rebecca Bates, vice chair of the ASEE Diversity Committee. To achieve this vision, the society works to increase the visibility and discussion of diversity issues, develop inclusive environments in which all engineers can thrive, and facilitate and encourage the use of translatable strategies that create both bottom-up and top-down empowerment. It partners with other organizations and societies on diversity issues; does a full slate of conference programming, including a "diversity pavilion" each year, safe zone workshops and trainings, and an award for best scholarly paper on the issue; sponsors a student video and essay contest; and publishes a newsletter and website with resources. At a more personal level, it provides child care, gender-neutral bathrooms, mothers' rooms, and closed captioning for plenary sessions at its annual conference.

American Society of Civil Engineers (ASCE; https://www.asce.org). ASCE's Committee on Diversity and Inclusion provides leadership for standards in diversity, equity, and inclusion for ASCE and the engineering community. In 2017 ASCE added a standard to its code of ethics that directly speaks to diversity and inclusion. The society has an ongoing strategy and strategic partnerships with the National Society of Black Engineers, Society of Hispanic Professional Engineers, Society of Women Engineers, and other organizations as part of the 50K Coalition.[16] An annual diversity award, women in engineering short courses, and webinars and institute conference sessions at the ASCE annual meeting all promote diversity and inclusion.

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[15] The UK Scientific Women's Academic Network (SWAN) charter was expanded in 2015 to cover gender equality in the arts, humanities, social sciences, business, and law disciplines.

[16] The 50K Coalition (50kcoalition.org)—whose 19 professional society members include the American Indian Science and Engineering Society (AISES), National Society of Black Engineers (NSBE), Society of Hispanic Professional Engineers (SHPE), and Society of Women Engineers (SWE)—is focused on the goal of producing 50,000 diverse engineering graduates annually by 2025.

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National Society of Black Engineers (NSBE; www.nsbe.org). NSBE's mission is to increase the number of culturally responsible Black engineers who excel academically, succeed professionally, and positively impact the community, said Constance Thompson, senior director of operations for NSBE and co–project manager for the 50K Coalition. Established in 1975, NSBE is one of the largest student-governed societies, serving about 17,000 precollege, collegiate, and professional members. With more than 500 chapters worldwide, it fosters academic achievement, self-efficacy, career readiness, and leadership development. In 2015 it established as a strategic goal the graduation of 10,000 Black engineers annually by the year 2025, representing a threefold increase in current graduation levels. Among the practices to move toward this goal are summer bridge scholarships to better prepare high school students for college, connections with corporate partners, and an emphasis on "working harder, not just smarter," as described in a book of the same title by the organization's executive director, Karl Reid. The society is partnering with the ExxonMobil Foundation on impact awards and on a student retention toolkit that operationalizes the engagement strategies spelled out in a white paper titled "Paving the Way."[17]

The Minerals, Metals & Materials Society (TMS; https://www.tms.org). TMS has approximately 13,000 members around the world—8,000 professionals and 5,000 students—of whom 41 percent reside outside the United States, reported Justin Scott, technical project leader. About 13 percent of the members are female, 4 percent Hispanic, and 3 percent African American. "Folding diversity discussions into that international population is very much on our mind," Scott said. The society has sponsored gender-focused activities, such as a committee for women in materials science and engineering, and expanded its diversity activities to encompass race/ethnicity and LGBTQ representation. The board of directors has established a strategic goal on diversity and inclusion that has led to such initiatives as a family care program, society-level diversity and inclusion awards, and a Materials Explorers program for middle and high school students. It is also trying to cultivate diversity and inclusion in the society's committee and leadership structure. Change requires both top-down leadership and bottom-up efforts from volunteers, Scott said. Staff and volunteers must be willing to adapt to address implicit biases in existing procedures, and accelerating the ascension of underrepresented groups to top leadership levels requires strong efforts on many fronts.

Women in Engineering Proactive Network (WEPAN; https://www.wepan.org). WEPAN was founded in 1990 with the goal of propelling higher education to increase the number and advance the prominence of diverse women in engineering. It envisions a future where half of engineers are women by 2050, said Teri Reed, past president of the organization—and "we hope we get there sooner." Its core values are knowledge, collaboration, diversity, and leadership, and it bases its work on four "frames." The first is to equip members of underrepresented groups with experience and knowledge to help them compete as equals. The second is to create equal opportunity by eliminating barriers to advancement; this requires looking critically at policies and practices. The third is to value rather than eliminate difference to place equity in a broad diversity perspective—for example, by rethinking faculty hiring and leadership. The fourth is to evolve engineering culture by focusing on underlying systemic factors that lead to inequity—for example, through whole campus change and by enlisting men as advocates. These four frames have led to work on a variety of fronts and with many other organizations to transform the culture and climate of engineering to advance diversity and inclusion.

American Institute of Aeronautics and Astronautics (AIAA; https://www.aiaa.org). AIAA has developed a plan to conduct reliable, representative, and continuous assessment of its membership diversity, raise awareness of diversity and inclusion in AIAA, and facilitate improvements in the diversity of its members and groups, said Daniel Dumbacher, executive director of the organization. It has created a website and social media presence that address this vision, ensured that its print materials reflect a more diverse audience, and conducted dedicated events such as presentations and panel discussions at meetings. It invites diverse speakers and panelists for its forums and has established a diversity scholars program that provides opportunities for underrepresented university students pursuing a degree in aerospace to attend an AIAA forum. But there is always more to do.

Institute of Electrical and Electronics Engineers (IEEE; https://www.ieee.org). IEEE has over 400,000 members in 160 countries, resulting in a decentralization that has made it challenging to unify diversity and inclusion activities, said Kristen Russell, a program specialist at the organization. In February 2017 a Committee on Diversity and Inclusion was established under the Technical Activities Board (TAB) and it has undertaken a number of actions: It approved recommendations regarding diversity in the charters of committees that report to TAB as well as a TAB statement reaf-

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[17] Reid KW, Ross M, Yates N. 2016. Paving the Way: Engagement Strategies for Improving the Success of Underrepresented Minority Engineering Students. Alexandria VA: NSBE.

firming the IEEE Codes of Ethics and Conduct and Nondiscrimination Policy, which over half of IEEE's 46 societies and technical councils have adopted. Membership signup and renewal pages will soon require that members read and sign off on core principles of the IEEE codes. The committee has collected diversity metrics, conducted a survey of IEEE's women members, and evaluated ethics and reporting processes for harassment and discrimination cases. In addition, said Burt Dicht, director of student and academic education programs, the society has a variety of education activities designed to provide students with the critical boost they need to consider STEM careers. For example, Try Engineering Together is a STEM e-mentoring platform that matches third- to fifth-grade students in underresourced areas one-to-one with an industry mentor, and the I Am an Engineer program highlights a diverse workforce so that students can see themselves as engineers.

American Society of Mechanical Engineers (ASME; https://www.asme.org). As part of its Vision 2030 for mechanical engineering education, ASME has taken a multipronged approach to diversity and inclusion, said Aisha Lawrey, director of engineering education. It worked with outside experts and its members to update its diversity policy, and did an organizational culture and climate survey with all the staff, not just those at higher levels. It instituted monthly team dialogues led by managers rather than directors and made hires designed to increase diversity in the staff leadership. In addition to participating with other societies in Transforming Engineering Culture to Advance Inclusion and Diversity (TECAID) and in the 50K Coalition, ASME has sponsored engineering festivals and career workshops and reached out to historically Black colleges and universities (HBCUs) to engage with department heads. A graduate teaching fellowship program for PhD students has supported 61 fellows, a majority of whom are women. And the society's awards and honors for engineering, education, and innovation all have a diversity component.

National Association of Multicultural Engineering Program Advocates (NAMEPA; www.namepa.org). Founded in 1979, NAMEPA consists of diversity professionals and advocates from academic institutions, industry, and nonprofit organizations, explained Darryl Dickerson, associate director of the minority engineering program at Purdue University and president-elect of NAMEPA. It provides services to deans and institutional leaders to cultivate diversity, equity, and inclusion by sharing evidence-based practices and using data to demonstrate impact. Some of its member activities focus on retention through bridge programs and mentoring and support services; others involve outreach and recruitment through preparation for college and exposure to engineering careers. Dickerson mentioned a program to work with third graders so that they are ready for algebra by seventh grade and ready for calculus in high school. In the area of professional development, the association provides certification, training, and support for advocates through such means as webinars. It also leverages networks of current and future engineering students, faculty, industry professionals, and organizational partners.

KEY TAKEAWAYS AND OPTIONS FOR MOVING FORWARD

In the final session, participants met in small groups to discuss takeaways from the presentations and possible options for moving forward. Members of each group then reported these in a final plenary session. While the following do not represent consensus recommendations of the workshop participants, they offer many ways of making continued progress.

- Find out how many professional societies are engaged in diversity and inclusion activities and the types and breadth of work they are doing.

- Determine the impacts of diversity and inclusion activities.

- Emphasize the shared values of technical societies and affinity societies so that students can affiliate with both and not feel that they have to choose one or the other.

- Examine organizations' institutional structures to determine whether these structures are perpetuating bias.

- Be intentional about asking people to volunteer for activities such as making presentations or serving on committees rather than waiting for volunteers.

- Share resources among organizations so that all can work more effectively on diversity and inclusion.

- Make diversity and inclusion activities pervasive and part of daily practice in an organization rather than compartmentalized and periodic.

- Be systemic rather than programmatic in promoting diversity and inclusion in organizations.

- Incorporate diversity and inclusion considerations, such as the Safe Zone training workshops offered by ASEE, into organizations' discussions and activities.

- Ensure that codes of conduct in academic and industrial organizations mention harassment, bias, and discrimination.

- Set expectations for representation by historically underrepresented groups.

- Require diversity and inclusion plans for accreditation.

- Consider the experiences and challenges of international students in diversity and inclusion programs.

- Consider different dimensions of diversity and inclusion to see which groups are doing well and which are not.

- Involve institutional leadership in discussions of diversity and inclusion issues so that diversity and inclusion are part of leaders' expectations.

- Make sure that institutional awards and honors reflect diversity and inclusion, perhaps through the creation of tiered levels of recognition.

- Make diversity and inclusion a core aspect of hiring and evaluation processes.

- Ensure that all levels of an organization, and all individuals associated with the organization, see diversity and inclusion as part of their jobs.

- Use networks and contacts to create opportunities to further diversity and inclusion.

The objective of the workshop was for representatives of engineering societies to "take stock and think about what's happening in your society or institution and where the opportunities are," said Leah Jamieson, the John A. Edwardson Dean of Engineering and Ransburg Distinguished Professor of Electrical and Computer Engineering at Purdue University and chair of the program committee for the workshop series. "The outcomes are going to depend on you. Where will you go personally with what happens today? Where will you go in collaboration with others?… There's a huge need, a huge passion, and a huge opportunity."

For additional information regarding the workshop, visit https://www.nae.edu/Activities/Projects/126089/167196/181467.aspx

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