Lisa Frehill, National Action Council for Minorities in Engineering

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Since earning her doctoral degree Dr. Frehill has developed expertise in the science and engineering workforce with a focus on how gender and ethnicity impact access to careers in these fields. While she was an associate professor of sociology at New Mexico State University, she was the Principal Investigator and Program Director of the National Science Foundation funded ADVANCE: Institutional Transformation program, which sought to increase women’s recruitment, retention and advancement in academic science and engineering. She has consulted with numerous colleges and universities on gender equity issues.

More recently, Frehill has worked with the Society of Women Engineers on a study of retention in the engineering workforce and the annual review of literature on women in engineering. She was the lead author of the Motorola Foundation-funded study released by NACME in 2008 titled “Confronting the ‘New’ American Dilemma: Underrepresented Minorities in Engineering: A Data-Based Look at Diversity” and the NACME databook.

Research in progress includes projects funded by the National Science Foundation on women’s international participation and collaboration in science and engineering and on career outcomes of engineering bachelor’s degree recipients. In addition, she is working on analyses of supply and demand for engineers and scientists.

Support for this research was provided by NACME with additional support via a grant from the National Science Foundation, Research on Gender in Science and Engineering HRD#0827461. Any findings or conclusions are those of the author and do not reflect those of the National Science Foundation.
Policy analysts and researchers who study the issues that face women of color often make reference to the double-bind such women often experience. The term “double-bind” dates to the 1970s Women’s Liberation Movement, which coincided with the maturation phase of other identity-focused social movements in progress at the time such as the American Indian Movement, the Chicano Movement, and the Civil Rights Movement. In all of these ethnic movements, women’s role was sometimes subordinated to that of men. Indeed, an infamous example of this perspective is found in the remarks of Stokely Carmichael, who in the 1960s said “The only position for women in the civil rights movement is prone.” Since that time, the relative position and role of women of color in a range of social outcomes, such as engineering bachelor’s degrees, has been unclear because of the complex ways in which ethnic and gender identities interact.

In the engineering context, identities and the ways that advocates of engineering education address them can have serious ramifications for the participation of women of color in engineering. The organizational context in engineering has often witnessed a parallel development of a Women in Engineering (WIE) office alongside a Minority Engineering Programs (MEP) office. Some institutions have both such offices, some have only one, and still others have combined these functions under a broad “diversity” heading. There are ongoing debates about the efficacy of combining versus maintaining separate offices. To some extent these debates are grounded in the different realities that may be experienced by women and minorities, while to another they are informed by serious questions about the distribution of scarce resources at the university.

This paper reports preliminary results of a pilot study that explores the following research questions within a set of nine institutions:

- What has been the trend in representation of women, underrepresented minority women, underrepresented minority men in engineering?
- What are the key features of MEP and WIE offices?
- To what extent do institutional/contextual factors affect the representation of women? At institutions with relatively high numbers of women of color, how are these student services structured? Does institutional type impact these organizations and outcomes related to women of color in engineering? (E.g., private/public, research-intensive or bachelor’s granting, engineering specialty and minority, etc.)
- What role can scholarship programs that target minority engineering students play in leveling the field for women of color in engineering? How can such programs keep in mind the double-bind for women of color within colleges of engineering?

The preliminary analyses in our paper focus on a specific subset of the 50 institutions that are in a partnership with a large non-profit engineering scholarship and research organization, the National Action Council for Minorities in Engineering, Inc. (NACME). Data on programmatic availability and general structure, combined with existing data on degree trends by ethnicity and sex will be analyzed to answer these research questions. Nationally, women of color represented
17 percent of all bachelor’s degrees awarded to underrepresented minorities in engineering in 2008 but accounted for 31 percent of all students at the 50 Partner institutions. Hence, studying the institutional context of this particular set of institutions holds forth some promise for understanding how we might increase women’s participation in engineering. In this paper, we present results of a preliminary study of nine of the NACME block grant partner institutions and plan to refine and expand these analyses in the next year.

The nine institutions represent three sets of three different institutional contexts. All nine are NACME block-grant recipients. This partnership represents investments by NACME in scholarships and research support to the institutions, and on the part of the institutions, themselves, which are required to implement programming shown to be effective in recruiting and retaining students of color.

First are three institutions in the State of California, which “looks like” how the United States will look by 2050 in terms of the race and ethnicity. Two campuses of the California State University System, Los Angeles and Sacramento, are grouped with the larger University of California at San Diego. These schools would be expected to shed some light on issues for Latinas, as Latinas are the largest URM female group. A second set of institutions are three engineering-intensive schools, which are private: Drexel University, Kettering University, Polytechnic of New York University. The final set includes three HBCUs: Prairie View A&M, Tuskegee and North Carolina State University.

**The General Context of U.S. Engineering**

Over the past 30 years, trends in engineering degrees have been uneven at the bachelor’s level, shown relative increases at the master’s level and a slow but steady increase at the doctoral level as shown in Figure 1. Unlike many other areas of science, technology, engineering and mathematics (STEM), a bachelor’s degree rather than an advanced degree, is the principle credential for entry to the engineering profession. Among students who earned a bachelor’s degree between 2003 and 2006, median earnings for those who secured employment upon graduation were $50,000, which is higher than median earnings in any other STEM field. About two-thirds of practicing engineers in the United States have no more than a bachelor’s degree although master’s education is becoming a more important mechanism for engineers to maintain and expand their job skills.

![Figure 1. U.S. Engineering Degrees 1979-2008](image)

*Source: Author’s analysis of IPEDS data via National Science Foundation’s WebCASPAR database system, accessed October, 2010.*
System (IPEDS) accessed via the National Science Foundation’s WebCASPAR database system\textsuperscript{17}, Figure 1 shows that, in general, U.S. colleges of engineering have been producing between 60,000 and 70,000 new engineers (at the bachelor’s level) each year since the late 1980s. The early decline in the 1980s leveled off and the field has had a modest resurgence in the number of degrees awarded in the past several years. Some analysts argue that the numbers are insufficient to meet the demands of U.S. employers for new engineers, with some analysts claiming that nearly twice as many engineers need to be produced each year. The Bureau of Labor Statistics indicates that growth will continue in engineering slightly ahead of the pace of the overall labor force through 2018, with especially high growth in civil and environmental engineering\textsuperscript{4}.

Graduate education in engineering has tended to attract more students from around the world than from the United States. In 2009, according to data collected by the American Society for Engineering Education, 44 percent of master’s degrees and 55 percent of doctoral degrees in engineering were earned by foreign students\textsuperscript{14}.

Prior to the 1960s Civil Rights Movement and legislation barring discrimination on the basis of race (the Civil Rights Act of 1964), engineering schools, along with many other social institutions were legally permitted to bar entry to their programs on the basis of race and other characteristics. Women, too, as a class were often denied entry on the basis of sex discrimination. The complex system of racial segregation of education and the attendant disparities in funding and curriculum at the K-12 level further hindered early efforts to enable full access to the range of STEM fields, including engineering, for underrepresented minorities* (URMs).

Indeed, pre-1964 there were six Historically Black Colleges and Universities (HBCUs) that produced the

\* Underrepresented minorities (URMs) include African Americans, Hispanics, and American Indians and Alaska Natives. With the changes in OMB instrumentation related to racial identification, the previous category “Asians and Pacific Islanders” was, after 2000, able to be disaggregated into its constituent parts. Some analysts treat Native Hawaiians and Pacific Islanders as an underrepresented group—which, is accurate when one examines relative numbers—but members of this group account for less than 1 percent of the U.S. population as a whole, which means that the group is often quite small in numbers in most data collections of educational and workforce data and not all reports separate these two groups. While Asians have experienced labor market and educational discrimination, they tend to be overrepresented in the STEM fields (and engineering in particular) so issues for this group are not the focus of the proposed study.
majority of African American engineers and even after 1969, in the period from 1969 to 1973, these same institutions continued to produce nearly half of all new black engineers despite the changes in laws regulating access to higher education. The six HBCUs were Prairie View A&M, North Carolina A&T, Howard University, Tennessee State University, Tuskegee, and Southern University.

The trend since the late 1970s in the relative percentage of engineering degrees earned by women and those earned by URMs is shown in Figure 2. As with Figure 1, these data are IPEDS data that are publicly available via the National Science Foundation’s WebCASPAR database system. This is an interesting pair of curves showing that the real period of relative increase for URMs was between 1987 and 1999 with a recent leveling off of URM representation in engineering at just over 12 percent of all bachelor’s degrees, as shown by the solid line. Women’s relative representation among engineering degrees, indicated by the dotted line, shows two periods of increase: one that started in the 1970s and lasted through 1985 and another in the latter half of the last decade of the 20th Century. Indeed, recently, the overall number of women earning engineering degrees has declined slightly at the same time that the number earned by men has slightly increased, yielding the downward relative trend shown in Figure 2.

Figure 3, again using IPEDS data, shows the numbers of degrees that have been awarded to members of each of the three URM groups between 1979 and 2008. Among African Americans, the number of engineering bachelor’s degrees steadily increased over the 20-year period between 1975 and 1995 but has fundamentally leveled off at about 3,000 degrees annually since that time. For Hispanics, however, the story is much different: as this group’s representation within the 18-
24 year old population has increased—and will continue to do so according to U.S. Census Bureau projections—so too have the number of engineering degrees earned by members of this diverse ethnic category. It should be noted, though, that while members of these three groups account for about 35 percent of 18-24 year olds, they still account for just over 12 percent of all engineering bachelor’s degree recipients as shown in Figure 2.

Interventions: Efforts to Increase Minority Participation in Engineering

Because of the relatively low number of women who pursue engineering, in many institutions, women have been defined as a “minority” with respect to engineering. Over the years, special programs, such as Women in Engineering Programs (WIE) have attempted to increase the recruitment and retention of women to undergraduate engineering. Likewise, many colleges of engineering have put in place outreach efforts to increase minority participation in engineering, often referred to as Minority Engineering Programs (MEPs). These efforts, to a large extent, have tended to be a bit more diverse than the WIE efforts, simply because the various racial/ethnic-specific issues and strategies have differed more than those related to increasing women’s participation in the field.

The relation between WIE and MEP staff and programming will be an issue that we explore in greater detail later in our proposed research. Many MEP and WIE programs that once were separate have been merged in recent years, often due to resource issues, but also as a result of external forces such as the passage of Proposition 209 in California and the Hopwood decision in Texas. Many institutions that were concerned about targeted programs, then, combined their WIE and MEP programs under a larger, less politically problematic aegis of “diversity programs.” Administrators involved in these programs were concerned their specific focus group and effort might be undermined or supplanted by attention to the other group’s interests and needs. Also, there can often be a very real problem with these mergers because the issues for recruitment and retention of URMs are very different than those related to gender in engineering. That is, while the gender gap in preparation for engineering study has been closed for some time there remains a very large gap in URMs’ secondary mathematics and science preparation for engineering. The movement to consolidate WIE and MEP programs under one diversity umbrella varies across institutions and has important implications for outcomes for the groups they aim to serve.

Early efforts to increase the recruitment of minorities into engineering were initiated in the early 1970s. These early efforts had one foot planted in the social equity issues that were at the heart of the civil rights movements, citing the need to bring more minorities into engineering as soon as possible. J. Stanford Smith, a Vice President of General Electric in 1972 stated the logic behind this need succinctly:

[I]t takes fifteen to twenty-five years for people to rise to top leadership positions in industry. So if industry is getting one percent minority engineers in 1972, that means that in 1990, that’s about the proportion that will emerge from the competition to the top leadership positions in industry....(J. Stanford Smith, speech at Engineering Education Conference, June 25, 1972, quoted in The
A first group was organized in 1972, called the Minority Engineering Education Effort (ME²) was sponsored by the Engineers Council for Professional Development to engage in outreach to talented high school students. In May 1973 the National Academy of Engineering (NAE) held the Symposium on Increasing Minority Participation in Engineering. Two other organizations were born from this symposium: the NAE formed a Committee on Minorities in Engineering and a group of corporate leaders formed the National Action Council for Minorities in Engineering. By the time the NAE produced its volume, *Proceedings of the Symposium on Increasing Minority Participation in Engineering*, at least 20 institutions had implemented special programs to recruit minority students into engineering. By the late 1970s, according to Blackwell, at least half of the nation’s 282 colleges of engineering were engaged in some sort of focused recruitment effort to attract minority students². Finally, the 1974 Annual Meeting of the American Association for the Advancement of Science included a number of symposia to address the issue of increasing minority representation in science and engineering²,¹⁹.

As more MEP programs were developed at engineering colleges, the professionals involved in these efforts sought to develop a network by which they could share ideas. The National Association of Multicultural Engineering Program Advocates (NAMEPA) has worked to organize the efforts of college and university MEP professionals. Founded in 1979 as the National Association of Minority Engineering Program Administrators, NAMEPA “has served to increase the effectiveness of educators, corporations, government agencies, and nonprofit organizations…[to expand] the number of traditionally underrepresented minority engineers.” The National Academies continued to be active in the late 1970s, too, publishing a resource directory of MEPs¹⁹.

**Challenges to Diversity Efforts**
In 1996 California’s Prop 209, the Hopwood decision in Texas, and the more recent Supreme Court ruling in the University of Michigan case, all represent challenges to “targeted programs.” The effect in California was particularly chilling, with anti-diversity groups forming to monitor and ensure educational institutions’ compliance with the proposition. These challenges have caused institutions to move away from simple and towards more complex systems to assess, for example, students’ applications for admission and for scholarships, that take into account many factors rather than relying on standardized test scores. Issues related to diversity can still play a role in these processes, but they must do so in a way that does not mean that a students’ race or ethnicity is the sole factor in the decision¹⁵.

The first WIE program was started at Purdue University in 1969 but most other programs had their genesis in the 1980s much later than the 1972 Title IX ruling that barred discrimination by institutions based on sex. Up until that time, the Society of Women Engineers (SWE), founded in 1953, was the main national membership organization that represented women in the field. SWE’s focus was on working women engineers versus the WIE focus on recruiting women to the field in college. Whereas many MEP programs grew out of the 1973 National Academy of Engineering symposium, and the professional organization associated with these college administrators, NAMEPA, the Women in Engineering Programs and Advocates Network
As with similar types of efforts in other contexts\(^1\), from their inception, though, WIE programs, when they were started at institutions with existing MEP programs, faced a variable climate that depended upon how the programs were established and integrated with each other. In instances where tight resources left MEP administrators with the impression that their budgets had been cut to enable the establishment of a new office or when WIE administrators seemed to lack a background and understanding of issues that affected minority women, the relations between the two offices could be tense. At the other end of the spectrum, in situations where there was not the appearance of a “zero-sum” game with resources for diversity efforts in engineering and administrators took additional effort to ensure that that the leaders of the two efforts collaborated, a more collaborative arrangement could occur\(^8,20\).

**Data and Methods**

Several sources of data were used for this paper, which, again, should be viewed as an initial exploration. First, data on bachelor’s degrees were obtained from the Integrated Postsecondary Education Data System (IPEDS) accessed using the National Science Foundation’s WebCASPAR data system. These same data were used earlier to show general national trends in degree awards to women and minorities in engineering. IPEDS data are collected annually by the National Center for Education Statistics from all Title V institutions (those that receive any Federal funds), which is virtually every college or university in the United States. Data are provided at the institutional level on degrees awarded by field, degree level, sex, race/ethnicity, and citizenship status. The IPEDS data also include institutional information such as Carnegie classification, state, and highest degree level, among other data.

Because the numbers of minorities receiving degrees in engineering, and especially of minority women, are small, year-to-year changes can appear to wildly fluctuate due to these small numbers. Therefore, as is commonly the case in social data analysis, we used three-year moving averages to examine minority participation in engineering at the schools under consideration. So the most recent three-year period was 2007-2009, inclusive.

Next, we collected data about the efforts related to women and minorities at nine of NACME’s 50 partner universities. We limited ourselves to a purposive sample from among the 28 that were “block grant” institutions, which receive substantial scholarship funding from NACME and are held accountable to specific goals in terms of retention of both NACME scholars and underrepresented minorities. Institutions are expected to implement programming that has been shown to improve the likelihood that students, especially minority students, are successfully retained to graduation including but not limited to: mentoring, supplemental instruction, bridge programming, tutoring, support groups, etc \(^21\).

Selection of institutions was purposeful. In order to examine the issues for MEP and WIE within different institutional contexts, therefore, we chose to look at institutions that would provide some variation, yet also some meaningful comparisons. First, we selected a set of schools...
located in California, where Prop 209 has had a major impact upon diversity efforts\textsuperscript{15}: California State University - Sacramento, California State University – Los Angeles, and University of California at San Diego. Next, we selected three institutions with a strong engineering tradition and focus: Drexel University, Kettering University, and Polytechnic University of NYU. Finally, the three NACME’s block grant schools that are HBCUs were examined: Tuskegee, Prairie View A&M, and North Carolina State A&T.

We used the world wide web to collect data about the engineering schools at these nine institutions. We completed searches for programs that were generally supportive of women students (i.e., women’s resource centers and women’s or gender studies programs) as well as specific WIE programs. Likewise, we looked at the role of MEP programming within the college of engineering. Student organizations are important within engineering schools: some institutions provide much support to these organizations while others provide few resources. We looked at the websites associated with the key organizations that relate to diversity issues: Society of Women Engineers (SWE), National Society of Black Engineers NSBE), and the Society of Hispanic Professional Engineers (SHPE). Because of the fluidity of student organizations, we paid particular attention to the apparent current status of the organizations—were they still active? What activities did they engage in? Were photos of members inclusive?

**Findings**

**Degree Data**

The first series of charts shows the trend, since 1977, in bachelor’s degrees awarded to underrepresented minorities at the three sets of institutions under consideration. The first set of institutions, three universities in California, show growth in the representation of URMs among the recipients of bachelor’s degrees in engineering, especially at the California State University Los Angeles campus. Growth at the Sacramento campus increased since 2005 after a period of stagnation. Although there has been a slight increase in URM representation at the University of California at San Diego, the representation of URMs among engineering bachelor’s degree recipients has leveled off at about 10 percent.

At the engineering-intensive institutions, URM representation has been very uneven at Polytechnic, which has recently become a unit of New York University. Like CSU, Sacramento, though, after 2005 there has been a marked increase in the percentage of engineering bachelor’s degrees earned by URMs to one-in-five. Drexel and Kettering, though, have clearly had greater challenges in graduating URMs with only modest improvement in URM representation and a decline since 2005 at Drexel and since 2004 at Kettering.
Finally, not surprisingly, the three NACME HBCU block grant universities awarded nearly all of their engineering bachelor’s degrees to URMs. All have, however, witnessed recent declines in URM representation, with the most marked decline at Tuskegee. Still, more than 70 percent of bachelor’s degrees at each of these institutions were earned by URM students in the 2008-2009 period.
The next series of charts shows the numbers of degrees awarded to URMs and non-URMs, separately by sex. Two time-periods are shown: 1987-1990 and 2007-2009. The data for 2007-2009 represent a true three-year average, while 1987-1990 is a three-year average of the three available years: 1987, 1989, and 1990. This was the earlier three-year period available in the IPEDS data used for this paper. Figure 7 shows the two California State University campuses, Los Angeles and Sacramento, both awarded fewer degrees in engineering in the later period (2007-2009) than in the earlier period, but the University of California at San Diego has seen a nearly doubling in the number of engineering degrees. The overall number of degrees depends largely upon the participation of non-URM males, which includes Asian and Pacific Islanders, a significant group in California, as well as whites. URM females, shown by the thin sliver of dark black in each of the sets of stacked bars are barely present among engineering bachelor’s degree graduates from any of these institutions in either time period. Indeed, their numbers are so small, that it is nearly impossible to discern the increase in 2007-2009 versus 1987-1990. The numbers of non-URM females appears unchanged at the two CSU campuses but has clearly increased at UC San Diego.

The number of URM females among engineering bachelor’s degree recipients has clearly increased at Drexel, slightly increased at Kettering and has slightly decreased at Polytechnic, as shown in Figure 8. Again, though, the thin slices of black in these stacks reveals the significantly low numbers of URM females among engineering bachelor’s degree recipients at all three institutions in both 1987-1990 and 2007-2009. The numbers of URM males among graduates has declined at Polytechnic, increased very slightly at Drexel and stayed about the same at Kettering. All three institutions have witnessed declines in the number of degrees awarded to non-URM males, with decreased numbers to non-URM females at Kettering and
Polytechnic. Drexel, which shows an increase in the number of degrees awarded to URM females also shows an increase in the number awarded to non-URM females.

Figure 7 Number of Engineering Bachelor's Degrees by Sex and Ethnic Category, California Block Grant Universities, 1987-1990 and 2007-2009

![Average Annual Engineering Bachelor's Degrees, NACME California Block Grant Universities](image1)

Source: Author’s analysis of Integrated Postsecondary Education Data System degrees access via the National Science Foundation WebCASPAR database system, January, 2011.

Figure 8 Number of Engineering Bachelor's Degrees by Sex and Ethnic Category, Engineering-Intensive Block Grant Universities, 1987-1990 and 2007-2009

![Average Annual Engineering Bachelor's Degrees, NACME Engineering-Intensive Block Grant Universities](image2)

Source: Author’s analysis of Integrated Postsecondary Education Data System degrees access via the National Science Foundation WebCASPAR database system, January, 2011.

The picture is very different at the HBCUs, shown in Figure 9. These institutions have historically been critical in the production of African American engineers, but, traditionally very male-dominated. The representation of women among engineering graduates from these schools...
is noteworthy, yet, only North Carolina A&T has seen an increased number of degrees earned by women while Prairie View has about the same number and Tuskegee has a marked decline in the number of engineering bachelor’s degrees awarded to women in the 2007-2009 period as compared to the 1987-1990 period. A similar trend is noted for men: while North Carolina A&T has seen an increased number, Tuskegee and Prairie View have had declines in the numbers of URM men among engineering bachelor’s degree recipients.

Figure 9 Number of Engineering Bachelor's Degrees by Sex and Ethnic Category, HBCU Block Grant Universities, 1987-1990 and 2007-2009

![Figure 9](image)

Source: Author’s analysis of Integrated Postsecondary Education Data System degrees access via the National Science Foundation WebCASPAR database system, January, 2011.

The final set of graphs drill down into the URM category to look at its composition. American Indians and Alaska Natives are relatively small groups, so, even though the data from this category was included in the larger URM category, they are not included here. Not surprisingly, the HBCUs award almost all of their engineering bachelor’s degrees to African Americans, with a little more than a third to women and just under two-thirds to men. The engineering-intensive institutions awarded 276 engineering bachelor’s degrees in engineering to URMs, of which 68 percent of these were earned by African Americans and just 32 percent by Hispanics. It is interesting to note, though, that Hispanic females’ representation among the 460 bachelor’s degrees awarded to URMs in the three California schools—where Latinas are a significant part of the populations—was only slightly higher than that at the engineering-intensive institutions. The relatively high level of participation—although not at parity—of African American women at both the engineering-intensive and the HBCUs is important to note.
WIE, MEP and Other Programming to Support Women and Minorities in Engineering

We completed web research on each of the nine NACME block grant institutions reviewed in this paper. This section reports our findings from this research activity. Each site for each university and then each college of engineering (as appropriate) was searched for key terms: women’s studies, women’s center, women in engineering, minority engineering, etc. Student organizations are key in the engineering school experience, so I would also look at the list of student organizations and then examine the websites for the three major ones that have to do with identity: NSBE (National Society of Black Engineers), SHPE (Society for Hispanic Professional Engineers), and SWE (Society of Women Engineers). To what extent are officers and other “key participants” women and men? To what extent does the college of engineering have content (pictures) that feature women and men? How recent is the information on the student pages? Does it look like the student organizations are active?

We found that while women’s studies programs—and their more recent incarnations, gender studies programs—and women’s centers are not, specifically located within a college of engineering, their presence can reflect an availability of services and programming that is woman-centered and woman-identified. These programs and centers may not specifically work with the college of engineering, but they provide access to content that is unlikely to be covered in a college of engineering and is often not incorporated into WIE programs.20

Women in Engineering (WIE) programs, like Minority Engineering Program (MEP) offices, typically at predominantly-white institutions, often seek to increase recruitment and retention of underrepresented groups in the college of engineering. These offices vary greatly in terms of the way in which they are organized, their budgets, reporting lines, and the like. In recent years, too, when a campus had two such offices—both a WIE and an MEP—consolidation into one program has occurred8. Reasons for consolidation differ across institutions. Some face challenges to any targeted efforts as a result of external forces, such as Prop 209 in California, so consolidating and adopting a less obvious name such as “Office of Engineering Diversity” may be a way to avoid
negative attention. In other cases, as funding tightens in higher education and/or engineering enrollments decline (which affects state formula funding), engineering colleges need to tighten their budgets so that programs that appear similar are merged.

Of course, the challenges for women, on average, and for students of color, on average, differ in engineering schools. Women’s pre-college preparation in mathematics, physics, and chemistry is now on parity with that of men. But the preparation of Hispanics and African Americans in these same courses continues to lag far behind that of whites, especially in pre-calculus, calculus, and physics. These preparation differences, then, mean that women represent a viable pool of students that is not being sufficiently tapped by engineering schools. Minority students, while it is clear that the pool is not being tapped, with lower levels of preparation are a less attractive group to engineering schools: on average, such students are more likely to need remedial classes, which add time to an already-full engineering course of study. These data also illustrate part of the challenge for women of color because these data are available for race/ethnicity and sex but not for ethnicity and sex simultaneously.

Out of the nine institutions, only one appeared to have a formal WIE program: Kettering University. At Kettering, though, the WIE program was distinct from the MEP but it was also clear that the distinction enabled the programs to be able to address the issues that were either gender-specific or race/ethnicity-specific. That is, as discussed earlier, women, on average, have similar levels of preparation for engineering as men, so the supports that institutions need to implement relate to community building for women so that when they encounter difficulties, they can weather these and persist in engineering school. Kettering also had a women’s center. The WIE was under the Associate Provost and Dean of Students, who was a woman. The SWE chapter was very active: at the 2009 SWE National Conference, Kettering held an alumnae reception, reflecting the institution’s long history of support for SWE.

The Kettering MEP program was named the “Office of Multicultural Student Initiatives,” reflecting a more contemporary mission. The office was staffed entirely by African Americans (five staff), with three staff members dedicated to pre-college efforts. Two of the staff were highly educated: one staff member had an Ed.D. and another had earned a Ph.D. and was also a “Consultant to the President,” which suggests that issues for minority students are considered important enough to merit presidential oversight at the institution. The pre-college effort is clearly intended to address the persistently low representation of ethnic minorities among the institutions graduates, which was shown in the previous section. Both SHPE and NSBE had chapters, but the strong student organization for African American students was the Black Unity Congress, which sponsors many multicultural events during the year.

The other two engineering-intensive institutions, Drexel University in Philadelphia and Polytechnic of New York University in Brooklyn, NY had little programming or attention to gender issues. At Polytechnic, race/ethnicity and gender issues were almost completely absent from the website. A list of scholarships, though, revealed the diversity of the school, including many opportunities targeted at various groups, including particular immigrant groups of various origins. At Drexel, the SWE chapter appeared “active-ish” while NSBE and SHPE seemed inactive. Further, Drexel was a participant in a Louis Stokes Alliance for Minority Participation grant, which is how the college of engineering appeared to compartmentalize the special services
that were necessary for underrepresented minority student success. Without an active SHPE, SWE, or NSBE chapter, it is unclear the extent to which the engineering students have access to communities of collaboration, which are essential in engineering school for both the overt reason (skills) and the less obvious social networking/connectivity issues that are important for student retention (Tinto 1993).

The three HBCUs among NACME’s partners, Prairie View A&M University, Tuskegee University, and North Carolina A&T University (NC A&T), generally had little attention to gender issues evidenced on their websites. Both Prairie View and Tuskegee lacked any attention to gender issues in any way. SWE’s presence varied: from being non-existent at Tuskegee to having a presence at Prairie View and NC A&T, albeit with unclear current activity level. Only NC A&T had a women’s studies program, indeed, the program’s courses focused on the experiences of women of color, in general and on the experiences of African American women in particular. NSBE was present at all three institutions and despite a generally “masculine edge” to the Tuskegee site, a woman was the president of the very active NSBE chapter there. In a nutshell, there was little evidence of attention to gender issues at either Prairie View or Tuskegee with stronger evidence of such attention at NC A&T.

The three California institutions, which have a stronger Latino/a presence, as shown in the previous charts were reviewed. All three of these institutions had fairly strong non-engineering gender-based programs and women’s centers. Indeed, CSU Sacramento’s Women’s Studies program had been founded in 1971 by the legendary Kate Millet. CSU Sacramento had chapters of NSBE, SHPE, and SWE. The NSBE website was last updated in 2008, with the SWE site showing photos of more recent events. SWE’s photos indicated that the organization included women of apparently diverse ethnic backgrounds as well as men (although there were only a handful of men).

The CSU Sacramento SHPE chapter was especially active, with high levels of participation by both men and women and many activities. Weekly study tables, family-oriented events, sporting events, academic events, etc. were held on an on-going basis by the SHPE chapter. The “about us” section of the website leads with the following:

“Today more than ever, our youth needs to dream, but dreaming can not take place if there isn’t hope. That is why our Sacramento State University SHPE chapter has been at the forefront of the promotion of higher education. Our members with the help of our chapter advisor, Marianna Rivera and the Dean of the College of Engineering and Computer Science, Dr. Emir Jose Macari, were able to reach out to hundreds of kids and their parents in the community with a cultural touch.” (http://gaia.ecs.csus.edu/~shpe/about.html)

In short, as reflected in this quote, the chapter frames its activities in a gender-inclusive way and has both female and male leaders as role models. Three of ten officers were women, who served as treasurer, fundraising director and events director. While CSU Sacramento engineering has experienced declining production of bachelor’s degrees in the 2007-2009 period as compared to the 1987-1990 period, there has been growth in the average numbers of Hispanic males and females, especially since 2005.
The website review of the CSU Los Angeles campus revealed that the SWE chapter was quite strong and active, with photos that included more than a handful of men, while the local SHPE chapter, which was called the Society of Hispanic Engineering and Science Students (SHESS) seemed to be inactive. The website for this latter student organization had an animated image, which was a broken link, and no other links.

The UCSD website review revealed a high level of integration of gender and ethnic diversity efforts in multiple ways. The campus women’s center was staffed by an apparently diverse group and held events that reflected close attention to diversity and cultural issues. The campus has a generally strong emphasis on diversity, with committees at the university level and equity advisors in the colleges. Equity advisors were an innovation that originally grew out of the University of California at Irvine’s ADVANCE: Institutional Transformation program (an NSF-funded, $3.5 million 5-year effort to increase recruitment, retention, and advancement of women in academic STEM fields). It was clear that the faculty at the campus had embraced the diversity efforts and were committed to their success and that gender and ethnic diversity efforts were highly interrelated and connected. The SWE, NSBE and SHPE chapters were all up-to-date and operational.

**Discussion and Conclusions**

This paper reports initial, exploratory findings about how engineering schools are attentive to issues for women and minority students. As an exploratory study, therefore, care must be taken in interpreting our results. Clearly, additional research is necessary to better understand how women of color “fit” within the organizational structures of engineering schools.

The difficulties for women students often stem from larger gender issues related to stereotype threat, solo status, and the like. The average female student enters engineering school academically well-prepared, therefore community-building activities and those designed to provide mechanisms for women to feel they have a place in the engineering school are important. Hence, across these institutions, formal WIE programs tended to be non-existent (except at Kettering) and, instead the SWE chapter was an avenue for providing these supports. It is noteworthy that at some institutions the SWE chapter also provided these supports to male students, including men of color, especially in cases where the institution lacked an active ethnic-based student organization such as CSU-Los Angeles.

Underrepresented minority students, on average, enter engineering school with lower average levels of preparation for engineering coursework. Indeed, NACME has found that when considering course-taking data by high school seniors, only 4 percent of underrepresented minority students possess a sufficiently strong high school academic record to immediately enter and complete a rigorous college engineering program in just four years’ time. Hence, programming for these students needed to address these particular issues. Few of the campuses had formal, overt MEPs: instead, with the exception of Kettering, the academic supports and outreach to minority communities were “buried” in student support services or were provided by the SHPE chapter (at CSU Sacramento) or NSBE (Tuskegee). While the ethnic-based organizations of NSBE and SHPE served similar functions as SWE did at some institutions in
terms of community building for member students, to some extent those chapters that were relatively gender equitable such as NSBE at Tuskegee and SHPE at CSU Sacramento (reflected by officers, photos, events and discourse on the website) served important bridging functions for women of color.

While we have examined only a handful of colleges, this paper has provided us with a useful starting point from which we can develop a more formalized coding system for capturing the relationships between women-oriented and minority-oriented programming in engineering schools. Further, by connecting these analyses with data on engineering school outcomes, we may be able to shed light on those aspects of programmatic structure that are effective in increasing minority, women’s and, in particular, minority women’s participation in engineering. In addition to the degree data we have presented here, NACME collects data on retention to graduation at its 28 block grant institutions for NACME Scholars, all underrepresented minority students and for all other students. As we further build this project over the next couple of years, we will be able to more formally model degrees and retention as key dependent variables.

Here, too, we emphasized using secondary and existing sources to form initial impressions about the role of gender equity in the institution. A next step is to more formally codify these and then to engage key personnel at each institution in an interview to explore the nature of the relationships between the ethnic-based and gender-based programming.

References


