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North Carolina State University Center for Minority Engineer Development

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Abstract: North Carolina State University, located in Raleigh, North Carolina, USA, is the largest state-supported university of the sixteen-campus University of North Carolina educational system. The College of Engineering at NC State University is among the best in the country, offering outstanding degree programs and preparing students for exciting and rewarding careers. Our graduates are heavily recruited internationally for positions in a variety of settings, including business management, construction, transportation, hardware and software development, computer engineering and design. The College of Engineering comprises 10 departments offering 16 BS, 17 MS, and 14 Ph.D. degree programs and conducts the largest undergraduate and graduate engineering education and research programs in the State of North Carolina. The College continues to rank among the United States of America's leading colleges in the total number of degrees awarded, the number of degrees awarded to women and minorities, the quality of the graduate programs, and research and extension activities. The profession of engineering faces significant challenges in developing a well qualified diverse workforce in sufficient numbers to meet projected needs. Contributing to the shortage of students pursuing engineering degrees is a lack of public understanding of the field and a perception that the field is not open to women and minorities. Both of these problems must be addressed as widely as possible. But information dissemination to adults is too little, too late. Under the Center for Minority Engineer Development, the NC State College of Engineering Directors of Minority Engineering, Recruiting, and Women in Engineering Programs are moving to provide blanket, effective support to, and coverage of all constituents. These constituents include the engineering academic departments, dozens of primary and secondary schools in North Carolina, and scores of major corporations that annually recruit our students for jobs all over the world.

Key Words: Activity, diversity, engineering, model, minority

1. National Minority Student Enrollment, Graduation and Success

According to the National Action Council for Minorities in Engineering [NACME], Inc., freshman enrollment, the gateway through which minorities enter the engineering profession, is considerably smaller today than it was five years ago. From a peak enrollment of 15,181 African-American, Latino and American Indian freshmen in 1992-93, minority freshman enrollment declined 8.2 percent, dropping to 13,929 in 1997-98. As a share of the class, minority students lost ground also, falling from 16.4 percent of all freshmen that enrolled in 1992-93, to 15.7 percent in 1997-98. Not surprisingly, for both African-Americans and Latinos, losses were concentrated among engineering institutions enrolling the largest numbers of, and providing the greatest access to minorities [1]. While historically black colleges and universities (HBCUs) continue to enroll and graduate the largest share of African-American engineers [2], employment opportunities, aggressive recruiting and the comprehensive nature of major traditional white institutions (TWI) contribute to the increased opportunities for African-Americans to earn engineering degrees at these institutions. For decades several programs at the national and local levels have been developed and attempted to help meet the projected shortage anticipated in an ever-increasing high-technology work force. For the first time ever, Bowen and Bok recently published results of a comprehensive longitudinal study of one specific, significant thrust at addressing minority student success: affirmative action. Their study [3] provides defensible, concrete proof of the positive impact affirmative action has had not just on the minority participants, but also on society as a whole. While such results are notable from a historical perspective, anyone serious about minority student success will quickly acknowledge that there remains tremendous work to be done in reaching a point where access to education, and a diverse, well-prepared work force pool are assured.

2. Focus on North Carolina

In recent correspondence to our College of Engineering associated with the transmittal of a grant from its new Minority Engineering Recruitment and Retention Initiative, top-level officials of a major international high-technology employer expressed its industry's sentiment succinctly by stating "we believe in the future that we are all trying to build together. We believe that this world will only reach its full potential when those of us of like mind put our commitment, our spirit and our resources behind the development of young people, who will ultimately lead the way. Clearly these individuals must look like the mosaic that our world has become." [4]

The State of North Carolina had been at the forefront in implementing progressive programs and initiatives that address minority student success. At its annual conference in Washington, D.C. during February 1998, the Quality Education for Minorities (QEM) Network released a national action plan [5] developed in conjunction with North Carolina. This action plan is designed to enhance the state's likelihood at meeting or exceeding its "fair share" of the new science, engineering and mathematics minorities entering the national workforce. Along with the release of the action plan and its companion Top Ten Colleges and Universities Report [6], QEM officials honored the state and its top-level officials for "helping lead the nation" in production of minority undergraduates in mathematics, science and engineering. As one of the 16 institutes of higher education so recognized, NC State University's College of Engineering set the pace.

3. Brief Background on the NC State University College of Engineering

North Carolina State University is the largest state-supported school of the sixteen-campus University of North Carolina system. The College of Engineering at NC State University is among the best in the country, offering outstanding degree programs and preparing students for exciting and rewarding careers. Our graduates are heavily recruited for positions in a variety of settings, including business, construction, transportation, hardware and software development, and design. The College comprises 10 departments offering 16 BS, 17 MS, and 14 Ph.D. degree programs and conducts the largest undergraduate and graduate engineering education and research programs in the State. The College continues to rank among the nation's leading colleges in the total number of degrees awarded, the number of degrees awarded to women and minorities, the quality of the graduate programs, and research and extension activities. The College ranks seventh nationally in the number of undergraduate engineering degrees awarded. With a spring 2000 enrollment of enrollment of 5,097 (1,017 freshmen, 1,172 sophomores, 1,214 juniors, 1,716 seniors, and 18 unclassified), the College of Engineering is the largest of the NC State campus units that make up the University enrollment of about 27,000. Each year, over 1000 new high school graduates enter the College of Engineering. Approximately 20% of each entering freshman class are members of an under-represented minority ethnic group. Total undergraduate minority engineering enrollment for spring 2000 includes 548 African-Americans, 129 Hispanics, and 39 Native Americans. Female students make up between 19 and 20% of the entering class of engineering students each fall. NC State University has the second largest African American engineering undergraduate enrollment of all non-Historically Black Colleges and Universities (HBCUs) in the nation. Among non-HBCUs, we award the second highest number of Bachelor of Science in engineering degrees to African-Americans.

4. Descriptive Components of the NC State Center for Minority Engineering Development

4.1 Motivation for Establishing CMED

The profession of engineering faces significant challenges in developing a well qualified diverse workforce in sufficient numbers to meet projected needs. Contributing to the shortage of students pursuing engineering degrees is a lack of public understanding of the field and a perception that the field is not open to women and minorities. Both of these problems must be addressed as widely as possible. But information dissemination to adults is too little, too late. Since 1995 in the College of Engineering at North Carolina State University, we have administered the University of Pittsburgh "Attitude About Engineering" questionnaire [7] to entering engineering students at the beginning and end of their first year Introduction to Engineering Course. The analysis of these surveys consistently indicates that female engineering students begin their college careers less confident in their ability to succeed in engineering than their male colleagues. This confidence gap persists and, in fact, deepens over the course of their early career, even though they take only basic introductory classes and no disciplinary specific classes. Female students' confidence in physics fell over the course of their first semester, despite the fact that they do not take a

physics course. Yet the female students' grade point averages were generally a full 0.2 higher than their male counterparts [8,9].

Creating CMED allows us to formalize an umbrella infrastructure for developing, expanding, managing, and evaluating the success of several programs or concepts currently in various life-cycle stages. All programs and activities are intended to have a dramatic, positive impact on the number of minorities and women graduating from NC State University with an undergraduate engineering degree.

We expect a significant, sustained increase in the number of under-represented minority and women engineering graduates that result from two major thrusts: 1) Increasing the undergraduate minority and women engineering population; and 2) Providing more intense mentoring experience for continuing students.

The primary population served under CMED includes under-represented minority and women engineering students. Outreach and recruiting focus will range from K-12 primary and secondary school. Our efforts mentoring efforts will target the undergraduate minority and women populations as we impact their successful job or graduate school placement following receipt of the undergraduate engineering degree.

4.2 CMED Organizational Structure

Under the CMED, our Directors of Minority Engineering, Recruiting, and Women in Engineering Programs are finally be able to provide blanket, effective support to, and coverage of all constituents. These include the engineering academic departments, dozens of primary and secondary schools in North Carolina, and scores of major industry firms that annually recruit our students.

4.3 CMED Target Areas

The five specific activities targeted by CMED are: 1) Academic Scholarships for recruiting and increasing the diversity of our undergraduate engineering student population; 2) Dramatic expansion of pilot mentoring programs that impact retention; 3) Engineering outreach that allows us to use engineering student ambassadors and far exceed the 15 public schools visited through outreach last year; 4) Faculty incentive support for participating in recruitment and undergraduate research; and 5) Expansion of research experiences for undergraduates.

4.4 Current CMED Activities

Activity #1: Student Advancement and Retention Teams (START)

This student-centered program is an aggressive early intervention and peer-mentoring program for minority engineering students. Compensated mentors chosen from among graduate and upper class undergraduate minority engineering students are each assigned five to eight minority mentees. These mentors act as big brothers or big sisters to their mentees, meeting weekly as a START group to discuss academic and social maturation issues. The START leaders meet regularly with minority engineering program staff to insure awareness of any evolving concerns. Approximately 125 students are involved.

Activity #2: NC State College of Engineering Summer Transition Program (STP)

This program begins enhancing the academic and social maturation of incoming minority engineering freshmen prior to the start of the regular academic year. Fifty to 75 minority engineering freshmen participate in this program conducted during the second summer academic session. Participants receive instruction and where applicable, academic course credits in mathematics, English, and a science course. In addition, they gain early hands-on experience in engineering design, and an introduction to the College of Engineering computing environment. Weekly industry site visits introduce the students to opportunities available to them as they move through their undergraduate program, and seek permanent employment. Approximately 90 students are involved in this program.

Activity #3: College of Engineering Professional Student Development Courses

The minority engineering staff administers E144 and E145, Professional Student Development I & II. These courses are designed specifically for first year minority engineering students, and serve to help increase the possibility of student success. Course topics in the fall semester (E144) include time management, social adjustment, expectations, leisure alternatives, test management, and other issues relevant to minority student success. The spring course topical coverage includes effective communication, resume writing, interview skills, internships and co-operative education, critical thinking, and portfolio preparation. This program serves about 130 students annually.

Activity #4: Minority Scholarship Monitoring

This function monitors for corporate or private donors scholarship awards made to target minority engineering students. Scholarship recipients are selected by the funding agency, and most awards are made to minority engineering students directly by corporate donors (Dupont, Eli Lilly, Procter & Gamble, etc.), or national agencies that promote minority success in engineering (NACME, GEM). Our involvement includes dissemination of the scholarship applications to eligible students, processing of award reports when warranted, and facilitating internship and permanent job placement. Two hundred to 250 students are impacted annually in this activity.

Activity #5: College of Engineering Writing Assistance and Tutorial Programs

Description: Engineering has a full-time permanent professional staff who work aggressively and continuously with all students to improve their writing and academic course work performance. Assistance is available on a walk-in basis, individually or as a group. Students can obtain writing assistance with any writing effort, regardless of course or purpose. Resume writing is a key help-area, and is an integral part of special orientation courses designed for minority engineering students. Last year, this program provided assistance to 302 students during 1,378 tutorial sessions for 1,878 hours with another 447 students received writing instruction.

Activity #6: Engineering Outreach Teams

EOT's composed of both faculty and students make regular visits to K-12 institutions around the state of North Carolina. These teams take with them hands-on activities to use interactively with the younger students they are visiting. The teams have a variety of purposes. They teach K-12 students about the fields of engineering and demonstrate that engineering can be fun. Also, since the teams are composed heavily of minorities and women, they model for the younger students what an "engineer" looks and acts like, which is of course different from what has come to be the standard view. The teams also contribute to on-campus events involving visitations K-12 students.

Activity #7: Undergraduate Women in Engineering Programs

These programs include peer mentoring, email industrial mentoring and a Parents' Weekend activities for students and their parents. The peer mentoring program started in the fall of 1998 with 130 voluntary participants. All but ten mentoring relationships are one-on-one, and matches are made according to discipline, interests and future plans. The majority of the mentees are first year students, while the mentors are spread across sophomores, juniors and seniors. The email mentoring program was pilot tested with five mentoring pairs in the spring of 1998 and will soon begin again at full scale. To date, ten large companies have indicated an interest in participating. During the pilot program, several of the local mentors invited their mentees to visit them at work. Because of the large industry interest, this program will be immediately open to female and male students. In order to address a perceived need for increased parental support for female engineering students, a seminar is held each November during Parents' Weekend for students and parents. During the seminar, parents hear from College of Engineering faculty and then from a panel of female engineering students. The students are instructed to speak on their experiences either as an engineering student or as a female engineering student or both. They are then asked to give advice to the parents in attendance about how to support their daughters. Attendance at the seminar for the past two years has been between 30 and 40, and feedback has been overwhelmingly positive.

4.5 CMED Milestone and Decision Points

The following delineates key milestones and decision points for each of the five key areas of CMED.

1. Academic Scholarships
 - Annual Yield Increase of Graduating H.S. Seniors; Decision Point is Fall Student Census Date
 - Annual Increase in Quality of Entering Minority Student; Decision Point is Fall Student Census Date
 - Annual Increase in Minority Student and Women GPA; Decision Point is End of Each Spring Semester
2. START (Mentoring Program)
 - Dramatic Increase in Assigned Engineering Mentors; Decision Point is Fall Student Census Date
 - Increased Minority Student Persistence Rate; Decision Point is Fall Student Census Date
 - Steady Real Growth in Minority Graduation Rates; Decision Point is End of Each Spring Semester
3. Engineering Outreach Teams

- Pre- and post-activity surveys to determine K-12 student exposure to engineering; Decision Point is Fall Academic Semester
 - Pre- and post-program assessment of K-12 student engineering knowledge; Decision Point is Fall Academic Semester
 - Eighth graders preparation to pursue H.S. college preparatory; Decision Point is Fall Academic Semester
4. Faculty Incentive to Support Research Experience for Undergraduates
 - Annual Increase in Faculty Involvement; Decision Point is End of Each Spring Semester
 - Increase in the number of academic departments in which faculty reside; Decision Point is End of Each Spring Semester
 5. Research Experience for Undergraduates
 - Annual number of undergraduate students active in research; Decision Point is End of Each Spring Semester
 - Annual Increase in engineering participation in campus-wide REU Symposium; Decision Point is End of Each Spring Semester
 - Annual Number of undergraduates making presentations at national REU conferences; Decision Point is End of Each Spring Semester

4.6 Expected Outcomes and Measures of Success

Ultimate deliverables from CMED will be to increase our undergraduate enrollment and degree award success to a level that moves us from the number two producer, to number one in the annual production of African-American undergraduate engineers. We also expect to challenge the top producers of women engineers for that top honor. Finally, given our substantial presence of Native Americans in this state, creation of CMED should allow us to make significant increases in the annual production of Native American engineering graduate. Our resulting model for developing a larger and more diverse engineer graduate pool should become the standard for other schools across the nation to replicate.

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