A Model Partnership for WIEP and MEP at the University of Colorado at Boulder

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Abstract – Can Women in Engineering and Multicultural Engineering Programs function collaboratively and effectively accomplish their distinct missions? At the College of Engineering and Applied Science at the University of Colorado at Boulder these two programs – the Multicultural Engineering Program (MEP), established in 1973, and the Women in Engineering Program (WIEP), established in 1988 – have operated as distinct entities since their establishment. In the late 1990s a grant to the College initiated the first effort jointly developed by the Programs. Now in 2005, the Programs find themselves following their College mandate to occupy shared space and resources and thriving!

In Part 1 of this workshop the Directors will discuss each program's history and mission and how individual identities are maintained through distinct operating parameters, funding sources and advisory boards. Specific examples of their efforts to manage a shared use resource center will be discussed, including methods for effective communication with students and staff, maintenance of distinct program cultures and student study spaces, and strategic planning for successful collaborative endeavors. The Directors will also discuss the partnership that exists between the two Programs and the Integrated Teaching and Learning Program whose strong outreach programs have been the basis for multiple successful collaborative endeavors. In Part 2 of this workshop the WIEP Director and the MEP Director will discuss various joint program activities and outcomes. Workshop participants will experience a portion of the activities from the WIEP and MEP Student Leadership Conference, successfully held for 5 years.

Introduction

After many years of operating as independent programs, the Women in Engineering Program (WIEP) and the Multicultural Engineering Program (MEP) at the University of Colorado at Boulder recently moved into shared space. The administrative directive to make this move recognized the resource limitations of both programs, the advantages of being in closer proximity, and the common strategic objectives that could be reinforced. This paper discusses the means by which the WIEP and MEP are collaborating to better achieve their similar program missions while maintaining distinct program identities, cultures and services.

Background

Multicultural Engineering Program

The Multicultural Engineering Program was established in 1973, at a time when only 6 underrepresented minority (URM) engineering students were enrolled in the College of Engineering and Applied Science (CEAS), a minority enrollment about equal to the national figure of one percent. For over 30 years, the MEP has operated as a joint venture between the University, the federal government, and both corporate and individual partners to achieve its mission: *to recruit, retain and graduate students culturally underrepresented in the College of Engineering and Applied Science*.

The history of the MEP effort at the University of Colorado is distinguished by the establishment of a comprehensive retention program in 1989, which was developed in response to the alarming attrition (over 50%) among URM (African American, Hispanic/Latino and Native American) engineering students from the freshman year to the sophomore year. The "Building Community" model for collaborative learning and student development was designed as - and continues to be - a strategic means to increase academic performance in the first-year through a variety of academic community building activities including: 1) program participation grants averaging $1,000 year, 2) a freshman for-credit course titled, "Self-Management and Leadership Principles", 3) Academic Excellence Workshops – a set of honors peer study groups held daily for "gate-keeping" courses in calculus 1 and 2, chemistry and physics, 4) a resource and study center with computer lab and kitchenette accessible for student use 24-hours/day, and 5) regular academic monitoring, advising, mentoring and tutoring of freshmen and sophomore students. An additional feature of the MEP retention model is the option to participate in a five-week intensive academic summer bridge program for entering freshmen.

The freshmen-to-sophomore year return-rate of URM engineering students has increased dramatically as a result of the "Building Community" retention model, consistently yielding freshman-to-sophomore return rates averaging more than 80% for participating URM students since 1989. The data for the past five years demonstrate than on average 84% of each participating URM freshman class has returned as sophomores into engineering compared to only 47% on nonparticipating URM freshmen each year, for the academic years 1999-00 to 2003-04, as shown in Figure 1. The average class size for entering URM engineering freshmen during this 5-year period was 44 students. On average 66% (29 new freshmen) have participated in the MEP program each year and 34% (15 students) have elected not to participate during this same period. In addition, the same five-year period shows significantly lower academic suspension rates, 6% for MEP participants vs. 17% for non-participants, as well as lower withdrawal rates (i.e. transfer to other disciplines and/or colleges), 9% for MEP participants vs. 35% for non-participants, after the freshman year, as shown in Figures 2 and 3. The MEP also augments the

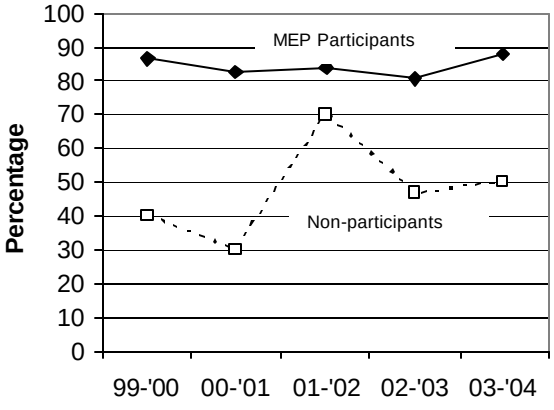

Figure 1. URM EN FR-SO return rates for freshmen to sophomores

retention foundation of the first-year program with other initiatives including undergraduate research and summer internships, an annual leadership conference, annual awards banquet, and active mentoring of engineering student society organizations.

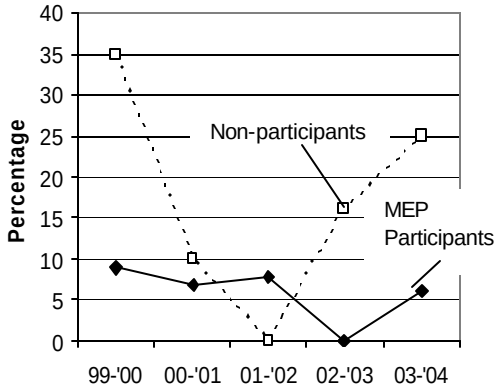

Figure 2. URM EN FR academic suspension rates.

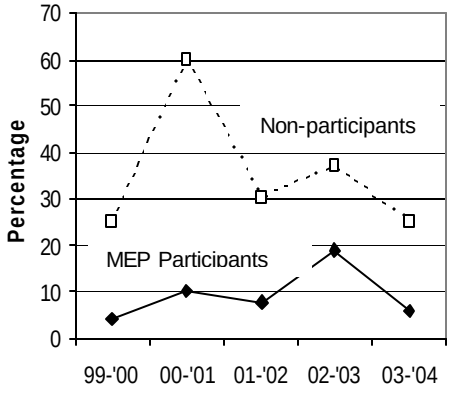

Figure 3. URM EN FR withdrawal rates.

The combined effect of these efforts has created a vibrant learning environment for MEP students resulting in impressive retention and graduation results. The University of Colorado at Boulder has performed well in national retention studies compiled by the National Action Council for Minorities in Engineering, Inc. (NACME). In a 2003 study (NACME, 2003) the University of Colorado at Boulder was cited 1st among public schools and 6th overall in the nation for its minority engineering retention-to-graduation rate of 66.3 percent, as compared to a national average of 38.8 percent. In a similar retention study published in 1999, NACME ranked the University of Colorado at Boulder 7th overall in the nation for its minority engineering retention-to-graduation rate of 66.9%, as compared to a national average of 36.5% (NACME, 1999).

Women in Engineering Program

The Women in Engineering Program (WIEP) was started in 1988 as one of the first five in the country. At the time national enrollment of women in engineering colleges had stagnated at around 15%, and the representation of women in the professional ranks was below 10%. The WIEP focused on recruitment and retention initially. Changing the climate to boost retention, providing course counseling and general advice and establishing a dedicated space for a resource center that was accessible on a 24-hour basis, were important initial accomplishments. As fund-raising became more successful, the WIEP also began offering scholarships to incoming first year women as a recruitment strategy. When National Engineer's Week was established, the WIEP began giving presentations to elementary and middle school students. These presentations formed the basis of the third WIEP focus, outreach to K-12 girls to consider engineering as a career. Over time the program has grown and further developed the three focus areas that are reflected in its mission statement: *To foster the academic success of women in engineering by recruiting, retaining, and encouraging women engineering students.*

The representation of women students at CU-Boulder rose after the establishment of the WIEP, as shown in Figure 4 (PBA, 2004). It reached its highest level of 21.4% in 1999 before declining

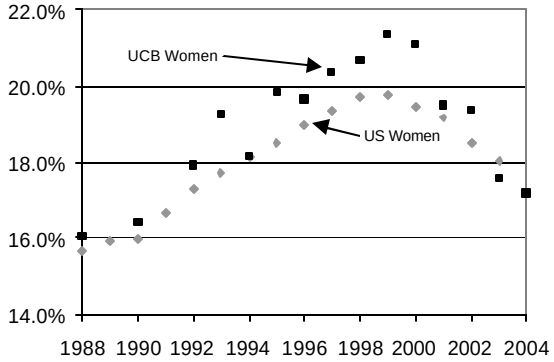

Figure 4. Representation of women in EN, CU & National.

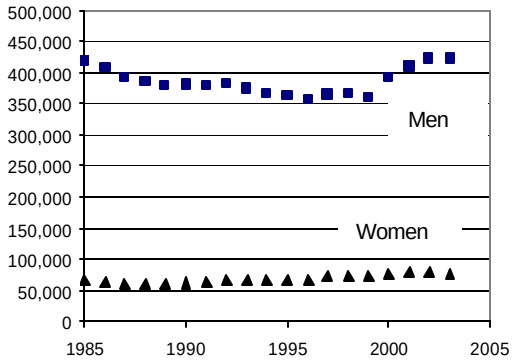

Figure 5. National engineering enrollment.

to 17.2% in 2004. This trend is similar to that shown by the national figures which also peaked at 19.8% in 1999 and in 2003 was 18%. The national enrollment of men over the past four years in particular has risen sharply, corresponding to a rise in total enrollment, as shown in Figure 5. However, the national enrollment of women has risen far more slowly. These trends are also observed at CU-Boulder, as shown in Figure 6. After falling during the mid-1990's, the enrollment of men has increased steadily to record levels at CU-Boulder; the enrollment for women has not shown the same change. Over the entire 16 year period at CU-Boulder, the annual enrollment of men has increased nominally by 226 men, while the enrollment of women has increased by 80 women.

Consequently, in an effort to steadily increase the total number of enrolled women and the overall representation of women students at CU-Boulder, the WIEP has increased the emphasis on K-12 outreach and recruitment activities. Outreach activities now include hosting over 500 girls in Girl Scout Badge Days activities, mentoring students for science fair projects, hosting Take Our Children to Work Day, and emailing high school women. The WIEP provides information about engineering to over 1000 girls and young women each year.

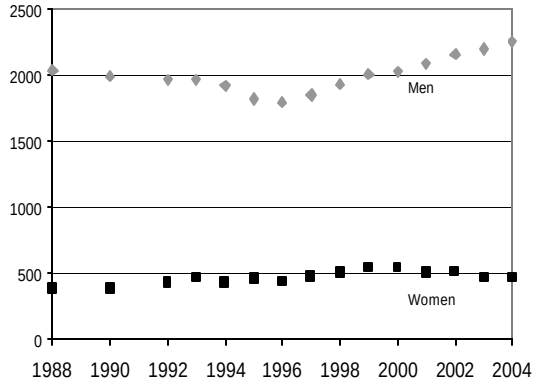

Figure 6. Total EN enrollment at CU-Boulder.

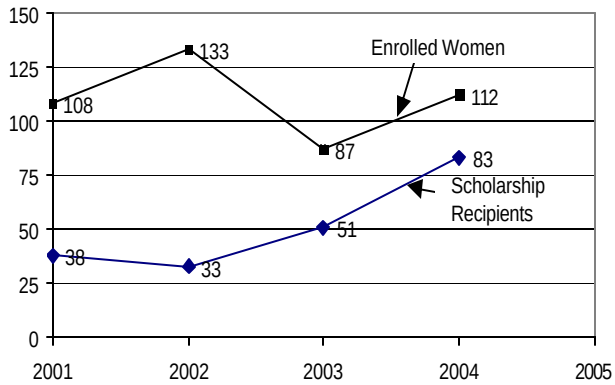

Figure 7. FR scholarships to women and enrollment

Over the past few years more effective fund-raising has enabled the WIEP to increase its emphasis on scholarships to entering freshmen women, as shown in Figure 7. The number of

scholarship recipients has risen and demonstrates a direct correlation to the rising number of women students enrolled in the College.

A New Collaborative Model

It is the acknowledgement of an overriding common strategic objective – namely, to increase the diversity of the student population entering the College of Engineering – that has served as the greater impetus for collaboration between the WIEP and MEP. Additionally, we have realized an opportunity for a complementary relationship between the programs whereby we are able to learn from each other's areas of strength such as: programming for outreach and retention, student bonding and camaraderie, staff expertise and cross-over, student staff utilization, and donor relations. An added driving motivation for collaboration is the recognition of a need for significant additional resources that will enable the programs to conduct new innovative programs in partnership with each other and in coordination with the larger College community in accord with its increased emphasis on outreach and recruitment.

Outreach and Recruitment

Effective K-12 outreach and recruitment requires a comprehensive strategy that aims to increase the overall diversity in the college enrollment population. The strategy should include a means to reach a sufficiently large audience in high impact, single events (often a single day event), along with reaching out to a targeted smaller audience on a continuous basis, which is especially vital in working with underrepresented minority populations. Examples of the single events include the MESA Fall Fling and Engineering Career Day for Women. The MEP hosts 200 high school students from MESA clubs throughout Colorado for a two-day program during the Fall Fling each year. Engineering Career Day for Women is an all-day program that enables high school women to visit the college and learn about engineering. Both programs incorporate fun, team-oriented engineering design-build projects emphasizing hands-on learning as well as promoting a high degree of interaction between the college students and high schools students.

The new collaborative approach between WIEP and the MEP is further evolving as the programs increase their alliance with a third partner, the Integrated Teaching and Learning (ITL) Program, to host events that enable underrepresented students to participate in extended engineering outreach workshops over the course of their high school careers. The unique ITL Program has resources (personnel, curriculum and supplies) and a far-reaching outreach strategy that features an "in-schools" presence in area middle schools and high schools. In addition, the ITL Program contributes the use of a state-of-the-art laboratory facility and equipment, experimental modules, and dedicated support staff (Carlson and Sullivan, 2005).

The ITL Program serves as an especially significant partner with WIEP and MEP in offering the Success Institute, a one-week on-campus summer experience for underrepresented minority high school students from the Denver-Boulder metropolitan area. Approximately 75 high school students (grades 9-12) participate in the Success Institute annually where they learn about engineering first-hand through intriguing design-build projects such as retrofitting a remote control vehicle into a "Mars Rover" with additional mechanical parts for moving lava rocks. The Success Institute has become a highly regarded CU engineering outreach effort in the Denver/Boulder minority community (deGrazia et al, 2001). Over the past three years, 20 Success Institute participants (high school seniors) have applied to CU each year on average,

which has translated into an average of 6 enrollees into engineering and an additional 3 more into CU programs in arts and sciences and business (the remaining applicants either were not accepted to CU or choose to enroll at another university). The Success Institute is viewed as a critical and strategic means in our efforts to reverse the trend towards reduced enrollments of URM students in engineering that is occurring both regionally and nationally.

The ITL partnership with WIEP and MEP also extends to Girls Embrace Technology, a six-week summer internship day camp to encourage high school girls to create imaginative software technology (Sullivan et al, 2003), which has also increased its participation of Latina high school students specifically to meet college diversity objectives. At least three current freshmen women attribute their participation in GET as a significant reason for their decision to enroll in engineering at CU-Boulder.

The WIEP, MEP and ITL Program are initiating new long term relationships with two local high schools, Centaurus High School in Lafayette in Boulder County, and the Denver School of Science and Technology in Denver. Centaurus HS hosts the only Pre-Engineering Academy in the Boulder Valley Schools that will soon graduate its first cohort of students. Centaurus HS has the highest diversity in its student population (28.1% URM and 20.9% free and reduced lunch) in Boulder County. Its students have attended neighborhood elementary and middle schools in which the ITL Program's graduate student personnel have been teaching for several years. In its first graduating class, 11 of 16 students will enroll in engineering at CU-Boulder. The Denver School of Science and Technology is a new charter school with a technology and engineering focus. Its student population by charter includes at least 45% low income students and 40% female. In actuality the first class of 9th graders is 46% female and 46% low income; also, 44% are Latino and 22% are African American.

The growing collaborations of WIEP, MEP and ITL for outreach have allowed for the critical leveraging of key resources (such as staffing and funding) necessary to effectively implement all aspects of a successful high impact engineering outreach effort which includes program planning, curriculum development and instruction, community relations, student mentoring, parent programming, fundraising, budgeting and assessment. These joint efforts have yielded successful fundraising from corporate and private donors, government grants and institutional support. Future outreach plans will build upon this partnership with the objective to impact a greater number of students in the pre-college community ultimately yielding a significantly increased enrollment of women and underrepresented minorities in engineering in our College.

Retention and Student Leadership

For the past five years the WIEP and MEP have collaborated on a leadership conference for students in both programs. The goals include providing networking opportunities with successful role models in industry and gaining new leadership skills and knowledge. In addition, both the WIEP and MEP have observed a recent trend of younger students becoming officers of the student engineering diversity societies. The transition of society methods and historical knowledge and the skills to effectively lead the societies has been weak or lacking. The leadership conference is an effective means to reinforce the leadership foundations for the student societies. Sponsored by Lockheed Martin, the "WIEP-MEP Student Leadership

Conference" leadership conference has served as an important means to increase the camaraderie between the WIEP and MEP students after moving into shared space this fall.

In a previous leadership conference, the WIEP and MEP worked collaboratively to create an especially unique case study titled, "Buffalo Nation", used to elicit critical thinking and decision-making on a real-world scenario. Role-playing as the leaders of the Buffalo Nation tribe, the students were required to discuss the merits of constructing either a natural gas processing plant or a casino on the reservation property. Students from both WIEP and MEP served as representatives from the tribe in one of three groupings (i.e. the Fort Hansen reservation town, the Horn Ridge remote community and the Red Prairie Tribal business center). They were required to discuss and evaluate the economic, legal, cultural, and ethical implications of each proposal. Ultimately they brought their arguments to the Council of Elders for a final decision.

Not only have these conferences helped to develop the ethical, professional and leadership skills among the students, they have also helped the WIEP and MEP students to realize and appreciate their common experiences as undergraduates in engineering and their mutual ambition to give back to their respective communities as future professional engineering role models. The 50 students who attended the leadership conference this fall are more at home interacting with each other in the shared resource center and they are actively exploring the possibility of future joint events such as holding a spring formal for the college hosted by the WIEP and MEP students.

Scholarships

Historically, the WIEP and MEP have been limited in the amount of funds that are available for student scholarships. Scholarships had been awarded by either the WIEP or the MEP so as to stretch scholarship funds. This funding pattern meant that some women engineering students had to align with only one of the programs. Recently, the College administration recognized the advantages of increasing the number and value of scholarships as a tool to aid in recruiting students underrepresented in engineering and, along with gifts made to the programs themselves, has provided scholarship funds for these efforts. The WIEP and MEP have each been able to award scholarships to students who participate in both WIEP and MEP. This effect has resulted in a great increase in women's enrollment numbers. In fact, for the fall 2004 semester the enrollment of URM engineering female students was 25.3% as compared to 17.2% for female engineering students overall. The results suggest that following this strategy is an effective means to meet the overall objective of increasing college diversity. However, it does require effective fund-raising to increase scholarship funds to meet this demand.

Benefits of the New Shared Space

Moving into the new WIEP-MEP resource center has been a great exercise for both programs, with challenges and newly realized benefits. Before the move, students who used the study spaces in each program were often isolated from the other students in the college. The WIEP space was located high in a tower that had one access point. The MEP space was in the basement level in the classroom wing. Neither space was on the beaten path; most students were unaware of their locations. While the isolation helped create an atmosphere of unity, it acted to prevent students from reaching out to include majority students effectively. A reasonable amount of skepticism by program students and staff greeted the proposed move. It required

numerous meetings to reach consensus on room configurations and to reassure each other that such a move was indeed beneficial to all.

The greatest initial benefit would be the use of space that was larger than either program had previously. However, initial attempts to configure separate study spaces seemed artificial. Eventually, students recognized that everyone needed access to computers, areas for group study, and areas for quiet studying. When the study rooms were defined in this way (a larger room designated for group study and a smaller room designated for quite study), everyone seemed to settle in and come together more. We are now experiencing increased usage of the resource center by students from both programs; and, events and activities are organized with both groups of students in mind.

One change that became a more of an advantage than had been previously anticipated was the proximity of the two staffs to each other (a total of 6 full-time and 2 part-time staff) and to the central administration. The directors have found it easier to brainstorm and strategize for fund-raising, to share industry contacts, to organize events, and to meet students from each other's programs. The administrative staff members have been able to support each other as needed and to discuss and clarify joint expenditures and administrative processes. Both staffs have enjoyed the ease of getting to and working with the central administrative staff because of the new location. Moreover, the space location is beneficial to the students as it is near classrooms, key laboratories and other student work and study areas. Many more students find it easier to drop-in for questions and to spend time between classes, in addition to using the study rooms. Also, staff members from the CU-Boulder campus offices of Career Services and Financial Aid hold regular hours within the new shared space. This increases the visibility and use of the space to the rest of the College as well.

Joint Advisory Board Meetings

The program advisory boards for both WIEP and MEP are comprised of government and corporate executives, human resource personnel, and high level engineering professionals from industry who have a genuine interest in the strategic goals for each program. Each board holds several meetings a year to work on strategies and analyze the outcomes of various initiatives. Board members offer their personal support, professional expertise and resources from their respective organizations. Their efforts are greatly appreciated.

For the past several years the boards have had one shared meeting each year. College administrators, including the deans, chairs and other program directors, are also invited to attend. The focus of this annual gathering is usually a prominent speaker such as the president of the university and the state director for technology. The meetings provide a venue for the board members to interact with each other and with college administrators. This networking results in a greater appreciation by board members for both programs and the ability to see the bigger picture in the context of the college diversity mission. It also results in additional donations and professional opportunities for students from companies who had not previously supported both programs.

Summary

The WIEP and MEP have found collaboration to be beneficial to both programs in many ways. The move into larger shared space in a premium location within the CEAS has increased the profile of both programs. It is reinforcing the opportunity to synergize for outreach and recruitment, student retention and leadership development, fundraising and resource development, as well as securing external support from corporate and individual donors. Some of the new collaborative outreach and recruitment efforts such as HS summer institutes and joint scholarships are already resulting in a higher yield of URM students matriculating into the College of Engineering. We are optimistic that the programs will be able to maintain distinct program identities, cultures and services while working collaboratively to achieve common missions and objectives.

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