

## DIVERSITY IN THE ENGINEERING ENVIRONMENT

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### INTRODUCTION

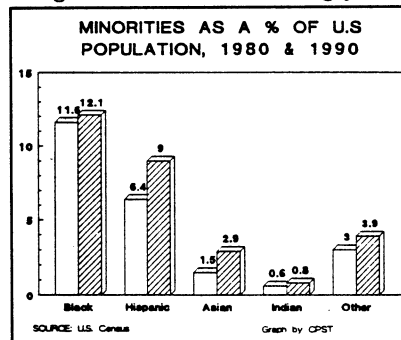
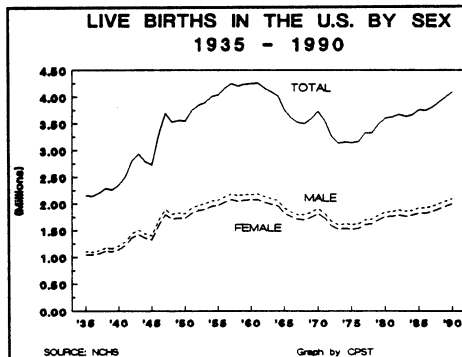
During the past three or four years, most academic institutions have held up their enrollment by increased recruiting of non-traditional and foreign students; while most engineering schools have seen a quite substantial drop in students, largely because engineering typically attracts mostly college-age students.

Because of the drop in U.S. births beginning in 1962, there are 2.5 million fewer college age students today than in the mid to late 1970s, and the size of that population will continue downward through the mid 1990s - a 25% drop overall.

Looking ahead, a rising number of births after 1975 continues through 1990, when the number almost matches the 1961 peak. But it is quite a different crop of babies in the new wave, which will be the source for our engineering students in the coming years.

During the 1980s, the U.S. minority population increased 35% while the white, non-Hispanic population grew only 2%. Minorities rose from 24% of Americans to 29%. Immigration, both legal and illegal, accounts for some of the increase, particularly among Asian and Hispanic groups, and higher birth rates among these minorities accounts for more.

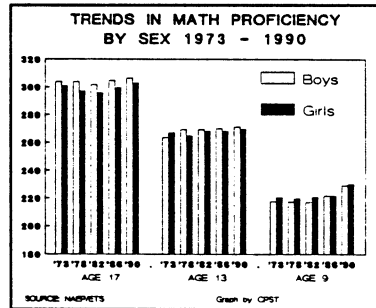
Most of all, the minority populations are significantly younger, with a median age of 22, compared with a 35 year median for white, non-Latinos.



In 1982, minorities were one fourth of the school age population. By 2000, they will be one third, and by 2010, they are expected to be about half. And within each race or ethnic group, half of these children are girls, leaving a smaller and smaller fraction of white males!

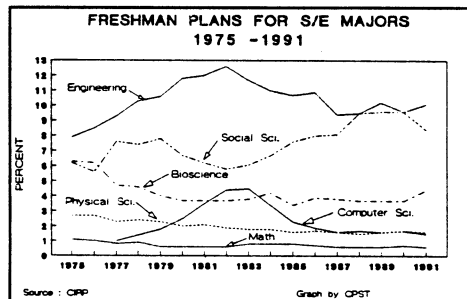
This would be no problem except that in the past, we have relied almost exclusively on white males for our engineers, as well as our scientists, our physicians, our college faculty, and our leaders in government, education, and all other essential activities. Our educational system has done a very poor job up to now in preparing most minority youngsters to have the **choice** when they are about age 18, to go to college and to major in engineering. Further, we have allowed, and sometimes even encouraged minority boys as well as girls of every racial or ethnic group, to drop out of math in high school, or to take a mathematics course sequence that will eliminate math-based college majors. Half of all American students take no mathematics after 9th grade!

Both our national assessments of achievement, and our international competitions indicate that girls do as well as or better than boys when taking the same courses in mathematics, but girls drop out of math sooner than boys, so that they have fallen behind by age 17. Although more students stay in school longer than in previous generations, typical American students of both sexes know less math and science than students the same age elsewhere in the world.

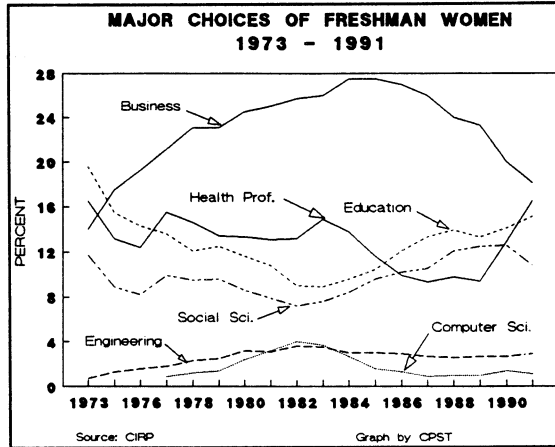


No single, cataclysmic event changed our schools from good to unacceptable. But, ironically, one important factor in the declining achievement of American students was the women's movement. As career options for women expanded beyond nursing, teaching, and library science, the brightest women students moved away from education majors and into business, engineering, biology, psychology, or pre-law.

As the traditional white male source pool for engineering shrank, sincere efforts were made to add minority students to the talent pool, and women were allowed, but not necessarily encouraged, to choose engineering. But not all women who were capable and would have been interested were prepared for that choice. Even today, High School guidance counselors rarely see engineering as a potential career for girls.



Even among that dwindling group of students eligible to enter an engineering program, student interest in engineering has dropped. Since 1982, college freshmen have expressed less interest in majoring in engineering or in any math-based field than was true in earlier years. The percentage of the freshman class planning to major in engineering (or any related fields such as computer science, mathematics or physical sciences) peaked in 1982 at 12.6%, and has dropped by one fourth in engineering and more than two thirds in computer science since that time. Interest in physical science majors has dropped slowly but steadily for 15 years.



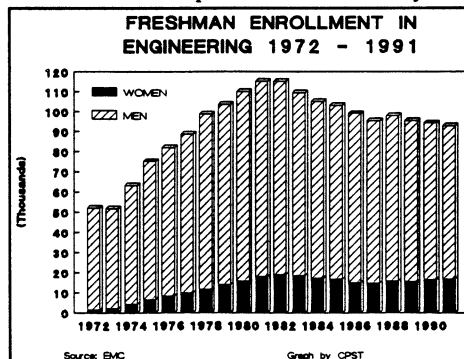
This diminishing interest within a shrinking population is occurring across both sexes. After rising steadily from 1973 to the early eighties, interest in engineering among women leveled off at under 3% of the class.

Equally disturbing is the fact that the percentage of merit scholars choosing engineering majors dropped from 20% in 1983 to 16% in 1988; those choosing natural science are down from 23% to 19%. This may indicate a drop in the **quality** of students choosing engineering as well as in quantity. The drop occurs among both men and women.

### TRENDS IN FRESHMAN ENGINEERING

Freshman enrollment in engineering has followed the pattern indicated by the measure of freshman plans. Although the total number of college freshmen has continued to increase each year, as colleges and universities filled their classrooms with non-traditional and foreign students, the freshman class in engineering has dropped by 22,200 students since 1982.

A considerable effort to recruit minority students finally has resulted in bringing increasing numbers of minority freshmen into engineering, particularly since 1986. However, minority representation in the age group continues to be a

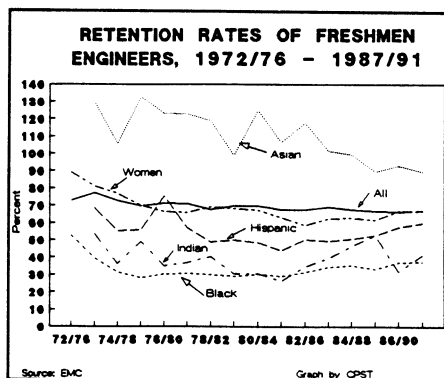
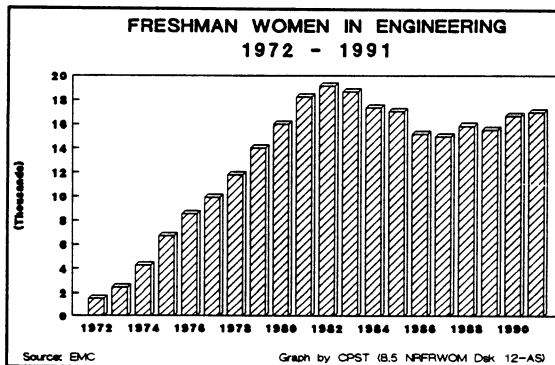
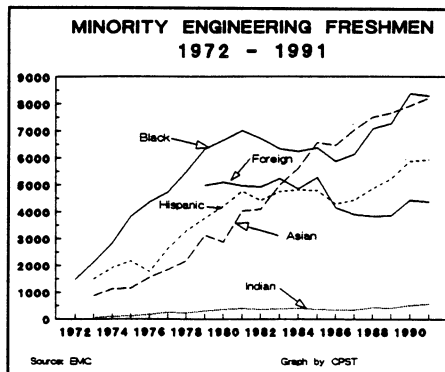


third higher than their representation among engineering freshmen.

The number of women choosing to begin an engineering major rose quickly from fewer than 2,000 in 1972 to more than 19,000 in 1982. However, as with men, interest in engineering among freshmen women started to fall after 1982, so that their percentage of the freshman class held at about 15% rather than the 50% that would represent parity with the population. The increase in the fall of 1990 and again in 1991 is particularly encouraging.

Of course, not all students who plan to major in engineering stay in school or in this major until they complete a bachelor's degree. Although the true retention rates after the freshman year are not known, we can compare the graduating class, over time, with the freshman class four and a half years earlier to get an estimate of retention. Actually, this measure exaggerates the completion rate, since neither the students coming in from two year programs at the junior year or those in institutions that do not register freshman as engineering students are counted in the freshman figures. We do not know how many students this involves, but since 1978, the junior year enrollment reported to the Engineering Manpower Commission has exceeded the numbers of sophomores reported the previous year.

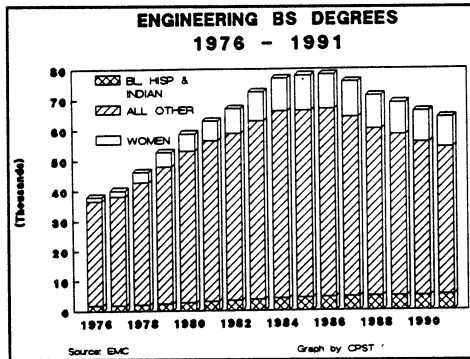
About two thirds as many students earned a bachelor's degree in engineering in 1991 as were in the freshman class in fall 1987. The rate is about the same for men and women. However, the attrition rates among non-Asian minority students is higher.



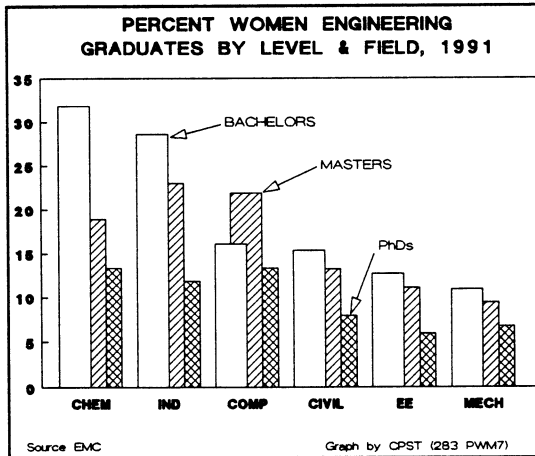
The graduating class of 1991 included 41% as many Native Americans, 37.5% as many blacks, 60% as many Hispanics, and 90% as many Asian students as were in the corresponding freshman class. The so-called retention of Asian students is down from an average 110% in the early eighties! This neat feat emphasizes the importance of the sophomore and junior year input of previously uncouned students. Incidentally, these figures do not change materially if we compare 1991 baccalaureates with freshmen five, or even six years earlier.

### BACHELOR'S DEGREES

The drop in bachelor's degree awards since 1986 is steep - down 18% (14,000) in the past five years, including a 3% drop of 2000 students in 1991, to a total graduating class of 64,000. Based on undergraduate enrollment changes, there will be some further drop for at least the next three years, so that graduating classes in the early 1990s will be only about four fifths as large as those in the 1984-86 period.



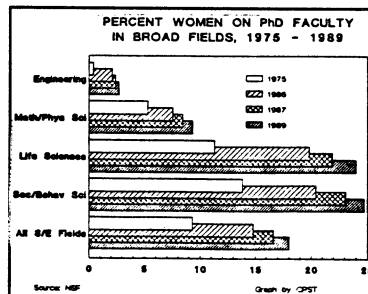
Neither women - now holding at less than 16% of the graduates - nor non-Asian minorities, whose representation is less than half of that in the college age population, or even Asian Americans, who make up 9% of the class have been able to make up for the substantial drop in the number of white males earning engineering baccalaureates. In 1991, white, non-Hispanic male Americans made up only two thirds of the engineering baccalaureate graduates from American universities, down from 95% just two decades earlier. So diversity among baccalaureate graduates is a growing reality.



As you know, women are better represented in some engineering fields than in others, particularly in chemical and industrial engineering. They now earn almost as high a percentage of master's degrees in most engineering fields as of bachelor's degrees, but their representation among PhDs continues to lag well behind, in spite of steady growth.

*W*OMEN IN ENGINEERING CONFERENCE: INCREASING ENROLLMENT AND RETENTION

Indeed, the number of women earning engineering doctorates is so small that even white women are a minority, earning a record 216 PhDs in 1991. Only 267 American women of any racial or ethnic group earned an engineering PhD in 1991; and non-Asian minority men earned only 76 engineering doctorates that year. This explains in part why less than 4% of engineering faculty are women. Further, women are less than a fourth of doctoral faculty in any of the sciences. There are essentially no minority faculty in engineering, except for Asian Americans.



**Diversity** in engineering faculty is provided only by foreign men, who are about four times as likely as women to be faculty members. The greater presence of foreign faculty is easy to understand when you realize that since 1980, more than half of all PhD awards in engineering at American Universities have been earned by foreign citizens. The problem, however, is not in having foreign faculty; it is in **not** having more women and American minority faculty.

### CONCLUSION

So much for the data! What can be done, and importantly, what can **we** do, to achieve a diverse engineering workforce? One of the first things is to deflate the myths that set up barriers to participation and achievement, in engineering and elsewhere, by girls and minority boys. This includes the one that says girls don't do well in math.

Another factor that moderates against achievement by girls in science and math is a well-documented societal bias against girls that drastically lowers their self-esteem by the time they enter their teens, and holds it down thereafter. Two recent devastating reports from The American Association of University Women show that bias exists throughout their educational experience, and how this shortchanging of girls also shortchanges America.

Schools and society also shortchange most minority children. Teachers expect Asian students to do well, particularly in math and science, and so, of course they do. But teachers expect less of African American or Mexican American children. They give them less challenging work, and feel justified when their expectations for lesser achievement are met.

Diversity is not just a goal - it is an inevitability. Either we achieve diversity in engineering by seeking to qualify a larger fraction of our youth to be able to choose engineering; or diversity will be thrust upon us by the inevitable demographics of our population. If our engineering community does not welcome women and racial or ethnic minorities, the engineering work will go abroad.