

Appendix B.

Engineering Manpower Commission Data, 231 Engineering Colleges With Complete Data 1980-81 through 1989-90*

	Number of Schools	Freshman Enrollment		Sophomore Enrollment		Graduates	
		Minority	Nonminority	Minority	Nonminority	Minority	Nonminority
1980-81	231	9,496	88,749	NA	NA	NA	NA
1981-82	231	10,329	92,393	6,295	71,709	NA	NA
1982-83	231	10,319	93,857	6,619	74,756	NA	NA
1983-84	231	9,843	86,256	6,482	72,518	3,210	63,335
1984-85	231	9,569	82,817	6,079	67,962	3,261	64,724
1985-86	231	9,148	81,989	5,855	63,864	3,577	64,325
1986-87	231	NA	NA	5,576	60,925	3,603	61,596
1987-88	231	NA	NA	NA	NA	3,703	57,702
1988-89	231	NA	NA	NA	NA	3,556	55,506
1989-90	231	NA	NA	NA	NA	3,494	52,845
Average		9,784	87,677	6,151	68,622	3,486	60,005

*Excluding the University of Puerto Rico. Cal Poly-Pomona, Columbia University, Cornell University and Stevens Institute of Technology provided missing data to NACME.
NA - Not Applicable

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Research Letter

Highlights

- Nationally, only 35.6 percent of the freshmen from underrepresented minority groups who enroll in engineering graduate, compared to 68.4 percent of nonminority engineering majors (Table 1, Figure 1).
- Among those who make it into the sophomore year, 56.7 percent of minorities and 87.4 percent of non-minorities graduate (Table 1, Figure 1).
- While colleges achieve widely varying results with minority sophomores, nonminorities who survive the freshman year tend to be a stable population, independent of school.
- Of the 118 schools for which complete freshman retention rates could be computed, only nine schools had rates for minorities at or above the 68.4 percent gross national rate for nonminority students (Table 2).
- On six campuses, minority freshmen graduated at a rate virtually equal to or higher than that of nonminority students on the same campus (Table 6).
- Fifteen schools had above average performance in each of the measures examined, i.e., above average graduation rates for minority freshmen and sophomores, 35.6 and 56.7 respectively; above average relative retention indices, 52.0 and 64.9 respectively; and above average number of graduates annually, 13 (Table 9). Unfortunately, the enrollment of minority students at many of these schools is small.
- Based on data reported to the EMC, 62 of the 325 engineering schools produced no minority engineering graduates during the academic years from 1983-84 through 1989-90.
- One of every seven engineering colleges with statistically significant data attracted more than 15 percent of its average cohort class through the transfer process. This inflates the apparent graduation rates of those schools.

Minority Graduation Rates Comparative Performance of American Engineering Schools

George Campbell Jr., Ronni Denes,
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The enrollment of minority freshmen in engineering schools has skyrocketed, growing 49.0 percent from 1986-87 through the 1990-91 academic year. Increases occurred for each of the underrepresented groups (African Americans, 42.5 percent; Hispanics, 60.2 percent; American Indians, 49.0 percent), at a time when the number of nonminority students choosing to major in engineering fell 10.5 percent. Unfortunately, only one of every three minority students who enrolls in engineering earns a BSE degree. The success rates at different engineering schools, however, vary dramatically.

Overview

To compare the success of individual institutions, we calculated and analyzed three parameters that can be used to define the performance of engineering schools in graduating minorities: (i) graduation rates of minorities, (ii) graduation rates of minorities relative to nonminorities, for which we define a new measure, the Relative Retention Index (RRI) and (iii) absolute number of graduates (see Computing the Graduation Rate, page 3).

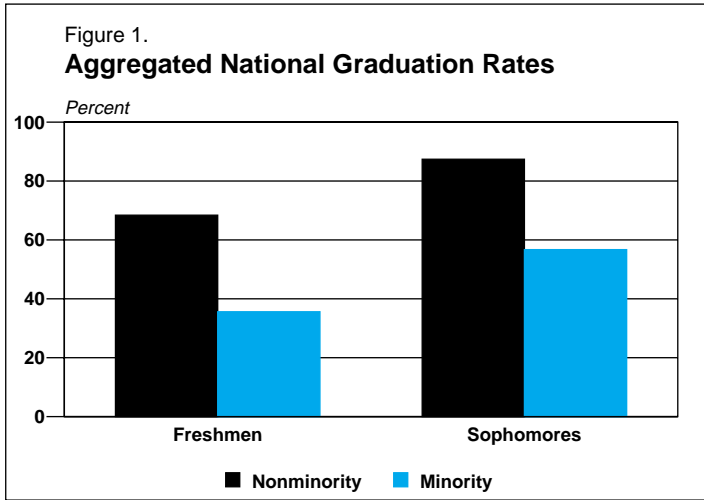
Based on national enrollment and graduation data averaged over a decade, we found that only one out of three (35.6 percent) minority freshman engineering majors obtains a bachelor of science in engineering degree (BSE).

For nonminorities, the rate is two out of three (68.4 percent). Statistically, a minority student entering engineering school is only about half as likely (52.0 percent) to obtain a BSE as a nonminority student.

To find out what happens to those students who survive into the sophomore year, we recalculated minority graduation rates beginning with a sophomore year baseline. We found that minority sophomores were retained at rates somewhat better than freshmen, with slightly more than one out of two graduating (56.7 percent), while almost nine out of ten (87.4 percent) nonminority sophomores graduate. The relative success of engineering schools in graduating minorities who have achieved sophomore status compared to non-minorities who have gotten to the sophomore level improves to 64.9 percent. Though the relative improvement is significant, the gap remains wide.

Minorities constituted a very small percentage of engineering schools' annual graduates – an average of 5.6 percent over the period included in this study or, excluding the Historically Black Colleges and Universities (HBCUs), only 5.0 percent. Looking at

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the individual engineering colleges, we find a highly skewed distribution where a relatively small number of schools produce the bulk of the minority graduates. Only about one-third (29.8 percent) of the nation's engineering schools graduated the national average of 13 or more minorities, and only one in 14 (7.1 percent) graduated 50 or more minorities annually (Table 8, Figure 2).

After filtering out the colleges where there was incomplete data, where the numbers were statistically insignificant and where the results were skewed by an influx of transfer students, we still found evidence of wide variation in performance. Using the algorithm detailed on page 3, we were able to compute well-defined freshman minority graduation rates for 118 schools. Of these:

- Nine graduated minorities above the gross national rate of 68.4 percent for nonminorities (Table 2);
- Six graduated minority freshmen at a rate equivalent to or better than nonminority engineering students on the same campus (Table 6); and
- Fourteen graduated an average of 50 or more minority engineers per year (Table 8). (An additional nine institutions with 50 or more graduates did not have data that met our criteria for inclusion in the 118.)

Typically, engineering colleges with the highest minority graduation rates

and highest relative retention indices were not among the schools producing the largest number of total minority graduates. It follows that the schools producing large numbers of minority engineers don't have the best retention performance. This has important policy implications. It suggests that a focused effort on

increasing retention at the relatively small number of schools already producing the lion's share of minority engineers can improve the national graduation figures substantially.

Only 15 schools among the 118 performed in the top category across all five measures of success – above average minority graduation rates for freshmen and sophomores, above average relative retention indices for minority freshmen and sophomores and above average number of minority graduates per year (Table 9).

The RRI allows us to compare minority and nonminority retention at the same institution. Very few schools have an RRI near or greater than 100 percent, indicating that those successful with

minority students are still *somewhat* more successful with nonminorities on an absolute scale. However, it's important to keep in mind that, on average, engineering colleges do much better with nonminorities. Looking over Tables 6 and 7, we see very few schools with both high minority and high nonminority graduation rates relative to the respective national averages.

When ethnic data are disaggregated, we find that African American freshmen graduated at a rate slightly less than half (44.8 percent) that of nonminority students. For American Indians it was slightly more than half (52.1 percent). Hispanics graduated at nearly two-thirds (65.5 percent) the rate of nonminorities.

National Graduation Averages

From 1980 to 1986, the average annual enrollment of minority engineering freshmen was 10,670, or 9.8 percent of the total freshman enrollment of 108,909. For the sophomore cohorts, the average was 6,811, or 8.1 percent of the total of 83,639. Tracking the progress of these classes four to six years later, an average of 4,121 minority engineering students graduated annually. This represents 5.6 percent of the 73,106 average number of total graduates over the same period. These average annual enrollments and graduations are based on all 325 schools included in EMC reports (Appendix A). The graduation rates, however, were derived through an analysis of only those schools with complete data (see Computing the Graduation Rate, page 3 and Appendix B).

Freshmen. The national average minority graduation rate, based on freshman enrollments, was 35.6 percent, compared with 68.4 percent for nonminority students (Table 1, Figure 1). The ratio of these two rates is a measure of how the nation's schools performed with minorities relative to nonminority students, an indicator we've defined as the Relative Retention Index (RRI). The gross national average RRI for freshmen indicates that minorities graduated at 52.0 percent of the rate of nonminority freshmen.

Table 1.
National Aggregate Graduation Rates and Relative Retention Indices*

	Freshmen	Sophomores
Minority Graduation Rate	35.6%	56.7%
Nonminority Graduation Rate	68.4%	87.4%
Relative Retention Index	52.0%	64.9%

*Includes only schools with complete data. Excludes the University of Puerto Rico.

Sophomores. To examine what happens to those students who complete the freshman year or who enroll in engineering as sophomores, we also computed rates for the sophomore class. When the national graduation rate is based on sophomore enrollments, 56.7 percent of minority and 87.4 percent of nonminority students graduate (Table 1, Figure 1), an RRI of 64.9 percent. This indicates that minority sophomores are more closely aligned with their peers than freshmen. That is, all students who survive into the sophomore year are more likely to graduate, as we might expect, and, at the sophomore level, the performance of schools in graduating minority students gains relative to that for non-minorities. Nonetheless, universities still only graduate minority sophomores at two-thirds the rate of nonminority

sophomores. In fact, the graduation rate for minority sophomores does not even reach that of nonminority freshmen.

Graduation Rates by Institution

Freshman Graduation Rates. Of the 138 schools* used in the analysis of freshmen, we found 118 to have data that met the criteria for inclusion (see below). Figure 3 shows the distribution of minority graduation rates among these engineering schools.

The freshman-based minority graduation rates for this selected sample of 118 schools can be fit approximately to a normal distribution with

*Only schools with annual average freshman enrollments of at least 10 minority students were included in the school-by-school comparison data base.

$$\mu = 37.0$$

and

$$\sigma_{n-1} = 17.4$$

where μ and σ are the mean and standard deviation, respectively. The spread of the distribution, i.e., the variation in performance, measured by σ is fairly broad. Seventy percent of the population have graduation rates within one standard deviation of the mean, i.e., between 19.6 and 54.4. Schools with minority graduation rates above 72 percent ($\mu + 2\sigma_{n-1}$) are among the top 5 percent in performance.

It is very interesting that the mean of this sample, where those schools with significant numbers of transfer students have been removed, is slightly *higher* than the gross national aver-

Computing the Graduation Rate

To compute an aggregate graduation rate for the 1980s, we developed an algorithm comparing total freshman enrollments from the 1980-81 through 1985-86 cohort years to total graduations from the 1983-84 through 1989-90 cohort years. This averaging algorithm inherently smooths out anomalies associated with variations in the amount of time different students take to graduate. For sophomores, we used the same algorithm, except that the initial enrollment year was 1981-82, to complement the 1980-81 freshman year, and the final year was 1986-87, to complement the 1985-86 freshman year.

The large number of enrollments and graduations stabilize the national graduation rate, as computed with our algorithm, despite fluctuations in enrollments associated with incoming transfer students. This provides a decade of the 1980s perspective on the retention performance of the nation's engineering schools.

In the individual school calculations, the graduation rate is quite sensitive to the influx of transfer students. Schools that acquire engineering

majors after a first cohort year will have an overstated freshman graduation rate. Students enrolled after the second year will affect the sophomore rate similarly. We, therefore, filtered out institutions with especially skewed rates by first examining changes in enrollment between the freshman-to-sophomore and sophomore-to-junior classes and then making judgments about the degree of confidence that these changes imply. In the aggregate, for all schools in the sample, there was a decrease of 37.1 percent from the average minority freshman-to-sophomore class (from 9,784 to 6,151) and a 13.4 percent decrease from the minority sophomore-to-junior class (from 6,151 to 5,325). Nationally, the average percent decrease in minority enrollment from the freshman-to-sophomore class was 36.2 percent (from 10,670 to 6,811) and 9.1 from the sophomore-to-junior class (from 6,811 to 6,192).

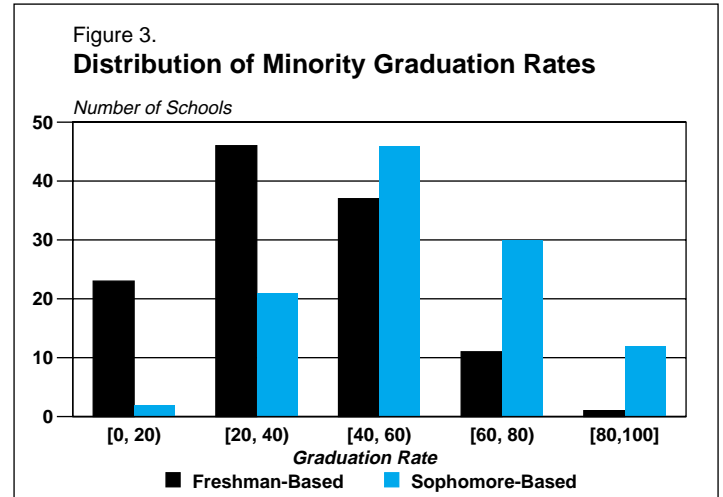
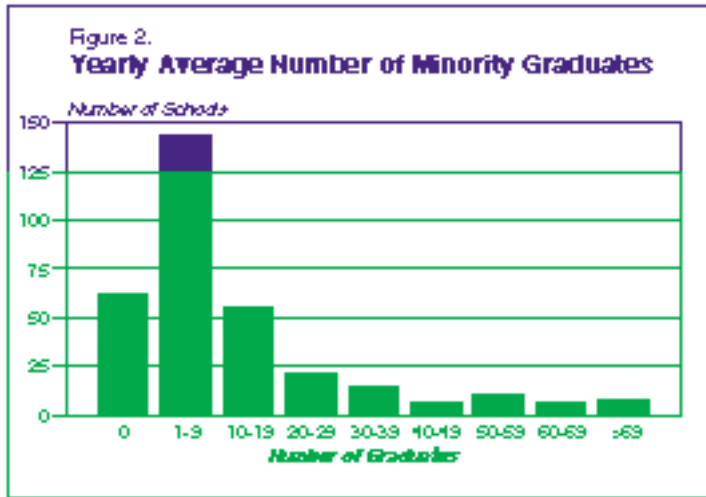
While the change in class size from entering freshmen to upperclassmen decreases nationally, individual schools often show significant growth between the freshman and succes-

sive years. We considered it possible to compute a meaningful graduation rate only if the average increase in enrollment for freshmen and sophomores was less than 15 percent. Individual school graduation rates must still be interpreted cautiously. Even when overall enrollments declined from the sophomore to junior year, the addition of the small number of students who transfer from two-year colleges, who declare an engineering major after the freshman or sophomore year, who participate in dual-degree 3/2 programs and who ultimately graduate may slightly underestimate the actual attrition of freshmen or sophomores.

Data Bases

In computing graduation rates,* only schools with complete enrollment and graduation data were included. Schools without complete data were excluded in order not to distort the graduation rates.

*All data in this report are derived from EMC annual enrollment and graduation surveys, unless otherwise noted.



age, which does include junior college transfers, as well as students who declared themselves engineering majors after the freshman year.

Among the 118 schools, 20 had inflated *nonminority* graduation rates because of transfers. Eliminating those, the mean and standard deviation of the *nonminority* graduation rate for the 98 remaining are:

$$\mu = 65.4$$

and

$$\sigma_{n-1} = 18.1$$

and 70.4 percent of this population have *nonminority* graduation rates between $\mu \pm \sigma_{n-1}$, 47.3 and 83.5. Here the mean is statistically equivalent to the gross national average.

Other significant findings include:

- Only nine schools had minority graduation rates exceeding the 68.4 percent gross national rate for *nonminority* freshmen (Table 2).
- Of the 138 schools analyzed, 19 that appear to have minority graduation rates higher than the national average actually have inflated rates because of the influx of transfer students (Table 3).
- Many of the schools with the highest minority graduation rates were among those with the most stringent admis-

sions policies. Based on admissions difficulty as defined in *Peterson's Guide to Four-Year Colleges, 1990*, 37.3 percent of the schools in Table 2 with above average graduation rates were considered "Most Difficult" or "Very Difficult."

- Many of the schools with high graduation rates have low minority enrollment.

Sophomore Graduation Rates. Based on minority sophomore graduation rates, 111 of the 129 schools* in the sophomore sample had appropriate data permitting them to be included (Table 4, Figure 3).

Assuming that sophomore-based minority graduation rates for this selected sample of 111 schools also approximate a normal distribution,

$$\mu = 54.5$$

and

$$\sigma_{n-1} = 18.9.$$

Sixty-eight percent of the population have graduation rates within one standard deviation of the mean, i.e., between 35.6 and 73.4.

*Only schools with annual average sophomore enrollments of at least 10 minority students were included in the school-by-school comparison data base.

Among the 111 schools, 14 had inflated *nonminority* graduation rates because of transfers. Eliminating those, the mean and standard deviation of the *nonminority* graduation rates of the remaining 97 are:

$$\mu = 83.9$$

slightly less than the gross national average, and

$$\sigma_{n-1} = 14.8$$

which indicates a very narrow distribution. Seventy-three percent of the population have *nonminority* sophomore graduation rates between 69.1 and 98.7, $\mu \pm \sigma_{n-1}$. That is, the performance of schools is much more consistent for *nonminority* sophomores than for either minority freshmen, minority sophomores or *nonminority* freshmen. The high graduation rate for *nonminority* sophomores together with the small variation among schools indicates that *nonminority* engineering majors who have completed the freshman year constitute a relatively stable group.

Other significant findings include:

- Only seven schools had minority graduation rates at or above the 87.4 percent gross national sophomore rate for *nonminority* students. Five other schools had minority graduation rates that exceeded 80 percent (Table 4).

Table 2.

Engineering Colleges Ranked by Freshman-Based Minority Graduation Rate*

	Percent Change in Minority Enrollment			Percent Change in Minority Enrollment			
	Graduation Rate (%)	Freshman to Sophomore	Sophomore to Junior	Graduation Rate (%)	Freshman to Sophomore	Sophomore to Junior	
U Bridgeport	85.7	13.6	-26.7	U Cal-Santa Barbara	33.7	-50.8	-5.2
George Washington Univ	78.4	-15.9	-4.3	+ Howard University	33.3	-57.4	-12.6
Northwestern University	75.7	9.2	-12.2	U Notre Dame	33.2	-50.3	-16.3
Tulane University	74.4	-22.3	9.6	U Wisconsin-Milwaukee	33.1	-33.3	-44.0
Johns Hopkins University	72.4	-27.3	-14.3	Clemson University	32.5	-29.7	-19.0
Florida Institute of Tech	72.0	14.9	-32.4	Illinois Inst of Tech	32.3	-45.4	-19.2
U Miami	71.8	-24.7	11.2	Penn State University	32.1	-34.4	-31.8
Princeton University	71.4	-5.6	-20.6	+ Prairie View A&M Univ	31.7	-36.3	-12.9
U Cal-Berkeley	69.3	-10.0	2.6	U South Carolina	31.4	-49.5	-12.9
Marquette University	66.7	1.4	-18.3	U Alabama	31.0	-39.3	-16.6
U Alabama-Huntsville	65.8	1.4	0.0	U Wisconsin-Madison	31.0	-26.9	-32.3
U Maryland-College Park	62.4	-33.1	11.6	So Illinois-Carbondale	30.8	-26.9	-15.8
U Minnesota	56.9	-18.4	3.9	Boston University	29.7	-29.7	-24.2
Stevens Inst of Tech	55.7	-18.1	-35.7	U Michigan-Dearborn	28.6	-20.0	-38.1
Purdue Univ-W Lafayette	55.2	9.5	-33.1	Ohio University	28.2	-55.3	-17.6
Rice University	55.0	-38.1	-31.3	U Cincinnati	28.2	-46.4	-18.7
U Mississippi	53.7	-18.7	0.0	Lawrence Technological U	28.1	-48.3	-32.5
Rensselaer Polytechnic	53.7	-26.2	-8.3	Auburn University	28.1	-39.3	-58.4
U Delaware	53.1	-4.2	2.2	+ Southern University	27.5	-9.3	-50.6
U Michigan-Ann Arbor	52.6	-16.2	-15.5	U New Mexico	27.1	-48.5	-37.9
Tennessee Tech Univ	52.6	-36.8	-34.3	U Rochester	26.6	-36.6	-44.4
Purdue Univ-Calumet	51.4	-35.7	-31.1	U Arkansas	25.7	-28.4	-44.2
U Pacific	51.1	-24.5	-8.5	U Cal-Irvine	25.7	-45.9	-22.8
U Detroit	50.7	-5.8	-54.9	NM State University	25.4	-39.5	-26.8
U Colorado-Boulder	50.4	-46.3	1.1	Arizona State University	25.0	-40.7	8.7
Texas A&I University	50.3	-42.3	3.7	U Texas-Austin	24.9	-48.0	-23.6
Drexel University	50.1	-25.5	-32.9	U Kansas	23.6	-48.6	-31.8
U Louisville	49.7	-40.0	-18.3	U Alabama-Birmingham	22.2	-47.2	-44.2
U Missouri-Rolla	49.2	-34.9	-5.3	U Arizona	22.0	-52.9	-25.9
Cleveland State Univ	48.5	-38.2	-10.6	Wright State University	21.7	-47.0	-8.5
Colorado State University	48.3	-45.4	-1.5	U NC-Charlotte	21.7	2.5	-28.4
Cornell University	47.2	-15.7	-32.6	U Kentucky	21.4	-44.8	-3.8
US Naval Academy	46.7	-32.1	-21.8	Oklahoma State Univ	20.2	-50.6	-19.0
U Pennsylvania	46.2	-2.7	-19.2	Christian Brothers Coll	19.8	-30.0	-46.4
U Mass-Amherst	45.9	-10.6	6.8	U Texas-Arlington	19.7	-53.4	5.8
+ Tuskegee University	45.3	-8.1	-17.4	U Connecticut	19.3	-39.6	-56.6
Cal State U-Los Angeles	44.5	-42.6	11.2	U Texas-El Paso	19.3	-47.0	-28.5
GMI Engrg & Mgmt Inst	44.1	-26.7	-23.1	Memphis State University	19.1	-26.4	-13.2
SUNY-Buffalo Campus	43.6	-34.5	0.9	+ Tennessee State Univ	18.6	-35.8	-24.7
Lehigh University	43.3	-2.8	-50.0	U Illinois-Chicago	18.5	-58.2	-19.0
+ U District of Columbia	42.9	-26.9	-22.9	Embry-Riddle U-Daytona	18.1	-41.3	-45.9
NC State Univ-Raleigh	42.7	-19.3	-12.2	Iowa State University	17.4	-61.5	-29.8
Colorado School of Mines	42.6	-31.2	-20.6	U Missouri-Columbia	17.1	-55.9	-13.7
Vanderbilt University	42.5	-24.0	-17.3	U Houston	16.5	-44.4	-23.8
U Virginia	42.2	-38.2	-7.4	CCNY (City College, CUNY)	15.7	-61.9	-11.7
U Cal-Los Angeles	42.0	-40.4	3.9	Western Michigan Univ	15.2	-41.6	-48.5
Kansas State University	40.6	-34.0	-13.1	U Southwestern Louisiana	14.6	-50.7	-41.5
Syracuse University	40.3	-30.7	-19.3	U Oklahoma	13.5	-51.3	-38.4
Loyola Marymount Univ	40.1	-39.8	-16.5	Michigan State University	13.5	-49.4	-62.5
U Southern California	39.2	-14.8	-18.3	U Toledo	13.4	-63.9	-61.4
Virginia Poly Institute	39.2	-23.4	-22.9	Ohio State University	13.2	-61.9	-29.5
U Tennessee-Knoxville	37.8	-54.9	-5.8	Louisiana State Univ	10.8	-76.2	-4.3
U Illinois-Champaign	37.6	-42.1	-9.3	U South Alabama	9.8	-58.9	-11.1
Northeastern University	37.4	-56.1	13.8	Oakland University	6.9	-39.4	-72.3
Brown University	37.0	-37.6	-27.9	Indiana Inst of Tech	6.2	-77.3	-36.4
Virginia Military Inst	36.7	-41.8	-22.6	U Akron	5.7	-63.6	-50.0
Rochester Inst of Tech	36.3	-37.0	8.6				
NM Institute of Mining	35.6	-53.9	-7.3				
Cal State U-Northridge	35.6	-15.4	-16.5				
Rutgers University	34.4	-32.8	-21.4				
+ NC A&T State University	34.1	-36.4	-17.9				
U Pittsburgh	33.9	-11.9	-53.1				

*Selection Criteria: 1) Only schools with complete data. 2) A yearly average minority freshman class of at least 10. 3) Increases in minority freshman-to-sophomore and sophomore-to-junior enrollments do not exceed 15%.

+HBCU

- Eighteen schools in the overall sample had increases in minority sophomore-to-junior enrollments in excess of 15 percent (Table 5). These schools are effective in attracting a large number of minority students who did not begin their studies there as freshmen. However, the influx of transfers obscures their sophomore graduation rates.
- Forty of the 46 schools with above average graduation rates for sophomores (Table 4), also had above average graduation rates for freshmen (Table 2). A substantial majority (87.0 percent) of the schools effective with sophomores, then, tend to be successful with freshmen. The reverse is also generally true. There are, however, examples of disparate performance. Comparing the retention of sophomores and freshmen at individual institutions provides useful insights which have policy and program implications.

Relative Retention Index

Intra-institutional comparisons of graduation rates of minorities versus nonminorities provide insights of a different kind. To make these comparisons, we defined the Relative Retention Index (RRI):

$$RRI = (\text{Minority graduation rate} / \text{Nonminority graduation rate}) \times 100$$

Freshman RRI. In this analysis, we eliminated schools with significant transfers of either minorities or nonminorities. Ninety-eight institutions met the criteria for inclusion in the freshman analysis. The mean RRI for this population was 55.1, very nearly equal to the gross national average of 52.0. The relatively large standard deviation of 23.2 indicates a wide variation in this parameter.

- Six schools had freshman RRIs of 95 or higher, indicating that they were doing as well, within the statistical margin of error, or better with minorities than nonminorities (Table 6).

Sophomore RRI. For sophomores, 97 institutions met the standards for inclu-

Table 3.

Engineering Colleges with Greater Than 15% Increase in Minority Freshman to Sophomore or Sophomore to Junior Enrollment*

	Freshman-based Minority Graduation Rate (%)	Percent Change in Minority Enrollment	
		Freshman to Sophomore	Sophomore to Junior
Cal Poly-Pomona	87.8	-24.0	63.8
Cal State U-Fresno	44.7	-2.6	73.7
Cal State U-Long Beach	71.8	-42.0	105.9
Cal State-Fullerton	89.7	24.6	87.7
Case Western Reserve Univ	65.9	25.6	-41.8
Columbia University	63.7	21.9	-44.6
Georgia Inst of Tech	68.7	-17.0	25.0
Manhattan College	103.8	3.2	25.5
Michigan Tech University	45.7	-43.5	34.6
Mississippi State Univ	56.2	-0.5	24.9
Old Dominion University	54.1	-42.3	46.7
Pratt Institute	209.5	45.7	71.2
San Diego State Univ	43.7	-43.7	63.5
San Jose State University	79.9	-8.6	36.2
Texas A&M University	46.8	-36.0	19.1
U Central Florida	42.1	-51.3	109.8
U South Florida	99.1	-22.8	80.9
U Washington	42.7	-26.8	28.6
Washington University	80.7	-9.3	23.1

*Selection Criteria: 1) Only schools with complete data. 2) A yearly average minority freshman class of at least 10. 3) Freshman-based minority graduation rates above the national rate of 35.6%.

sion, yielding a mean of 64.2 and a standard deviation of 22.5. The stability of the nonminority sophomore population suggests that the large variance here is due to widely varying performance of schools in graduating minority sophomores.

- Six schools did better with minority than with nonminority students (Table 7). Of these, four schools had both freshman and sophomore indices above 95 percent; one was an HBCU. Figure 4 shows the distribution of RRIs among the engineering colleges.

Number of Graduates by Institution

As a final measure of performance, we compared the number of minority graduates at each school. As mentioned earlier, an average of 4,121 minorities graduated annually during the last seven years, 5.6 percent of the average class of 73,106. This yields an average by school of 13 minority graduates, compared to 223 nonminority graduates.

Of the 325 engineering schools, only 97 (29.8 percent) equaled or surpassed the national yearly average of 13 minority graduates. Only 23 schools graduated 50 or more minority engineers. This highly skewed distribution is exhibited in Figure 2. Table 8 lists the average number of graduates for each school. Unfortunately, many of the schools with good minority retention rates have low minority enrollment, and many of the schools that graduate a large number of minorities have low retention rates. As we've noted, these observations have important strategic implications.

Variation by Ethnicity

African Americans comprised more than half (53.8 percent) of the yearly average minority graduates, Hispanics 42.9 percent and American Indians 3.3 percent (Figure 5). Freshman- and sophomore-based graduation rates for African Americans are 30.6 percent and 50.0 percent, Hispanics 44.8 percent and 70.2 percent, and American Indians 35.6 percent and 59.1 percent, respectively. The respective RRIs indi-

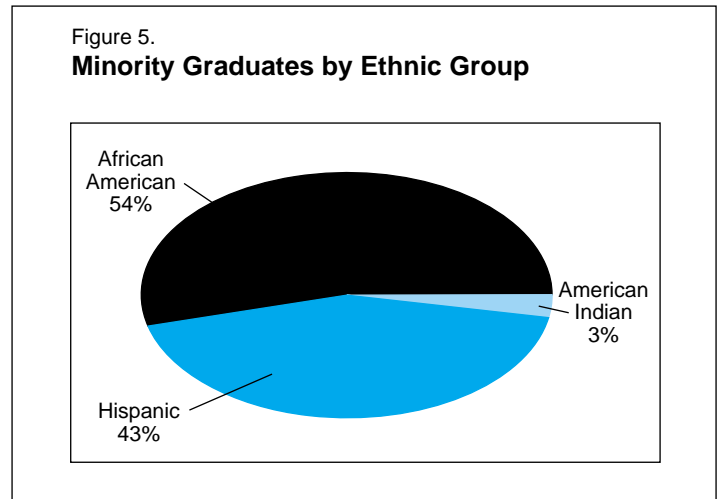
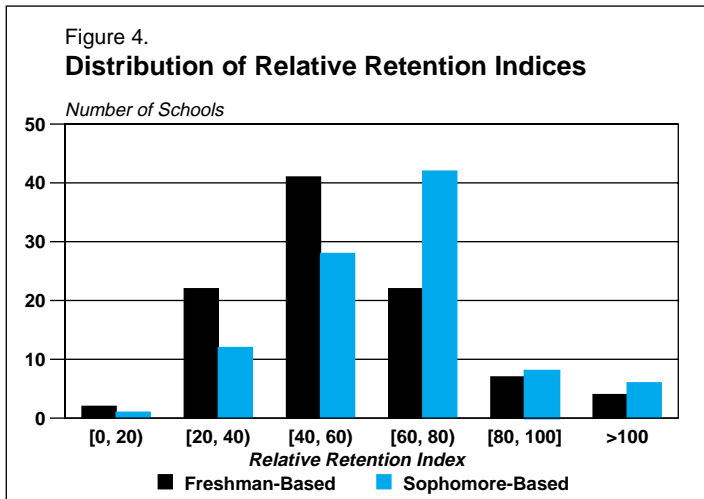
Table 4.

Engineering Colleges Ranked by Sophomore-Based Minority Graduation Rate*

	Graduation Rate (%)	Percent Change in Minority Enrollment Sophomore to Junior		Graduation Rate (%)	Percent Change in Minority Enrollment Sophomore to Junior
Tulane University	95.7	9.6	Columbia University	52.3	-44.6
U Miami	95.3	11.2	U Mass-Amherst	51.3	6.8
U Colorado-Boulder	93.9	1.1	Rutgers University	51.2	-21.4
U Maryland-College Park	93.3	11.6	U Alabama	51.2	-16.6
George Washington Univ	93.2	-4.3	Virginia Poly Institute	51.2	-22.9
Rice University	88.8	-31.3	Purdue Univ-W Lafayette	50.4	-33.1
Colorado State University	88.4	-1.5	+ Prairie View A&M Univ	49.7	-12.9
Texas A&I University	87.2	3.7	+ Tuskegee University	49.3	-17.4
Northeastern University	85.1	13.8	Penn State University	49.0	-31.8
U Tennessee-Knoxville	83.7	-5.8	U Texas-Austin	47.8	-23.6
Tennessee Tech Univ	83.2	-34.3	U Cal-Irvine	47.5	-22.8
U Louisville	82.9	-18.3	U Pennsylvania	47.5	-19.2
+ Howard University	78.0	-12.6	U Arizona	46.6	-25.9
Cal State U-Los Angeles	77.6	11.2	Clemson University	46.3	-19.0
U Cal-Berkeley	77.0	2.6	Auburn University	46.3	-58.4
Princeton University	75.6	-20.6	U Southern California	46.1	-18.3
U Missouri-Rolla	75.5	-5.3	U Kansas	45.8	-31.8
U Bridgeport	75.4	-26.7	Louisiana State Univ	45.6	-4.3
Rensselaer Polytechnic	72.8	-8.3	Iowa State University	45.1	-29.8
U Cal-Los Angeles	70.4	3.9	Lehigh University	44.5	-50.0
U Minnesota	69.7	3.9	U Illinois-Chicago	44.3	-19.0
Northwestern University	69.4	-12.2	U Wisconsin-Madison	42.4	-32.3
US Naval Academy	68.7	-21.8	U Texas-Arlington	42.4	5.8
U Cal-Santa Barbara	68.5	-5.2	Boston University	42.2	-24.2
U Virginia	68.3	-7.4	Arizona State University	42.1	8.7
Stevens Inst of Tech	68.1	-35.7	NM State University	42.1	-26.8
U Pacific	67.6	-8.5	Cal State U-Northridge	42.1	-16.5
Drexel University	67.3	-32.9	U Alabama-Birmingham	42.0	-44.2
U Notre Dame	66.8	-16.3	CCNY (City College, CUNY)	41.3	-11.7
Loyola Marymount Univ	66.6	-16.5	Wright State University	41.0	-8.5
SUNY-Buffalo Campus	66.5	0.9	Oklahoma State Univ	40.9	-19.0
U Mississippi	66.0	0.0	U Missouri-Columbia	38.7	-13.7
Marquette University	65.8	-18.3	U Pittsburgh	38.5	-53.1
U Illinois-Champaign	65.0	-9.3	U Toledo	37.2	-61.4
U Alabama-Huntsville	64.9	0.0	U Texas-El Paso	36.4	-28.5
Ohio University	63.0	-17.6	U Arkansas	36.0	-44.2
U Michigan-Ann Arbor	62.8	-15.5	U Michigan-Dearborn	35.7	-38.1
Florida Institute of Tech	62.7	-32.4	Ohio State University	34.7	-29.5
U South Carolina	62.3	-12.9	U Connecticut	32.0	-56.6
Colorado School of Mines	61.9	-20.6	Embry-Riddle U-Daytona	30.9	-45.9
Kansas State University	61.5	-13.1	Carnegie Mellon Univ	30.7	-3.3
GMI Engrg & Mgmt Inst	60.2	-23.1	+ Southern University	30.3	-50.6
Brown University	59.2	-27.9	U Houston	29.6	-23.8
Illinois Inst of Tech	59.0	-19.2	U Southwestern Louisiana	29.6	-41.5
+ U District of Columbia	58.6	-22.9	+ Tennessee State Univ	29.0	-24.7
Syracuse University	58.2	-19.3	Christian Brothers Coll	28.3	-46.4
Cornell University	56.0	-32.6	U Oklahoma	27.8	-38.4
Vanderbilt University	56.0	-17.3	Michigan State University	26.7	-62.5
U Delaware	55.5	2.2	Memphis State University	26.0	-13.2
SUNY-Stony Brook Campus	54.7	10.5	Western Michigan Univ	26.0	-48.5
Lawrence Technological U	54.3	-32.5	U South Alabama	23.8	-11.1
U Detroit	53.9	-54.9	U NC-Charlotte	21.2	-28.4
+ NC A&T State University	53.6	-17.9	U Akron	15.7	-50.0
NC State Univ-Raleigh	52.9	-12.2	Oakland University	11.4	-72.3
U Cincinnati	52.6	-18.7			
U New Mexico	52.6	-37.9			
Case Western Reserve Univ	52.5	-41.8			

*Selection Criteria: 1) Only schools with complete data. 2) A yearly average minority sophomore class of at least 10. 3) Increases in minority sophomore-to-junior enrollments do not exceed 15%.

+ HBCU.



cate that African American freshmen graduate at 44.8 percent of the rate at which nonminority freshmen graduate and 57.2 percent of the rate for nonminority sophomores. For Hispanics the RRI's are 65.5 and 80.3 percent and for American Indians 52.1 and 67.6 percent, respectively.

A large proportion of African Americans graduate from Historically Black Colleges and Universities. Annually, the HBCUs graduate 25.8 percent of all the African Americans who receive BSEs, and they account for seven of the 12 institutions graduating at least 25 African American engineers annually (Table 10).

While Hispanics and American Indians are not as concentrated in particular schools, 14 institutions conferred at least 25 BSE degrees annually to Hispanics (Table 11). A significant number of schools attract a large influx of Hispanic students as transfers between the sophomore and junior years (Table 12). It is noteworthy that the University of Puerto Rico, Mayaguez, has graduated an average of 452 engineers annually during the period of this study. The inclusion of this data, however, would have obscured the achievement of all other engineering schools relative to the Hispanic population.

Only four schools averaged more than one percent American Indian graduates annually (Table 13). Because of the small numbers, it's difficult to draw

significant conclusions about the performance of engineering schools with American Indian students.

Conclusions and Recommendations

The data that universities provide to the Engineering Manpower Commission (EMC) annually is, of course, imperfect. Moreover, the only way to measure retention with absolute accuracy is to follow each individual student longitudinally. Nonetheless, EMC's data base is the best, most comprehensive source of information available on engineering enrollment and graduation, and a comparative analysis spanning a ten-year period provides enormously rich and valuable insights.

Perhaps the most significant insight is one that is already well known, that American engineering schools have not served their minority student populations well, certainly not nearly as well as they have served their nonminority engineering students. That attrition of minority freshmen is twice that of nonminorities and that this situation has persisted for at least a decade, represents a catastrophic failure of the academic community to meet its responsibility in this area.

A mitigating factor and a disadvantage of our computations is that progress being made as a result of recently established retention or minority engineering programs at a number of institutions is obscured. There is also

preliminary evidence suggesting that retention of minorities has improved slightly on a national level in recent years, but not enough to alter the conclusion of the preceding paragraph.

While a few strident voices on the national scene attribute minority attrition to the misguided interpretation of affirmative action as a lowering of standards, the data suggest otherwise, at least with respect to engineering. Far from being deficient in academic training and preparation, the African American, Hispanic and American Indian students who enroll in the nation's engineering schools are an extraordinarily select group of young men and women. Based on a statistically significant sample of students, we've found that minority engineering majors leave high school with grades and SAT scores indistinguishable, on average, from those of their white and Asian peers – and yet they drop out of engineering school at double the rate of their classmates.

The argument that this group of minority students may be disproportionately placed, relative to their educational development, in the more competitive institutions is also suspect. Almost 40 percent of the schools with the highest minority graduation rates have admissions policies that are among the most stringent.

In any case, other factors that serve as impediments to the success of minority

Table 5.

Engineering Colleges with Increase in Minority Sophomore to Junior Enrollment Exceeding 15%*

	Sophomore-based Minority Graduation Rate (%)	Percent Change in Minority Enrollment Sophomore to Junior
Cal Poly-Pomona	115.5	63.8
Cal State U-Long Beach	123.8	105.9
Cal State U-Sacramento	73.0	131.4
Cal State-Fullerton	72.0	87.7
Georgia Inst of Tech	82.8	25.0
Harvard University	63.2	16.4
Manhattan College	100.6	25.5
Old Dominion University	93.7	46.7
Pratt Institute	143.8	71.2
San Diego State Univ	77.6	63.5
San Jose State University	87.4	36.2
Texas A&M University	73.1	19.1
U Central Florida	86.5	109.8
U South Florida	128.3	80.9
U Washington	58.4	28.6
Washington University	89.0	23.1

* Selection Criteria: 1) Only schools with complete data. 2) A yearly average minority sophomore class of at least 10.

As the nation's largest privately funded source of scholarships for minority engineering majors, NACME has a critical stake in the ability of colleges and universities to provide an environment conducive to the success of underrepresented students. This report is the second in a series planned to develop a comprehensive analysis of the retention problem (See NACME Research Letter, Volume 1, Number 1, "Minorities in Engineering School, A Data Base for Retention Efforts", April, 1990). We will continue to analyze and report on effective strategies for retaining minorities in order to facilitate replication. Our goal is to assist colleges and universities as they begin to conserve and nurture the minority talent in each year's freshman class. The next report will analyze contributions of minority engineering programs (MEPs), the result of a joint NACME/ETS (Educational Testing Service) research project. And, in a recently published monograph titled Retention By Design, Dean Raymond B. Landis, of California State University, Los Angeles, discusses effective program strategies with demonstrated results. Future studies will examine such institutional factors as curriculum innovation, financial aid, and faculty sensitivity to diverse student populations.

students in engineering school are clearly operating and must be addressed more effectively than they have been in the past, if universities are to be considered successful as institutions of higher learning in the future.

A somewhat serendipitous observation, which can be made from the data and requires further study, is that those schools (e.g. some of the California institutions) attracting significant numbers of *nonminorities* through articulation relationships with two-year colleges do not seem to attract comparable numbers of minority transfers. It is also noteworthy that a majority of the HBCUs attract a substantial fraction of their nonminority graduates through the transfer process.

It must not be overlooked that, examining the data on a school-by-school basis, we see a number of individual successes which could serve as standards for the nation. The commitment of these institutions to educating minority engineers is reflected in graduation rates that exceed the rate for

nonminority students nationally, minority graduation rates comparable to or even exceeding the rate for nonminority students at the same institution, and numbers of engineering degrees granted to minorities annually that exceed the national average. Their performance offers the remaining institutions a set of benchmarks that must be matched more broadly; in particular, retention of minority students at least equal to that of other students (68 percent for freshmen and 87 percent for sophomores), along with specific time lines and clear-cut responsibility and accountability for achieving these modest goals.

Another important recommendation that emerges from the study is that an intense effort should be devoted to improving retention at those institutions that already graduate a large number of minority students. At the same time, those schools with high minority retention rates, which in many cases have a small percent minority student enrollment, should intensify their outreach and recruitment efforts. The return on investment in both categories is likely to be high.

Table 6.

Engineering Colleges Ranked by Freshman-Based Relative Retention Index*

	Relative Retention Index (%)	Graduation Rate (%)			Relative Retention Index (%)	Graduation Rate (%)	
		Minority	Nonminority			Minority	Nonminority
Purdue Univ-Calumet	130.8	51.4	39.3	U Cal-Santa Barbara	49.9	33.7	67.5
+ Howard University	129.3	33.3	25.7	Virginia Poly Institute	49.9	39.2	78.5
Tulane University	116.5	74.4	63.9	U Notre Dame	49.7	33.2	66.8
Florida Institute of Tech	114.5	72.0	62.9	Auburn University	49.6	28.1	56.6
George Washington Univ	99.1	78.4	79.1	U Pennsylvania	49.0	46.2	94.2
Tennessee Tech Univ	97.7	52.6	53.8	Cornell University	48.1	47.2	98.1
Cleveland State Univ	93.5	48.5	51.9	NC State Univ-Raleigh	47.9	42.7	89.1
U Bridgeport	90.4	85.7	94.8	U Kansas	47.2	23.6	49.9
U Louisville	88.1	49.7	56.4	Rochester Inst of Tech	46.6	36.3	78.0
Marquette University	87.8	66.7	76.0	U Wisconsin-Milwaukee	45.9	33.1	72.3
Stevens Inst of Tech	83.0	55.7	67.1	Lawrence Technological U	45.4	28.1	62.0
U Minnesota	79.9	56.9	71.3	Arizona State University	43.6	25.0	57.4
Northwestern University	79.3	75.7	95.4	Rutgers University	43.5	34.4	79.1
SUNY-Buffalo Campus	79.2	43.6	55.0	U Rochester	43.3	26.6	61.4
Texas A&I University	77.8	50.3	64.6	U Texas-Austin	43.1	24.9	57.8
Princeton University	77.8	71.4	91.8	Boston University	42.1	29.7	70.4
U Delaware	77.2	53.1	68.8	U NC-Charlotte	42.1	21.7	51.6
Brown University	74.8	37.0	49.4	Memphis State University	42.1	19.1	45.5
Kansas State University	73.2	40.6	55.4	U Cincinnati	42.1	28.2	67.0
U Colorado-Boulder	72.9	50.4	69.2	Illinois Inst of Tech	41.7	32.3	77.4
U Mississippi	70.3	53.7	76.4	U Toledo	41.0	13.4	32.7
U New Mexico	69.0	27.1	39.2	U Texas-Arlington	40.5	19.7	48.8
Purdue Univ-W Lafayette	68.6	55.2	80.5	Christian Brothers Coll	40.2	19.8	49.3
Drexel University	68.0	50.1	73.7	U Wisconsin-Madison	39.7	31.0	78.1
Colorado School of Mines	66.1	42.6	64.4	Oklahoma State Univ	38.2	20.2	52.9
U Pacific	65.0	51.1	78.6	Embry-Riddle U-Daytona	36.0	18.1	50.3
Virginia Military Inst	64.3	36.7	57.1	U Cal-Irvine	35.0	25.7	73.4
U Texas-El Paso	63.4	19.3	30.4	U Michigan-Dearborn	34.8	28.6	82.1
Loyola Marymount Univ	62.3	40.1	64.3	So Illinois-Carbondale	34.8	30.8	88.4
U South Carolina	60.5	31.4	52.0	U Arizona	34.3	22.0	64.0
U Alabama	60.3	31.0	51.5	Iowa State University	33.5	17.4	52.0
U Detroit	60.1	50.7	84.4	Louisiana State Univ	32.9	10.8	33.0
Colorado State University	60.0	48.3	80.4	U Southwestern Louisiana	32.2	14.6	45.4
Rice University	59.4	55.0	92.5	Wright State University	32.0	21.7	68.0
GMI Engrg & Mgmt Inst	59.2	44.1	74.4	Ohio State University	31.4	13.2	42.1
Johns Hopkins University	58.3	72.4	124.2	U Kentucky	30.3	21.4	70.8
U Missouri-Rolla	57.6	49.2	85.3	U Alabama-Birmingham	30.3	22.2	73.3
Vanderbilt University	57.6	42.5	73.9	Michigan State University	30.1	13.5	44.8
U Tennessee-Knoxville	56.7	37.8	66.7	U Oklahoma	29.5	13.5	45.8
U Mass-Amherst	56.2	45.9	81.7	U Connecticut	28.9	19.3	67.0
Rensselaer Polytechnic	56.0	53.7	95.9	Indiana Inst of Tech	27.5	6.2	22.5
U Southern California	55.4	39.2	70.8	Western Michigan Univ	26.7	15.2	56.7
U Arkansas	55.3	25.7	46.5	U Houston	26.6	16.5	61.9
Penn State University	55.3	32.1	58.1	U South Alabama	24.8	9.8	39.5
Clemson University	53.2	32.5	61.2	U Missouri-Columbia	23.3	17.1	73.3
U Virginia	53.1	42.2	79.5	U Akron	16.8	5.7	34.1
NM State University	52.0	25.4	48.9	Oakland University	7.5	6.9	91.3
Syracuse University	51.6	40.3	78.2				
Ohio University	50.3	28.2	56.1				
+ Tuskegee University	50.3	45.3	90.1				
Northeastern University	50.0	37.4	74.8				

*Selection Criteria: 1) Only schools with complete data. 2) A yearly average minority freshman class of at least 10. 3) Increases in freshman-to-sophomore and sophomore-to-junior enrollments do not exceed 15% for either minorities or nonminorities..

+ HBCU.

Table 7.

Engineering Colleges Ranked by Sophomore-Based Relative Retention Index*

	Relative Retention Index (%)	Graduation Rate (%)			Relative Retention Index (%)	Graduation Rate (%)	
		Minority	Nonminority			Minority	Nonminority
+ Howard University	173.4	78.0	45.0	U New Mexico	61.6	52.6	85.4
Tulane University	126.2	95.7	75.8	Oklahoma State Univ	60.8	40.9	67.3
George Washington Univ	110.0	93.2	84.7	Case Western Reserve Univ	60.7	52.5	86.4
Tennessee Tech Univ	109.8	83.2	75.7	U Mass-Amherst	60.3	51.3	85.2
U Colorado-Boulder	103.0	93.9	91.2	Rutgers University	60.2	51.2	85.0
Colorado State University	101.8	88.4	86.8	Louisiana State Univ	59.7	45.6	76.5
U Louisville	95.2	82.9	87.0	Illinois Inst of Tech	58.6	59.0	100.8
Stevens Inst of Tech	90.3	68.1	75.4	U Texas-El Paso	58.4	36.4	62.3
Rice University	89.0	88.8	99.8	Penn State University	58.0	49.0	84.5
Texas A&I University	88.5	87.2	98.5	Iowa State University	57.6	45.1	78.4
US Naval Academy	88.0	68.7	78.1	Arizona State University	57.3	42.1	73.5
Brown University	87.8	59.2	67.5	U Texas-Austin	57.3	47.8	83.5
Northeastern University	83.6	85.1	101.8	Clemson University	55.7	46.3	83.1
U Tennessee-Knoxville	81.6	83.7	102.7	Cornell University	54.3	56.0	103.1
Drexel University	79.6	67.3	84.5	U Pennsylvania	53.9	47.5	88.1
Marquette University	79.2	65.8	83.1	U Kansas	52.7	45.8	86.9
Northwestern University	79.1	69.4	87.7	U Cal-Irvine	52.5	47.5	90.4
Loyola Marymount Univ	78.0	66.6	85.3	U Southern California	51.6	46.1	89.3
Princeton University	77.9	75.6	97.1	+ Tuskegee University	51.2	49.3	96.3
+ U District of Columbia	77.8	58.6	75.4	Boston University	49.2	42.2	85.8
U Virginia	77.3	68.3	88.3	Columbia University	49.1	52.3	106.6
GMI Engrg & Mgmt Inst	76.3	60.2	78.9	U Toledo	48.2	37.2	77.1
Kansas State University	74.9	61.5	82.1	U Texas-Arlington	48.1	42.4	88.2
U Alabama	73.9	51.2	69.3	U Wisconsin-Madison	46.9	42.4	90.5
Colorado School of Mines	73.2	61.9	84.5	U Connecticut	45.8	32.0	69.9
Syracuse University	72.6	58.2	80.2	Ohio State University	45.6	34.7	76.1
Lawrence Technological U	72.2	54.3	75.3	Michigan State University	44.8	26.7	59.6
U Pacific	71.9	67.6	94.0	Christian Brothers Coll	44.6	28.3	63.4
Rensselaer Polytechnic	71.8	72.8	101.4	U Oklahoma	44.5	27.8	62.5
U Cal-Santa Barbara	71.6	68.5	95.6	Wright State University	41.7	41.0	98.3
U Notre Dame	71.6	66.8	93.3	Carnegie Mellon Univ	41.7	30.7	73.8
U Delaware	71.6	55.5	77.5	U Pittsburgh	41.4	38.5	93.0
SUNY-Buffalo Campus	71.5	66.5	93.0	U Arkansas	40.9	36.0	88.0
U Arizona	71.3	46.6	65.4	Embry-Riddle U-Daytona	39.9	30.9	77.5
U Minnesota	71.1	69.7	98.1	U Michigan-Dearborn	39.5	35.7	90.5
U Detroit	71.0	53.9	75.8	Western Michigan Univ	38.7	26.0	67.1
SUNY-Stony Brook Campus	71.0	54.7	77.1	Memphis State University	38.5	26.0	67.6
U Bridgeport	70.5	75.4	106.9	U Southwestern Louisiana	38.4	29.6	77.0
U Missouri-Rolla	70.2	75.5	107.5	U NC-Charlotte	37.1	21.2	57.1
Ohio University	69.8	63.0	90.2	U Missouri-Columbia	36.6	38.7	105.9
U Mississippi	69.8	66.0	94.6	U South Alabama	34.5	23.8	69.0
Vanderbilt University	69.6	56.0	80.5	+ Southern University	34.0	30.3	89.1
U South Carolina	69.3	62.3	89.8	U Houston	34.0	29.6	87.0
Florida Institute of Tech	67.5	62.7	92.9	U Akron	32.0	15.7	49.0
U Cincinnati	67.1	52.6	78.4	U Alabama-Birmingham	26.9	42.0	156.0
Auburn University	66.0	46.3	70.1	Oakland University	10.8	11.4	105.5
NM State University	65.9	42.1	63.8				
Purdue Univ-W Lafayette	65.8	50.4	76.6				
Virginia Poly Institute	64.8	51.2	79.0				
NC State Univ-Raleigh	62.3	52.9	84.9				
Lehigh University	61.7	44.5	72.1				

*Selection Criteria: 1) Only schools with complete data. 2) A yearly average minority sophomore class of at least 10. 3) Increases in sophomore-to-junior enrollments do not exceed 15% for either minorities or nonminorities.

+ HBCU.

Table 8.

Engineering Colleges Ranked by Yearly Average Number of Minority Graduates

	Number of Minority Graduates		Number of Minority Graduates		Number of Minority Graduates	
	CCNY (City College, CUNY)	109	US Naval Academy	23	U Detroit	10
+	Howard University	99	U Cal-Santa Barbara	22	# U New Orleans	10
	Georgia Inst of Tech	94	Virginia Poly Institute	22	U Oklahoma	10
+	Prairie View A&M Univ	87	San Jose State University	22	Colorado School of Mines	10
+	NC A&T State University	84	U South Carolina	21	Iowa State University	10
	Texas A&M University	83	US Air Force Academy	21	U Kansas	10
+	Tuskegee University	74	U Washington	21	Cal State-Fullerton	10
	U Texas-Austin	69	Mississippi State Univ	20	Colorado State University	10
	U Florida	68	U Cal-Davis	20	SUNY-Stony Brook Campus	10
	U Texas-El Paso	67	Northeastern University	20	U Notre Dame	10
+	Southern University	65	Clemson University	19	U Bridgeport	9
	Cal State U-Long Beach	63	U Virginia	18	U Missouri-Columbia	9
	NC State Univ-Raleigh	60	Boston University	18	Johns Hopkins University	9
	U New Mexico	58	Penn State University	18	Tennessee Tech Univ	9
	U Miami	58	Lawrence Technological U	18	Vanderbilt University	9
#	Mass Inst of Technology	58	# Florida Atlantic Univ	17	Catholic Univ of America	9
	NM State University	57	Princeton University	17	Cal State U-Fresno	9
	Florida Intl University	57	Arizona State University	17	Case Western Reserve Univ	9
	Pratt Institute	57	Columbia University	17	# NY Institute of Tech	9
	Cal Poly-Pomona	54	Texas Tech University	16	U Dayton	8
	Purdue Univ-W Lafayette	52	U Central Florida	16	U Louisville	8
	Stanford University	51	Auburn University	16	Santa Clara University	8
	Texas A&I University	51	Marquette University	16	U Pacific	8
#	New Jersey Inst Tech	48	U Mass-Amherst	15	Duke University	8
	Cornell University	45	Tulane University	15	Lehigh University	8
+	U District of Columbia	43	Cal State U-Sacramento	15	# FAMU/FSU College of Engrg	8
	Polytechnic University	43	U Colorado-Boulder	15	U Colorado-Denver	8
	Rensselaer Polytechnic	41	U Houston	15	U Alabama-Huntsville	8
+	Tennessee State Univ	40	# U Texas-San Antonio	15	U Alabama-Birmingham	7
	U Cal-Berkeley	39	Louisiana State Univ	14	U Cal-Irvine	7
	U South Florida	39	U Pennsylvania	14	Ohio University	7
	U Maryland-College Park	39	U Wisconsin-Madison	14	Michigan Tech University	7
	Cal State U-Northridge	38	Wayne State University	14	U Southwestern Louisiana	7
	U Tennessee-Knoxville	36	Syracuse University	14	U Hartford	7
	U Arizona	35	Loyola Marymount Univ	13	Brown University	7
	U Illinois-Champaign	35	U Arkansas	13	# George Mason University	7
	U Michigan-Ann Arbor	32	U Texas-Arlington	13	U Mississippi	7
	U Southern California	32	U Pittsburgh	13	U Tulsa	7
	U Illinois-Chicago	31	San Francisco State Univ	13	ND State University	7
	Illinois Inst of Tech	31	Southern Methodist Univ	13	U Cincinnati	7
	Cal Poly-San Luis Obispo	30	SUNY-Buffalo Campus	13	Harvard University	6
	Northwestern University	30	U Delaware	13	Cleveland State Univ	6
	U Cal-Los Angeles	30	Rice University	12	Purdue Univ-Calumet	6
	U Alabama	30	Louisiana Tech University	12	+# Morgan State University	6
	U Missouri-Rolla	28	U Minnesota	12	U Lowell	6
	Rutgers University	27	# Lamar University	12	Oregon State University	6
	Manhattan College	27	Old Dominion University	12	Rochester Inst of Tech	6
	Drexel University	27	Washington University	12	Virginia Military Inst	6
	Michigan State University	26	Florida Institute of Tech	11	Worcester Poly Institute	6
	San Diego State Univ	26	# U Cal-San Diego	11	So Illinois-Edwardsville	5
	GMI Engrg & Mgmt Inst	26	George Washington Univ	11	Christian Brothers Coll	5
	Ohio State University	25	Fairleigh Dickinson Univ	11	# Milwaukee School of Engrg	5
#	US Military Academy	24	Oklahoma State Univ	10	NM Institute of Mining &	5
	Cal State U-Los Angeles	23	Kansas State University	10	U Connecticut	5
	Stevens Inst of Tech	23	Memphis State University	10	U Toledo	5

	Number of Minority Graduates		Number of Minority Graduates		Number of Minority Graduates
West Virginia University	5	# Central State University	2	# Baylor University	0
U Michigan-Dearborn	5	Mass Maritime Academy	2	# Cogswell College North	0
Northern Arizona Univer	5	Valpariso University	2	# Mankato State University	0
Wright State University	5	Youngstown State Univ	2	New England College	0
Carnegie Mellon Univ	5	Oakland University	2	# Northeastern State Univ	0
Yale University	5	Parks College-St. Louis U	2	SD State University	0
Cal State U-Chico	5	Tri-State University	2	St Cloud State University	0
US Merchant Marine Acad	5	U Nebraska-Lincoln	2	# U Maryland-Baltimore	0
Bradley University	4	SUNY: Maritime College	1	U Texas-Permian Basin	0
U New Haven	4	Geneva College	1	U Wyoming	0
# College of Staten Island	4	Hofstra University	1	Washington & Lee Univ	0
U Rhode Island	4	Montana State University	1	Arkansas Tech University	0
U Wisconsin-Milwaukee	4	Western New England Coll	1	# Calvin College	0
Widener University	4	Southeastern Mass Univ	1	Grove City College	0
So Illinois-Carbondale	4	# SUNY: College of Env Sci	1	Idaho State University	0
West Coast University	4	Swarthmore College	1	Le Tourneau College	0
U Utah	4	U Hawaii	1	Merrimack College	0
Cooper Union	4	U Nevada-Las Vegas	1	# Northern Illinois Univ	0
# Temple University	3	U Wisconsin-Platteville	1	Pacific Lutheran Univ	0
Tufts University	3	US Coast Guard Academy	1	Purdue Univ-Ft Wayne	0
U Kentucky	3	Citadel	1	# St Ambrose University	0
Villanova University	3	# Embry Riddle U-Prescott	1	# U Minnesota-Duluth	0
Embry-Riddle U-Daytona	3	Indiana Inst of Tech	1	U North Dakota	0
Northrop University	3	U Evansville	1	# US International Univ	0
St Marys University	3	U Portland	1	Webb Inst of Naval Arch	0
Trinity University	3	John Brown University	1	# Wentworth Inst of Tech	0
U Nevada-Reno	3	Monmouth College	1	# California Maritime Acade	0
U Rochester	3	Montana Coll Min Sci/Tech	1	# College of St Thomas	0
Cal Inst of Technology	3	U Georgia	1	# Grand Valley State Univ	0
Portland State Univ	3	Dartmouth College	1	# Hartford Graduate Center	0
Purdue Univ-Indianapolis	3	# Miami University	1	Humboldt State University	0
U Tennessee-Chattanooga	3	Phila Coll of Textiles	1	# Inst of Paper Sci & Tech	0
Union College	3	St Martins College	1	Marietta College	0
U NC-Charlotte	3	U Maine-Orono	1	# Mercer University	0
U South Alabama	3	# U Southern Colorado	1	# Messiah College	0
Washington State Univ	3	# Air Force Inst of Tech	1	# Natl Tech University	0
Western Michigan Univ	3	Arkansas State University	1	# Oral Roberts University	0
Wichita State University	3	Norwich University	1	# Oregon Grad Inst Sci/Tech	0
Brigham Young University	3	# SUNY: College at New Paltz	1	# U Akron-Polymer Sci	0
McNeese State University	3	Texas A&M U-Galveston	1	# U Cal-Santa Cruz	0
Clarkson University	3	U Alaska-Fairbanks	1	# U Denver	0
Gonzaga University	3	# U Scranton	1	# U NC-Chapel Hill	0
SD School of Mines & Tech	3	U Vermont	1	U New Hampshire	0
West Virginia Inst Tech	3	Alfred University	0	# U Tennessee-Space Inst	0
Harvey Mudd College	2	Gannon University	0	# U Texas-Dallas	0
U Colorado-Colorado Springs	2	Loyola College	0	# U West VA-Grad Studies	0
U Iowa	2	Ohio Northern Univ	0	# U Wisconsin-Parkside	0
# Bridgeport Engrg Inst	2	Seattle Pacific Univ	0	# US Naval Postgraduate Sch	0
Lafayette College	2	Seattle University	0	# Washington U (STIM)	0
U Idaho	2	# SUNY-Binghamton Campus	0	# Wilkes College	0
Walla Walla College	2	# U Alaska-Anchorage	0		
Rose-Hulman Inst of Tech	2	# U Nevada-Sch of Mines	0	+ HBCU.	
U Akron	2	U Redlands	0	# Schools with incomplete graduation data.	
# Hampton University	2	Utah State University	0		
Bucknell University	2	# Alabama A&M University	0		

Table 9.

Engineering Colleges Performing Above Average Across All Measures Examined*

	Minority Graduation Rate (%)		Relative Retention Index (%)		Yearly Average Number of Minority Graduates
	Freshman-Based	Sophomore-Based	Freshman-Based	Sophomore-Based	
Drexel University	50.1	67.3	68.0	79.6	27
GMI Engrg & Mgmt Inst	44.1	60.2	59.2	76.3	26
Loyola Marymount Univ	40.1	66.6	62.3	78.0	13
Marquette University	66.7	65.8	87.8	79.2	16
Northwestern University	75.7	69.4	79.3	79.1	30
Princeton University	71.4	75.6	77.8	77.9	17
Rensselaer Polytechnic	53.7	72.8	56.0	71.8	41
Stevens Inst of Tech	55.7	68.1	83.0	90.3	23
SUNY-Buffalo Campus	43.6	66.5	79.2	71.5	13
Texas A&I University	50.3	87.2	77.8	88.5	51
Tulane University	74.4	95.7	116.5	126.2	15
U Colorado-Boulder	50.4	93.9	72.9	103.0	15
U Missouri-Rolla	49.2	75.5	57.6	70.2	28
U Tennessee-Knoxville	37.8	83.7	56.7	81.6	36
U Virginia	42.2	68.3	53.1	77.3	18

*Selection Criteria: 1) Only schools with complete data. 2) Above average graduation rates for both minority freshmen and sophomores. 3) Above average relative retention indices. 4) An average of at least 13 minority graduates per year. 5) Increases in minority and nonminority freshman-to-sophomore and sophomore-to-junior enrollments do not exceed 15%.

Table 10.

Engineering Colleges with a Graduating Class of at Least 25 African Americans*

	Average Annual African American Graduates	
	Number	Percent
+ Howard University	99	87.8
+ Prairie View A&M Univ	87	77.7
+ NC A&T State University	83	63.3
+ Tuskegee University	74	86.0
CCNY (City College, CUNY)	70	20.2
Georgia Inst of Tech	65	5.7
+ Southern University	64	45.7
NC State Univ-Raleigh	51	5.3
Pratt Institute	42	27.0
+ Tennessee State Univ	40	49.6
Purdue Univ-W Lafayette	38	3.0
+ U District of Columbia	37	50.6
U Tennessee-Knoxville	31	5.7
U Alabama	27	9.2
Northwestern University	27	9.4

*Selection Criteria: Only schools with complete data.

+ HBCUs.

Table 11.

Engineering Colleges with a Graduating Class of At Least 25 Hispanics*

	Average Annual Hispanic Graduates	
	Number	Percent
Texas A&M University	67	4.8
U Texas-El Paso	66	37.3
U Texas-Austin	58	7.0
NM State University	53	20.3
U New Mexico	52	18.4
Texas A&I University	50	39.7
U Miami	50	19.0
Cal Poly-Pomona	42	9.2
CCNY (City College, CUNY)	39	11.4
Cal State U-Long Beach	38	6.0
U South Florida	28	7.4
U Arizona	27	5.1
Georgia Inst of Tech	27	2.3
Stanford University	27	8.4

*Selection Criteria: Only schools with complete data.

Table 12.

Engineering Colleges with Greater Than 15% Increase in Hispanic Sophomore to Junior Enrollment*

	Change in Average Annual Hispanic Enrollment		
	Sophomore to Junior (%)		Number
		Sophomores	Juniors
Cal State U-Sacramento	146.3	11	27
U Central Florida	130.5	10	23
Cal State U-Long Beach	123.8	28	63
U South Florida	97.2	18	35
San Diego State Univ	73.6	21	37
Cal State U-Fresno	67.0	15	25
Cal Poly-Pomona	56.3	37	58
San Jose State University	51.8	14	21
Pratt Institute	42.9	13	18
U Washington	41.4	10	14
U Mass-Amherst	21.5	11	13
Texas A&M University	21.1	84	102
U Cal-Los Angeles	19.8	28	33
Georgia Inst of Tech	18.4	26	31
U Miami	18.2	50	60
Manhattan College	18.1	21	25
U Illinois-Champaign	17.6	17	20
Cal State U-Los Angeles	15.4	22	25
Illinois Inst of Tech	15.1	12	14

*Selection Criteria: Only schools with complete data.

Table 13.

Engineering Colleges with a Graduating Class of At Least 1% American Indians*

	Average Annual American Indian Graduates	
	Number	Percent
U New Mexico	5	1.6
U Tulsa	2	1.5
U Nevada-Reno	1	1.3
NM Institute of Mining	1	1.4

*Selection Criteria: Only schools with complete data.

Appendix A.

Engineering Manpower Commission Data, All Engineering Colleges 1980-81 through 1989-90*

	Number of Schools	Freshman Enrollment		Sophomore Enrollment		Number of Schools	Graduates	
		Minority	Nonminority	Minority	Nonminority		Minority	Nonminority
1980-81	286	10,399	98,915	NA	NA	NA	NA	NA
1981-82	285	11,116	103,085	6,861	79,956	NA	NA	NA
1982-83	285	10,721	103,796	6,974	81,977	NA	NA	NA
1983-84	291	10,603	98,160	7,052	81,711	FNA	3,817	72,759
1984-85	288	10,594	93,780	6,863	76,331	288	3,883	73,646
1985-86	296	10,588	91,697	6,832	71,939	302	4,107	73,708
1986-87	312	NA	NA	6,286	69,053	308	4,171	71,048
1987-88	NA	NA	NA	NA	NA	314	4,318	66,547
1988-89	NA	NA	NA	NA	NA	317	4,310	63,981
1989-90	NA	NA	NA	NA	NA	325	4,242	61,209
Average	292	10,670	98,239	6,811	76,828	309	4,121	68,985

*Excluding the University of Puerto Rico, NA - Not Applicable, FNA - Figure Not Available