NACME **Research Letter**

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Research Letter

Patterns in the Production of Minority Engineers 1994-95

George Campbell Jr., Ph.D.

Highlights

- The total number of African Americans, Latinos and American Indians who earned Bachelor's of Science degrees in Engineering (BSEs) reached an all time high in 1995 rising to 5,931 from 5,490 the year before.
- Ten percent of the engineering institutions (31 schools) in the United States produced almost half (49.7 percent) of the minority engineering graduates. Half of all institutions produced eight or fewer minority engineering graduates and 38 schools produced no minority graduates at all in 1995.
- The nation's 31 largest producers of bachelor's degrees in engineering generated 40 percent of the nonminority BSE graduates, but only 28 percent of the minority BSE graduates.
- Historically Black Colleges and Universities and members of the Hispanic Association of Colleges and Universities produced 28.2 percent of all minority engineering graduates in 1995 while only comprising 8.0 percent of the total number of engineering institutions.
- Receiving the bulk of federal taxpayer grant monies for research, the nation's research institutes produced the majority of nonminority BSE graduates (57.2 percent), but a significantly lower percentage of minority BSE graduates (47.5 percent).
- The distribution of minority BSE graduates by institutional selectivity and academic ranking mirrored that of nonminorities, e.g., the most selective institutions produced 7.0 percent of nonminority graduates and 7.7 percent of minority graduates.
- Few states in the country produced engineering graduates that represent the ethnic composition of their

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Overview

While the rising number of minority Bachelor's of Science in Engineering (BSE) graduates continues a 20-year trend, there are circumstances that foreshadow a leveling off, if not a decrease, in the production of African American, Latino and American Indian engineers in the near future. The 10 percent drop in minority freshman engineering enrollment between 1992-1993 and 1995-1996 portends a reversal of current growth and an erosion of the production achievements of the last two decades. The situation is all the more tenuous because the majority of underrepresented BSE graduates come from a relatively small number of schools. Any changes in these institutions that affect BSE production will have a magnified affect on the number of minority engineers nationwide. While we applaud the achievement of these colleges and universities, their gains, as those of other institutions, are endangered by a climate of fiscal restraint, diminishing scholarship awards, shifting market demands, changing student interests and a growing assault on affirmative action policies.

If the nation is to benefit from the talents of its broad and diverse population, we cannot afford to rest on the good work of the past. Understanding the patterns in the production of minority engineering graduates is imperative in order to plan for the future.

Minority Bachelor's of Science in Engineering Graduates: 1995

In 1995, the total number of minority graduates who earned BSE degrees rose to 5,931 from 5,490 in the previous year, an 8 percent increase (Table 1). Each underrepresented minority group, African Americans, Latinos, and American Indians, contributed to this increase. The greatest increase in relative share was experienced by Latinos (11.5 percent), followed by American Indians (11.1 percent) and African Americans (4.6 percent). The total increase in minority earned BSE degrees from the previous year was 441: 290 to Latinos, 128 to African Americans and 23 to American Indians. While the minority share of the graduating class continues to rise, the absolute numbers of Bachelor's of Science in Engineering degrees awarded to minorities remains small. Hence, although minorities have grown from 3.9 percent of the BSE graduates in 1975 to 9.2 percent in 1995, their proportions are far from parity with their representation in the college-age population, now 28.1 percent (Figure 1).

The largest gains over the past year in the number of BSE degrees produced

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were among women, who increased by greater percentages than their male counterparts across all ethnicities (Figure 2). The American Indian female population grew by 21.1 percent, followed by Latinas at 13.8 percent and African American women at 10.7 percent. Nonminority women also showed impressive gains (3.4 percent). However, like the growth experienced by minorities, the large percentage gains obscure the small increases in the number of degrees earned (Figure 3). For example, although American Indian women showed the highest percentage gains, their ranks increased by only 8 graduates. Gains for Latinas totalled 66 degrees, for African American women, 98 degrees, and for nonminority women, 314 degrees.

The total number of minority and women graduates in engineering was dwarfed by the 58,212 BSE degrees earned by nonminority men. Notwithstanding the importance of the 1995 gains for minority men and all women, the total increase of 755 in the number of BSE degrees they received did not offset the loss of 1,020 BSE degrees (2.1 percent) among nonminority males during the same period.

Institutional Distribution of Minority BSE Production

In 1995 there were 321 accredited engineering colleges and universities in the United States that reported to the Engineering Workforce Commission (EWC), which collects data by gender and ethnicity under a grant from NACME. Among these institutions the distribution of engineering degrees conferred upon minority graduates continues to be skewed and highly concentrated in a small number of schools (Figure 4). About ten percent of engineering institutions (31 schools) produced almost half (48.7 percent) of the minority engineering graduates. Half of all the institutions in the United States produced eight or fewer minority engineering graduates and 38 schools produced no minority graduates at all in 1995. This distribution indicates that a few schools are educating most of the minority engineers in the country. Table 2 presents an alphabetical list of all the engineering institutions in the United States along with rankings based on the number of minority graduates produced in 1995.

Table 1
Bachelor of Science Degrees, 1994 and 1995

	1994 Degrees (N)	1994 Degrees (%)	1995 Degrees (N)	1995 Degrees (%)	Change (N)	Change (%)
All Graduates	**64408**	**100.0**	**64143**	**100.0**	**-265**	**-0.4**
Men	**53780**	**83.5**	**53029**	**82.7**	**-751**	**-1.4**
Women	**10628**	**16.5**	**11114**	**17.3**	**486**	**4.6**
Minority Graduates	5490	8.5	5931	9.2	441	8.0
Men	4055	6.3	4324	6.7	269	6.6
Women	1435	2.2	1607	2.5	172	12.0
African American	2769	4.3	2897	4.5	128	4.6
Men	1850	2.9	1880	2.9	30	1.6
Women	919	1.4	1017	1.6	98	10.7
Latino	2514	3.9	2804	4.4	290	11.5
Men	2036	3.2	2260	3.5	224	11.0
Women	478	0.7	544	0.8	66	13.8
Native American	207	0.3	230	0.4	23	11.1
Men	169	0.3	184	0.3	15	8.9
Women	38	0.1	46	0.1	8	21.1
Nonminority Graduates	58918	91.5	58212	90.8	-706	-1.2
Men	49725	77.2	48705	75.9	-1020	-2.1
Women	9193	14.3	9507	14.8	314	3.4

Note: These data exclude the University of Puerto Rico.
Source: National Action Council for Minorities in Engineering, Inc.

Geographic Distribution of Minority BSE Production

An analysis of minority BSE production by state and region shows that few areas of the country are producing engineering graduates that represent the ethnic makeup of the resident population. Although schools do draw from out-of-state populations, NACME freshman data analyses suggest that approximately 80 percent of minority freshman engineering students enter public institutions. In order to realize the optimum financial benefits of attending these schools, students must remain in their home states. Thus, a comparison of college-age minority population and minority BSE production by state is useful.

To measure the level of participation in engineering education relative to population distribution and to facilitate comparison of different groups, NACME studies have traditionally used the Engineering Participation Factor (EPF). The EPF for a particular group in the graduating class is the ratio of percent of engineering graduates to percent of college-age population, in this case within the state or region. An EPF of 1.00 implies exact parity, i.e., participation in engineering commensurate with proportion of the population. An EPF greater than 1.00 indicates overrepresentation.

Table 3 presents the production of minority BSE degrees by region[1] and by state, and Figure 5 presents a comparison of the EPFs by region. From these data several interesting conclusions can be drawn about access. First, the variation between regions ranges

Highlights, *continued from page 1*

resident populations. Only two states, New Hampshire and Vermont, both of which have extremely small minority college-age populations, produced minority BSE graduates at or above parity. Two states, Florida and North Carolina, and the District of Columbia produced minority BSE graduates at ratios approaching parity. Each has a concentration of HBCUs and HACUs. Forty states did not produce minority BSE graduates at even 50 percent of parity with their resident populations.

Figure 1.

College-Age Population vs. Minority BSE Graduates
1995

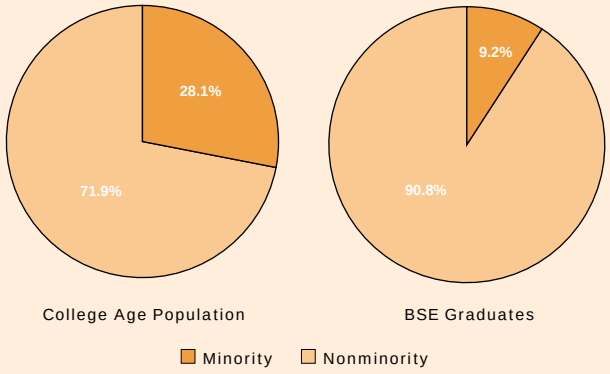


Figure 2 .

Percent Change in BSE Graduates, 1994 to 1995

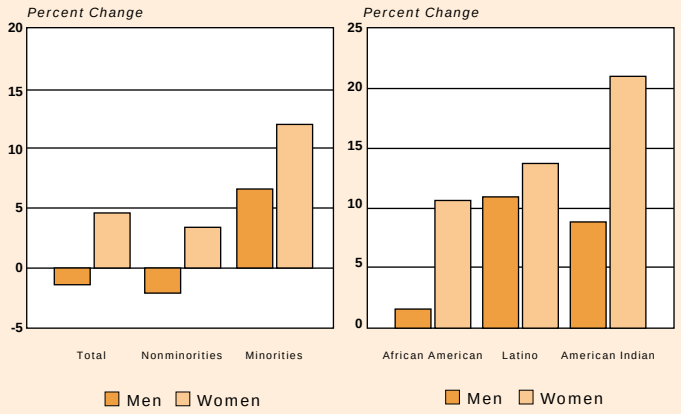


Figure 3.

Change in Number of BSE Graduates, 1994 to 1995

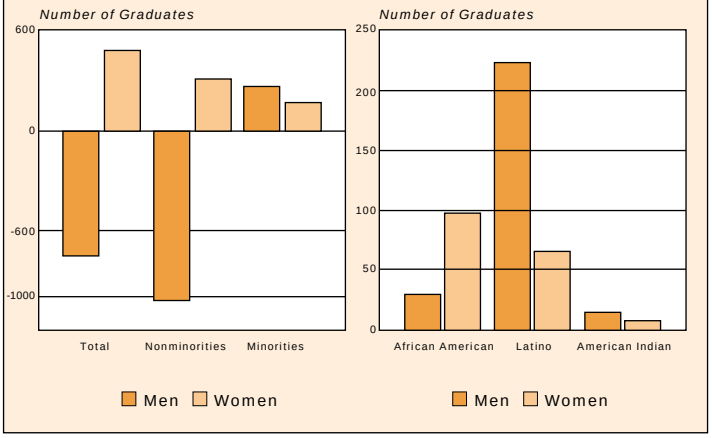


Figure 4.

Distribution of Minority BSE Graduates
1995

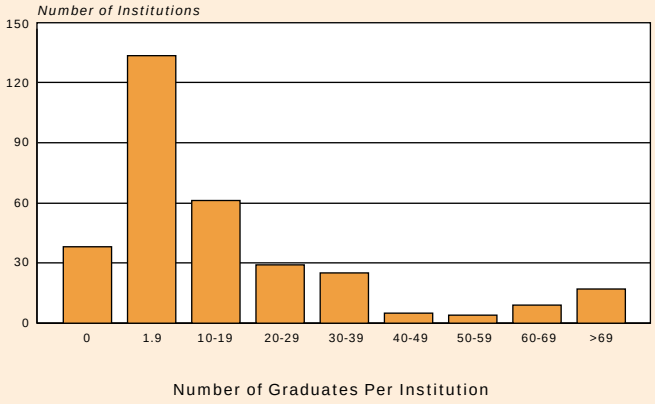


Figure 5.

Minority Engineering Participation Factors

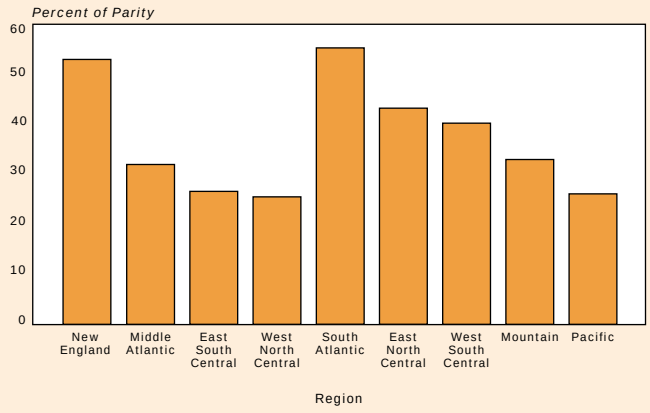


Figure 6

Geographic Distribution of BSE Graduates

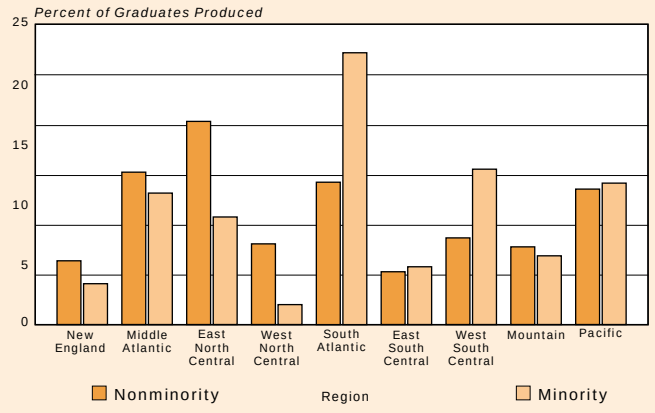


Table 2

Production of Minority BSE Graduates by Engineering Institutions, With Rankings, 1995

Institution	Rank	Total Minority (N)	Total (N)	Percent Minority (%)	African American (N)	Latino (N)	American Indian (N)
Alabama A&M University*	188	5	8	62.5	5	0	0
Alffed U/SUNY-Ceramics	234	2	67	3.0	1	1	0
Arizona State University	47	35	424	8.3	4	26	5
Arkansas State University	220	3	49	6.1	3	0	0
Arkansas Technological University	234	2	13	15.4	2	0	0
Auburn University	83	21	600	3.5	20	1	0
Baylor University	253	1	39	2.6	0	1	0
Boston University	97	16	285	5.6	6	10	0
Bradley University	166	7	93	7.5	3	4	0
Brigham Young University	166	7	369	1.9	1	5	1
Brown University	188	5	60	8.3	4	1	0
Bucknell University	188	5	138	3.6	1	4	0
CalifornialnstituteofTechnology	127	11	112	9.8	3	8	0
California Maritime Academy	284	0	8	0.0	0	0	0
California Polytechnic-Pomona	28	54	452	11.9	5	49	0
California Polytechnic-San Luis Obispo	11	105	708	14.8	9	94	2
California State U-Chico	137	10	98	10.2	1	8	1
California State U-Fresno	66	26	177	14.7	3	21	2
California State U-Fullerton	137	10	79	12.7	2	8	0
California State U-Long Beach	30	52	443	11.7	20	31	1
California State U-Los Angeles**	59	30	115	26.1	1	29	0
California State U-Northridge	36	39	206	18.9	11	28	0
California State U-Sacramento	40	37	309	12.0	16	20	1
Calvin College	NA	0	32	0.0	0	0	0
Capitol College	234	2	11	18.2	2	0	0
Carnegie Mellon University	104	14	278	5.0	7	6	1
Case Western Reserve University	137	10	232	4.3	9	1	0
Catholic University of America	166	7	58	12.1	1	5	1
CCNY (City College CUNY)**	6	116	256	45.3	72	44	0
Central State Univeisity*	166	7	16	43.8	7	0	0
Christian Brothers University	234	2	35	5.7	2	0	0
Citadel	137	10	52	19.2	4	2	4
Clarkson University	104	14	368	3.8	6	6	2
Clemson University	35	40	468	8.5	40	0	0
Cleveland State University	156	8	178	4.5	5	1	2
Cogswell College	253	1	8	12.5	0	1	0
Cogswell College North	284	0	.8	0.0	0	0	0
College of Staten Island	220	3	29	10.3	0	3	0
Colorado School of Mines	81	22	361	6.1	7	15	0
Colorado State University	111	13	229	5.7	1	10	2
Colorado Technical University	253	1	37	2.7	1	0	0
Columbia University	118	12	219	5.5	4	8	0
Cooper Union	118	12	119	10.1	8	4	0
Cornell University	25	60	717	8.4	18	39	3
Dartmouth College	127	11	145	7.6	8	2	1
Dordt College	284	0	8	0.0	0	0	0
Drexel University	83	21	409	5.1	17	2	2
Duke University	74	24	187	12.8	13	11	0
Embry Riddle Aeronaut University	176	6	112	5.4	1	4	1
Embry Riddle U-Prescott	200	4	66	6.1	2	1	1
Fairfield University	253	1	19	5.3	1	0	0
Fairleigh Dickinson University	234	2	23	8.7	1	1	0
FAMU/FSU College of Engineering*	4	132	157	84.1	113	19	0
Ferris State University	NA	0	28	0.0	0	0	0
Florida Atlantic University	40	37	185	20.0	15	22	0
Florida Institute of Technology	137	10	179	5.6	1	8	1
Florida International University**	3	158	258	61.2	23	135	0
Gannon University	284	0	19	0.0	0	0	0
Geneva College	NA	0	19	0.0	0	0	0
George Mason University	127	11	163	6.7	4	7	0
George Washington University	156	8	69	11.6	4	4	0
Georgia Institute of Technology	2	182	1257	14.5	125	56	1
GMI Engineering & Management Institute	68	25	422	5.9	16	8	1
Gonzaga University	200	4	65	6.2	0	4	0
Grand Valley State University	234	2	34	5.9	1	1	0
Grove City College	284	0	63	0.0	0	0	0
Hampton University*	101	15	15	100.0	15	0	0
Harvard University	137	10	87	11.5	7	2	1
Harvey Mudd College	188	5	73	6.8	2	3	0
Hofstra University	176	6	48	12.5	4	2	0
Howard University*	13	100	101	99.0	99	1	0
Humboldt State University	253	1	67	1.5	0	1	0
Idaho State University	253	1	31	3.2	0	0	1
Illinois Institute of Technology	74	24	180	13.3	15	9	0
Indiana Institute of Technology	284	0	11	0.0	0	0	0
Indiana U-Purdue Ft Wayne	284	0	16	0.0	0	0	0
Indiana U-Purdue Indianapolis	200	4	72	5.6	2	2	0
Iowa State University	118	12	683	1.8	8	4	0
John Brown University	188	5	16	31.3	0	5	0
Johns Hopkins University	97	16	191	8.4	9	6	1
Kansas State University	137	10	332	3.0	5	3	2
Lafayette College	176	6	96	6.3	4	2	0
Lamar University	127	11	106	10.4	8	3	0
Lawrence Technological University	83	21	295	7.1	14	4	3
Le Tourneau University	253	1	37	2.7	0	1	0
Lehigh University	166	7	349	2.0	5	2	0
Loras College	NA	0	0	0.0	0	0	0
Louisiana State University	81	22	354	6.2	10	12	0
Louisiana Technological University	176	6	167	3.6	4	1	1
Loyola College	284	0	2	0.0	0	0	0
Loyola Marymount University	111	13	48	27.1	2	11	0
Maine Maritime Academy	284	0	3	0.0	0	0	0
Manhattan College	90	19	160	11.9	5	14	0
Mankato State University	284	0	31	0.0	0	0	0
Marietta College	284	0	14	0.0	0	0	0
Marquette University	93	17	271	6.3	1	14	2
Mass Maritime Academy	284	0	86	0.0	0	0	0
Massachusettsinstituteof Technology	8	112	648	17.3	45	62	5
McNeese State University	253	1	37	2.7	1	0	0
Mercer University	166	7	65	10.8	5	2	0
Merrimack College	220	3	37	8.1	0	3	0
Messiah College	253	1	18	5.6	0	1	0
Miami University	220	3	66	4.5	1	2	0
Michigan State University	47	35	577	6.1	27	7	1
Michigan Technological University	111	13	797	1.6	9	3	1
Milwaukee School of Engineering	200	4	186	2.2	2	2	0
Mississippi State University	51	34	396	8.6	33	0	1
Monmouth College	284	0	6	0.0	0	0	0
Montana State University	176	6	194	3.1	0	2	4
Montana Tech of U Montana	284	0	128	0.0	0	0	0
Morgan State University*	68	25	32	78.1	24	0	1
New England College	284	0	1	0.0	0	0	0
New Jersey Institute Technology	19	68	375	18.1	30	37	1
New Mexico Highlands University**	166	7	8	87.5	0	6	1
New Mexico Institute of Mining &Technology	234	2	48	4.2	0	2	0
New Mexico State University**	15	92	284	32.4	1	84	7
New Yorkinstituteof Technology	68	25	113	22.1	17	8	0
Norfolk State University*	156	8	9	88.9	8	0	0
North Carolina A&T State University*	1	232	282	82.3	232	0	0
North Carolina State U-Raleigh	16	84	1140	7.4	62	14	8
North Dakota State University	253	1	289	0.3	0	1	0
Northeastern State University	284	0	3	0.0	0	0	0
Northeastern University	118	12	268	4.5	10	2	0
Northern Arizona University	137	10	92	10.9	0	5	5
Northern Illinois University	156	8	74	10.8	3	5	0
Northwestern University	83	21	297	7.1	19	2	0
Norwich University	200	4	58	6.9	1	3	0
Oakland University	234	2	128	1.6	2	0	0
Ohio Northern University	200	4	75	5.3	3	1	0
Ohio State University	57	31	715	4.3	20	10	1
Ohio University	176	6	183	3.3	5	1	0
Oklahoma Christian University	234	2	13	15.4	0	2	0
Oklahoma State University	90	19	254	7.5	5	3	11
Old Dominion University	127	11	178	6.2	8	3	0
Oral Roberts University	151	9	11	81.8	2	0	7
Oregon State UniversityNA	0	344	0.0	0	0	0	
Pacific Lutheran University	284	0	11	0.0	0	0	0
Parks College-St Louis University	111	13	71	18.3	1	10	2
Penn State University	66	26	1172	2.2	18	7	1
Philadelphia College of Textiles	253	1	5	20.0	1	0	0
Polytechnic University	44	36	286	12.6	15	21	0
Portland State University	176	6	134	4.5	0	5	1
Prairie View A&M University*	8	112	125	89.6	110	2	0
Princeton University	79	23	199	11.6	16	6	1
Purdue U-Calumet	188	5	55	9.1	1	4	0
Purdue University	19	68	1170	5.8	32	29	7
Rensselaer Polytechnic Institute	22	63	643	9.8	29	33	1
Rice University	104	14	166	8.4	5	9	0
Rochester Institute of Technology	151	9	221	4.1	4	4	1
Roger Williams University	284	0	15	0.0	0	0	0
Rose-Hulman Institute of Technology	253	1	231	0.4	1	0	0
Rutgers University	31	49	407	12.0	26	23	0
Saginaw Valley State University	253	1	42	2.4	1	0	0
San Diego State University	53	33	278	11.9	7	25	1
San Francisco State University	156	8	81	9.9	2	6	0
San Jose State University	74	24	460	5.2	8	14	2
Santa Clara University	118	12	127	9.4	3	9	0
Seattle Pacific University	253	1	16	6.3	0	0	1
Seattle University	284	0	95	0.0	0	0	0
So Illinois-Carbondale	93	17	188	9.0	10	6	1
So Illinois-Edwardsville	127	11	127	8.7	10	0	1
South Dakota School of Mines &Technology	200	4	205	2.0	0	0	4
South Dakota State University	253	1	149	0.7	0	0	1
Southern Methodist University	111	13	93	14.0	3	8	2
Southern University*	18	69	74	93.2	69	0	0
St Ambrose University	284	0	7	0.0	0	0	0
St Cloud State University	284	0	40	0.0	0	0	0
St Martins College	200	4	21	19.0	4	0	0
St Marys University**	176	6	8	75.0	0	6	0
Stanford University	27	58	316	18.4	16	40	2
Stevens Institute of Technology	53	33	171	19.3	9	24	0
SUNY-Binghamton Campus	220	3	91	3.3	1	2	0

Institution	Rank	Total Minority (N)	Total (N)	Percent Minority (%)	African American (N)	Latino (N)	American Indian (N)
SUNY-Buffalo Campus	74	24	437	5.5	11	12	1
SUNY-College at New Paltz	234	2	21	9.5	2	0	0
SUNY-College of Environmental Science	234	2	68	2.9	1	0	1
SUNY-Maritime College	156	8	53	15.1	2	6	0
SUNY-Stony Brook Campus	118	12	113	10.6	9	3	0
Swarthmore College	253	1	23	4.3	0	1	0
Syracuse University	93	17	148	11.5	6	11	0
Temple University	156	8	53	15.1	8	0	0
Tennessee State University*	34	41	58	70.7	41	0	0
Tennessee Technological University	104	14	271	5.2	13	1	0
Texas A&M U-Galveston	234	2	23	8.7	0	2	0
Texas A&M U-Kingsville**	21	65	123	52.8	1	64	0
Texas A&M University**	5	129	1247	10.3	22	104	3
Texas Technological University	68	25	227	11.0	0	23	2
Trenton State College	220	3	40	7.5	1	2	0
Trinity College	253	1	9	11.1	1	0	0
Trinity University	253	1	17	5.9	0	1	0
Tri-State University	220	3	98	3.1	3	0	0
Tufts University	253	1	130	0.8	1	0	0
Tulane University	61	29	187	15.5	17	12	0
Tuskegee University~	12	101	107	94.4	100	1	0
U Akron	200	4	233	1.7	3	1	0
U Alabama	47	35	238	14.7	34	1	0
U Alabama-Birmingham	137	10	88	11.4	10	0	0
U Alabama-Huntsville	176	6	221	2.7	6	0	0
U Alaska-Anchorage	284	0	20	0.0	0	0	0
U Alaska-Fairbanks	284	0	44	0.0	0	0	0
U Arizona	32	48	458	10.5	1	43	4
U Arkansas	137	10	239	4.2	9	1	0
U Bridgeport	284	0	11	0.0	0	0	0
U California-Berkeley	51	34	762	4.5	10	22	2
U California-Davis	44	36	407	8.8	9	23	4
U California-Irvine	88	20	222	9.0	4	14	2
U California-Los Angeles	38	38	408	9.3	5	32	1
U California-Riverside	200	4	34	11.8	1	3	0
U California-San Diego	92	18	254	7.1	2	16	0
U California-Santa Barbara	101	15	214	7.0	5	9	1
U California-Santa Cruz	176	6	101	5.9	1	3	2
U Central Florida	40	37	349	10.6	4	32	1
U Cincinnati	101	15	320	4.7	13	2	0
U Colorado-Boulder	57	31	510	6.1	4	27	0
U Colorado-Colorado Springs	220	3	54	5.6	0	2	1
U Colorado-Denver	118	12	127	9.4	6	4	2
U Connecticut	151	9	177	5.1	5	4	0
U Dayton	200	4	155	2.6	4	0	0
U Delaware	88	20	154	13.0	16	4	0
U Denver	234	2	15	13.3	0	2	0
U Detroit Mercy	156	8	63	12.7	7	1	0
U District of Columbia*	59	30	67	44.8	27	3	0
U Evansville	284	0	52	0.0	0	0	0
U Florida	17	73	635	11.5	25	44	4
U Georgia	253	1	27	3.7	0	1	0
U Hartford	220	3	79	3.8	2	1	0
U Hawaii	127	11	173	6.4	1	1	9
U Houston	40	37	239	15.5	6	30	1
U Idaho	200	4	198	2.0	0	4	0
U Illinois-Chicago	55	32	311	10.3	8	23	1
U Illinois-Urbana Champaign	25	60	1150	5.2	34	25	1
U Iowa	188	5	211	2.4	2	3	0
U Kansas	188	5	258	1.9	2	3	0
U Kentucky	253	1	347	0.3	1	0	0
U Louisville	127	11	173	6.4	10	1	0
U Lowell	156	8	213	3.8	6	2	0
U Maine-Orono	253	1	133	0.8	0	0	1
U Maryland Baltimore City	200	4	80	5.0	4	0	0
U Maryland-College Park	24	61	466	13.1	45	14	2
U Massachusetts-Amherst	97	16	235	6.8	6	10	0
U Massachusetts-Dartmouth	234	2	71	2.8	1	1	0
U Memphis	137	10	100	10.0	10	0	0
U Miami	14	95	147	64.6	1	94	0
U Michigan-Ann Arbor	22	63	931	6.8	41	21	1
U Michigan-Dearborn	166	7	174	4.0	0	6	1
U Minnesota	93	17	764	2.2	10	7	0
U Minnesota-Duluth	253	1	109	0.9	0	0	1
U Mississippi	200	4	81	4.9	2	1	1
U Missouri-Columbia & KC	127	11	340	3.2	5	5	1
U Missouri-Rolla	44	36	590	6.1	28	8	0
U Nebraska-Lincoln	284	0	264	0.0	0	0	0
U Nevada-Las Vegas	137	10	86	11.6	4	6	0
U Nevada-School of Mines	284	0	25	0.0	0	0	
U Nevada, Reno	220	3	87	3.4	1	2	0
U New Hampshire	253	1	127	0.8	0	1	0
U New Haven	200	4	135	3.0	2	2	0
U New Mexico**	28	54	184	29.3	1	49	4
U New Orleans	104	14	114	12.3	8	6	0
U North Carolina-Charlotte	234	2	162	1.2	1	1	0
U North Dakota	284	0	108	0.0	0	0	0
U Notre Dame	137	10	196	5.1	0	9	1
U of Southern Maine	253	1	17	5.9	0	1	0
U Oklahoma	62	28	319	8.8	15	3	10
U Pacific	156	8	52	15.4	1	7	0
U Pennsylvania	104	14	271	5.2	9	5	0
U Pittsburgh	127	11	340	3.2	6	4	1
U Portland	253	1	58	1.7	0	1	0
U Redlands	284	0	7	0.0	0	0	0
U Rhode Island	200	4	132	3.0	0	2	2
U Rochester	200	4	150	2.7	3	1	0
U Scranton	284	0	3	0.0	0	0	0
U South Alabama	220	3	110	2.7	2	1	0
U South Carolina	64	27	217	12.4	23	4	0
U South Florida	47	35	297	11.8	9	26	0
U Southern California	32	48	274	17.5	20	28	0
U Southern Colorado	234	2	9	22.2	0	2	0
U Southwestern Louisiana	151	9	110	8.2	5	4	0
U Tennessee-Chattanooga	NA	0	81	0.0	0	0	0
U Tennessee-Knoxville	64	27	353	7.6	24	2	1
U Texas-Arlington	97	16	286	5.6	6	10	0
U Texas-Austin	7	114	831	13.7	14	96	4
U Texas-Dallas	137	10	45	22.2	7	3	0
U Texas-El Paso**	10	109	171	63.7	0	109	0
U Texas-Pan American**	200	4	4	100.0	0	3	1
U Texas-San Antonio**	68	25	92	27.2	2	23	0
U Toledo	166	7	226	3.1	4	3	0
U Tulsa	188	5	117	4.3	2	3	0
U Utah	176	6	292	2.1	0	5	1
U Vermont	284	0	116	0.0	0	0	0
U Virginia	36	39	347	11.2	36	3	0
U Washington	55	32	645	5.0	10	16	6
U West Florida	284	0	10	0.0	0	0	0
U Wisconsin-Madison	104	14	603	2.3	5	6	3
U Wisconsin-Milwaukee	118	12	209	5.7	5	7	0
U Wisconsin-Platteville	253	1	198	0.5	0	1	0
U Wyoming	166	7	160	4.4	0	5	2
Union College	234	2	70	2.9	1	1	0
US Air Force Academy	62	28	296	9.5	1	12	2
US Coast Guard Academy	234	2	68	2.9	2	0	0
US Merchant Marine Academy	234	2	102	2.0	0	2	0
US Military Academy	74	24	323	7.4	11	12	1
US Naval Academy	38	38	318	11.9	14	21	3
Utah State University	284	0	160	0.0	0	0	0
Valparaiso University	284	0	84	0.0	0	0	0
Vanderbilt University	83	21	241	8.7	1	4	0
Villanova University	188	5	174	2.9	1	4	0
Virginia Military Institute	220	3	76	3.9	3	0	0
Virginia Polytechnic Institute	68	25	925	2.7	17	8	0
Walla Walla College	151	9	54	16.7	4	5	0
Washington State University	111	13	428	3.0	3	10	0
Washington University	118	12	237	5.1	8	3	1
Washington & Lee University	253	1	8	12.5	0	1	0
Wayne State University	79	23	161	14.3	22	1	0
Webb Institute of Naval Architecture	253	1	14	7.1	1	0	0
Wentworth Institute of Technology	284	0	13	0.0	0	0	0
West Coast University	200	4	16	25.0	2	2	0
West Virginia Institute of Technology	284	0	100	0.0	0	0	0
WestVirginia University	188	5	306	1.6	3	2	0
Western Michigan University	176	6	180	3.3	4	2	0
Western New England College	253	1	60	1.7	1	0	0
Wichita State University	200	4	169	2.4	2	1	1
Widener University	188	5	90	5.6	2	0	3
Wilkes University	284	0	53	0.0	0	0	0
Winona State University	284	0	27	0.0	0	0	0
Worcester Polytechnic Institute	111	13	485	2.7	5	7	1
Wright State University	220	3	139	2.2	1	1	1
Yale University	220	3	32	9.4	2	1	0
Youngstown State University	253	1	88	1.1	1	0	0
TOTAL		**5931**	**64143**	**9.2**	**2897**	**2804**	**230**

*HBCU - Historically Black Colleges and Universities.

**HACU - Hispanic Association of Colleges and Universites.

Ten institutions that did not report undergraduate graduation data to the Engineering Workforce Commission were excluded from the list including: US Naval Postgraduate School. Natl Technological University, Harvard Graduate Center, Institute of Paper Science & Technology, U St Thomas, U North Carolina-Chapel Hill, Air Force Institute of Technology U Akron-Polymer Science, Oregon Grad Institute of Science &Technology, West VIrginia Graduate College. U of Puerto Rico was also excluded.

NA - Institutions that did not report minority undergraduate graduation data to the Engineering Workforce Commission.

These institutions are also excluded from institutional comparisons.

Source: National Action Council for Minorities in Engineering, Inc.

from 26 to 56 percent of parity. The group of institutions in New England and the South Atlantic region demonstrate the best performance in educating a representative population of minority engineers. In each of these two regions, the percentage of minority engineering graduates is approximately half the percentage of minority college-age population. The East North Central, West North Central and Pacific regions demonstrate the worst performance. In these regions the percentage of minority engineering graduates is approximately one quarter of the college-age minority residents. Second, only states with a relatively small minority college-age population (3.0 percent and below) or have large numbers of HBCUs and/or HACUs have EPFs that represent parity or close to parity situations. Institutions in New Hampshire (EPF=1.68), and Vermont (EPF=1.18), both located in the New England region, have produced BSE graduate classes in 1995 in which minorities are overrepresented. However, among states with 3.0 percent minority college-age populations or greater, only institutions in the District of Columbia (EPF=0.78), Florida (EPF=0.79) and North Carolina (EPF=0.70) approach a representative minority population in engineering. Located in the South Atlantic region, each of these states shows significantly better performance than their counterparts largely because of the number of HBCUs and/or HACUs present. Washington, D.C. is home to two HBCUs, Florida has an HACU and a HBCU and North Carolina is home to North Carolina A&T State University, an HBCU, and the largest producer of minority BSE graduates in the country. The overriding conclusion is that most states are not producing minority BSE degrees commensurate with their residential populations.

A comparison of the regional distribution of BSE degrees earned by minorities with the regional distribution of degrees earned by nonminorities also helps to identify disparities in the relative production of minority engineering graduates. For example, the greatest differences between these groups occurs in the East North Central and West North Central regions (Figure 6). While together these areas produce over 28 percent of the nonminority engineering graduates, they produce less than 13 percent of the minority BSE graduates. This poor performance is not related to the available minority college-age population. Given EPFs in these regions of 0.27 and 0.26 respectively, it is clear that populations earning BSE degrees do not represent the resident minority populations and that engineering institutions located in these regions have the *potential* to produce many more minority engineers.

In contrast, the South Atlantic and West South Central regions are areas that produce a disproportionate share of minority BSE degrees. In 1995, the South Atlantic region produced 1,621 minority BSE graduates (27.3 percent of all minority BSE graduates) and the West South Central region produced 928 minority BSE graduates (15.6 percent of the total). The high percentages of minority BSE graduates produced in these regions are related to both the percentage of minority college-age residents and the high concentrations of HBCUs and/or HACUs which are working to meet the needs of underrepresented populations. In the South Atlantic region there are four HBCUs or HACUs. These schools produced 700 minority BSE graduates (12 percent of all minority BSE degrees). The HBCUs in this area produced 518 African American BSE graduates (18 percent of all African American BSE graduates). In the West South Central there are eight HBCUs and HACUs that produced 519 minority BSE graduates. This area, known for its high concentration of Latinos, produced 309 Latino BSE graduates, 11 percent of all Latino BSE graduates that year.

Characteristics of Institutions Producing Minority BSE Graduates

To identify the institutional characteristics related to high and low production, we explored the distribution of minority BSE graduates by the size of the total engineering graduating class, membership in Historically Black Colleges and Universities or the Hispanic Association of Colleges and Universities, research status of the institution,[2] institutional control, and the institution's academic selectivity.[3]

Size of Institution

Although there was a weak negative correlation between the size of the engineering class and the percent of minority BSE graduates ($r=-0.12$, $p<0.035$), the relationship was contingent upon the inclusion of HBCUs and HACUs. We divided the institutions in the Engineering Workforce Commission (EWC) database into categories of equal size, based on the total engineering graduating class in 1995: small (less than 50 graduates) medium (51 to 127 graduates), large (128 to 262 graduates) and very large (more than 262 graduates). When HBCUs and HACUs were excluded from the analysis no statistically significant difference between the percent production of minority BSE graduates was found between various size institutions, indicating that institutions providing the greatest access to engineering careers are not providing the greatest access for minority students.

HBCUs and HACUs

HBCUs accounted for 14.8 percent of all minority engineering graduates and 29.3 percent of all African American engineering graduates in 1995. HACUs accounted for 13.4 percent of all minorities and 23.4 percent of all Latino engineering graduates. Together, HBCUs and HACUs, which comprise only 8 percent of the total number of engineering institutions, produced 28.2 percent of minority engineering graduates (Table 4). These schools are the anchor for minority engineering education in the United States, and their ability to meet the changing demands posed by the engineering workforce, student interests, and student financial need is crucial to the production of minority BSE degrees. As we might expect, these schools were the hardest hit by the declines in freshman enrollment in engineering over the past three years.[4]

Figure 7
Distribution of BSE Graduates
Research and Top Ranked Institutions

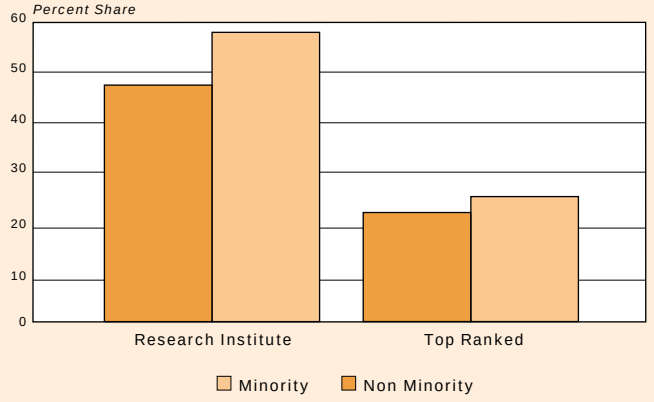


Figure 8
Distribution of BSE Graduates
Selectivity

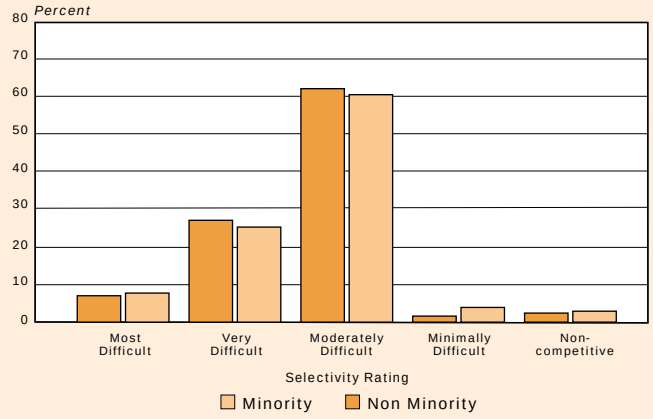


Figure 9.
BSE Graduates
Percent of Total Bachelor's Degrees

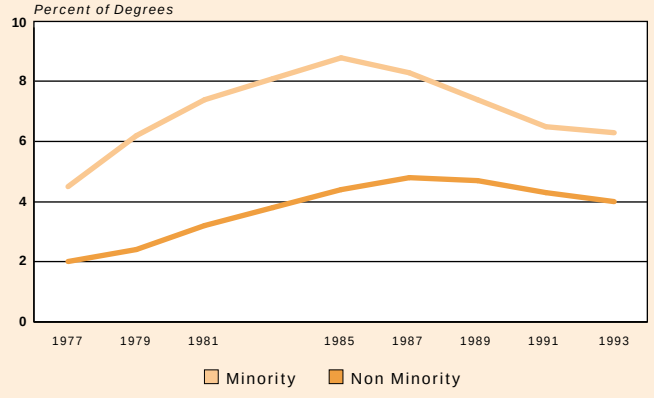
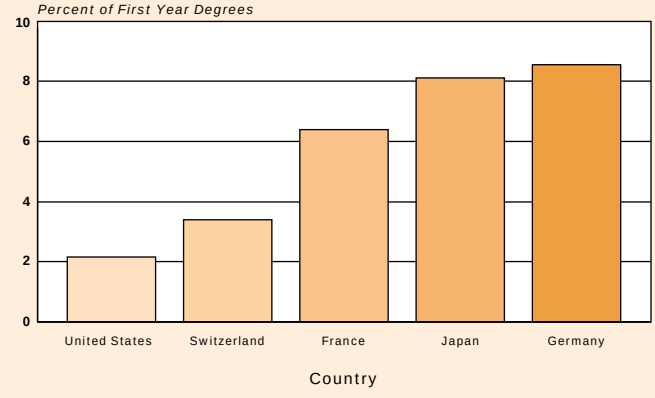


Figure 10.
Percent of First Degrees in Engineering
Selected Countries



Research Institutes

Research institutes are the colleges and universities categorized by the Carnegie Foundation for the Advancement of Teaching as institutions receiving more than $15.5 million annually in federal grants (Table 5). They are statistically larger than all other institutions (t=-7.78, p<0.00), having an average graduating class of 358 BSE degrees. These institutions also produce the majority of nonminority BSE graduates (57.2 percent), but a lower percentage of the minority BSE graduates (47.5 percent) (Figure 7). Receiving the bulk of federal taxpayer grant monies for research, they can and should be held accountable for providing access to a diverse population of students.

Institutional Control

Institutional control refers to the primary source of funding for an institution. Those colleges and universities for which the largest source of support is the federal, state or local government are characterized as public institutions. All other schools receive the majority of their operating funding from private sources.[5] Among the engineering institutions in the EWC database, 196 (61.1 percent) are public and 125 (38.9 percent) are private. Public schools are the most accessible to minority students. While three fifths of the engineering institutions are public, they produce 74.7 percent of the minority engineering graduates. It's important to note, however, that among the institutions in the database, 76.9 percent of the HBCUs and 92.3 percent of HACUs are public institutions. When HBCUs and HACUs were excluded from the calculations, the percent of minority BSE graduates from public schools dropped to 50.3 percent.

Although public schools are producing the largest number of minority engineering graduates, they have lower performance in retaining minority students (38.5 percent) than the private institutions (60.5 percent).[6] Effective pro-

Table 3
Minority BSE Graduates, by Region, 1995

Region	State	Engineering Institutions (N)	Total (N)	Minority* (N)	Minority* (%)	College-age Minority* Population (%)	Engineering Participation Factor
New England							
	Connecticut	8	530	23	4.3	19.4	0.224
	Massachusetts	13	2618	194	7.4	12.0	0.619
	Maine	3	153	2	1.3	2.2	0.594
	New Hampshire	3	273	12	4.4	2.6	1.682
	Rhode Island	3	207	9	4.3	10.6	0.412
	Vermont	2	174	4	2.3	1.9	1.181
	Region Totals	***32***	***3955***	***244***	***6.2***	***11.6***	***0.532***
Middle Atlantic							
	New Jersey	7	1221	178	14.6	29.1	0.501
	New York	25	4836	478	9.9	31.4	0.315
	Pennsylvania	18	3554	125	3.5	13.2	0.267
	Region Totals	***50***	***9611***	***781***	***8.1***	***25.3***	***0.321***
East North Central							
	Illinois	9	2491	193	7.7	28.3	0.274
	Indiana	11	1993	91	4.6	24.2	0.188
	Michigan	12	3804	206	5.4	19.1	0.284
	Ohio	14	2640	103	3.9	13.3	0.293
	Wisconsin	5	1467	48	3.3	9.4	0.350
	Region Totals	***51***	***12395***	***641***	***5.21***	***9.3***	***0.267***
West North Central							
	Iowa	3	901	17	1.9	4.4	0.428
	Kansas	3	759	19	2.5	13.7	0.182
	Minnesota	5	971	18	1.9	5.7	0.327
	Missouri	3	1167	59	5.1	14.6	0.347
	North Dakota	2	397	1	0.3	6.6	0.038
	Nebraska	1	264	0	0.0	8.7	0.000
	South Dakota	2	354	5	1.4	10.5	0.134
	Region Totals	***19***	***4813***	***119***	***2.5***	***9.7***	***0.256***
South Atlantic							
	District of Columbia	4	295	145	49.2	62.9	0.781
	Delaware	1	154	20	13.0	22.3	0.582
	Florida	10	2329	583	25.0	31.8	0.788
	Georgia	3	1349	190	14.1	32.3	0.436
	Maryland	7	1100	146	13.3	32.2	0.412
	North Carolina	4	1771	342	19.3	27.5	0.703
	South Carolina	3	737	77	10.4	33.5	0.312
	Virginia	8	1721	113	6.6	24.7	0.266
	West Virginia	2	406	5	1.2	4.4	0.281
	Region Totals	***42***	***9862***	***1621***	***16.4***	***29.6***	***0.55***
East South Central							
	Alabama	7	1372	181	13.2	28.9	0.456
	Kentucky	2	520	12	2.3	9.3	0.247
	Mississippi	2	477	38	8.0	40.6	0.196
	Tennessee	6	1058	115	10.9	19.4	0.561
	Region Totals	***17***	***3427***	***346***	***10.1***	***23.2***	***0.434***
West South Central							
	Arkansas	4	317	20	6.3	20.1	0.314
	Louisiana	7	1043	150	14.4	36.9	0.389
	Oklahoma	6	717	63	8.8	21.8	0.403
	Texas	19	3879	695	17.9	44.2	0.406
	Region Totals	***36***	***5956***	***928***	***15.6***	***38.6***	***0.404***
Mountain							
	Arizona	4	1040	97	9.3	32.8	0.284
	Colorado	9	1638	114	7.0	21.4	0.325
	Idaho	2	229	5	2.2	9.8	0.224
	Montana	2	322	6	1.9	10.1	0.184
	New Mexico	4	524	155	29.6	56.5	0.523
	Nevada	3	198	13	6.6	24.9	0.264
	Utah	3	821	13	1.6	8.2	0.192
	Wyoming	1	160	7	4.4	10.5	0.415
	Region Totals	***28***	***4932***	***410***	***8.32***	***5.1***	***0.331***
Pacific							
	Alaska	2	64	0	0.0	27.4	0.000
	California	32	6916	760	11.0	43.5	0.253
	Hawaii	1	173	11	6.4	14.0	0.455
	Oregon	2	192	7	3.6	10.1	0.359
	Washington	9	1343	63	4.7	12.4	0.377
	Region Totals	***46***	***8688***	***841***	***9.7***	***36.9***	***0.262***

**Regions were defined by the US Department of Commerce, Economics and Statistics Administration, Bureau of the Census.
*Minorities include African Americans, Latinos, and American Indians.
Note: These data exclude University of Puerto Rico and Institutions that did not report minority data to the Engineering Workforce Commission (EWC).
Source: National Action Council for Minorities in Engineering, Inc.

Table 4
HBCU and BACU Engineering Institutions Ranked by Number of Minority BSE Degrees, 1995

Hispanic Association of Colleges and Universities

Institution	Minority Degrees (N)	Minority Degrees (%)
Florida International University	158	61.2
Texas A&M University	129	10.3
CCNY (City College, CUNY)	116	45.3
U Texas-El Paso	109	63.7
New Mexico State University	92	32.4
Texas A&M U-Kingsville	65	52.8
U New Mexico	54	29.3
California State U-Los Angeles	30	26.1
U Texas-San Antonio	25	27.2
New Mexico Highlands University	7	87.5
St Marys University	6	75.0
U Texas-Pan American	4	100.0
Total	**795**	**28.9**

Historically Black Colleges and Universities

Institution	Minority Degrees (N)	Minority Degrees (%)
North Carolina A&T State University	232	82.3
FAMU/FSU College of Engineering	132	84.1
Prairie View A&M University	112	89.6
Tuskegee University	101	94.4
Howard University	100	99.0
Southern University	69	93.4
Tennessee State University	41	70.7
U District of Columbia	30	44.8
Morgan State University	25	78.1
Hampton University	15	100.0
Norfolk State University	8	88.9
Central State University	7	43.8
Alabama A&M University	5	62.5
Total	**877**	**83.4**

Note: These data exclude University of Puerto Rico, an HACU member.
Source: National Action Council for Minorities in Engineering, Inc.

grams to improve retention at public institutions can therefore yield a tremendous payoff. Private schools, on the other hand, have significantly higher retention rates, but are not enrolling enough minority students. All of the125 private institutions (38.9 percent of the total number of engineering colleges), produced only 25.3 percent of the minority BSE graduates.

Institutional Selectivity

The distribution of minority BSE graduates by institutional selectivity and academic ranking mirrored that of nonminorities (Figure 8). The percentage of minority students graduating with BSE degrees from highly selective schools was 7.7 percent compared to 7.0 percent of nonminority students graduating with BSE degrees from these schools. The percentages of minority and nonminority BSE graduates are also approximately the same for all other selectivity categories. Further, evidence of the similar graduation patterns among minorities and nonminorities is provided by the comparison of the distribution of minorities and nonminorities graduating from the top 25 engineering graduate schools[7] (Table 6, Figure 7). This similar distribution across selectivity levels indicates, at least to the

first order, a symmetry in academic competitiveness between minority and nonminority graduating populations.

The Shift of Undergraduates Away from Engineering Degrees

One trend readily gleaned from the graduation data for the last few years is the decrease in total number of BSE awards. This decline reflects both a drop in college enrollment and a declining interest in engineering. Data on the total number of bachelor's degrees conferred between 1971 and 1993 by field of study indicates that engineering is losing more than its share of students.[8]

Since 1966 engineering and science[9] degrees have accounted for approximately one third of the total bachelor's degrees awarded in the United States, with some fluctuations within the various science disciplines. Over the last few years, Bachelor's degrees in engineering and mathematics have been declining relative to fields such as psychology, biology/agriculture and the social sciences. The percentage of students graduating with physical science and earth, atmospheric and ocean science degrees over the last six to ten years has been relatively flat.[10] The fall off in engineering has been experienced differently by the minority and nonminority populations (Figure 9). For nonminorities the fraction of degrees in engineering, relative to other disciplines, has been declining since the mid 1980s. Among nonminority BS degrees, the percentage of BSE degrees produced has fallen from a high of 8.8 percent in 1985 to 6.3 percent in 1993. During the same period, the share of degrees earned by minority graduates in engineering has remained much more stable. Since 1985, approximately 4 percent of all minority bachelor awards each year have been in engineering.

The total production of engineering degree graduates in the United States is significantly lower than many of our competitor nations (Figure 10). In 1992 the percent of first university degrees in engineering was higher in Japan (20.3 percent), France (16.0 percent), Germany (21.4 percent) and Switzerland (8.5 percent).[11]

The total number of minority students enrolling in college continues to increase. African American, Latino and American Indian total enrollment increased by approximately 47.1 percent from 1986 to 1994 (compared with a 8.7 percent increase for the nonminority population)[12] and by 45.1 percent in engineering programs. The percentage of high school graduates prepared for engineering programs is also improving, with African Americans who have credits in calculus increasing from 1.4 percent in 1982 to 6.9 percent in 1992 and Latinos increasing from 1.6 percent to 4.7 percent over the same time period.[13] The gains for these same students earning credits in physics is even more impressive jumping from 6.8 percent of the African American high school graduate population in 1982 to 17.6 percent in 1992 and from 5.5 percent of the Latino population in 1982 to 15.7 percent in 1992.[14] Yet, while the number of minority high school graduates and the percentage of those prepared for engineering programs climbs, the numbers entering engineering institutions is falling.

Potential Influences on Minority BSE Production

Entering minority engineering students have demonstrated academic performance commensurate with their nonminority peers. African American, Latino and American Indian students who enroll in the nation's engineering schools leave high school with grades and SAT scores indistinguishable, on average, from those of their white and Asian peers.[15] NACME studies have shown that minority students have graduation rates in engineering similar to nonminority students in highly selective schools.15 These studies, in combination with growing numbers of minority BSE graduates, might suggest that the years ahead will bring ongoing success in making engineering education accessible to underrepresented minority groups. However, there are foreboding trends on the horizon.

The number of minority freshmen enrolling in engineering programs across the United States has dropped over the past three years. This will mean fewer minority graduates two to five years hence if the retention rates of minority students do not improve. Other new pressures may further change the accessibility of engineering programs, negatively impacting the population. Minority students are taking on heavier debt burdens, minority scholarships are under legal attack and newly emerging engineering firms have been slow to diversify their staffs. Each of these challenges may make engineering programs less attractive to prospective minority students.

Scholarship money is becoming less available to minority students

The attack on minority scholarships became explicit in 1994 with a federal court ruling that the University of Maryland could not award race-based scholarships.[17] This decision invalidated the University's Benjamin Banneker Scholarship Program for outstanding African American Students. The U.S. Court of Appeals used the "strict scrutiny" test for race-based programs, stating that the program would be valid if and only if it was proven that the current racial inequities were caused by past discrimination at the University. Using this test, the court found defects in previous arguments made by proponents of the program. As one analysis noted, "It is extraordinarily difficult to satisfy the 'strict scrutiny' test."[18]

In the next major judicial statement, the Supreme Court held that the federal, state or local government practice of racial classification must also come under the "strict scrutiny" test.[19] The government's use of racial classification is limited to applications that further compelling governmental interest. The arguments for diversity, used by proponents, have not been considered sufficiently compelling. Because of this decision there will be a greater degree of judicial oversight of the scholarship practices of institutions

receiving money from any level of government.

In the most recent judicial decision, the U.S. 5th Circuit Court ordered the University of Texas Law School to discontinue considering race in admissions.[20] The Supreme Court, in a recent decision, refused to hear this case, although the opportunity to bring a new challenge on this issue remains open.

Together these decisions pose significant challenges to universities that have a commitment to minority education. While these institutions can still forge ahead, albeit with greater difficulty, a larger problem lies in the potential for overreaction to the legal environment among institutions with lesser commitment. The new rulings may even become excuses for institutions to withdraw from the struggle to offer equitable access to education for minority students.

Not only do the cases provide judicial precedent that may reverse the gains made in the past, they have also stimulated legislative attempts to limit government affirmative action programs, both at the national level and by the states.[21]

Changes in financial aid packages are forcing minorities to increase debt

Over the past few years a climate of fiscal conservatism has been apparent in the nation's statehouses, where colleges have had to compete for funding allocation with prisons and health care. The impact of these funding crunches is often revealed in higher tuition at state colleges and universities. Tuition at four-year public colleges has risen by 234 percent over the last 15 years, far outpacing rises in median household incomes.22 Simultaneously, the government's policy of replacing educational grants with loans has made the continuance of financial aid a crucial factor in minority student retention in college.[23]

Traditionally, minority families have been reluctant to take on substantial debt, particularly since the payoff, the promise of upward mobility, is perceived as uncertain.24 However, given the current structure of tuition and financial aid grants, minority students have been forced to increase their borrowing. Minority students experienced substantial increases in their levels of cumulative borrowing from 1990 to 1993. These increases were more than twice as high as for nonminorities. A report from The Education Resources Institute and The Institute for Higher Education Policy in stated that while white non-hispanic borrowing for college increased 9 percent from 1990 to 1993, non-white borrowing increased by 19 percent over the same period of time.[25]

This new borrowing trend is expected to affect all minority undergraduates in two important ways. First, because of financial obligations students may shun longer, more work intensive programs, such as five-year engineering degree programs, in favor of majors that are less time-consuming and which can be completed in four years. Second, many students may opt to go part-time or to community colleges, which are generally less expensive than four-year colleges, rather than enter full time engineering programs. This trend has already been reported.[26] Between 1986 and 1994 total minority enrollments in two-year colleges increased by 48.7 percent compared with a 45.6 percent increase in total minority enrollments in four-year colleges.[27] Unfortunately, only 16 percent of Latinos and 10 percent of African Americans transfer from community colleges to four year institutions where engineering studies are offered.[28]

Newly emerging engineering firms are not diversifying their staffs

From 1989 to 1994, some of the Big Ten engineering schools noted a large drop off in the number of recruiters visiting their campuses.[29] As part of a recent but significant trend, medium to large-size corporations which traditionally offered the highest starting salaries, are downsizing their operations.[30]

At the same time that large companies are downsizing, engineering jobs have been migrating to smaller entrepreneurial companies[31] with specialized needs. This migration is significant. During 1995, given downsizing and drops in employment provided by the traditional companies, the number of employed engineers continued to grow and is expected to reach, at least, 2.2 million by 2005.32

Recent National Association of Colleges and Employers (NACE) reports indicate that technical majors are in high demand by industry.33 Many of these "high-tech" employers are newly emerging, small firms. Unfortunately, while there are opportunities in these companies for engineers, in general these organizations are not diversifying their technical staffs.34 Breaking into the new, highly technical, small engineering firms may present another barrier to minorities, which may further increase minority student attrition from the field.

Conclusions

It is ironic that at a moment in which the number of minority graduates in engineering reached a new all time high — 5,931 African Americans, Latinos and American Indians earning bachelor's degrees in engineering in 1995 — signs in the environment indicate that the growth, stability and long term gains in minority graduations are in serious jeopardy. The confluence of four powerful trends is, right now, endangering the fragile progress of the last 20 years.

Most obvious and persistent among these trends is that the bulk of minority graduates continue to be produced by an extremely small number of institutions. Any change that affects these colleges and universities can result in dramatic shifts in the production of minority engineers. One omen is the impact of the 12 percent drop in freshman enrollment of minority engineering students from 1992-93 to 1995-96. Because the bulk of the loss of minority freshmen occurred in HBCUs and HACUs, these institutions, which currently produce almost 30 percent of the minority graduates annually, can be expected to post a significant decline in the number of BSE degrees awarded four or five years hence.

The situation is compounded by attacks on affirmative action programs

around the country, which have been an important factor influencing the education of minority engineers. For more than 20 years growth in minority production has been stimulated by proactive policies — led by NACME along with a host of local, regional and campus based organizations — to recruit minority freshmen and assure that their financial needs were met. The results of recent policy changes may mean less available scholarship money for minority students and lower total freshman enrollment levels. Further complicating the life of all students are changes in financial aid packages that emphasize borrowing. Minorities, traditionally conservative and inexperienced borrowers, have increased their rates of debt much faster than nonminorities. Because of financial pressures, minority students may already be turning from time-intensive studies, such as engineering, to those that afford more time for paid employment outside of the classroom.

The perception of changed opportunity for minorities in the workforce may also be impeding the diversification of institutional engineering programs. Although the engineering job market is healthy, many large companies committed to diversity have downsized. Outsourcing the work that was previously done in house has yielded a proliferation of jobs in smaller companies that are not aggressively or visibly hiring minority engineering graduates. It is therefore reasonable to expect that minority students, perceiving these changes, will turn away from the profession to competing fields where aggressive recruiting has begun making access apparent.

Rather than retreat in the face of complex obstacles, the time is right to take advantage of farsighted opportunities to stem the decline we've already seen in enrollment and to head off a large potential falloff in graduations. Two openings that must immediately be addressed are the commitment of large research institutions to educate a student body more reflective of the population and the commitment of the nation to educate all students to contribute to a technology-based economy.

Research institutions enjoy a privileged position in engineering education that brings with it significant responsibilities. These colleges and universities are extremely attractive to students because of their ability to provide "high-tech" engineering education, afforded by substantial federal (i.e., taxpayer) funding. Yet, they have not fulfilled their responsibility to assure that their graduating classes reflect the nation's demographics. Indeed, while many have the potential to educate large populations of students they have not provided equitable access to minority populations. Answering the call to equity will mean more aggressive recruiting, establishing a more nurturing campus environment, guaranteeing adequate financial aid and scholarship support and providing early exposure for all students to research and development careers.

Clearly the pool of available minority talent remains untapped. In 40 of the 50 states, institutions have not graduated even the half percentage of minorities that can be found in their resident college-age population. In fact, the variation in producing minority BSE graduates among regions and states is not related to the proportion of college-age minority students, but to the number of institutions within their borders that explicitly include minority service as part of their mission. Educators at the precollegiate level must improve their performance in producing more academically prepared minority high school graduates. This is a public policy issue that demands immediate and focused attention. Although middle school and high school students are considering careers in the sciences, where they have choices, they are opting out of the appropriate sequence of science and math courses.[35]

Current highs in the production of minority engineering graduates reflect the enrollment achievement of bygone years. In the new climate, the chill winds sweeping across minority and education policy, will surely freeze progress in place, if not erode it. A new proactive agenda must be developed and aggressively implemented — despite the emerging economic and political trends — if the nation's technical workforce is to weather the storm.

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Table 5

Research Institutions Ranked By Number of Minority BSE Graduates, 1995

Institution	Total (N)	Total Minority (N)	Total Minority (%)	African American (N)	Latino (N)	Native American (N)
Georgia Institute of Technology	1257	182	14.5	125	56	1
Texas A&M University	1247	129	10.3	22	104	3
University of Texas at Austin	831	114	13.7	14	96	4
Massachusetts Institute of Technology	648	112	17.3	45	62	5
Howard University*	101	100	99.0	99	1	0
University of Miami	147	95	64.6	1	94	0
North Carolina State University-Raleigh	1140	84	7.4	62	14	8
University of Florida	635	73	11.5	25	44	4
Purdue University	1170	68	5.8	32	29	7
University of Michigan - Ann Arbor	931	63	6.8	41	21	1
University of Maryland - College Park	466	61	13.1	45	14	2
University of Illinois - Urbana Champaign	1150	60	5.2	34	25	1
Cornell University	717	60	8.4	18	39	3
Stanford University	316	58	18.4	16	40	2
University of New Mexico**	184	54	29.3	1	49	4
Rutgers University	407	49	12.0	26	23	0
University of Arizona	458	48	10.5	1	43	4
University of Southern California	274	48	17.5	20	28	0
Clemson University	468	40	8.5	40	0	0
University of Virginia	347	39	11.2	36	3	0
University of California - Los Angeles	408	38	9.3	5	32	1
University of Houston	239	37	15.5	6	30	1
University of California - Davis	407	36	8.8	9	23	4
Arizona State University	424	35	8.3	4	26	5
University of South Florida	297	35	11.8	9	26	0
Michigan State University	577	35	6.1	27	7	1
University of California - Berkeley	762	34	4.5	10	22	2
Mississippi State University	396	34	8.6	33	0	1
University of Washington	645	32	5.0	10	16	6
University of Illinois - Chicago	311	32	10.3	8	23	1
University of Colorado - Boulder	510	31	6.1	4	27	0
Tulane University	187	29	15.5	17	12	0
University of Oklahoma	319	28	8.8	15	3	10
University of South Carolina	217	27	12.4	23	4	0
University of Tennessee -Knoxville	353	27	7.6	24	2	1
Penn State University	1172	26	2.2	18	7	1
Virginia Poly Institute	925	25	2.7	17	8	0
Texas Technological University	227	25	11.0	0	23	2
Duke University	187	24	12.8	13	11	0
SUNY - Buffalo Campus	437	24	5.5	11	12	1
Princeton University	199	23	11.6	16	6	1
Wayne State University	161	23	14.3	22	1	0
Louisiana State University	354	22	6.2	10	12	0
Auburn University	600	21	3.4	20	1	0
Northwestern University	297	21	7.1	19	2	0
University of California - Irvine	222	20	9.0	4	14	2
University of Delaware	154	20	13.0	16	4	0
Oklahoma State University	254	19	7.5	54	3	11
University of California - San Diego	254	18	7.1	2	16	0
Syracuse University	148	17	11.5	6	11	0
University of Minnesota	764	17	2.2	10	7	0
Southern Illinois Carbondale	188	17	9.0	10	6	1
Boston University	285	16	5.6	6	10	0
University of Massachusetts -- Amherst	235	16	6.8	6	10	0
Johns Hopkins University	191	16	8.4	9	6	1
University of California - Santa Barbara	214	15	7.0	5	9	1
University of Cincinnati	320	15	4.7	13	2	0
Carnegie Mellon University	278	14	5.0	7	6	1
University of Wisconsin - Madison	603	14	2.3	5	6	3
University of Pennsylvania	271	14	5.2	9	5	0
Rice University	166	14	8.4	5	9	0
Colorado State University	229	13	5.7	1	10	2
Washington State University	428	13	3.0	3	10	0
Iowa State University	683	12	1.8	8	4	0
Columbia University	219	12	5.5	4	8	0
Northeastern University	268	12	4.5	10	2	0
University of Wisconsin - Milwaukee	209	12	5.7	5	7	0
Washington University	237	12	5.1	8	3	1
SUNY - Stony Brook Campus	113	12	10.6	9	3	0
University of Hawaii	173	11	6.4	1	1	9
California Institute of Technology	112	11	9.8	3	8	0
University of Pittsburgh	340	11	3.2	6	4	1
Harvard University	87	10	11.5	7	2	1
University of Notre Dame	196	10	5.1	0	9	1
Case Western Reserve University	232	10	4.3	9	1	0
University of Arkansas	239	10	4.2	9	1	0
Kansas State University	332	10	3.0	5	3	2
University of Alabama - Birmingham	88	10	11.4	10	0	0
University of Connecticut	117	9	5.1	5	4	0
Temple University	53	8	15.1	8	0	0
George Washington University	69	8	11.6	4	4	0
University of Wyoming	160	7	4.4	0	5	2
Brigham Young University	369	7	1.9	1	5	1
Lehigh University	349	7	2.0	5	2	0
Ohio University	183	6	3.3	5	1	0
University of California - Santa Cruz	101	6	5.9	1	3	2
University of Utah	292	6	2.1	0	5	1
Brown University	60	5	8.3	4	1	0
West Virginia University	306	5	1.6	3	2	0
University of Kansas	258	5	1.9	2	3	0
University of Idaho	198	4	2.0	0	4	0
University of California - Riverside	34	4	11.8	1	3	0
University of Mississippi	132	4	3.0	0	2	2
University of Rhode Island	132	4	3.0	0	2	2
Yale University	32	3	9.4	2	1	0
Tufts University	130	1	0.8	1	0	0
University of Georgia	27	1	3.7	0	1	0
University of Kentucky	347	1	0.3	1	0	0
University of Vermont	116	0	0.0	0	0	0
Utah State University	160	0	0.0	0	0	0
University of Nebraska - Lincoln	264	0	0.0	0	0	0
TOTAL	36,135	2815	7.8	1314	1368	133

* HBCU - Historically Black Colleges and University.

** HACU - Hispanic Association of Colleges and Universities.

Two Research Institution that did not report undergraduate graduation data the the Engineering Workforce COmmission was excluded from the list: University of North Carolina - Chapel Hill and Oregon State University.

Source: National Action Council for Minorities in Engineering, Inc.

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