

**ATTENTION TO RETENTION:
A Summary of the Merck-NACME Think Tank on Retention**

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EXECUTIVE SUMMARY:

The National Action Council for Minorities in Engineering (NACME) and its corporate partner, Merck & Co., Inc., have agreed on next steps in their initiative to close the achievement gap between minority and non-minority engineering students. The new measures aim to help underrepresented minorities -- African Americans, Latino and American Indians -- overcome the four principal barriers to their success: lack of preparation, cost of education, isolation on campus, and low faculty expectations.

Step One is to formalize a “checklist” of programs, such as student clustering, structured study groups, mentoring and pre-college classes to improve academic preparation, that are documented successes in improving academic performance. The checklist also details resources both inside and outside the university that can be used to support these programs. The list is intended to serve as a national blueprint for change in science and technology education.

Step Two is to ask Merck and the other corporate members of NACME’s board of directors to push for adoption of these programs by the nation’s engineering schools. The premise is that business, as the primary customer for engineering schools’ product, their graduates, is best positioned to move this agenda forward.

Step Three is to ask the American Association of Engineering Societies, the American Society for Engineering Education, the National Academy of Engineering (NAE) and other broad-based professional organizations to endorse the proposal and move it out into the mainstream. In addition, NACME will work with media advisors to refine the presentation of this plan and make minority retention part of the national dialogue.

Fundamental to the strategy is the “business case” for retention. Changes in demographics and university enrollments show a looming shortage in the number of college graduates qualified to fill the needs of business, government and the academic world. Increasing the number of minorities completing degrees in these fields is one way to avoid this catastrophe. Continuing to import technology students and workers is another. The nation’s leaders must decide which is in our best interest.

INTRODUCTION:

This report and appendices summarize a recent workshop on ways to improve the retention of minority engineering students. We present data on trends in U.S. demographics and workforce requirements, and figures on the retention of minority vs. non-minority students and describe programs that have improved minority performance. The report concludes by proposing a strategy and next steps, spearheaded by NACME, in partnership with engineering, education and employment organizations, to make minority retention a national goal.

THE SUMMARY:

Twenty educators, college administrators, minority engineering program directors joined Merck & Co., Inc. and NACME staff on April 11, 2002, for an all-day “think tank” to review principles and practices associated with retention programs for minority engineering students, forge new strategies, and make concrete recommendation about next steps.

The goal, as stated by Dr. John Slaughter, President and CEO of NACME, is to achieve parity for underrepresented minorities -- African Americans, Hispanics and Native Americans -- in the quantitative disciplines. But this won't be easy. According to a recent GE Fund study, just 116,000 African-Americans, Hispanics and Native Americans have earned engineering baccalaureate degrees over the last 30 years. This represents only 6 percent of the engineering degrees awarded in the U.S. during this period. To achieve parity, the completion rate will have to grow to 250,000 over the next 10 years – a gargantuan effort.

A few statistics related by Dr. Daryl Chubin, NACME's senior vice president for policy and research, tell why: At present nationally, two out of three non-minority students who begin engineering programs go on to receive baccalaureate degrees, compared with two out of five minorities. Studies conducted for NACME spell out some of the reasons for lower minority retention: Lack of preparation (a reflection, in part, of the shortcomings in K-12 education, specially in urban schools); cost of

education (engineering programs can take five years, and heavy study demands discourage part-time employment); isolation on campus (on predominantly white campuses, minorities tend to be less involved in student activities, enjoying less contact with peers and faculty), and low faculty expectations.

For NACME's mission to succeed, both enrollments and retention rates will have to increase significantly. The challenge will be to convince colleges and universities to commit to minority retention and to allocate their resources accordingly. The strategy will be to find, and sell, the “drama” inherent in this goal, and to invite industry to become a selling partner (see below).

The drama is playing out now in sweeping U.S. demographic shifts. Minorities have accounted for 98% of U.S. population growth over the last decade. Non-Hispanic white males, who comprised 37% of the workforce in 1995, are expected to drop to 26% by 2050. At the same time, underrepresented minorities are projected to rise from 26% to 48%. Meanwhile, jobs in the quantitative disciplines will continue to make up the fastest-growing segment of the employment market.

Clearly, the pool from which colleges and universities draw their students is going to become increasingly minority, while the human resources requirements of U.S. business will increasingly require jobs in the STEM (science, technology, engineering and mathematics) disciplines. This, in a nutshell, is the “business case” for recruitment and retention of minority engineering students.

BEST PRACTICES:

If the nation's colleges and universities are to achieve better retention results, they will need to work with proven strategies and programs, known in industry as “best practices.” Several successful approaches were pioneered by California's Minority Engineering Program (established in 1973) and later codified to serve as a model for MEP ventures at more than 100 universities. Others were developed outside the MEP network.

Research has shown that the best programs foster the growth of a student's capacity for learning, promote involvement with peers and faculty, and provide

continuity of academic and financial support. Widely accepted “best practices” include pre-college initiatives, summer bridge programs, team building, and structured study groups.

Pre-college initiatives: The New Jersey Institute of Technology -- with 1,800 African Americans, Latinos and American Indians among its 9,000-member student body -- sponsors a Consortium for Pre-College that serves over 600 students from three adjoining communities, including several cities. The program provides for 20 Saturday sessions and a five-week summer course; students begin in the seventh grade and continue through high school.

The curriculum concentrates on academics, especially math and science. There are also intensive blocks that teach some basic facts about college: Students are going to have to work hard, eat properly to stay mentally alert, and most importantly, pay part of the cost of their education through loans. It is no surprise that at an urban school like NJIT, where many students are the first generation of their families to go to college, cost of attendance is a huge stumbling block. Longstanding negative attitudes about borrowing make the problem worse.

In fact, government studies show that for the nation's poorest families, a shift of just \$1,000 worth of assistance from scholarship aid to a loan reduces the probability of graduation by 17%. For most low-income households, the notion of borrowing connotes a high-interest loan from finance companies, which use door-to-door collectors. They need to be assured that college loans are government-backed and that the repayment obligation is delayed until after graduation. Administrators at NJIT find it is critical to educate students and parents about this process.

SATs are another important gatekeeper, and the first commandment for incoming students is, “do not allow yourself to be measured by one three-hour test.” Students are encouraged to start taking the test as early as the seventh grade, if possible, and as many as five times, on the theory that familiarity will breed mastery. And if the test's cost is a problem, NJIT intercedes with the Educational Testing Service or asks corporations for financial help.

Rensselaer Polytechnic Institute (RPI), another think-tank participant, takes part in the U.S. Department of Education Gear-Up program, where colleges work with a cohort of 1,000 students, sticking with the same group from seventh grade all the way to college. This is an important program that improves retention by giving faculty, graduate students and the institution an advance look at the kind of students they'll be teaching.

RPI's cohort will be among the first graduating class hit with New York State's new diploma requirements. Starting in 2005, the option of a local diploma (for non-college track students) will be eliminated and all graduates will have to receive a certificate by passing demanding Regent's-level (college-preparatory) courses in math, two sciences and technology, among other subjects. But statewide tests last year showed that 60% of New York's twelfth grade students could not pass a Regent's math course, lending even greater urgency to the pre-college mission.

Summer Bridge Programs and Extended Orientation: Minority freshmen should be offered orientation classes where they get to know one another and learn the benefits of group study. Most successful examples are full-year courses with academic credit, and a summer experience, to provide both enough contact hours and an incentive for students to attend. The goal is to build the freshmen cohort into a cohesive, supportive group.

Clustering: Clusters establish small academic units within the larger university environment; clustered students sign up for the same sections of the same courses so they can work together to strengthen confidence and study skills. Clustering requires only that cluster sections be identified, that students be advised to register for them, and that there be guarantees they will be able to register for them. It does not mean that the sections are minority-only.

Clusters could be seen as fostering exclusivity, contrary to the corporate idea of everyone being on the same team. But the consensus is that they make large universities seem smaller, help build self-esteem and, on predominantly non-minority campuses, provide safe havens where minority students can work and ask questions

without feeling threatened. The only other objection concerns the practical difficulty of arranging schedules so clusters can stay together through four years of college.

Team building with industry: At Howard University, major U.S. corporations collaborate with university groups to enhance retention through teambuilding and internship opportunities. The companies – Ford, GM, Chrysler, Corning – have official adoption ceremonies where they make incoming students members of a company “team.” Students visit company facilities on field trips and are given summer internships. Full-fledged mentoring often occurs. The goal is to offer a taste of corporate culture and augment the technical competence students acquire in the classroom with leadership, team-building and communication skills. The competition kindled by the presence of teams has boosted engineering retention rates at the university.

Structured Study Groups: Like freshman orientation, clusters and drop-in study centers, study groups are designed to promote collaborative learning. Under a model developed at UC-Berkeley, students meet with their cluster partners and a study group leader for several two-hour sessions each week. Students are required to try to complete assigned homework prior to the study sessions, where they work in small groups on problems prepared by the study group leader in consultation with the course instructor. The leader assists students and may give a short lecture if several groups are encountering the same problem. The Berkeley concept has served as a model for similar programs at many universities.

Student/Faculty Contact: The value of student involvement with faculty members was cited often by speakers at the think tank. One referred to a new Web-based survey called Women's Engineering College Experiences, in which respondents were labeled as "stayers" or "leavers." Faculty encouragement was one of the factors cited by the former, faculty discouragement by the latter. RPI is trying to foster more faculty/student involvement by making advising more student-friendly. The

institution's new president, Dr. Shirley Jackson, has mandated that all faculty members, regardless of status, will perform advisory duties. Advisors have been given an electronic tool that puts a student's curriculum into an electronic format. Information on completed course requirements is entered at the end of each semester to assist students in future course selection.

THE DATA:

There should be a national repository for admission, retention and graduation figures, disaggregated by race, gender and ethnicity. However, few federal agencies or other organizations now gather “disaggregated data” that create profiles of students for each year of their college careers. And, as one participant said, “When you don't have the data in the engineering and science field, nobody listens.”

Some examples illustrate the problem:

- In some of the compilations, Asians are counted as underrepresented minorities, in other cases not, and it's difficult to discern which is which.
- The National Science Foundation keeps records on women who have earned degrees in engineering and science. Disciplines such as biology and psychology attract women, but their representation in the “life sciences” and “social and behavioral sciences” far outstrips their participation in most engineering and science disciplines.
- Merck, to gauge the success of efforts to improve K-12 science education, sought information on students who chose science and math as college electives. The company found that no schools in New Jersey and Pennsylvania, where the company does most of its work, record this information.
- In California, the leaders of Proposition 209 (challenging affirmative action) have launched a Racial Profiling Initiative that would prohibit the collection of racial data in education. The measure was withdrawn from the June ballot; if it ever were to pass, it not only would squelch data-gathering

in a state with 8% of the nation's students, but could also spark similar efforts in other states.

Even if the data were available, it is doubtful that numbers alone will carry the day. A case in point is the National Science Foundation's (NSF) *Louis Stokes Alliances for Minority Participation* program. Although its success on numerous campuses is well-documented, it continues to be under-funded. Bringing forward the human stories behind the data is a better strategy, but at the end of the day, success or failure will largely depend on how the political climate recognizes programs that work and can be scaled.

WHAT IS SUCCESS?

Success can hardly be measured by numbers alone. If we increase the output of minority engineers, but there is no commensurate improvement in the quality of their education, and they are no better able to become leaders and innovators in their fields, is that success? And if an institution draws more R&D dollars than its rivals, is that success? The definition adopted by NACME, based on Prof. Gary May's report (appended) on factors drawing minorities to engineering, is "satisfactory preparation for, recruitment and admission into, and completion of a baccalaureate engineering degree for members of underrepresented minority populations."

WHO ARE THE STAKEHOLDERS?

The overriding reality is that all of us have an interest in retention, and therefore, we are all part of the audience for "the pitch": society and business because STEM jobs are a critical national need, universities because they are turning out the graduates to meet this need, and students because their futures are at stake. Faculty members, too, can become stakeholders if they are given incentives -- earlier sabbaticals, more opportunities to travel, credit toward promotion and tenure -- to enhance student performance.

However, NACME must focus on a selective audience, and corporations appear to be the best catalysts for change. They have funding to help pay for university research, they hire many of the graduates, and they should be able to influence the higher education agenda.

As a first step, NACME should call on its corporate partners to endorse the agenda. To move this idea along, the think tank recommends that NACME prepare a White Paper spelling out specific actions business can take.

Ultimately, success will hinge on institutional leadership. Witness the impact of a strong president like Freeman Hrabowski at the University of Maryland, Baltimore County (UMBC). Under his lead, UMBC has become a model for how institutions should develop budding minority scientists and engineers and document their progress and outcomes. Consider, too, that the schools that seem recently to have made the greatest gains in producing women and minority engineers – the University of Washington, Michigan State, and Johns Hopkins – all have women deans of engineering. The message has to echo from the top. Changing the climate of the university is critical.

WHERE IS THE DRAMA?

The drama is in the classroom, in the failures and the successes. It resides in an observation: If minority women and people with disabilities received engineering degrees in numbers proportionate to their fraction of the population, the U.S. would satisfy its technical workforce needs. Over time, the events of Sept. 11, 2001 are expected to reduce the number of visas allotted for study at U.S. colleges and universities, further shrinking the output of engineers needed by American businesses. Currently, some U.S. universities have no American citizens enrolled in their engineering programs, especially at the graduate level. The pressure on our corporations to find science and engineering workers -- from abroad or from the domestic talent pool -- will grow.

NEXT STEPS:

We must develop a “checklist” of effective steps colleges and universities can take to provide a more supportive environment for minority engineering students. This new product would take the knowledge generated at the think tank and, as think tank facilitator Dr. Eric Jolly advises, move it out into the field, where it would be a template for institutional change. Major items on the checklist could include:

- Student debt load -- is it increasing over time, so that by the fifth year the student has abandoned hope?
- Are peer mentoring and clusters available -- what size are the clusters, are they working and does every student have one?
- Are there drop-in study centers -- what are the hours and how are those resources made available?
- What is the status of academic advising, how frequent is the contact, what is the effectiveness of the contact?
- Are there summer bridge programs and extended orientation programs?
- Is there hands-on research -- how many students are involved and at what level?
- What institutional resources are devoted to these programs -- what is the number of staff, who is paying for them and how much space is allocated?
- Do these programs have a relationship with the development office? (Georgia Tech’s MEP director, S. Gordon Moore Jr., cites this as a factor in the school’s rise to number one producer of minority engineers.)
- What are the incentive and reward systems to which the institution has committed, especially for faculty?
- Does the system adapt to the student as she progresses to junior and senior year and career plans create different needs?
- Has the institution committed research resources to collect data on these efforts and to write about what the student can expect?

The checklist would also match programs with resources both within the university -- institutional leaders, faculty, students, parents and alumni, and student service programs -- and from without -- federal and state governments, corporations, the media, accreditation agencies, and professional societies.

The checklist must also be well-documented, well-wrought, and tested first in a number of minority- and non-minority-serving institutions of different sizes. University leaders aren't going to commit to practices that don't have documented outcomes.

The expectation is that institutions that adopt these ideas will see a "ripple effect." Experience shows that what began as mentoring for minorities will become mentoring for all students. Study drop-in centers for minorities will become study centers for all students.

Not all universities will be able, or want, to offer every program in the package. At some institutions, the college of engineering will play a prominent role; at others, individual departments will have complete discretion. The approach will be shaped by particular needs and resources. For instance, schools located near GE Centers can call on the GE Fund for the kind of corporate partnership and mentoring found at Howard University. Rural schools may have to consider other options. The resource list will suggest how schools can best use on-campus talent and assets, and also where to go for outside help.

"It's not a matter of simply replicating a program," NACME's Dr. Daryl Chubin said. "It's a matter of introducing it, adapting it, making it work, given the baseline conditions that you find in that environment, including faculty and the administration, composition of the student body, and the academic support structure. One of the challenges to change, in an operational sense, is 'What travels, what would work in more than one site?'"

The first step is for NACME to mobilize its member *corporations* behind this initiative. A White Paper would spell out areas for specific actions, such as:

- **Teacher standards:** Lobby in state capitals for higher standards for public school teachers.

- **Recruiting efforts:** Broaden recruiting activities beyond the top 10 or 25 schools since the top-tier schools do not have sizable minority enrollments. Corporate leaders could even advocate for linking recruitment to improvements in campus diversity.
- **Leader influence:** Where corporate leaders have close ties to universities, use their influence to establish minority programs.
- **Alignment:** Ensure that each corporation is aligned from top to bottom on retention, recruitment and hiring issues.

Merck is a good example of how the “teacher standards” and “leader influence” items can be successful. The pharmaceutical company’s non-profit science education institute leaders and staff have worked with state legislators and educators to improve standards for New Jersey math and science teachers. The company also maintains close ties with Rutgers University, and informal meetings between the two organizations allow Merck to continue to focus university attention on vital education issues, such as retention of minority science and engineering students.

Other immediate actions NACME can take are:

- Prepare a report on schools that have the best support programs for minorities to help parents and students screen colleges.
- Provide technical assistance to schools that want to offer these services.
- Mentor minority faculty members so they can move into administrative positions and become role models for minority students.
- Call on its alumni to speak to secondary school students to reinforce a positive image of engineering.

There are several longer-term strategies NACME should consider:

- Enlist the help of mainstream engineering societies, recognizing that past strategies have failed to gain wide acceptance of its policies. It can start by asking the American Association of Engineering Societies -- of which

NACME is a member -- to take up the new initiative and circulate it under its own banner.

- Bring together a consortium of high profile corporate leaders to get the minority education issue up on the national radar screen. The tide has turned on affirmative action and there are too few strong voices for these ideas on the national landscape.
- Engage public relations experts to develop a successful public strategy. “A Nation At Risk,” a major study of K-12 education issued 20 years ago, was marketed by media specialists to the public. This landmark report is still part of today’s pre-college reform discussions.
- Use media advisors in a campaign to insert minority concerns into the criteria used to rank colleges.
- Recognize that minority alumni who go on to successful corporate careers may be able to influence their alma maters’ policies toward minorities and should be called on as allies.

CONCLUSION:

As observed at the think tank, “Business must step up and drive the train.” Undergraduate engineering education is driven by corporate demand. The voices of corporate leaders must be heard. The first order of business for NACME is mobilizing its board members and providing them with a White Paper of suggested actions.

Data are necessary. This need, too, should be taken up by NACME’s business allies. Only disaggregated data can give a clear picture of the retention problem and, once programs have been implemented, measure whether NACME products are doing the job.

The future will require new partnerships, alliances and processes with unique roles for all the stakeholders: students, parents, schools, corporations, college faculties and their institutions. Reports like this one can only identify next steps and assign some responsibility for making NACME’s goal of “achieving parity for underrepresented minorities in the quantitative disciplines” a national goal.

APPENDIX A: Think Tank Agenda

April 10-11 2002

- April 10: ***Icebreaker Reception/Dinner*** (including self-introductions)
6-9 PM Keen's Steak House, 72 West 36th Street (between 5th & 6th)
- April 11: ***Think Tank Sessions*** (NACME, Empire State Building, Suite 2212)
- 8:00 AM Continental Breakfast
- 8:30 *Merck-NACME Welcome:* Andrea Turner and Aileen Walter
Statement of Purpose and Expectations for Day: Daryl Chubin
- 9:30 *Panel I: Retention Programs & Practices: Issues, Barriers*
- Lessons from the Literature
Discussion Leader: Eric Jolly
Discussant: Susan Metz
- 10:45 Break
- 11:15 *Panel II: From the Trenches: Models That Work*
- Institutional Profiles: Presentations on NJIT
(Laurence Howell) and RPI (Mark Smith)
- Discussion – Common Factors, What Transfers:
Sentry Louis, Gordon Moore, Leo Osgood
- 12:30 PM Buffet Lunch
- 1:15 *A Distillation* (Daryl Chubin) + *Stakeholders' Perspectives* (Joel Bloom, LaWanda Peace, Johanna Rovira-Carraquillo, Bassam Shakhashiri)
- 2:15 *A Model Retention Program:*
Moderated “Whiteboard” on Essential Elements
(Eric Jolly, Joey Grinkley, Carlo Parravano)
- 3:00 Break
- 3:15 *Thoughts on Testbed Institution(s) and Next Steps:*
Andrea Turner and Aileen Walter
- 4:00 Adjourn

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Merck-NACME Think Tank on Retention
April 10-11, 2002
New York City

Issues for Research and Experimentation*

- **Data:** Of persons who earned science and engineering baccalaureate degrees in 1995 and 1996, 11% of African Americans, 15% of Hispanics, and 20% of American Indians had earned associate's degrees. These 2-year colleges could potentially provide a valuable source of baccalaureate engineers. What policies encourage recruitment and eliminate barriers for potential transfers to four-year institutions? How widespread are articulation agreements? What is the evidence that 2-year college transfer students better prepared and therefore easier to retain?
- **Institutions:** Minority-serving institutions (MSIs) play a key role in the enrollment, retention, and degree completion of underrepresented students. How well documented are the reasons for this, and can the elements of support be replicated at non-minority institutions? Which of the latter have been particularly successful? How might policies other than set-asides facilitate such replication?
- **MEP Model:** The California Minority Engineering Program (MEP) was initiated nearly thirty years ago. The MEP model has demonstrated the capacity for successful replication at a large number of universities and in privately sponsored programs. However, this model has not yet solved the attrition problem in engineering. Why not? What is missing or misunderstood?
- **Strategies:** Several strategies used in MEPs work to enhance the academic performance of student participants. Which strategies seem more readily transferable, adaptable, or amenable to institutionalization? Would evaluating the MEP model at multiple sites help to determine what ingredients contribute most to student retention to graduation?
- **Retention Tools:** Structural elements such as assessment tools, peer and professional advising, undergraduate research programs, and even computer-aided learning have been added to the basic MEP paradigm. Is there evidence that all or some combination of these are essential for increasing retention?
- **Research and Advanced Degrees:** One of the most effective approaches for motivating students to pursue advanced degrees and research careers in science and engineering is a fruitful research experience as an undergraduate. To what extent do undergraduate research opportunities enhance retention, academic performance, and degree completion? Are there examples of success in degree completion coupled to a research experience that can be cited at various kinds of institutions (e.g., public v. private, minority v. majority), or are the successes more localized by department and faculty?

* adapted by NACME from Gary S. May, "Engineering Success: Research Agenda," NACME Contractor Report, December 2001.

**A Retrospective on Undergraduate Engineering Success for
Underrepresented Minority Students**

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Completed December 2001 – Excerpted April 2002

Abstract

This paper consists of an exposition of the various factors that contribute to the success of minority students in engineering programs. The paper explores past and current paradigms that promote minority success in engineering and analyzes models for advancing the participation of members of these populations. The report includes a literature review of articles, government reports, web sites, and archives published since 1980. Student success is correlated to several indicators, including pre-college preparation, recruitment programs, admissions policies, financial assistance, academic intervention programs, and graduate school preparation and admission. The criteria used for inclusion are the relevance of the source to minority student success in engineering and the appropriateness of the source for the topical categories selected.

**A revised version of this paper will be published in the
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