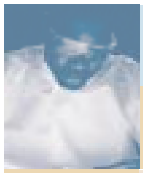


BEST
Building Engineering & Science Talent

The Talent Imperative:

Meeting America's challenge in science and engineering, ASAP

BEST
Building Engineering & Science Talent

Board of Directors

Alfred Berkeley*
Former Vice-Chairman
NASDAQ

Kathleen Buechel
President and Treasurer
Alcoa Foundation

Mary Cirillo
Chairman and CEO
OPCENTER, LLP

Arnold Donald
Chairman and CEO
Merisant

Marye Anne Fox
Chancellor
North Carolina State University

Augustine Gallego
Chancellor
San Diego Community College District

MRC Greenwood
Provost
University of California

Irwin Mark Jacobs*
Chairman and CEO
QUALCOMM

Anne Petersen
Senior Vice President for Programs
W.K. Kellogg Foundation

Deborah Wince-Smith
President
Council on Competitiveness

***Member of the Executive Committee**

National Leadership Council

Chair
Rep. Eddie Bernice Johnson (D-TX)

Bruce Alberts
President
National Academy of Sciences

George Boggs
President and CEO
American Association of Community Colleges

Rita Colwell
Director
National Science Foundation

Malcolm Gillis
President
Rice University

Dain Hancock
President
Lockheed Martin Aeronautics Company

Rep. Ruben Hinojosa (D-TX)
Chair, Education Committee
Hispanic Caucus

Erle Nye
CEO
TXU Corporation

Jill Sideman
President
Association for Women in Science

John Slaughter
President
National Action Council for Minorities in Engineering

William Wulf
President
National Academy of Engineering

National Research Board

Eugene Garcia
Dean, School of Education
Arizona State University

Shirley Malcom
Head Directorate for Education
American Association for the Advancement of Science

Willie Pearson, Jr.
Chair, School of History, Technology and Society
Georgia Institute of Technology

Paula Rayman
Professor
University of Massachusetts

Richard Tapia
Professor
Rice University

Corporate and Foundation Sponsors

Alcoa Foundation

American Institutes for Research

Bill and Melinda Gates Foundation

CH2M Hill

Hewlett Packard

Intel Foundation

W.K. Kellogg Foundation

Lockheed Martin

Microsoft

Pfizer

QUALCOMM

Richard Lounsbery Foundation

TXU

William and Flora Hewlett Foundation

BEST is a public-private partnership dedicated to building a stronger, more diverse U.S. workforce in science, engineering and technology by increasing the participation of under-represented groups.

America's engine of growth is fueled by our brightest engineers, scientists and advanced-degree technologists, a mere 5 percent of America's 132-million-person workforce.

The Talent Imperative:

Meeting America's challenge in science and engineering, ASAP

What if America's engine of growth runs out of fuel? It runs on the brainpower of our brightest engineers, scientists and advanced-degree technologists, a mere five percent of America's 132-million-person workforce. But what an engine they stoke. In the last 50 years, *more than half of America's sustained economic growth* has come from this fantastic five percent. From microwave ovens to microchips embedded in handheld computers and mobile telephones, from curing polio to eventually curing cancers, innovation has made our lives richer, more productive and more promising.

And we don't mean only culturally richer, we mean bottom-line richer in a variety of ways:

• Ownership, power and profit reside with the innovators. Hence, for instance, the wealth created by the innovators of CDMA mobile phone technology is enjoyed throughout San Diego County where the innovators, their employees and their families live.

• Innovators create demand, markets, jobs and income at all levels. Hence, the inventors of wireless technologies not only create more well-paid innovation jobs (in research and development) and good-paying manufacturing jobs, but have you noticed the proliferation of entry-level sales jobs at kiosks in every mall in America?

It all adds up to hundreds of billions of dollars per year created by this 7.2-million-person, five percent scientific and engineering techno-segment of our workforce.

But what happens if "America's engine of growth," our ability to create technologies and scientific breakthroughs, begins to sputter? By 2010, will the offshore migration of computer innovation and semiconductor manufacturing, already underway today, weaken America's national defense by limiting access to the world's most advanced microelectronics and nanotechnology? By 2015, if we fall behind in these and other leading-edge technologies, will America's former edge in the world economy be so dulled that average families can no longer afford the American dream?

We face these risks because we're not developing the human capital to meet the country's future needs.

Twenty-five percent of our scientists and engineers will reach retirement age by 2010. In addition, important new opportunities are opening up at the intersection of information technology, life sciences, materials sciences, and engineering. The Bureau of Labor Statistics projects that our greatest needs will be in computer-related fields that propel innovation across the economy.

But who will fill these jobs?

Unless we attract and prepare ample numbers of Americans for science and engineering careers, the answer increasingly will be international talent.

Our capacity to attract bright young people from other countries has been a phenomenal asset both for our economy and our society. But the sheer availability of such talent has allowed to go unnoticed the drop-off in American student interest in many key technical fields.

Does it matter that we are producing more college majors in parks and recreation than math? You bet. But the public has not been energized about long-term declining enrollments in math, physics, chemistry and engineering because our universities have made up the difference — especially at the graduate level — with international students who want the world's finest education. This pool earned nearly half the physical science and engineering doctorates awarded here in 2002 and makes up a growing share of university faculty.

And our reliance on this source of supply has increased steeply, propelled by explosive growth in H1-B temporary work visas during the technology boom of the 1990s. According to the National Science Board, foreign-born professionals held 22 percent of all U.S. science and engineering jobs in 2000, up

Greatest Engineering Achievements of the 20th Century[1]

1. Electrification
2. Automobile
3. Airplane
4. Water Supply and Distribution
5. Electronics
6. Radio and Television
7. Agricultural Mechanization
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration
11. Highways
12. Spacecraft
13. Internet
14. Imaging
15. Household Appliances
16. Health Technologies
17. Petroleum and Petrochemical Technologies
18. Laser and Fiber Optics
19. Nuclear Technologies
20. High-performance Materials

[1]Greatest Engineering Achievements of the 20th Century, National Academy of Engineering, www.great achievements.org/great achievements/indexp.html.

[2]Porter, Michael E. and Stern, Scott. The New Challenge to America's Prosperity: Findings from the Innovation Index. Council on Competitiveness, Washington, D.C., 1999.

The U.S. Technical Workforce Does Not Look Like the Overall Workforce

Sex, Race/Ethnicity & Disabilites	% U.S. Population 1999	% Total Workforce 1999	% S&E Workforce 1999
White Men	35.2	39.9	63.2
White Women	36.7	34.8	18.6
Asian Men	1.8	2.0	8.4
Asian Women	2	1.8	2.6
Black Men	5.7	4.9	2.1
Black Women	6.4	5.9	1.3
Hispanic Men	5.8	5.9	2.4
Hispanic Women	5.7	4.2	1.0
American Indian Men	0.4	N.A.	0.2
American Indian Women	0.4	N.A.	0.1
Persons with Disabilities	~20.0	N.A.	N.A.

Source: CPST data derived from National Science Foundation, SESTAT and U.S. Census Bureau, Current Population Survey, March 1999, and NSB, 2002.
Note: Totals may not add to 100 due to rounding.

from 14 percent in 1990 and double their percentage in 1980.

For all its pluses, our reliance on international talent carries risks that cannot be ignored. As their home countries raise their standards of living, qualities of life and place greater value on their own technical innovation, our international talent won't necessarily want to remain in Boston or Berkeley. And we know that in the aftermath of September 11, 2001, international access to U.S. universities has been tightened for national security reasons.

If we don't figure out how to refuel our science and engineering talent, America will lose our economic engine, our very base of power and prosperity, and with it our capacity to shape our own future. The risks of failing to build national capacity in science, engineering and technology were spelled out by Dr. Shirley Ann Jackson in "The Quiet Crisis," her aptly named 2002 introduction to the BEST mission. (Please see the BEST website to read "The Quiet Crisis," www.bestworkforce.org.)

Forming BEST and The Talent Imperative

BEST – Building Engineering & Science Talent – was formed in 2001, before September 11, with seed funding from the National Science Foundation, the Department of Defense, NASA, Department of Energy, National Institutes of Health, Department of Agriculture and the Department of Commerce to address this challenge of developing more science and engineering talent. John Yochelson, a veteran of the Council on Competitiveness, spearheaded the effort with the help of industrial, educational and government leaders across the country.

They are organized as BEST's Board of Directors, National Leadership Council, National Research Board, three Blue Ribbon Panels, and Project Integrators, and they are listed on the front and back inside covers of this document.

Even before the formation of BEST, framing America's problem pointed quickly to the source of America's solution: Americans. The traditional and disproportionate source of America's engineering and science talent – white males – is a dwindling percentage of the workforce. Despite decades of effort to broaden its base, the U.S. science and engineering workforce remains about 75 percent male and 80 percent white. Women, African Americans, Hispanics, Native Americans and persons with disabilities – the "under-represented majority" that makes up *two-thirds* of the entire U.S. workforce – *account for only 25 percent of the technical workforce.*

Our greatest untapped resource: America's under-represented majority.

Consider women, for example. They have emerged as the most educated segment of our society over the past quarter century, but large numbers still view technical fields as off-limits. Imagine the infusion of knowledge and creativity if they were to choose science or engineering at the same rate that they have opted for business, law or medicine?

Or take our burgeoning Hispanic population. Half of California's current kindergartners are Hispanic, yet the state's Science and Technology Council reports that only five percent of Hispanics who entered ninth grade in 1996 completed high school in 2000 fully ready to start college. What if that figure were multiplied 10-fold over the next decade? What could those kids, along with their African American and Native American classmates, bring to our innovation enterprise in 2025 and beyond?

Persons with disabilities, who comprise about 20% of our population, are another case in point. Technology is often their lifeline to a full and productive life. Think of what they could contribute if they had greater opportunities.

America's Talent Imperative is to insure we draw upon the strengths of all groups in science, engineering and technology. Innovation happens fast once all the pieces are in place.

Why We Must Act

It is easy to see why we have been slow to act on the Talent Imperative. Our economy has not felt the pinch. The best and brightest from around the world have streamed to our universities and laboratories. The aging of our current science and engineering workforce has not really hit home.

Meanwhile, warning signals keep flashing. Our dependence on international talent is increasing, even as U.S. firms locate growing numbers of state-of-the-art facilities in countries like China and India that have improved massively in science and engineering education. These trading partners and others recog-

The structural imbalance between America's need for, and production of, scientists and engineers, together with the risks and uncertainties of relying on imported talent, should give real urgency to the question, "who will do science in the new millennium?"

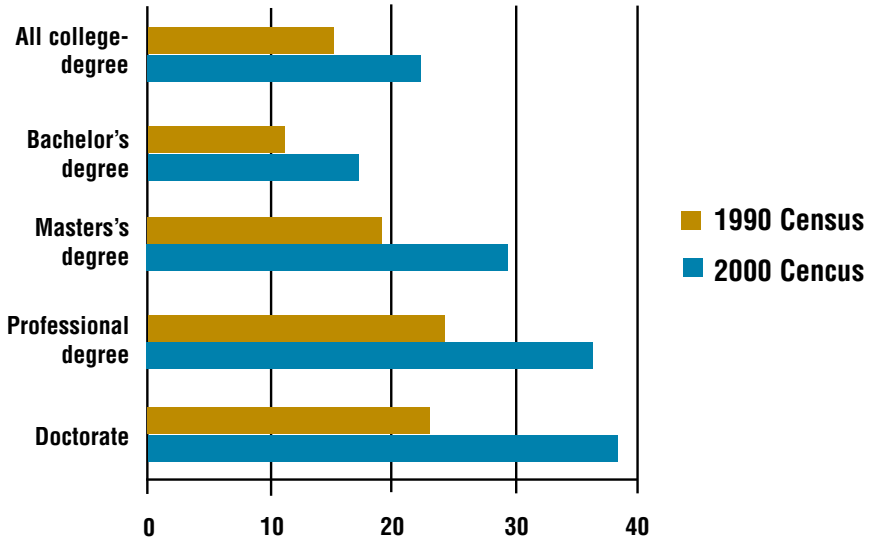
nize that human capital is their greatest strategic asset, and they are only beginning to leverage it.

As a result, a pivotal shift in know-how, research and manufacturing capabilities is taking place in some of our most advanced industries, not simply to capture overseas markets but to serve our home market as well. This shift is well underway in semi-conductors, a $100 billion-a-year sector, and it is gaining momentum in software development and information services.

The message is clear. Today's relentless search for global talent will reduce our national capacity to innovate unless we develop a science and engineering workforce that is second to none. Meeting the Talent Imperative is not just a matter of equity, but a compelling national interest.

The Growth of U.S. Reliance on International Talent

SHARE OF FOREIGN-BORN SCIENTISTS AND ENGINEERS IN U.S. S&E OCCUPATIONS, BY DEGREE LEVEL: 1990 AND 2000



SOURCE: National Science Board; The Science and Engineering Workforce Realizing America's Potential August 2003

In Search of What Works

The barriers that stand in the way of broadening the participation of the under-represented majority are built into our homes, schools, workplaces, communities, and psyches. Most would have fallen decades ago if they were not deeply embedded in our institutions and our behavior. The challenge of removing them goes beyond the reach of any group, organization, or economic sector. It is a shared task for which there is no single point of accountability. The piecemeal efforts upon which we have relied have opened up opportunities for thousands, but have not produced change on the scale that is required.

BEST created a foundation for action by calling upon more than 100 of the country's most respected educators and employers. Their mandate was to look across the board and in depth for pockets of success where the talent of historically under-represented groups is being nurtured, deployed, and retained. No assessment of what works had ever been attempted on this scale.

BEST divided the experts into three panels encompassing pre-K-12, higher education, and the workplace. Each was asked to identify and validate the effectiveness of programs to broaden the participation of women, under-represented minorities, and persons with disabilities in science, engineering and technology. The purpose was not simply to come up with a list of programs, but to establish benchmarks of excellence and extract from them the design principles, or success factors, that can be used nationwide.

BEST found pockets of excellence along the continuum of education and workforce development, but they were mostly isolated, and not part of systemwide solutions. Here is a snapshot of BEST's core findings, which will be presented to Congress, federal agencies, educators, industrialists, and trade groups in three forthcoming reports.

Pre-Kindergarten Through 12th Grade

The thinning of our technical talent pool starts early, and we have a good idea why. Unequal access to educational opportunities, a damaging achievement gap in reading and mathematics, and lack of encouragement are all key contributors. But there are a few bright spots where girls and boys of all backgrounds acquire the foundational skills and confidence to move forward in technical disciplines.

To find these bright spots, BEST did not just rely on the professional judgment of its blue-ribbon panel but on an actual review of research evidence by the Washington D.C.-based American Institutes for Research (AIR). After screening 200

Under-representation in the workforce is now an economic issue.

elementary and secondary school programs in math and science – some delivered inside and some outside the classroom – the BEST panel selected 34 for comprehensive analysis. AIR combed through 750 education journals, unpublished research, technical reports, professional papers and databases for studies of these candidate programs.

AIR and BEST then developed a protocol, a detailed procedure to evaluate the methods, contexts and findings of each study it found. Key to whether a study would be judged acceptably rigorous was this question: Can the results of the program be explained by any factors other than the intervention of the program itself? For example, could a program with high graduation rates be explained by the program itself, or were highly motivated or gifted students recruited to begin with? The protocol also required that each study's conclusions be justified by the data presented in the study itself.

These design principles apply not only to individual programs, but also system-wide. They are tools that can and should be applied to base decisions on knowledge rather than intuition or anecdote.

Using this procedure to evaluate the research it unearthed, AIR sorted the reports into two broad categories:

• Those with quantitative, measurable evidence of student outcomes. This category broke down further into studies judged **verified** (five rigorous, independent studies), **probable** (two or more rigorous, independent studies) or **notable** (at least one rigorous, independent study).

• Those with descriptive indications of student outcomes, a less rigorous category but still able to produce indicators of suc-

The BEST Evidence

The three expert panels assembled by BEST to identify what works in pre-K-12, higher education and workforce faced the same task: how to identify and validate the effectiveness of programs developed to broaden the participation of women, under-represented minorities and persons with disabilities in science, engineering and technology.

Each panel approached this task as rigorously as time, resources and availability of data allowed. Step one was to agree upon an analytical approach, recognizing the complexity and limits of using the same methods on groups as diverse as those under-represented in technical fields. Step two was to create a national sample of programs by drawing upon the professional knowledge of the panelists as well as a review of the research literature. Step three was to apply specific analytical criteria to rate programs, giving targeted attention to third-party evaluation and research rigor as well as taking into account descriptive evidence generated by programs and, where appropriate, the judgment of the panel. Step four was to draw inferences from exemplary programs distilling a shared set of "design principles" that are not full explanations of effectiveness but a shorthand for what it takes to succeed.

None of the panels found the research base alone sufficient to draw conclusive judgments about what works. Moreover, the standards applied by BEST's panels only begin to define what is effective, adaptable, affordable and deserving of further consideration as an intervention. These challenges speak to the need for hard thinking and real-world strategies about practices in the classroom, on campus and in the workplace. What seems exemplary warrants close scrutiny, subject to local constraints, goals, belief systems, opportunities, personnel and populations. The findings of the panels represent a starting point, not the last word.

With these caveats, BEST's rigorous approach sets the bar high. Doing so will contribute to more informed decisions to meet an important and increasingly urgent national challenge. We do not ask that readers trust our evidence implicitly, but that they seriously consider our findings even as BEST and other committed organizations work to fill gaps in knowledge and translate our understanding of what works into action.

What Works PRE-K THROUGH 12

Two Highly Rated Programs

BEST's search for evidence of effectiveness found two programs with enough rigorous research to earn the BEST rating of probable:

Improving Critical Thinking

From Berkeley, CA to Camden, N.J., students in third through sixth grade huddle with mathematicians and scientists four days a week for an hour to improve their critical thinking in mathematics in the **Special Elementary Education for the Disadvantaged (SEED)** program. After just a single SEED semester, students outscored their non-SEED counterparts on standardized math tests, and also enrolled in more higher-level math classes. The longer students took SEED, the longer their gains persisted.

Highly Structured Math

Some 650 elementary schools use the highly structured **Direct Instruction (DI)** method to teach basic math skills in intense, efficient lessons that enable all children - even the lowest performing - to master arithmetic operations. The program, which is based upon scripted lesson plans, fast-paced interaction among students, and frequent tests, has been researched since the 1970s. Results show that DI students outperform those taught by other methods and appear to retain their gains into middle school.

cess. These programs were judged to merit further research investment.

This rigorous approach showed that it is possible, even in a controversial area like pre-K-12 education, for nationally recognized experts to agree on what program effectiveness means. Although AIR's search for evidence confirmed that our research base is still far too thin, it yielded 21 programs with enough evidence to be rated or considered worthy of further study. The nine top programs are briefly profiled in this overview.

What matters more than a list of effective programs is the light they shed on the big picture. For example, BEST found that by and large effective programs succeed at the margins of our pre-K-12 system. Many are not embedded in yearly school budgets and rely instead upon "soft monies" from government, companies, and foundations. If we are going to do a better job of "lifting all boats" in pre-K-12, programs that work have to align much more closely with the system as a whole.

Strikingly, BEST found effective programs share a core set of features or design principles. These principles are not full explanations of success, but they are a first step toward what it will take to succeed over time.

So, what works?

1. Defined Outcomes: Successful programs rest on a shared understanding of goals. Students, parents, and staff all have a clear idea of what is to be accomplished. Success is measured against the intended result, creating the basis for continuous improvement.

2. Persistence: The history of modern American education is littered with short-term experiments and fascination with "the next new thing." Successful interventions to improve math and science performance last long enough to take hold, produce results and adapt to changing circumstances. Persistence requires active leadership, sufficient resources and determination in the face of setbacks.

3. Personalization: Students count as individuals in effective programs. At their core are student-centered teaching and learning methods, along with mentoring, tutoring, and peer interaction.

4. Challenging content: Effective programs have clearly defined curriculum that relates to real-world applications. They demand more of students than just bare minimums, and are anchored in local, state and national standards. Students understand the link between their classroom challenges and their futures beyond school.

What Works **PRE-K THROUGH 12**

Seven Programs That Earned the BEST Notable Rating

Foundational Approaches

Begun in Hawaii in 1971, **Foundational Approaches in Science Teaching (FAST)** emphasizes inquiry-based science learning for some 6,000 sixth through 10th graders in 36 states. Research indicates that that FAST students are more proficient in science-based thinking than their non-FAST counterparts.

Building on Determination

From its start in San Diego in 1980, **Advancement Via Individual Determination (AVID)** now reaches promising but underachieving middle and high school students in more than 1500 schools in 21 states. Research shows that students in this college-prep program, combining high expectations and support, enroll in four-year colleges at higher rates than non-participating, AVID-eligible students.

Seamless Progress

Starting with elementary and middle schools that feed into selected high schools, **Project GRAD (Graduation Really Achieves Dreams)** serves more than 130,000 students in 198 schools from Los Angeles to Newark, N.J. Research indicates that Project Grad has raised college enrollment rates of poor and minority students from 12 percent to 50 percent or more.

Bridging Through Mentors

California-based **Puente** is a "bridge" for non-immigrant, English speaking teens from high school to college. Research has shown that students in the three-level mentoring program, which encompasses college preparation, teacher training, and community leadership, are more likely to enroll in college than non-Puente students.

Making Algebra Tangible

From its origins in Cambridge, Massachusetts, **The Algebra Project** enables 10,000 elementary and middle schoolers in thinly resourced inner cities and rural areas to relate algebra to their own lives and cultures. Research shows that Algebra Project alumni grasp abstractions more fully and may enroll in college prep math more frequently than students from more affluent schools.

Incorporating Culture Into Math

In a world near the North Pole where temperatures can fluctuate 160 degrees over the year, **Yup'ik Mathematics** incorporates cultural features and values into an elementary school math curriculum. Students taking a three-week module showed greater grasp of geometric abstractions than counterparts with traditional math training.

Gateway to Science Majors

More than half of the graduates of New York City's **Gateway to Higher Education** during its three years chose science-based majors in college. Research shows the 2000 largely minority students now enrolled in this program are more likely to enroll in college and to take the New York State Regents exam in math and science than comparable non-Gateway students.

5. Engaged adults: Some successful educational programs are begun by charismatic individuals, but when the leader departs, the program withers. Effective programs have adults who provide support, stimulate interest and create expectations by acting as teachers, coaches, mentors, tutors and counselors. Active family support is another plus.

Better Teachers… Better Results

America cannot strengthen the technical talent pool without an ample supply of highly qualified, committed pre-K-12 teachers of mathematics and science. The challenge to build and maintain this group is a shared responsibility of government policy makers, educators, private sector leaders and parents.

Although research confirms that strong teachers make a defining difference in pre-K-12 student outcomes, their chronic shortage in mathematics and science hits underserved minority populations especially hard. More than 25 percent of America's current high school math and science teachers did not major or minor in the subject they teach. In high-poverty schools, that figure is nearly 50 percent.

This shortage reflects a classic mismatch between the importance of qualified teachers and the priority we place on creating a world-class U.S. mathematics and science-teaching workforce. While there is no single solution to the problem, the component parts of a solution are widely understood.

First, we must recognize the social and economic value of teaching pre-K-12 mathematics and science with rewards that attract and retain highly qualified individuals whose zest for teaching and learning inspires students to attain high levels of achievement.

Second, colleges and universities must build a pre-service teaching corps competent in mathematics and science as well as pedagogies that are attuned to the learning styles of all of today's computer-savvy students.

Third, employers must make clear to educators at all levels what knowledge and skills must be mastered in pre-K-12 to contribute to the U.S. innovation enterprise. Further, they must treat the teacher corps as an integral part of that enterprise, and be prepared to contribute to it.

Fourth, public and private sector partnerships must build teacher capacity through mentoring and role modeling. Through these in-service activities the real life experiences of scientists, mathematicians and engineers can enrich both the professional development and classroom effectiveness of the pre-K-12 teacher corps.

Higher Education

As the institutions that award advanced degrees, research universities are the strategic bridge between pre-K-12 education and the workplace. The most important test facing these crown jewels of U.S. education over the next decade – along with minority-serving institutions, women's colleges and community colleges – is whether they can meet our need for world-class technical innovation by developing a talent pool that looks so different from decades past. By 2010 women will earn more degrees than men at every level of higher education from associate degrees to doctorates. By 2015 the nation's undergraduate population will expand by more than 2.6 million students, 2 million of whom will be students of color.

The record to date shows how profound a change will be necessary. Lack of money, limited faculty commitment to teaching, social bias and other factors have taken a disproportionate toll on under-represented groups. African American, Hispanic, and Native American undergraduates leave technical majors in large numbers and are scarce at the graduate level. While women are doing better, their numbers have declined in such high-potential fields as computer science. At the same time, the huge diverse pool of talent in the nation's community colleges has scarcely been tapped to expand four-year and advanced degree production in technical fields.

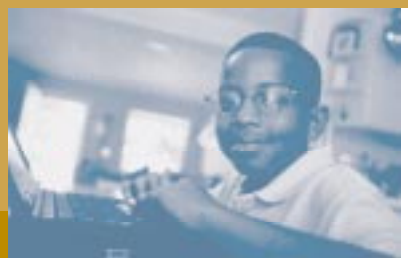
Yet expectations of higher education run high. We look to it to make up for deficiencies in pre-K-12 and to open the way to economic and social mobility for all. The acute financial pressure that many of our colleges and universities face — and the controversies that continue to swirl around admissions policies — only make the challenge harder.

Still, there are encouraging signs of headway. To pinpoint them, the BEST Panel on Higher Education reviewed the literature and developed criteria for judging the effectiveness of university-led programs. Program ratings hinged on the answers to eight questions:

- Was the goal spelled out before the program was launched?
- Were the results the product of the program itself?
- Did it increase the success of women or minority students?
- Did it add value to the experience of the target population, helping these students move to the next competitive level?
- Can it be adapted elsewhere or used at multiple sites?
- Was it effective with a population different than the one originally targeted?
- Has the program been in place long enough to have had more than one leader, i.e. is leadership self-sustaining?
- Were there positive unexpected consequences?

The panel identified a pool of 124 candidate programs by

The nation needs to know what's really working in elementary and high school mathematics, freshman physics and chemistry, graduate schools and corporate R&D teams to develop – and draw upon – the talent of under-represented groups.



reviewing federal research program evaluations, the reports of high-level commissions, and national awards for achievement in such fields as mentoring and minority degree production. BEST rated 10 programs as either exemplary or promising, based on its evaluation criteria. A sampling of the most highly rated programs appear in this overview.

BEST's Blue Ribbon Panel on Higher Education also found common principles designed into the most successful programs it identified. Consider these as essential ingredients in any recipe for producing diverse talent for science and engineering:

1. Institutional leadership: Leadership matters. Although passionate commitment to diversity may exist at any level on a campus, only commitment by campus administration and senior faculty ensures that the values, goals and paths toward increased participation are essential to everyone's success.

2. Targeted recruitment: Attracting the best available students and faculty from under-represented groups is critical, but so is establishing and sustaining a feeder system from pre-K-12, undergraduate and graduate schools.

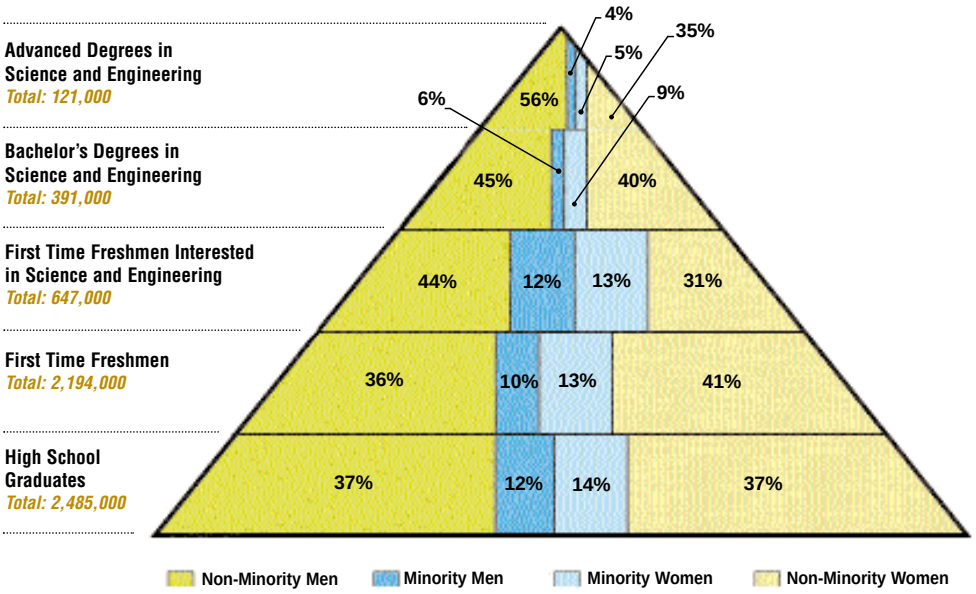
3. Engaged faculty: The traditional markers of academic accomplishment, such as research productivity, do not replace ongoing commitment to diversifying successful student talent. Student outcomes are a critical measure of faculty performance.

4. Personal attention: Students' need for personal attention does not end in high school. In the higher education classroom and often the academic residential setting, the value of personal attention remains high in meeting individual needs.

5. Peer support: Model programs enable students of all backgrounds to interact routinely and intensively with one another, as well as with students at other levels, post-docs and junior faculty. Developing an ethic of "family responsibility" fosters loyalty to institution, discipline and profession, and creates a new generation of mentors and leaders.

Lost Talent in Higher Education

(Rounded numbers)



Minority = Black/African American, Hispanic, and American Indian

Source: Joan Burrelli, NSF, based on 1999 Common Core of Data, U.S. Department of Education, National Center for Education Statistics (NCES); NCES, 1998 IPEDS Fall Enrollment Survey; UCLA Higher Education Research Institute,1998 American Freshman Survey (estimate); and NCES, 1998 IPEDS Completions Survey

6. Enriched research opportunities: Extending research opportunities beyond the classroom, for example, by way of internships, connects students' experiences to the world of work, establishes mentors and presents career options.

7. Bridging to the next level: The path from grade school through university may be uneven for even the most privileged students. Successful programs to promote diverse student success build both the institutional relationships and the students' skills to enable them to progress through the educational system and envision career achievements.

8. Continuous evaluation: Effective programs never stop asking basic questions about processes and outcomes: Are we doing the job?

A ninth ingredient that cannot be readily designed into a program, but is often vital to success: comprehensive financial assistance. Successful programs work diligently to construct packages of loans and grants that make academics the student's top priority.

These design principles are not ends in themselves. Instead, they are tools that can be used in many different contexts to expand our technical talent pool. They comprise a package

rather than an a la carte menu from which to pick and choose. Their impact hinges on quality of execution as well as a clear-eyed understanding of the specific setting in which they are being applied.

Such insights parallel in a striking way what BEST found to be effective in pre-K-12 education. In both settings, success does not come on the cheap. But it also takes more than money: Strong leadership, clear objectives, high expectations, personal support, and a link to the next level are fundamentals that apply from pre-school through graduate school.

What Works HIGHER EDUCATION

Exemplary Undergraduate Programs

The **University of Maryland Baltimore County (UMBC) Meyerhoff Scholars Program** prepares African American students for careers in science, engineering and medicine. Meyerhoff scholars have higher GPAs, are twice as likely to graduate college with a technical degree, and have attained graduate school admission at three times the rate of their counterparts outside the program. This multi-part program reflects every success factor needed to develop the talent of under-represented groups.

Since 1993, first year undergraduate women in science, math, and engineering undergraduate majors at the University of Michigan have had the option to reside in a living-learning community designed to provide academic and personal support. After an initial federal grant, the **University of Michigan Women in Science and Engineering Residence Program (WISE-RP)** is now a campus institution —75 percent of whose grads earn technical degrees compared to less than half of their counterparts on the campus at large.

Innovation in curriculum is one of the hallmarks of the **Gateway Engineering Education Coalition**, begun at Drexel University in 1988 and now encompassing eight additional institutions. Gateway schools seek to create engineering professionals proficient in content, but also well rounded as individuals and citizens. The program mainstreams women and minorities from the day of their admission, providing support programs that contribute to retention and graduation rates significantly above national averages.

Four Historically Black Colleges and Universities and the University of North Carolina at Chapel Hill began the **Partnership for Minority Advancement in Biomolecular Sciences (PMABS)** to introduce this discipline into high school and college programs. The partnership has since expanded into a statewide discipline-focused initiative whose scope includes graduate and post-doctoral programs as well as broadened outreach to under-served high schools. More than 6,000 students have benefited from the program since its establishment in 1990.

In the Workforce

Employers represent the demand side of the tech talent equation, whose needs define what our educational system is supposed to deliver. Many of our employers – especially in industry and government – are caught between competing pressures. The marketplace has created global options for securing technical talent, but has also increased demand for diverse American talent of high quality. Filling their immediate needs may point in one direction, but assuring long-term supply may point in another.

The BEST Workforce Blue Ribbon Panel faced a unique irony in its quest for empirical research on employer-sponsored diversity programs. On one hand, employers with large science and engineering workforces have been driven by market forces (including competition) and concerns over potential legal liability (including common sense) into the forefront of developing diversity programs. On the other hand, some companies, in competition and legally liable, aren't necessarily going to *tell you* what works.

Nonetheless, the BEST panel identified a number of examples from the winners of national diversity-related awards and "best to work for" lists, then applied the following criteria:

What Works HIGHER EDUCATION

Exemplary Graduate and Faculty Programs

Name a leading technology-based company or notable engineering school and chances are good that it will be a member of the **National Consortium for Graduate Degrees for Minorities in Science and Engineering (GEM)** program, dedicated to increasing the participation of African Americans, Hispanics and Native Americans at the masters and doctoral level. More than 450 GEM Fellows receive financial support and internship opportunities on 89 campuses, helping to produce more than 2200 engineers and 120 Ph.D.s to date.

The Compact for Faculty Diversity, sponsored by regional educational bodies from New England, the South and the West, seeks to develop a faculty pool which reflects the demographic profile of the current wave of students. Six hundred doctoral scholars receive mentoring, financial assistance, professional development and networking opportunities. Two hundred have completed a Ph.D., three-quarters in science, engineering, or mathematics.

The American Association for Higher Education and the Council of Graduate Schools developed a new model for developing a diverse pool of future faculty in the early 1990s. Preparing Future Faculty uses "clusters" anchored by a Ph.D.-granting institution, exposure to faculty roles and responsibilities and multiple mentors. Today PFF has 295 participating institutions whose shared objective is to communicate to prospective faculty what it means to be a professional scholar.

• Did the program receive a Catalyst, Diversity Inc. or Equal Opportunity award from the U.S. Department of Labor in the last five years?

• Did the program appear on the Business Women's Network "2002 Best of the Best" report, which compiled all the "best of" lists for 2002?

• Was the program nominated by a member of the BEST Blue Ribbon Panel on Workforce Diversity based on personal knowledge?

Twenty-five programs were chosen from the broader pool. However, because the list was not exhaustive at any stage, the Workforce Panel chose not to create another "best of" list, but rather to extract four fundamental principles that underpin the progress that the commendable organizations have made and illustrate them with examples:

1. Sustained commitment to change. Exemplary organizations seek lasting change through a comprehensive effort that starts at the top, but is ultimately embraced at all levels. The measure of sustained engagement is whether it lasts beyond the tenure of a particular CEO, university president or laboratory director.

2. An integrated organizational strategy. Exemplary organizations recognize that "stand-alone" initiatives do not succeed. They make diversity a seamless part of the organization by incorporating "the business case" into the organization's mission, strategy, operating structure and culture.

3. Management accountability. Exemplary organizations hold line managers at all levels personally accountable for meeting diversity objectives. They do so by setting high expectations, applying clearly defined metrics and rewarding outstanding performance.

4. Continuous improvement. Exemplary organizations adopt regular cycles of planning, execution and evaluation of progress. In addition to hard metrics, many use employee surveys, focus groups and personal interviews to determine what is working and identify problem areas.

The implementation of these design principles can lead to positive results in every key phase of an organization's workforce development strategy: recruitment, retention and career advancement. But these results depend on nuts-and-bolts policies and practices that make design principles actionable.

In the recruitment arena, for example, Hewlett Packard supports 47 campus partnerships including seven with minority-serving institutions to help ensure a supply of qualified, diverse talent while also encouraging a strong university research environment. IBM has teamed up with the American Association for the Advancement of Science to create a career pathway, ENTRY POINT!, for students with disabilities. Targeted strategies based on long-term partnerships set exemplary organizations apart from others.

The retention of scientists and engineers from under-represented groups requires comparable focus and effort. BEST found that the establishment of affinity groups is one strategy that works. Ford, for example, works closely with 10 employee resources groups, each championed by a senior executive, while Intel has almost 20 such groups divided into nearly 100 local chapters. Mentoring also makes a difference. Procter & Gamble reverses the usual senior-to-junior mentoring relationship by having mid-level women counsel senior-level men on the challenges facing women. Growth opportunities are the last piece of the workplace puzzle. Motorola, for example, increased its number of female vice presidents from two to 40 in less than 10 years by identifying high-potential employees early and putting them on a fast track. The National Science Foundation promotes the advancement of women to academic leadership through fel-

What Works **WORKFORCE**

Investing in the Supply Chain

San Diego's **QUALCOMM** partnered with San Diego City Schools and San Diego State University to improve math performance in the city's lowest-performing schools. With a focus on improving teachers' math-teaching skills and confidence, students have registered the highest gains in California within two years.

DuPont also applied the principles of partnership in its campaign to lift students' scores on statewide science assessment tests. Within two years, scores were on the rise and the gap between minority and non-minority students had been erased.

Teachers represent a key leverage point in the effort to improve math and science in schools. They participate in Viva Technology™, the acclaimed bilingual program by the **Hispanic Engineer National Achievement Awards Conference**. With a focus on how technology works in everyday life, Viva Technology works to stimulate interest and academic achievement in math, science and engineering.

Bell Labs puts its strongest asset — its own onsite facilities and staff — to work in its Graduate Research Fellowship Program. Participants from under-represented groups spend an initial summer at Bell, and receive tuition support after that.

Women and minorities garner a large share of the scholarships offered by **Microsoft** to computer science majors from the Puget Sound area. This is in addition to its High School Internship Program, which gives inner-city youth summer internships in companies where technology plays a major role. The goal is to track these students through college and prepare them for careers in technology.

These four strategies — community engagement, effective use of leverage points, capitalizing on stakeholder strengths, focusing on results — are the hallmarks of employers of choice who reach beyond their walls to open up the opportunity structure to the wider community. Supply-chain management is an exemplary practice to reach beyond the boundaries of the organization to create a stronger and more diverse pool of talent.

lowships and institutional awards.

Strikingly, BEST's look at what works in the workplace found that the same basics apply to industry, government and universities. In addition, best-in-class means taking action beyond organizational boundaries. We won't get the transformational change that is required unless employers are fully engaged with their suppliers and in the educational supply chain as well.

So, Where Are We?

The American economy has been the envy of the world. Despite its ups and downs, no other economic system provides more well-being for its citizens, more jobs, more goods, more prosperity, more income. We have the deepest technology base, the most productive workforce, and the richest domestic market.

What worries us is the hollowing out of the basic intellectual capital that has fueled U.S. economic and technological leadership throughout the 20th and now the 21st century. The new realities of global innovation should prompt us to build capacity at home to develop premium products and services that sustain our prosperity, national security, and quality of life. The approaching retirement of one-quarter of our largely white male science and engineering workforce should spur us to expand our own human resource base across the board in technical fields.

Yet we continue to draw upon a narrow and now declining segment of our population in core disciplines that have underpinned our strength throughout the postwar and post-Cold War periods. We rely increasingly on international talent not just as a supplement, but a mainstay of our high-tech economy. We seek competitive advantage by moving high-skill, high-wage jobs offshore rather than treating this migration as a wake-up call to reinvent our innovation enterprise.

Our greatest untapped resources, American women, African Americans, Hispanics, Native Americans and persons with disabilities, are a critical part of the solution. They have what it takes to help maintain our leadership in innovation. But realizing their potential will take a level of national effort that we have yet to make.

How We Secure the Future

What will it take for us to change course and get results?

First, the Talent Imperative needs high-level attention. The thousands of committed individuals who have been working in the trenches for decades to create a stronger, more diverse science and engineering workforce don't have to be convinced. The challenge laid out in this overview and BEST's forthcoming reports must be understood by the broad public. It must really matter to editorial boards, corporate leaders, university presidents, state school superintendents, governors, members of Congress, heads of federal agencies and the White House.

Without high-level attention, we will never create the national will to meet the Talent Imperative. We have generated the sense of urgency to tackle other complex problems, knowing full well there would be no quick fix. Whenever we have mobilized resources successfully – whether to win the race to the moon or to clean up the environment – the foundation for action has always been a shared high-level understanding of the need to act.

Second, we need to deepen the knowledge base regarding programs that are effective. BEST's reports confirm that there is evidence of what works, but not nearly enough. Extra dollars are much

What Works **WORKFORCE**

Design Principles for Workplace Diversity

Embedding Diversity Into Strategy

Connecticut-based **Pitney Bowes** requires that each of its business units create its own diversity plan encompassing communications and training, employee development, work-life balance, business diversity, and community relations. Progress toward goals is part of the evaluation process for each unit president and management team. This approach illustrates the workplace design principle of integrating the business case for diversity into organizational strategy.

Establishing Accountability

All of **Bayer's** U.S. executive vice presidents have business targets for diversity and create annual action plans for achieving those targets. About 70 percent of their bonuses depend on meeting these and other company objectives. Bayer's policy, which helped it win a 2002 Catalyst Award from the premier nonprofit research and advisory organization to advance women in business, exemplifies the workplace design principle of measurable accountability.

Measuring for Improvement

Using a combination of hard metrics and opinion survey, **AT&T** found that its company-wide focus on diversity decreased employee turnover from 22 to 16 percent, resulting in a $20 million saving and substantial improvement in employee satisfaction. AT&T's commitment to measurement of its diversity progress demonstrates the workplace design principle of continuous improvement based on internal and external benchmarks.

Sustained Commitment

Lockheed Martin's president and chief operating officer chairs the corporation's Executive Diversity Council, which meets regularly to review policies, procedures and performance. The corporation also supports 33 local diversity councils, each with its own charter to support the objectives of the business unit that houses it. This comprehensive approach illustrates the workplace design principle of sustained commitment at every level of the organization.

more likely to be used to try to change a youngster's life than to fund program evaluation. But research is the key to allocating limited resources wisely, not just to feel good. All of the decision makers with a stake in developing our technical talent — educators, employers, policy makers, parents, and students — need access to users' guides to effective programs that are regularly updated.

Third, we must pull the pieces of a solution together far more effectively than we have to date. The three domains that BEST has examined – pre-K-12, higher education and the workplace – are all part of one continuum. The connections among them, however, are often weak and sometimes nonexistent. These disconnects take a particularly heavy toll on women, minorities and persons with disabilities. All but the strongest or luckiest are liable to fall between the cracks in our fragmented system of education and workforce development.

Local communities are the most promising places to connect the dots. It is at this level that findings of researchers can help improve practice in the classroom, where scientists and engineers can make a difference as role models and mentors, where the multiple paths from pre-K-12 to higher education and the workplace can be most easily navigated, and where public-private partnerships are most naturally formed. Clearly, the nation's governors have an important leadership opportunity in fostering such community engagement across the country.

To rally committed national leaders and committed communities, BEST recommends:

• **A Leadership Pledge For Technical Workforce Development.**

Employers in the private and public sector are in a unique position to adopt, expand and replicate strategies that open up opportunity in the workplace and strengthen our educational supply chain. Their public commitment to a pledge, framed along the lines of the Sullivan Principles, will send a powerful message nationwide if it is followed by concrete action.

• **A National Workforce Leadership Initiative**

Congress and federal agencies have an opportunity to lead by example by taking workforce diversity directly into account in their review of all research and educational grants. A Presidential Workforce Excellence Award, modeled on the highly effective Malcom Baldrige Quality Award, could create a powerful incentive for change within organizations. Congress and federal agencies could join forces to provide additional resources to expand our technical talent pool.

• **A Grass Roots Community Engagement Initiative**

Working together, a test bed of communities across the country can apply the design principles of best practice, develop tool kits to implement them and further develop our knowledge base regarding what works. What these communities learn from each other, and the results they produce, will provide a beacon for every community.

The Talent Imperative implies that today is none too soon to direct America onto the best path toward prosperity and national security. The longer we wait, the more we risk.❖

The BEST Leadership Pledge for Technical Workforce Development

As an organization which endorses BEST's national call to action for diversity and excellence in the science, engineering and technology workforce, we commit to the following principles:

Support the goal of diversity and excellence in the American science and engineering workforce within our company, among our peers and partners with whom we do business, and in the communities in which we operate.

Adopt and actively advocate policies to promote excellence and diversity in our workforce, and to integrate our diversity goals into our overall business strategy.

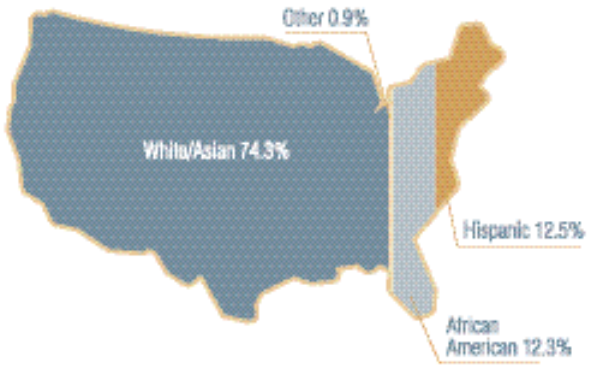
Develop a system to communicate with internal and external audiences our policies to promote diversity and excellence in our science and engineering workforce.

Create an internal governance structure to ensure our diversity initiatives have meaningful leadership, visibility, sustainability, measurable goals and accountability measures.

Hold all levels of management accountable for living up to our goals for excellence and diversity in our science and engineering workforce by creating specific performance goals, formal measurements of progress and systems of reward.

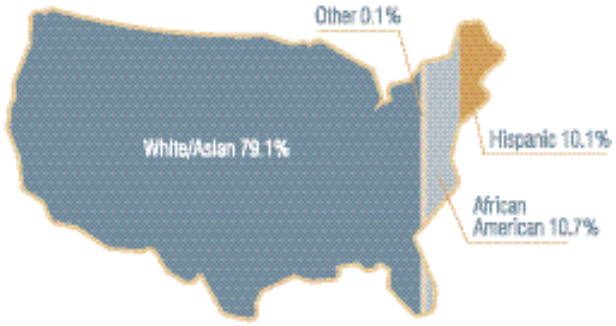
Reach beyond our organizational borders to promote excellence and diversity in those partners with whom we do business and in the educational institutions that prepare our future employees and, to the extent possible, hold both accountable for achieving diversity goals.

Overall Population
(Working & Nonworking)



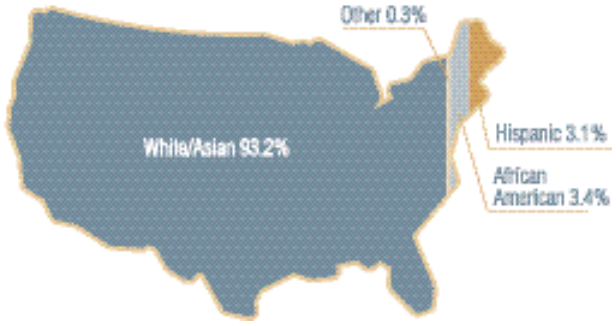
Source: 2000 Census

U.S. Workforce



Source: Women, Minorities, Persons with Disabilities, National Science Foundation , 2000

Science & Engineering Workforce



Source: Bureau of Labor Statistics, 2000 www.bls.gov

BEST Blue Ribbon Panelists

Best Practices in Pre-K-12 Education

Alfred Berkeley (Panel Co-Chair)
Former Vice Chairman
NASDAQ

Shirley Malcom (Panel Co-Chair)
Head, Directorate for Education
American Association
for the Advancement of Science

Eugene Garcia (Expert Leader)
Dean, School of Education
Arizona State University

Allan Alson
Superintendent
Evanston Township High School

Raymond V. "Buzz" Bartlett
President and CEO
Council for Basic Education

Muriel Berkeley
President
Baltimore Curriculum Project

Manuel Berriozábal
Professor, Mathematics
University of Texas at San Antonio

Susan Brady
Director, Education Programs
Merck Institute for Science Education

Costello Brown
Professor of Chemistry, California State
University Los Angeles

Patricia Campbell
President
Campbell-Kibler Associates

Douglas Carnine
Director, National Center to
Improve the Tools of Educators
University of Oregon

Elizabeth Cohen
Professor Emerita
Stanford University

Mike Cohen
President
Achieve, Inc.

Anthony Colón
Vice President
National Council of La Raza
Center for Community Educational
Excellence

Jacquelynne Eccles
Chair
MacArthur Foundation Research
Network on Successful Pathways
through Middle Childhood

Charles Eilber
President
Charles Eilber Associates

Stephanie Fanjul
Director of Student Achievement
National Education Association

Yolanda George
Deputy Director and Program Director
Directorate for Education and Human
Resources Programs
American Association for the
Advancement of Science

Kris Gutierrez
Professor
UCLA

Rebecca Herman
Senior Research Analyst
American Institutes for Research

Anthony Jackson
Vice President, Strategic Development
and Communications
The Galef Institute

Julia Lara
Deputy Executive Director
Council of Chief State School Officers

Leon Lederman
Nobel Prize Winner
Physics

Babette Moeller
Principal Investigator
Education Development Center

Sharon Nelson-Barber
Director, Culture and Language
Education Program
WestEd

Andrea Prejean
Senior Professional Associate in Science
and Mathematics
National Education Association in
Student Achievement

Linda Rosen
Consultant, former Math
and Science Advisor
U.S. Department of Education

Larry Rosenstock
Principal and CEO
High Tech High, San Diego

Barbara Schulz
Consultant, Science Education
Partnership
Fred Hutchinson Cancer Research

Diane Siri
Superintendent
Santa Cruz County Office of Education

Marshall Smith
Program Director
The Hewlett Foundation

Virginia Stern
Director
Project on Science, Technology
and Disability
American Association for the
Advancement of Science

Sam Stringfield
Principal Research Scientist
Johns Hopkins University Center
for the Social Organization of Schools

Louise Sundin
President
Minneapolis Federation of Teachers

Mary Catherine Swanson
Founder and Executive Director
AVID

Tom Vander Ark
Executive Director
Bill & Melinda Gates Foundation

Shelly Wolff
President
National Society of Women Engineers

Best Practices in Higher Education

Shirley Ann Jackson (Panel Chair)
President
Rensselaer Polytechnic Institute

Willie Pearson, Jr. (Expert Leader)
Chair, School of History, Technology
and Society
Georgia Institute of Technology

Margaret E. Ashida
Director, Corporate University Relations
IBM

Walter E. (Skip) Bollenbacher
Professor of Biology
University of North Carolina
at Chapel Hill

Salvatore "Tory" Bruno
Vice President of Engineering
Lockheed Martin's Space Systems

Jane Zimmer Daniels
Program Director
Clare Booth Luce Program for Women
in Science and Engineering
The Henry Luce Foundation

Cinda-Sue Davis
Director, Women in Science
and Engineering Program
University of Michigan

Alfredo de los Santos, Jr.
Research Professor, Hispanic
Research Center
Arizona State University

Mary Frank Fox
Professor, School of History,
Technology and Society
Georgia Institute of Technology

Judy R. Franz
Executive Officer
American Physical Society

Angela Ginorio
Associate Professor, Department
of Women's Studies
University of Washington

Evelynn M. Hammonds
Associate Professor, History of Science
Massachusetts Institute of Technology

Robert Ibarra
Office of the President
University of New Mexico

Alex Johnson
President
Cuyahoga Community College

Saundra Johnson
Executive Director
National Consortium for Graduate
Degrees for Minorities in Engineering

Wayne Johnson
Executive Director, Worldwide
University Relations
Hewlett-Packard

Kenneth Maton
Professor & Chair, Department
of Psychology
University of Maryland

Lionel "Skip" Meno
Dean, College of Education
San Diego State University

Carol B. Muller
Founder and Executive Director
MentorNet

Ken Pepion
Executive Director
Harvard University
Native American Program

Clifton Poodry
Director, Minority Opportunities
in Research Division
National Institute of General Medical
Sciences

James H. Stith
Director, Physics Resources Center
American Institute of Physics

Dan Sullivan
Corporate Executive Vice President
of Human Resources
QUALCOMM

Orlando L. Taylor
Dean, Graduate School of Arts
and Sciences
Howard University

Isiah M. Warner
Professor & Chair, Chemistry
Department
Louisiana State University

Melvin R. Webb
Director, Program for Research
Integration and Support for
Matriculation to the Doctorate
Clark Atlanta University

Best Practices in the Workforce

Dan Arvizu (Panel Chair)
Senior Vice President
CH2M HILL Companies, Ltd

Paula M. Rayman (Expert Leader)
Professor
University of Massachusetts

Linda Cubero
Strategic Program Director
EDS

Harold Davis
Vice President, Preclinical Safety
Assessment
Amgen, Inc

Allan Fisher
President and CEO
iCarnegie, Inc.

C. Michael Gooden
President and CEO
Integrated Systems Analysts

Mike Guyton
Vice President of Administration
Oncor Group

Paul Hanle
President
Biotechnology Institute

Thomas Kochan
George M. Bunker Professor of
Management
Sloan School of Management, MIT

Margaret "Penny" Lane
Former Director, Program on
Diversity in Engineering
National Academy of Engineering

Catherine Mackey
Senior Vice President
Global Research and Development
Pfizer, Inc.

Vivian Pinn
Director, Office of Research
on Women's Health
National Institutes of Health

Joyce Plotkin
President
Massachusetts Software
and Internet Council

Lura Powell
Former Director
Pacific Northwest National Laboratory

Una S. Ryan
President and CEO
AVANT Immunotherapeutics, Inc.

Robert L. Shepard
Founding Executive Director
Science and Engineering Alliance

Ray Smets
President
Sniffer Technologies
Network Associates

Katherine Tobin
Taylor Nelson Sofries Intersearch

Claudette Whiting
Senior Director of Diversity
Microsoft

Charla K. Wise
Vice President of Engineering
Lockheed Martin Aeronautics Company

Project Integrators

Cathleen A. Barton
U.S. Education Manager
Intel

Suzanne G. Brainard
Executive Director
Center for Workforce Development
University of Washington

Daryl E. Chubin
Senior Vice President
National Action Council
for Minorities in Engineering

Manuel N. Gomez
Vice Chancellor, Student Affairs
University of California, Irvine

Joyce Justus
Chair Emeritus, Department of Education
University of California at Santa Cruz

Shirley M. McBay
President
Quality Education for Minorities

Anne Pruitt-Logan
Scholar-in-Residence
Council on Graduate Schools

Carlos Rodriguez
Principal Research Scientist
American Institute for Research

Sue Rosser
Dean, Ivan Allen College
Georgia Institute of Technology

Claibourne D. Smith
President
Delaware Foundation for Science
and Math Education

Wanda E. Ward
Deputy Assistant Director
National Science Foundation

William Washington
Director, Program
Development
Lockheed Martin Corporation

Lilian Shiao-Yen Wu
Chair, Committee on Women
in Science and Engineering
National Academy of Science

BEST Staff

John Yochelson
President

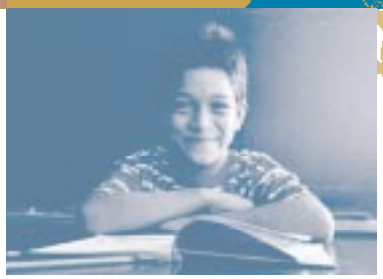
Anne Crossway
Executive Vice President

Brenda Sullivan
Communications Director

Robb Henderson
Research Associate

Wanda E. Ward
Chief Advisor 2001-2002

BEST would like to thank Gary Shaw, president of Metro San Diego Communications, Inc. and publisher of its San Diego Metropolitan Magazine, Uptown Examiner & Daily Business Report; contributing editor Joanne R. Gribble, Ph.D., production director Jim Matta and production assistant Taunya Pichitino for their fresh eyes and talent.



BEST
Building Engineering
& Science Talent

401 B Street Suite 2200 San Diego CA 92101 T: 619.237.8822 F: 619.237.8838 www.bestworkforce.org